**State of California**
**The Resources Agency**
**DEPARTMENT OF FISH AND GAME**

**PACIFIC STATES MARINE FISHERIES COMMISSION**

# JUVENILE SALMONID USE OF THE TIDAL PORTIONS OF SELECTED TRIBUTARIES to HUMBOLDT BAY, CALIFORNIA, 2007-2009

**By**

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**Final Report for Contract**
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***Author's Note-** Due to the Governor's Executive Order S-09-09 this project's approved contract amendment was unexpectedly cancelled in early July 2009 resulting in this report's due date being moved up from January 31, 2010 to July 31, 2009. Therefore, due to the short preparation time the data presented in this report is preliminary and may change at a later date. Also, data collected January-June 2009 will be reported at a later date.***

## 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) and sea-run coastal cutthroat trout (Trotter 1997; Northcote 1997; CDFG 2000; CDFG 2001). California Department of Fish & Game (CDFG) studies found 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 (CDFG 2006, 2007, and 2008; Wallace and Allen 2007) . Prior to these studies 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 CDFG's 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 2009 and Elk River 2005-2009 and found that some yoy coho salmon reared throughout the summer and into the fall and that some yearling coho rear over-winter in the stream-estuary ecotone in Freshwater Creek and Elk River sloughs. These studies also found that yoy Chinook salmon reared for up to 8 weeks in Freshwater Creek Slough in 2003 (Wallace and Allen 2007; CDFG 2008, 2007 and 2006; Wallace 2006).

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 of 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 (2007-2009) 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. Starting in early 2007 NSA began sampling 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 tidal streams as year round habitat or over winter rearing 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.

## Study Area

Humboldt Bay is located 275 miles north of San Francisco, CA. and its watershed area is 223 square miles (HBWAC 2005). Its three largest tributaries are Freshwater Creek, Elk River, and Salmon Creek (Figure 1). Numerous smaller tributaries also drain into Humboldt Bay and numerous sloughs and tidal streams exist around the bay (Figure 2).

Freshwater Creek Slough enters Humboldt Bay just north of Eureka via Eureka Slough. Freshwater Creek is a fourth order stream with a drainage area of approximately 9227 hectares (31 square miles). The lower 9 kilometers (km) of Freshwater Creek is primarily cattle grazing land and is characterized by a low gradient, with limited riparian development. Levees confine the channel in this reach. Elk River Slough enters the bay just south of Eureka near the mouth of Humboldt Bay. Elk River drains approximately 8632 hectares (29 square miles). The lower 10 kilometers (km) of Elk River is primarily cattle grazing land and is characterized by a low gradient, with limited riparian development. Levees confine the channel in this reach. Salmon Creek enters the bay at the extreme southern end of Humboldt Bay via Hookton Slough (Figure 1). Salmon Creek drains approximately 5060 hectares (17 square miles). The tidal portion of Salmon Creek is contained within the Humboldt Bay National Wildlife Refuge. A tidegate at the mouth of Salmon Creek where it enters Hookton Slough mutes tidal influence in Salmon Creek. Much of the above information comes from HBWAC (2005). Gannon Slough, Rocky Gulch, Wood Creek, and Martin Slough are all small tributaries with tide gates in various states of working order at their mouths. Ranching activities occur on all sites and a public golf course operates on Martin Slough.

The estuary was defined as the portion of the stream under tidal influence during low stream flow in the summer. NSA observed tidal influence approximately 9 km upstream of the mouth of Freshwater Creek Slough and about 6 km upstream of the mouth of Elk River. The lower portion of Freshwater Creek Slough is characterized by extensive mudflats, modest to moderate amounts of eelgrass beds, and some areas of salt marsh. The lower portion of Elk River Slough lacks the mudflats and instead flows through large areas of sand. Hookton Slough also has large areas of mudflats while Salmon Creek upstream of the tidegate is confined to a narrow channel. The tidal freshwater portions of all three tributaries have dense stands of riparian vegetation, primarily in the form of willow and alder trees. Physical conditions in Humboldt Bay tributaries such as saltwater intrusion show a high degree of annual, seasonal, and daily variation due to changes in river flow and tidal action. The lower sloughs experienced fluctuations in tidal height up to 3 meters (m) and brackish water 25-30 parts per thousand (ppt) is usually present from late spring through summer. Water temperatures of 20-25 C were present during the summer in the lower portion of Freshwater and Hookton Sloughs due to water heating up on the mudflats (Wallace 2006).

## Methods

In Freshwater Creek Slough, Elk River Slough, and Salmon Creek/Hookton Slough stratified sampling was used between the upper and lower sloughs due to differences in water salinity and the need to use different gear types in the two sections of the sloughs. The stratification was necessary due to the presence of heavy riparian vegetation in the upper sloughs requiring

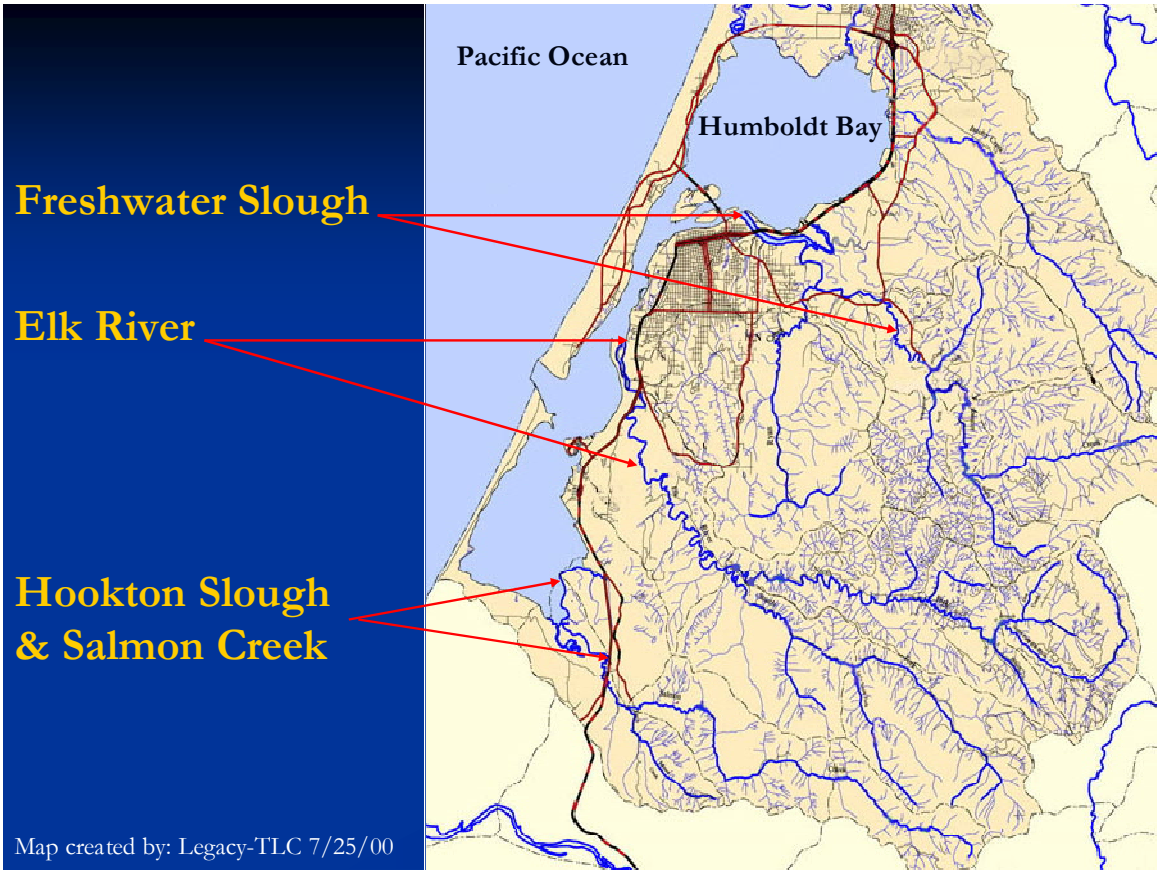

Figure 1. Locations of the tidal portion of major Humboldt Bay tributaries.

field crews to use a smaller seine net than the one used to sample the larger water area in the lower sloughs. This is also the general area where riparian vegetation started to appear and intuitively seemed to represent the boundary between primarily estuarine and tidal freshwater habitat. In Salmon Creek/Hookton Slough the tide gate at the mouth of Salmon Creek was the boundary between the lower and upper sloughs.

In Freshwater Creek Slough field crews conducted sampling for juvenile salmonids in the upper slough from January 2007-June 2009, and in the lower slough March-November 2007, January-October 2008, and February-June 2009. In Elk River Slough crews sampled the upper slough from January 2007-June 2009 and the lower slough from February to December 2007, January-October 2008, and February to June 2009. Crews sampled Salmon Creek from March to November 2007, January-October 2008, and January-June 2009. Crews sampled Hookton Slough March-November 2007, January-September 2008, and February-June 2009. We attempted to sample the sloughs on a weekly basis (except during high stream flows), with the exception of Salmon Creek/Hookton Slough which we sampled biweekly. Multiple sampling sites within each tributary were sampled to make sure we sampled the entire range of habitats found within the area of tidal influence.

In the upper sloughs crews made two hauls at each site using a 9.1mX1.8mX6.4millimeter (mm) mesh beach seine. In the lower sloughs crews made one seine haul at each site using a 30.5mX2.4m beach seine deployed by hand or boat. The mesh size of the wings was 19.1mm and the bag was 1.5m deep with 6.4 mm mesh.

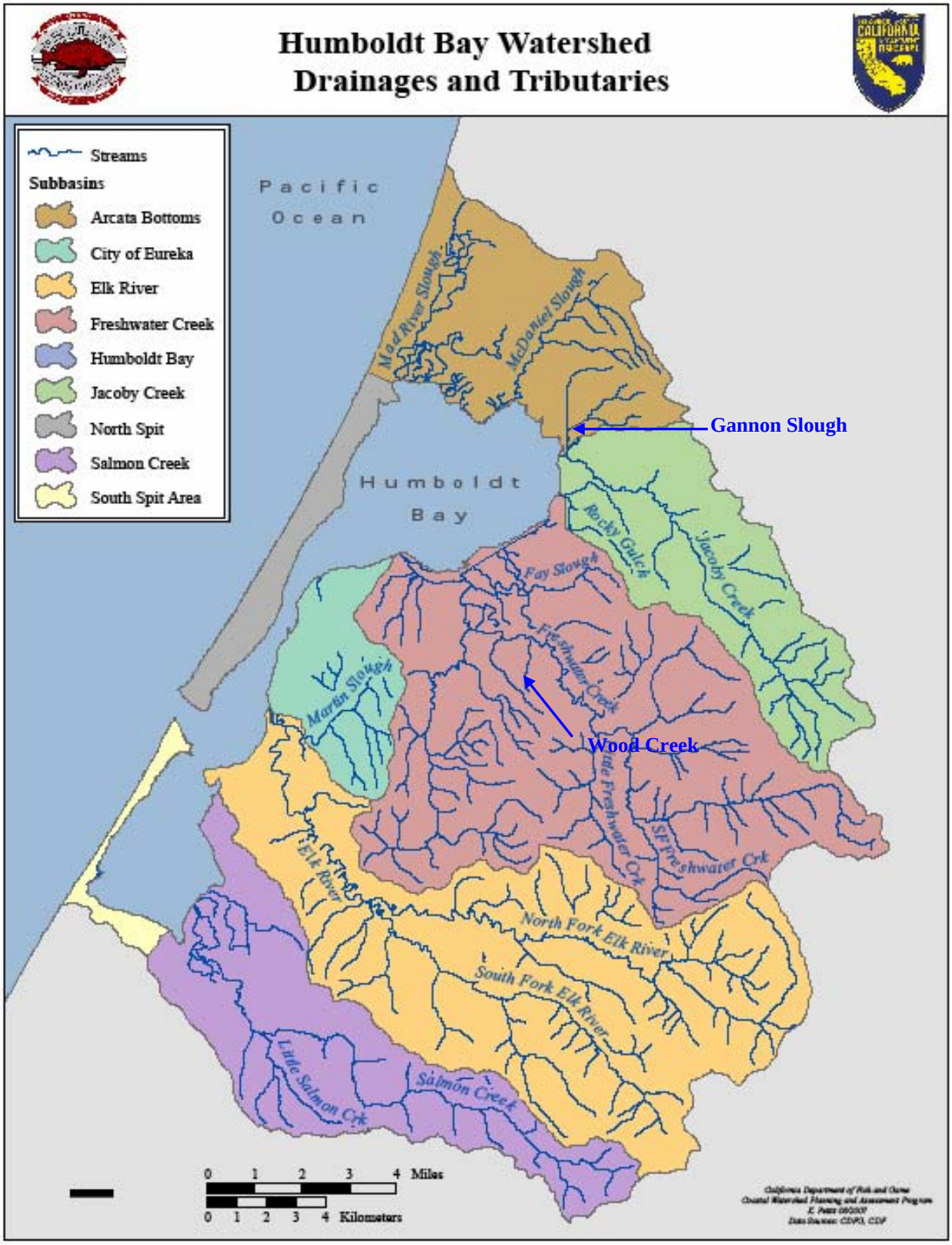


Figure 2. Map of Humboldt Bay tributaries.

In the smaller tributaries field crews used a variety of methods to collect fish. In Jacoby Creek we used the 9.1mX1.8mX6.4mm mesh beach seine to sample one site. In Gannon Slough we used the seine net to sample three sites. In Rocky Gulch we used the seine net to sample one site and minnow traps baited with frozen salmon roe at six sites where seine hauls couldn't be made. In Wood Creek we used minnow traps baited with frozen salmon roe at six sites. In Martin Slough we used the 30.5mX2.4m beach seine deployed by hand or kayak to sample a large pond, a 9.1mX1.8mX6.4mm mesh beach seine to sample two to four sites in the slough, and minnow traps baited with frozen salmon roe at four to eight sites where seine hauls couldn't be made.

Field crews anaesthetized, identified (for species and life stage i.e. yoy, parr, pre-smolt, smolt, adult), counted, and examined all juvenile salmonids for marks and tags. They also attempted to measure fork lengths (FL) to the nearest mm, weights to the nearest 0.1gram (g), and collect scale samples from all juvenile salmonids except when the number of fish captured or environmental conditions made it dangerous to process the fish. All salmonids containing tags or marks were measured for FL, weighed, scale sampled, and their mark or tag number was recorded. Once processed, the fish were allowed to recover and released back into the sampling site. NSA applied PIT tags to all juvenile salmonids by making a small incision and inserting the tag into the body cavity. All coho and Chinook salmon $\geq$ 70 mm FL received an 11.5 mm tag. Starting in 2008, all juvenile salmonids $\geq$55 mm and $\leq$69mm FL received an 8.5 mm tag. Juvenile steelhead and cutthroat trout $\geq$70 mm but < 100 mm FL received a 11.5 mm tag and trout $\geq$ 100 mm FL received a 23 mm tag. Length of estuarine residence for PIT tagged fish was calculated as the number of days between date of marking and date of last recapture.

## Results and Discussion

### Freshwater Creek Slough 2007

We captured very few salmonids in upper Freshwater Creek Slough prior to April (Table 1). NSA captured yearling coho salmon from March to July. Their peak catches occurred in April and May. Their monthly mean FL's varied little throughout the spring ranging from 100 to 101 mm from April to June. NSA captured yoy coho salmon from April to November and their peak monthly catch of 1.33 fish/set occurred in June. Overall, CPUE of yoy coho was considerably lower than past years. Their weekly mean FL increased from 42 mm in April to the mid to upper 80's mm August-November (Table 1). 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. NSA captured yoy Chinook salmon from May to August with the peak monthly catch of 0.96 fish/set occurring in June. Their monthly mean FL increased from 48 mm in May to 77 mm in August (Table 1). NSA captured a total of 61 juvenile steelhead from April to November with the peak monthly catch of 0.58 fish/set occurring in October (Table 1). Their FL's ranged from 63 to 229 mm (Table 1). NSA captured 25 cutthroat trout from March to November with no discernable peak catch. Their FL's ranged from 90 to 248 mm (Table 1).

We captured very few juvenile salmonids in lower Freshwater Creek Slough in 2007 (Table 2). NSA captured yearling coho salmon in April and May. We captured only 11 yearling coho in 2007 compared to 19 and 122 during the same time periods in 2006 and 2005, respectively. Their monthly mean FL increased from 105 mm in April to 107 mm in May (Table 2). 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 May to June with the peak monthly catch of 0.25 fish/set occurring in June. Their FL's ranged from 45 to 72 mm (Table 2). NSA captured a total of six juvenile steelhead from March to July. Their FL's ranged from 109 to 253 mm (Table 2). NSA

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, 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 | 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 |
| July | 48 | 0.13 | 72 | 70-77 | 0.77 | 79 | 69-91 | 0.02 | 123 | 123 | 0.08 | 83 | 70-106 | 0 | - | - |
| Aug | 60 | 0.02 | 77 | 77 | 0.15 | 86 | 80-97 | 0 | - | - | 0.17 | 77 | 63-122 | 0.05 | 182 | 163-200 |
| Sept | 24 | 0 | - | - | 0.13 | 88 | 85-94 | 0 | - | - | 0.33 | 75 | 70-79 | 0.04 | 226 | 226 |
| Oct | 24 | 0 | - | - | 0.83 | 86 | 63-105 | 0 | - | - | 0.58 | 99 | 73-174 | 0.21 | 185 | 152-247 |
| Nov | 24 | 0 | - | - | 0.13 | 85 | 76-101 | 0 | - | - | 0.04 | 192 | 192 | 0.13 | 204 | 146-248 |
| Dec | 12 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 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, 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 | 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 | - | - |
| July | 27 | 0 | - | - | 0 | - | - | 0 | - | - | 0.04 | 153 | 153 | 0 | - | - |
| Aug | 28 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Sept | 7 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Oct | 14 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Nov | 14 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |

captured a total of four cutthroat trout from April to June. Their FL's ranged from 144 to 310 mm (Table 2).

**PIT Tag Results for 2007.** 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 to 65 yoy coho in 2007 and recaptured 12 (18.5%) of them (Table 3). Their mean length of residence was 68 days and ranged from 6 to 167 days. In 2006 their mean length of residence was 33 days and ranged from 5 to 106 days (CDFG 2007). 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 presented in this report should be considered minimum residence times. Nine out of 12 (75.0%) 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 10 recaptured yoy coho salmon at large for at least 13 days was 0.17 mm/day and ranged from 0.12 to 0.45 mm/day (Table 3). In 2006 the mean growth rate of 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 (CDFG 2007). We applied PIT tags to 115 yearling coho in 2007 and recaptured 22 (19.1%) of them (Table 3). Their estuarine residence ranged from 5 to 224 days (one recaptured coho was marked in September 2006). 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 48 yearling coho that were tagged by other projects in the Freshwater Creek basin. The mean growth rate of the 15 recaptured yearling coho salmon at large for at least 13 days was 0.43 mm/day and ranged from 0.23 to 0.60 mm/day (Table 3). The 15 coho includes those marked both by NSA and other projects where we had FL information at least 13 days apart. We applied PIT tags to 45 juvenile steelhead in 2007 and recaptured eight (17.8%) of them (Table 3). They were at large for 14 to 124 days. Seven of eight (87.5%) project marked steelhead were recaptured at the same site where they were marked. We also captured another six juvenile steelhead that were tagged by other projects in the Freshwater Creek basin. The growth rates of the eight recaptured juvenile steelhead at large for at least 13 days ranged from 0.14 to 0.34 mm/day. We applied PIT tags to 14 cutthroat trout in 2007 and recaptured three (21.4%) of them (Table 3). They were at large from 8 to 295 days. Two fish were recaptured at the same site where they were marked. We also captured another eight cutthroat trout that were tagged by other projects in the Freshwater Creek basin. The growth rates were 0.27 mm/day for the fish at large for 70 days (6/13-8/22) and 0.13 mm/day for the fish at large 295 days (6/26/06-4/16/07). It is likely that some of the cutthroat trout captured by our project were resident adult fish.

**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.

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, 2007 and 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.

**2007**

| 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 | 65 | 12 | 18.5 | 68 | 6-167 | 75.0 | 10 | 0.17 | 0.12-0.45 |
| 1+ Coho | 115 | 22 | 19.1 | 21 | 5-224 | 100 | 15 | 0.43 | 0.23-0.60 |
| Steelhead | 45 | 8 | 17.8 | - | 14-124 | 87.5 | 8 | - | 0.14-0.34 |
| Cutthroat | 14 | 3 | 21.4 | - | 8-295 | 66.7 | 2 | - | 0.13-0.27 |

**2008**

| 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 |

**Freshwater Creek Slough 2008**

We captured very few salmonids in upper Freshwater Creek Slough in 2008 and none prior to April (Table 4). Our catches of yearling coho in 2008 were substantially lower than the same time period last year. In 2008 NSA captured yearling coho salmon from mid April to late June. Their peak catches occurred in May with a high of 0.70 fish/set in mid May. In 2007 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 (CDFG 2007). Their monthly mean FL's from April to June varied little ranging from 104 to 107 mm which was about 5 mm larger than last year. Our catches of yoy coho were markedly lower than last year. NSA captured yoy coho salmon from mid May to late June and the peak catch of 0.20 fish/set occurred in late May and early June. In 2007 NSA captured yoy coho salmon from mid April to late June and the peak catch of 2.25 fish/set occurred in mid June (CDFG 2007). Their weekly mean FL increased from 39 mm in mid May to 73 mm in late June. NSA captured yoy Chinook salmon from late May to late June with the peak catch of 0.25 fish/set occurring in late June. Their weekly mean FL increased from 60 mm in late May to 69 mm in late June. NSA captured a total of 16 juvenile steelhead from early May to late June with the peak catch of 0.40 fish/set occurring in early June. Their FL's ranged from 58 to 161 mm (Table 4). NSA captured six cutthroat trout from early May to late June with no discernable peak catch. Their FL's ranged from 133 to 167 mm (Table 4).

We captured very few juvenile salmonids in lower Freshwater Creek Slough in 2008, (Table 5) and none prior to April. We captured only nine yearling coho in 2008 compared to 11, 19 and 122 during the same time periods in 2007, 2006 and 2005, respectively. Our 2008 peak monthly catch of yearling coho salmon occurred in April. Their weekly mean FL increased from 113 mm in April to 122 mm in June. NSA captured four yoy Chinook salmon in June and July they were 70 to 92 mm FL. NSA captured a total of six juvenile steelhead in May, June, and September. Their FL's ranged from 143 to 176 mm (Table 5). NSA captured a total of five cutthroat trout in May, June, and July. Their FL's ranged from 167 to 214 mm (Table 5). We did not capture any yoy coho salmon in the lower slough.

**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 3). Yoy mean length of residence was 68 days in 2007 and 33 days in 2006 (CDFG 2007). We applied PIT tags to 27 yearling coho in 2008 and recaptured 1 (3.7%) of them (Table 3). 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 3). 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 3). 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.

**Downstream Migrant Weir**. 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

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, 2008. 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 | 10 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Feb | 10 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Mar | 12 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Apr | 34 | 0 | - | - | 0 | - | - | 0.09 | 104 | 99-110 | 0 | - | - | 0 | - | - |
| May | 46 | 0.02 | 60 | 60 | 0.07 | 39 | 39 | 0.43 | 105 | 74-125 | 0.09 | 112 | 94-161 | 0.11 | 149 | 133-167 |
| June | 44 | 0.16 | 66 | 59-72 | 0.09 | 66 | 55-73 | 0.25 | 107 | 101-112 | 0.27 | 95 | 58-123 | 0.02 | 145 | 145 |
| July | 60 | 0.02 | 72 | 72 | 0.05 | 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 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, 2008. 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 | 13 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Feb | 12 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Mar | 13 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Apr | 19 | 0 | - | - | 0 | - | - | 0.21 | 113 | 105-127 | 0 | - | - | 0 | - | - |
| May | 25 | 0 | - | - | 0 | - | - | 0.16 | 114 | 101-124 | 0.07 | 154 | 143-160 | 0.08 | 195 | 167-214 |
| June | 21 | 0.14 | 71 | 70-73 | 0 | - | - | 0.05 | 122 | 122 | 0 | - | - | 0.05 | 206 | 206 |
| 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 | - | - |

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 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 2007**

Due to high stream flows we conducted little quantitative sampling in upper Elk Slough January to April 2007. Yoy coho salmon were by far the most common salmonid captured and were found primarily in the upper slough. In the upper slough we captured yoy coho salmon from May to November (Table 6). Their peak monthly catch occurred in June but they were abundant from early May to October. Their monthly mean FL increased from 54 mm in May to 90 mm in September. We captured relatively few yoy coho in the lower slough except during December (Table 7) when their abundance peaked. Yearling and older coho salmon were present in our upper slough catches from May to July and their peak catch occurred in May (Table 6). Their monthly mean FL decreased from 109 mm in May to 104 and 105 mm in June and July. NSA captured yoy Chinook salmon from May to July with the peak monthly catch of 0.13 fish/set occurring in July. Their monthly mean FL increased from 50 mm in May to 76 mm in July (Table 6). NSA captured juvenile steelhead from May to October with the peak monthly catch of 0.34 fish/set occurring in June (Table 9). Their FL's ranged from 75 to 180 mm (Table 6). NSA captured cutthroat trout from May to October with a peak catch of 0.35 fish/set in May (Table 6). Their FL's ranged from 135 to 270 mm (Table 6).

During 2007 yearling coho salmon were the most common salmonid captured in lower Elk River Slough (Table 7). NSA captured yearling coho salmon from March to June. Their peak catches occurred in May with a CPUE of 11.95 fish/set (Table 7). 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 monthly mean FL peaked at 127 mm in April and then decreased to 109 mm by June (Table 7). NSA captured one yoy coho salmon in early May and then recorded a peak catch of 4.60 fish/set in December (Table 7). These fish were captured after the first significant rain and stream flow event of the fall. Many studies have shown a "fall redistribution" of juvenile coho in other river basins. NSA captured yoy Chinook salmon from June-August with the peak monthly catch of 0.80 fish/set occurring in July. Their monthly mean FL increased from 73 mm in May to 82 mm in June (Table 10). NSA captured juvenile steelhead from March to September with the peak monthly catch of 0.27 fish/set occurring in April (Table 7). Their FL's ranged from 133 to 241 mm (Table 7). NSA captured cutthroat trout from May to July with a peak catch of 0.35 fish/set in May (Table 7). Their FL's ranged from 135 to 270 mm (Table 7).

**PIT Tag Results for 2007.** NSA applied PIT tags to 180 yoy coho in 2007 and recaptured 55 (30.6%) 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 44 days (n=55) and ranged from 5-124 days (Table 8). In 2006 their mean length of residence was 39 days (n=41) and ranged from 6 to 128 days (CDFG 2007). All but one 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

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, 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 | 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+ |
| July | 32 | 0.13 | 76 | 72-80 | 3.59 | 73 | 52-95 | 0.09 | 105 | 100-114 | 0.25 | 114 | 92-126 | 0.16 | 169 | 148-194 |
| Aug | 38 | 0 | - | - | 3.08 | 80 | 65-100 | 0 | - | - | 0.24 | 109 | 75-157 | 0.05 | 191 | 188-194 |
| Sept | 16 | 0 | - | - | 1.44 | 90 | 84-97 | 0 | - | - | 0.25 | 130 | 127-132 | 0 | - | - |
| Oct | 16 | 0 | - | - | 2.38 | 86 | 54-97 | 0 | - | - | 0.13 | 159 | 151-167 | 0.13 | 207 | 196-217 |
| Nov | 16 | 0 | - | - | 0.56 | 78 | 58-100 | 0 | - | - | 0 | - | - | 0 | - | - |
| Dec | 8 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |

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, 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 |
| July | 25 | 0.80 | 82 | 68-93 | 0 | - | - | 0 | - | - | 0 | - | - | 0.04 | 270 | 270 |
| Aug | 19 | 0.11 | 68 | 60-75 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Sept | 10 | 0 | - | - | 0 | - | - | 0 | - | - | 0.10 | 169 | 169 | 0 | - | - |
| Oct | 10 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Nov | 11 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Dec | 5 | 0 | - | - | 4.60 | 73 | 57-98 | 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 2007 and 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.

**2007**

| 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 | 180 | 55 | 30.6 | 44 | 5-124 | 98.2 | 51 | 0.16 | 0.00-0.38 |
| 1+ Coho | 240 | 14 | 5.8 | - | 7-256 | 87.5 | 4 | - | 0.04-0.54 |
| Yoy Chinook | 29 | 0 | 0 | - | - | - | - | - | - |
| Steelhead | 37 | 5 | 13.5 | - | 8-57 | 100 | 3 | - | 0.19-0.27 |
| Cutthroat | 16 | 2 | 12.5 | - | 29-347 | 100 | 2 | - | 0.03-0.52 |

**2008**

| 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 | 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 mm to 124 mm and in weight from 11.0 g to 22.1 g.

51 recaptured yoy coho at large for greater than twelve days was 0.16 mm/day and ranged from 0 to 0.38 mm/day (Table 8). In 2006 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 (CDFG 2007). We applied PIT tags to 240 yearling coho in 2007 and recaptured14 (5.8%) of them (Table 8). They were at large for 7 to 256 days. Seven of eight (87.5%) fish marked and recaptured by NSA were recaptured at the same site where they were marked. One fish was marked on September 6, 2006 and recaptured on May 22, 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 is the first confirmation that juvenile salmonids from other Humboldt Bay tributaries move into lower Elk River slough on their way to the ocean. This information suggests that juvenile salmonids will utilize non-natal sloughs and marshes while rearing or migrating through Humboldt Bay. We applied PIT tags to 29 yoy Chinook in 2007 but did not recapture any of them (Table 8). We applied PIT tags to 37 juvenile steelhead in 2007 and recaptured five (13.5%) of them (Table 8). They were at large for 8-57 days and had growth rates of 0.19-0.27 mm/day. They were all recaptured at the same site where they were originally marked. We applied PIT tags to 16 cutthroat trout in 2007 and recaptured two (12.5%) of them (Table 8). They were at large for 29 and 347 days and had growth rates of 0.52 and 0.03 mm/day, respectively. They were both recaptured at the same site where they were originally marked. One fish was marked on October 26, 2006 and recaptured on October 8, 2007. It is likely that some of the cutthroat trout captured by our project were resident adult fish.

**Elk River Slough 2008**

Yoy coho salmon were by far the most common salmonid captured in the upper slough (Table 9). In the upper slough we captured yoy coho salmon from April to December. Their peak catches during full sampling effort occurred in June and July. Their highest CPUE occurred in December, but that was during limited sampling. Their high CPUE in December occurred after the first significant rain and stream flow event when many juvenile coho moved downstream to the estuary. Their monthly mean FL increased from 39 mm in April to 111 mm in December (Table 9). Yearling coho salmon were present in our upper estuary catches from April to August and their peak catch occurred in May. Their monthly mean FL decreased from 111 mm in April to 106 mm in June, then increased to 118 mm in July (Table 9). Juvenile steelhead were present in small numbers in our upper estuary catch in February, May to October and December. Their peak catch during full sampling effort occurred in May. Their highest CPUE occurred in December, but that was during limited sampling. Their FL's ranged from 100-203 mm with no apparent size pattern during the year. We captured small numbers of coastal cutthroat trout in the upper estuary in April, and June to December (Table 9). Their FL's ranged from 132-231 mm. It is likely that some of the cutthroat trout captured by our project were resident adult fish. We did not capture any yoy Chinook salmon in the upper slough in 2008 (Table 9).

In the lower slough we captured yearling coho salmon from early March to mid July and their peak catch occurred in May (Table 10). Their weekly mean FL increased from 115 mm in early March to 133 mm in early May, and then their mean FL ranged from 108 to 124 mm until mid July (Table 10). In the lower slough we captured yoy Chinook salmon from June to September and their peak catch occurred in July. Their monthly mean FL increased from 82 mm in June

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, 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 |
| Jan | 8 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Feb | 7 | 0 | - | - | 0 | - | - | 0 | - | - | 0.14 | 203 | 203 | 0 | - | - |
| Mar | 6 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Apr | 40 | 0 | - | - | 0.03 | 39 | 39 | 1.25 | 111 | 80-125 | 0 | - | - | 0.03 | 132 | 132 |
| May | 24 | 0 | - | - | 2.67 | 53 | 39-63 | 2.75 | 107 | 87-125 | 0.17 | 124 | 100-147 | 0 | - | - |
| June | 32 | 0 | - | - | 5.28 | 63 | 45-79 | 0.47 | 106 | 94-116 | 0.13 | 128 | 115-148 | 0.03 | 137 | 137 |
| 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 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, 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 |
| Jan | 8 | 0 | - | - | 0 | - | - | 0.25 | 72 | 55-89 | 0 | - | - | 0 | - | - |
| Feb | 10 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Mar | 10 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Apr | 20 | 0 | - | - | 0 | - | - | 1.19 | 119 | 94-143 | 0.05 | 236 | 236 | 0 | - | - |
| May | 20 | 0 | - | - | 0 | - | - | 1.90 | 109 | 90-133 | 0 | - | - | 0 | - | - |
| June | 23 | 0.17 | 82 | 79-86 | 0 | - | - | 1.83 | 120 | 101-143 | 0 | - | - | 0 | - | - |
| 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 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

to 125 mm in September. We captured only one steelhead in the lower slough. It was caught in April and was 236 mm FL (Table 10). We did not capture any yoy coho or cutthroat trout in the lower slough in 2008.

**PIT Tag Results for 2008.** We applied PIT tags to 331 yoy coho in 2008 and recaptured 104 (31.4%) of them (Table 8). 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 8). 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 8). We applied PIT tags to 17 juvenile steelhead in 2008 and recaptured one (5.9%) of them (Table 8). It was at large for 28 days and had a growth rate of 0.25 mm/day. It was recaptured at the same site where it was originally marked. We applied PIT tags to 9 cutthroat trout in 2008 and recaptured three (33.3%) of them (Table 8). 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.

**Salmon Creek/Hookton Slough 2007**

We captured markedly fewer juvenile salmonids in Salmon Creek/Hookton Slough than in Freshwater Creek and Elk River Sloughs.

Yoy trout that were too small to identify between steelhead and cutthroat trout were by far the most common salmonid captured during seining (n=86). Based on our catches of larger trout it is likely a great majority of these fish are steelhead. We captured them from June through November with their peak catch occurring in July (Table 11). Their FL's ranged from 38-69 mm. We could usually differentiate steelhead and cutthroat once they reached a size of 60-70 mm FL. We captured 18 juvenile steelhead, all of them were found upstream of the tidegate in Salmon Creek (Table 11). We captured juvenile steelhead from March to August and their peak catches occurred in March and May. Their monthly mean FL ranged from 75 to 91 mm.

We captured one yoy coho salmon downstream of the tidegate in Hookton Slough in June (Table 12). It was 116 mm FL. We did not capture any other juvenile salmonid species.

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 64 juvenile steelhead ranging in size from 64-156 mm (Table 11). We also captured one yearling coho and one cutthroat trout in March (Table 11).

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 Salmon Creek estuary, January-December 2007. CPUE is number of fish per seine haul. Also, shown are the numbers of juvenile salmonids captured and fork length (FL) in millimeters during minnow trapping January-June 2007.

**Seining**

| | | 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 |
| 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 | - | - |
| July | 12 | 2.92 | 56 | 51-65 | 0 | - | - | 0 | - | - | 0.42 | 90 | 82-98 | 0 | - | - |
| Aug | 12 | 1.00 | 60 | 54-69 | 0 | - | - | 0 | - | - | 0.17 | 75 | 72-78 | 0 | - | - |
| Sept | 6 | 0.17 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Oct | 12 | 1.00 | 59 | 48-67 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Nov | 12 | 0.67 | 58 | 49-64 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Dec | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

**Minnow Traps**

| | | YOY 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 |
| 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 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| July | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Aug | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Sept | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Oct | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Nov | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Dec | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

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 Hookton Slough during 2007 and 2008. CPUE is number of fish per seine haul.

2007

| | | 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 | - | - |
| July | 3 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Aug | 6 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Sept | 3 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Oct | 6 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Nov | 3 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Dec | 0 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |

2008

| | | 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 | 6 | 0 | - | - | 0 | - | - | 0* | - | - | 0 | - | - | 0 | - | - |
| Mar | 3 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Apr | 3 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| May | 3 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| June | 6 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| 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 | - | - |

*One adult coho captured

**PIT Tag Results for 2007.** We applied PIT tags to 68 juvenile steelhead and recaptured seven (10.3%) of them. This includes fish collected by seining and in minnow traps. The steelhead were at large 9 to 51 days (mean=28 days) and grew 0-12 mm (0-0.29 mm/day). All the steelhead were marked and recaptured in the site where we originally tagged them. We also applied a PIT tag to one yearling coho and did not recapture it.

**Salmon Creek/Hookton Slough 2008**

Field crews captured markedly fewer "yoy" trout in Salmon Creek/Hookton Slough in 2008 compared to 2007. We captured 26 "yoy" trout from January through March and their FL's ranged from 49-67 mm (Table 13). Actually, these fish were likely yearling trout born last year that had yet to reach adequate size for us to identify to species. In 2007 yoy trout did not arrive to the sample area until June (Table 11). Unlike 2007, we did not capture another cohort of yoy trout in the second half of 2008 suggesting that for whatever reason trout fry did not move into the stream-estuary ecotone of Salmon Creek. We captured 18 juvenile steelhead in 2008 (Table 13). We captured 17 of them January through May and one in September. Their FL's ranged 68 to 191 mm. We did not capture any other juvenile salmonid species.

We did not capture any juvenile salmonids in Hookton Slough in 2008 (Table 12). We did capture on adult coho salmon in February.

In order to determine if juvenile salmonids were using Hookton Slough/Salmon Creek estuary during high flows or if they were using other areas of Salmon Creek in the summer we conducted some qualitative sampling using minnow traps baited with frozen salmon roe in 2008. We fished these traps in deeper water or more heavily vegetated habitat near our normal seining sites. We captured 27 juvenile steelhead ranging in size from 70-136 mm (Table 13). We also captured one trout in February (Table 13).

**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.

**Martin Slough 2007**

Starting in January 2007 we began a standard monthly sampling effort in the tidal portion of Martin Slough. Juvenile coho salmon were the most abundant salmonids captured in Martin Slough (Table 14). Though juvenile coho salmon were present year round in Martin Slough the highest numbers were present in winter and early spring (Table 14). On average the coho we captured in Martin Slough were larger than those captured in any other Humboldt Bay tributary (Table 15). Their monthly mean FL's were >100 mm with individual fish as large as 144 mm and most coho were greater than 90 mm FL. Martin Slough is an important rearing area, especially over-winter rearing, for juvenile coho salmon. Smaller sized coho appeared in Martin Slough, and many of our other sample sites around Humboldt Bay, after storms increased stream flows. This provides evidence that juvenile coho salmon residing upstream redistribute themselves in the fall to the stream-estuary ecotone seeking low velocity over-winter habitat.

We also captured two juvenile steelhead, one each in September and October (Table 14). They were 223 and 177 mm FL, respectively. We caught a total of five cutthroat trout in May, June, September, and December (Table 14). Some of the cutthroat were probably adult fish.
We also captured threespine stickleback, prickly sculpin, Pacific staghorn sculpin, red legged frog, and rough skin newt.

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, January-December 2008. 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 |
| Jan | 6 | 2.00 | 60 | 51-66 | 0 | - | - | 0 | - | - | 0.17 | 71 | 71 | 0 | - | - |
| Feb | 12 | 0.42 | 59 | 49-65 | 0 | - | - | 0 | - | - | 0.08 | 191 | 191 | 0 | - | - |
| Mar | 12 | 0.75 | 63 | 59-67 | 0 | - | - | 0 | - | - | 0.50 | 80 | 72-96 | 0 | - | - |
| Apr | 12 | 0 | - | - | 0 | - | - | 0 | - | - | 0.75 | 92 | 68-161 | 0 | - | - |
| May | 12 | 0 | - | - | 0 | - | - | 0 | - | - | 0.17 | 116 | 83-148 | 0 | - | - |
| June | 12 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| 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 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

**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 |
| Jan | 2 | 0 | - | - | 0 | - | - | 0 | - | - | 2 | 90 | 70-110 | 0 | - | - |
| Feb | 2 | 1 | 65 | 65 | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - | - |
| Mar | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Apr | 2 | 0 | - | - | 0 | - | - | 0 | - | - | 1 | 113 | 113 | 0 | - | - |
| May | 4 | 0 | - | - | 0 | - | - | 0 | - | - | 7 | 89 | 82-102 | 0 | - | - |
| June | 4 | 0 | - | - | 0 | - | - | 0 | - | - | 12 | 104 | 76-127 | 0 | - | - |
| 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 | - | - |

Table 14. Comparison of the number of juvenile salmonids captured by month in Martin Slough, January 2007 to December 2008.

| Date | Yearling Coho | YOY Coho | Steelhead | Cutthroat Trout |
|---|---|---|---|---|
| 1-18-07 | 3 | 0 | 0 | 0 |
| 2-23-07 | 1 | 0 | 0 | 0 |
| 4-05-07 | 39 | 0 | 0 | 0 |
| 5-10-07 | 18 | 0 | 0 | 1* |
| 6-18-07 | 14 | 0 | 0 | 2* |
| 8-16-07 | 0 | 3 | 0 | 0 |
| 9-18-07 | 0 | 14 | 1 | 1 |
| 10-18-07 | 0 | 14 | 1 | 0 |
| 11-15-07 | 0 | 10 | 0 | 0 |
| 12-11-07 | 0 | 0 | 0 | 1 |
| 1-10-08 | 28 | 0 | 0 | 0 |
| 2-05-08 | 7 | 0 | 0 | 0 |
| 2-07-08** | 30 | 0 | 0 | 0 |
| 3-04-08 | 0 | 0 | 0 | 0 |
| 3-04-08** | 25 | 0 | 0 | 0 |
| 4-08-08 | 59 | 0 | 0 | 0 |
| 4-08-08** | 6 | 0 | 0 | 0 |
| 5-13-08 | 11 | 0 | 0 | 0 |
| 5-13-08** | 0 | 0 | 0 | 0 |
| 6-12-08 | 0 | 0 | 0 | 5* |
| 6-12-08** | 0 | 0 | 0 | 0 |
| 7-10-08 | 0 | 4 | 0 | 1* |
| 7-10-08** | 0 | 0 | 0 | 0 |
| 8-07-08 | 0 | 3 | 0 | 0 |
| 8-07-08** | 0 | 0 | 0 | 0 |
| 9-09-08*** | 0 | 6 | 0 | 0 |
| 10-09-08 | 0 | 0 | 0 | 2* |
| 10-09-08** | 0 | 0 | 0 | 0 |
| 11-06-08 | 0 | 14 | 0 | 7* |
| 11-06-08** | 0 | 0 | 0 | 1 |
| 12-02-08 | 0 | 7 | 1 | 4* |
| 12-02-08** | 0 | 0 | 0 | 0 |
| 12-11-08*** | 0 | 16 | 1 | 8* |

* Catch contained adult cutthroat trout.

** East tributary catch only

*** Much higher sampling effort occurred on this date

**PIT Tag Results for 2007.** We applied PIT tags to 36 yoy and 71 yearling and older coho salmon and recaptured four (11.1%) yoy and one (1.4%) yearling PIT tagged coho. The yearling coho was at large from May 10 to June 18 (39 days) and grew 40 mm (1.03 mm/day). Three of the recaptured yoy coho were at large from September 18 to October 18 (30 days) and grew 8-11 mm (0.27-0.33 mm/day). The other recaptured yoy coho was at large from September 18 to November 15 (58 days) and grew 17 mm (0.29 mm/day). All fish were marked and recaptured in the pond where we originally tagged them.

## Martin Slough 2008

Juvenile coho salmon were the most abundant salmonids captured in Martin Slough (Table 14). Though juvenile coho salmon were present year round in Martin Slough the highest numbers were present in winter and early spring (Table 14). On average the coho we captured in Martin Slough were larger than those captured in any other Humboldt Bay tributary (Table 16). Their monthly mean FL's ranged from 81-121 mm with individual fish as large as 136 mm. Martin Slough is an important rearing area, especially over-winter rearing, for juvenile coho salmon.

Table 15. Summary of the number and fork length (FL) information of juvenile salmonids

captured in Martin Slough, Rocky Gulch, and Wood Creek in 2007.

**Martin Slough**

| Date | Coho Salmon | | | Steelhead/RT | | | Cutthroat Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | FL | Range | No. | FL | Range | No. | FL | Range |
| 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 |
| 8-16-07 | 3 | 100 | 99-102 | 0 | - | - | 0 | - | - |
| 9-18-07 | 14 | 106 | 97-111 | 1 | 223 | 223 | 1 | 208 | 208 |
| 10-18-07 | 14 | 115 | 95-127 | 1 | 177 | 177 | 0 | - | - |
| 11-15-07 | 8 | 91 | 64-123 | 0 | - | - | 0 | - | - |
| 12-11-07 | 0 | - | - | 0 | - | - | 1 | 192 | 192 |

**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 |
| 7-31-07 | 0 | - | - | 0 | - | - | 4 | 121 | 112-132 |
| 9-17-07 | 0 | - | - | 0 | - | - | 10 | 126 | 98-158 |
| 10-17-07 | 1 | 85 | 85 | 0 | - | - | 1 | 128 | 128 |
| 11-16-07 | 0 | - | - | 0 | - | - | 2 | 116 | 112-120 |

**Wood Creek**

| Date | Coho Salmon | | | Steelhead/RT | | | Cutthroat Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | FL | Range | No. | FL | Range | No. | FL | Range |
| 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 |
| 7-10-07 | 12* | 70 | 56-89 | 0 | - | - | 2 | 128 | 120-135 |
| 8-12-07 | 4 | 93 | 83-105 | 0 | - | - | 2 | 117 | 113-120 |
| 9-17-07 | 1 | 98 | 98 | 0 | - | - | 0 | - | - |
| 10-16-07 | 3 | 96 | 82-110 | 1 | 135 | 135 | 2 | 139 | 137-140 |
| 11-16-07 | 9 | 95 | 68-109 | 0 | - | - | 0 | - | - |
| 12-12-07 | 5 | 87 | 65-102 | 0 | - | - | 0 | - | - |

* includes one yoy coho not included in size information

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.

During the year we also captured tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin and rough skin newt.

We also captured one juvenile steelhead in December and it was 219 mm FL (Table 16). We caught a total of 15 cutthroat trout mostly in June and October to December (Table 16). They ranged in size from 109-264 mm FL. Some of these cutthroat were probably adult fish. We also caught a number of large adult cutthroat greater than 300 mm FL during the year.

Table 16. Summary of the number of fish captured and fork length (FL) information of juvenile salmonids captured in Martin Slough, Rocky Gulch, and Wood Creek in 2008. Also, the effort and numbers of fish captured in Gannon Slough, and Jacoby Creek September 2007 to December 2008. Seine effort is number of seine hauls and minnow trap (MT) effort is number of traps set.

**Martin Slough**

| Date | Coho Salmon | | | Steelhead/RT | | | Cutthroat Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | FL | Range | No. | FL | Range | No. | FL | Range |
| 1-10-08 | 28 | 81 | 61-113 | 0 | - | - | 0 | - | - |
| 2-05-08 | 37 | 89 | 66-118 | 0 | - | - | 0 | - | - |
| 3-04-08 | 58 | 95 | 68-124 | 0 | - | - | 0 | - | - |
| 4-08-08 | 65 | 107 | 89-136 | 0 | - | - | 0 | - | - |
| 5-13-08 | 11 | 111 | 94-121 | 0 | - | - | 0 | - | - |
| 6-12-08 | 0 | - | - | 0 | - | - | 5 | 224 | 181-264 |
| 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 |

**Rocky Gulch**

| Date | Coho Salmon | | | Steelhead/RT | | | Cutthroat Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | FL | Range | No. | FL | Range | No. | FL | Range |
| 1-16-08 | 0 | - | - | 0 | - | - | 0 | - | - |
| 2-14-08 | 0 | - | - | 0 | - | - | 0 | - | - |
| 3-19-08 | 20 | 96 | 87-106 | 1 | 129 | 129 | 0 | - | - |
| 4-18-08 | 16 | 100 | 82-112 | 0 | - | - | 2 | 124 | 100-148 |
| 6-25-08 | 0 | - | - | 0 | - | - | 1 | 138 | 138 |
| 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 |

**Wood Creek**

| Date | Coho Salmon | | | Steelhead/RT | | | Cutthroat Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. | FL | Range | No. | FL | Range | No. | FL | Range |
| 1-09-08 | 31 | 74 | 58-112 | 0 | - | - | 0 | - | - |
| 2-06-08 | 47 | 84 | 55-112 | 0 | - | - | 2 | 125 | 110-140 |
| 3-06-08 | 47 | 95 | 73-116 | 0 | - | - | 0 | - | - |
| 4-04-08 | 39 | 95 | 65-115 | 1 | 125 | 125 | 2 | 96 | 92-100 |
| 5-02-08 | 11 | 98 | 83-117 | 0 | - | - | 2 | 123 | 121-125 |
| 6-03-08 | 0 | - | - | 0 | - | - | 1 | 130 | 130 |
| 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 |

| | Gannon Slough | | | | | Jacoby Creek | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | Effort | | Coho | SH | Cutt | Effort | Coho | SH | Cutt | Yoy Trout |
| | MT | Seine | | | | Seine | | | | |
| 9-28-07 | 4 | 0 | 0 | 0 | 0 | - | - | - | - | - |
| 10-31-07 | 3 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 3 |
| 12-4-07 | 4 | 6 | 0 | 0 | 0 | - | - | - | - | - |
| 1-15-08 | 5 | 6 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 2-14-08 | 5 | 6 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 3-13-08 | 5 | 6 | 0 | 0 | 0 | 0 | - | - | - | - |
| 4-14-08 | 5 | 6 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 5-13-08 | 7 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 6-12-08 | 6 | 4 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 5 |
| 7-9-08 | 6 | 5 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 |
| 8-21-08 | 6 | 4 | 0 | 0 | 1 | 2 | 14 | 6 | 0 | 0 |
| 9-22-08 | 4 | 6 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |
| 10-23-08 | 4 | 6 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 12-16-08 | 5 | 6 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |

**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 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.

**Rocky Gulch 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 15). Juvenile coho salmon were most abundant in winter and early spring (Table 15). Their mean monthly FL increased from 81-101 mm from February to April (Table 15). By late May most over-winter rearing coho had left Rocky Gulch with only two more fish captured during the rest of the year. It appears juvenile coho use Rocky Gulch primarily as over winter habitat to escape high velocity stream flows, however, we do not know if the coho rearing here migrate downstream from the upper basin or are non-natal fish from adjacent watersheds such as Washington Gulch or Jacoby Creek.

We also captured one juvenile steelhead in May that was 115 mm FL (Table 15). We caught a total of 35 cutthroat trout from March through November (Table 15). Their mean monthly FL increased from 75 mm in March to 128 mm in October and their sizes ranged from 73-158 mm FL (Table 15).

We also captured tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin, starry flounder, and mosquitofish.

**PIT Tag Results for 2007-** We applied PIT tags to 62 yearling and one yoy coho salmon and recaptured six (9.7%) PIT tagged yearling coho. The yearling coho were at large 10 to 37 days (mean=31 days), all between March 13 and April 19, and grew 2-11 mm. The mean growth rate for the five fish at large at least two weeks was 0.31 mm/day and ranged from 0.27 to 0.41 mm/day. Two of the fish moved one sampling site downstream and the rest were marked and recaptured in the site where we originally tagged them. We also applied PIT tags to 25 cutthroat trout and recaptured five (20.0%) of them. The cutthroat trout were at large for 60 to 178 days (mean=100 days). Their mean growth rate was 0.26 mm/day and ranged from 0.10 to 0.38 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.

**Rocky Gulch 2008**

We captured markedly fewer juvenile coho salmon in Rocky Gulch in 2008 than 2007 (Tables 15 & 16). We captured a total of 36 coho salmon in March and April (Table 16). Their mean monthly FL increased from 96-100 mm from March to April (Table 16). By late May all coho had left Rocky Gulch. It appears juvenile coho use Rocky Gulch primarily as over winter habitat to escape high velocity stream flows, however, we do not know if the coho rearing here migrate

downstream from the upper basin or are non-natal fish from adjacent watersheds such as Washington Gulch or Jacoby Creek.

We also captured one juvenile steelhead in March that was 129 mm FL (Table 16). We caught a total of 15 cutthroat trout from April through December which was fewer than 2007 (Tables 15 & 16). Their mean monthly FL ranged from 108 to 138 mm throughout the year and their sizes ranged from 67-150 mm FL (Table 16).

We also captured tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin, starry flounder, and mosquitofish.

**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 2007**

Starting in February 2007 we began a standard monthly sampling effort in the tidal portion of Wood Creek (a tributary to Freshwater Creek Slough). Juvenile coho salmon were the most abundant salmonids captured in Wood Creek (Table 15). We captured a total of 150 juvenile coho salmon and they were most abundant in winter and spring (Table 15). Their mean monthly FL increased from 95-102 mm from February to June and individual fish ranged from 72-127 mm FL. By June most over-winter rearing coho had left Wood Creek. Coho mean monthly FL dropped to 70 mm with the arrival of yoy coho in July (Table 15). Another group of smaller coho arrived in Wood Creek in November and December (Table 15) after the first rains of the year providing evidence that coho rearing in the upper basin redistribute downstream to the stream-estuary ecotone in the fall. Though coho are present throughout the year it appears juvenile coho use Wood Creek primarily as over winter habitat to escape high velocity stream flows, and since there is no spawning upstream in Wood Creek the coho rearing here are non-natal fish from adjacent watersheds such as Freshwater and Ryan Creeks (see PIT tag section below). The stream-estuary ecotone and freshwater tidal portions of Humboldt Bay tributaries provide low stream velocity over-winter habitat and very productive spring and summer rearing habitat for juvenile coho.

We also captured one juvenile steelhead in June and October and both were was 135 mm FL (Table 15). We caught a total of 10 cutthroat trout, most from June through August (Table 15). Their sizes ranged from 103-140 mm FL (Table 15).

We also captured tidewater goby, threespine stickleback, prickly sculpin, Pacific staghorn sculpin, starry flounder, and mosquitofish.

**PIT Tag Results for 2007.** We applied PIT tags to 92 yearling and 19 yoy coho salmon and recaptured five (5.4%) PIT tagged yearling coho and four (21.1%) yoy coho salmon. We also captured two yearling coho tagged by our project in July 2006 in Freshwater Slough at our 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. The yearling coho marked and recaptured in Wood Creek were at large 35 to 70 days (mean=49 days) and grew 6-15 mm (0.13-0.43 mm/day). All the yearling coho were marked and recaptured in the site where we

originally tagged them. The yoy coho were at large 26-129 days (mean=86 days) and grew 2-28 mm (0.03-0.22 mm/day). All the yoy coho were marked and recaptured in the same site where we originally tagged them. We also applied PIT tags to six cutthroat trout and recaptured three (50.0%) of them. The cutthroat trout were at large for 60 to 98 days (mean=73 days). Their mean growth rate was 0.04 mm/day and ranged from 0.02 to 0.05 mm/day. All of the fish were recaptured at the same site where we originally tagged them. We also applied a PIT tag to two juvenile steelhead and did not recapture either one.

**Wood Creek 2008**

Juvenile coho salmon were the most abundant salmonids captured in Wood Creek (Table 16). We captured a total of 181 juvenile coho salmon and they were most abundant in winter and spring (Table 16). Their mean monthly FL increased from 74-98 mm from January to May and individual fish ranged from 55-117 mm FL. By June most over-winter rearing coho had left Wood Creek. In 2008 very few yoy coho moved into Wood Creek which mirrored our observations of low numbers of yoy coho in Freshwater Creek Slough in the summer of 2008 (Table 16). We did capture a small number coho in Wood Creek in November and December (Table 16) after the first rains of the year. Though coho are present throughout the year it appears juvenile coho use Wood Creek primarily as over winter habitat to escape high velocity stream flows, and since there is no spawning upstream in Wood Creek the coho rearing here are non-natal fish from adjacent watersheds such as Freshwater and Ryan Creeks (see PIT tag section below). The stream-estuary ecotone and freshwater tidal portions of Humboldt Bay tributaries provide low stream velocity over-winter habitat and very productive spring and summer rearing habitat for juvenile coho.

We also captured one juvenile steelhead in April and it was 125 mm FL (Table 16). We caught a total of 17 cutthroat trout (Table 16). Their sizes ranged from 92-156 mm FL.

**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**

Beginning in September 2007 we began a standard monthly sampling effort in the tidal portion of Gannon Slough and Jacoby Creek. Compared to other tidal portions of Humboldt Bay tributaries we collected relatively few salmonids in Jacoby Creek and especially Gannon Slough. In Gannon Slough cutthroat trout (n=4) were the most common salmonid captured and all were caught in July and August 2008 (Table 16). We also caught two juvenile coho salmon in April 2008. In Jacoby Creek juvenile coho (n=16) were the most abundant salmonids captured and most were caught in August 2008 (Table 16). We also captured eight juvenile steelhead mostly in August 2008 and eight yoy trout.

We also captured tidewater goby, threespine stickleback, and numerous other estuarine fish

such as prickly Pacific staghorn sculpin, starry flounder, shiner surfperch, and surfsmelt. We also commonly captured juvenile Dungeness crab in the lower portion of Gannon Slough.

**Water Quality-** NSA deployed HOBO temperature data loggers in Freshwater Creek, Elk River, Salmon Creek/Hookton Slough, and Wood Creek to continuously measure spring to fall water temperatures in estuarine habitat. The HOBO meters documented that water temperatures in the freshwater portions of the sloughs did not exceed 17-18 $^{o}$C. However, in Hookton Slough and about a 5 km portion of lower Freshwater Creek Slough NSA recorded water temperatures routinely greater than 20$^{o}$C and up to 25$^{o}$C. They usually remained above 20$^{o}$C from mid June through mid August regardless of tide stage or time of day. A portion of lower Elk River Slough also had elevated water temperatures but was about 3-5 $^{o}$C lower than Freshwater Creek and Hookton Sloughs. The elevated temperatures in Freshwater Creek and Hookton Sloughs are probably due to the extensive mudflats that surround these two sloughs. The mud flats are heated by the sun at low tides and warms the slough water as it rises over the flats. The lack of water circulation within the leveed sloughs traps the warmed water within sections of the lower sloughs. Elk River Slough is not adjacent to extensive mud flats so it does not heat up as much as Freshwater Creek and Hookton Sloughs.

**Summary of Project Results:**
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 sonic tagged coho salmon smolts in lower Freshwater Creek Slough was about two weeks and was as long as four weeks. They also found that the average residence time of sonic tagged coho salmon smolts in Humboldt Bay was also about two weeks and was as long as 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 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?

**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 ectone 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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