

Annual Project Performance Report

1. State: California

Grant number: F-137-R

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

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

2. Report Period: July 1, 2012 through June 30, 2013

Report due date: September 30, 2013

Date prepared: August 2013

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

4. Objectives:

1. Monitor and evaluate the effects of ongoing estuarine habitat restoration projects in Wood and Salmon Creeks on juvenile salmonid use and basic water quality conditions, specifically in the newly created off channel ponds.
2. Gather pre-project fish and water quality data for planned estuarine habitat restoration projects in Martin Slough, Ryan Creek, and Jacoby Creek designed to increase the amount and quality of juvenile salmonid rearing habitat.
3. Better describe use of entire Freshwater Creek stream-estuary ecotone by monitoring juvenile salmonid entry timing, movement, and use of Freshwater Creek Slough, Wood Creek, and Ryan Creek/Slough.

5. Part of Larger Project: This work is being augmented by California Fisheries Restoration Grant Program to pay for Pacific States Marine Fisheries Commission fishery technicians to conduct the field sampling and a small portion of O&E. Aid in Sport Fish Restoration funds are being used to pay for project biologist, O&E, and a small portion of temporary help for project field work.

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

6. Describe how the objectives were met:

During the past year CA Dept of Fish and Wildlife's (CDFW) Natural Stocks Assessment Project (NSA) continued to sample the tidal portion of upper Freshwater Creek Slough, Wood Creek, Ryan Creek, and Salmon Creek estuary to document their use by juvenile salmonids and to assess estuarine habitat restoration projects in Wood and Salmon Creeks. Salmonid recovery plans encouraged numerous estuary and marsh habitat restoration projects around Humboldt Bay (NMFS 2012; HBWAC 2005; CDFG 2004). This project, by describing life history traits and habitat needs of juvenile salmonids in the stream-estuary ecotone of Humboldt Bay, has already played an important role by providing needed data to help in the design local estuarine habitat restoration projects. NSA monitored the effects of marsh restoration projects in Wood and Salmon Creeks on juvenile salmonid use and basic water quality conditions, specifically in the newly created off channel ponds. NSA installed PIT tag antennas in Wood and Salmon Creeks to assess the performance of a newly constructed off channel pond as over winter habitat for juvenile salmonids and installed a PIT tag antenna in Ryan Creek to better describe the use of the stream-estuary ecotone by juvenile salmonids. NSA began pre-project monitoring of an off channel habitat restoration project in Jacoby Creek October that will connect an existing isolated pond to Jacoby Creek sometime in 2014. By describing life history traits and habitat needs of juvenile coho salmon, Chinook salmon, steelhead trout, and sea-run coastal cutthroat trout and by assessing the performance of newly constructed off channel ponds this project hopes to provide important data to the restoration community to help restoration planning projects succeed. Planned habitat restoration projects were delayed until late summer 2013 in Martin Slough so we will begin to collect pre-project data there in late 2013 if the project begins.

Methods

When stream and weather conditions allowed, NSA conducted bi-weekly sampling for juvenile salmonids in Freshwater Creek Slough, Ryan Creek Slough, Salmon Creek estuary, and the off channel pond in Wood Creek. We conducted monthly sampling in Wood Creek and Jacoby Creek restoration site (Figure 1). We used a 30 ft X 4 ft seine net to capture fish in Freshwater Creek Slough, a 100 ft X 5 ft seine net to capture fish in the Salmon and Wood Creek ponds, and minnow traps baited with frozen salmon roe in Ryan Creek, Wood Creek, Jacoby Creek, and sections of Salmon Creek where we were unable to seine (Figure 1). In the winter of 2010 NSA installed two passive integrated transponder (PIT) tag antenna arrays in Wood Creek; one in a newly constructed off channel pond and one at the mouth of the creek. In the winter of 2011 we installed PIT tag antennas at the opening of the most upstream pond in Salmon Creek. In the winter of 2012 we installed PIT tag antennas in Ryan Creek. PIT tag detections were automatically stored on a data logger and NSA crew members downloaded this data every one to two weeks. This data was copied into Excel spreadsheets for future analysis back at the office. In the spring of 2013 NSA also assisted CDFW's Anadromous Fisheries Research and Monitoring Program (AFRAMP) with the operation of a juvenile fish weir set up at the Humboldt Fish Action Council (HFAC) weir site in upper Freshwater Creek Slough to capture

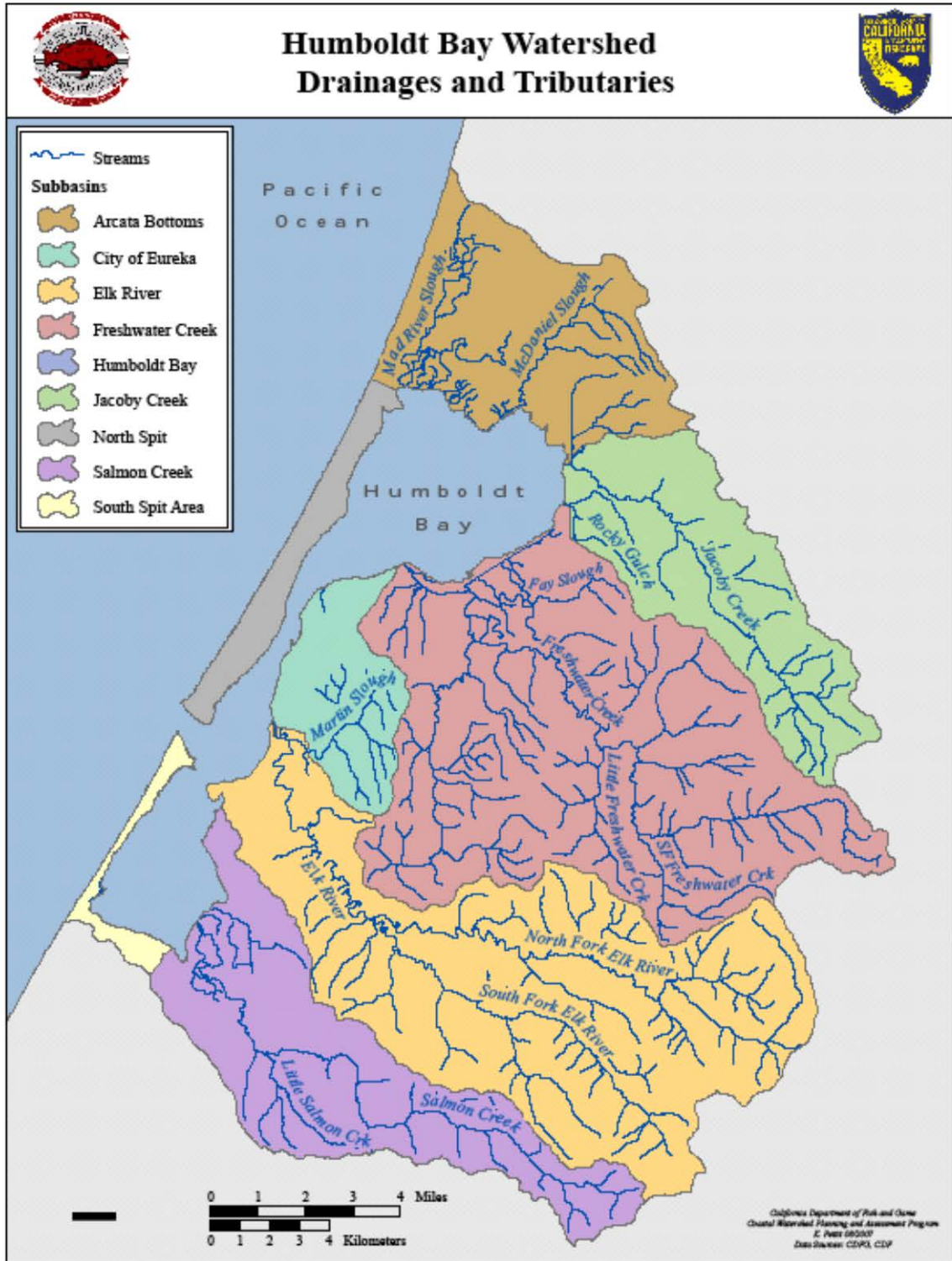


Figure 1. Map of Humboldt Bay tributaries.

juvenile salmonid smolts emigrating from Freshwater Creek. NSA applied PIT tags to all healthy juvenile salmonids ≥ 55 mm FL to gather residency, movement, distribution, and growth information while they were in the stream-estuary ecotone.

We also conducted water quality sampling bi-weekly at the habitat restoration sites in Wood and Salmon Creeks and monthly in Jacoby Creek. We collected temperature, salinity, conductivity, and dissolved oxygen data in the newly constructed ponds and adjacent slough habitat.

Results

Freshwater Creek Slough

Freshwater Creek Slough July 2012 to June 2013

Due to high flows we were unable to sample during December 2012. We captured 1,521 sub yearling coho salmon during July-November 2012. Their monthly catch per unit of effort (CPUE) was 13.06 fish/set in July, peaked at 19.95 fish/set in August, and then gradually dropped to 7.46 in October and 8.65 fish/set in November. Sub yearling coho CPUE was much higher in 2012 than in past years. Their monthly mean fork length (FL) increased from 56 to 76 mm from July to November. This is the smallest summer/fall FL's for sub-yearling coho we've observed during the duration of our project (Figure 2). We captured a total of 62 juvenile steelhead from July through November. We captured them every month and their peak CPUE was 0.73 fish/set in September. Their FL's ranged from 56 to 183 mm. We also captured a total of 22 cutthroat trout. We captured them every month but October and their peak CPUE was 0.33 fish/set in August. Their FL's ranged from 50 to 247 mm. We did not capture yearling coho or sub-yearling Chinook salmon during July-December 2012.

From January to June 2013 NSA captured 322 yearling coho salmon. We captured fish every month but January and their peak monthly CPUE occurred in April at 6.00 fish/set. Their monthly mean FL increased from 75 mm in February to 103 mm in June. We captured 109 sub yearling coho, 94% of them in May and June and their peak CPUE occurred in June at 3.33 fish/set. Our June catches of sub yearling coho in 2012 was about average since we began sampling in 2005 (Table 1). Their monthly mean FL increased from 41 mm in April to 56 mm in June. NSA captured a total of nine sub yearling Chinook salmon, seven in May and two in June. They ranged in size from 39 to 67 mm FL. We captured a total of 46 juvenile steelhead. We captured them in every month and their peak CPUE was 1.05 fish/set in May. Their FL's ranged from 54 to 180 mm. We also captured 22 cutthroat trout, 19 of them from April to June and their FL's ranged from 106 to 268 mm.

PIT Tag Results for 2012- We applied PIT tags to 555 sub-yearling coho in 2012 and recaptured 303 (54.6%) of them. Their mean length of residence was 58 days and ranged from 12 to 165 days and was similar to past years. The mean growth rate of recaptured sub-yearling coho was 0.17 mm/day and ranged from -0.07 to 0.63 mm/day. We applied PIT tags to 116 yearling coho in 2012 and recaptured none of them. However, we did capture 11 yearling coho we marked as sub-yearlings in

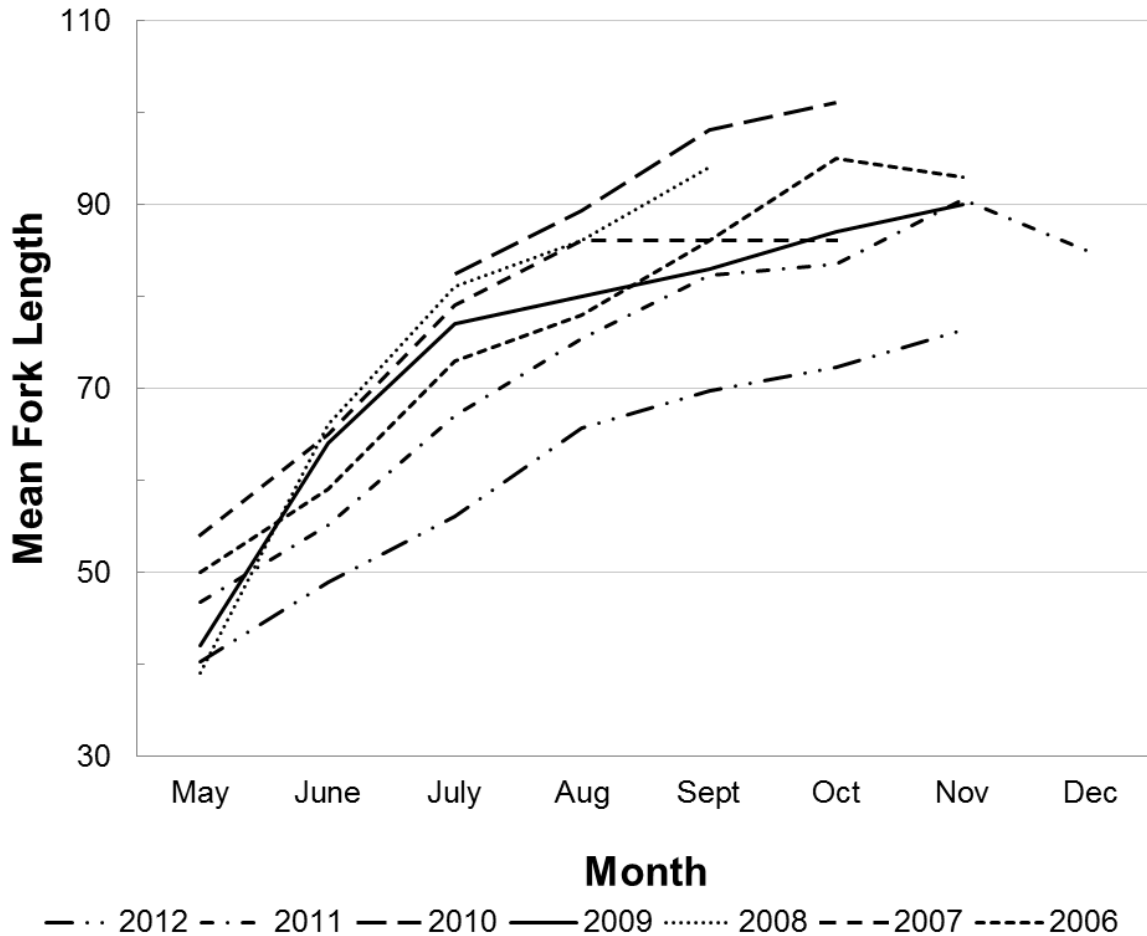


Figure 2. Mean monthly fork lengths of sub yearling coho salmon captured in Freshwater Creek Slough, 2006-2012.

Table 1. Effort, number captured, and catch-per-unit-effort of young-of-the-year coho salmon in upper Freshwater Creek Slough during June, 2003-2013.

Year	# Seine Hauls	# Caught	CPUE (fish/set)
2003	48	478	9.96
2004	60	335	5.58
2005	59	447	7.58
2006	48	161	3.35
2007	48	64	1.33
2008	44	4	0.09
2009	34	106	3.12
2010	10	2	0.20
2011	24	33	1.38
2012	22	146	6.64
2013	24	80	3.33

2011. They were at large 28-191 days and grew 1-23 mm (0.04-0.17 mm/day). We also recaptured three coho that were tagged by AFRAMP in the Freshwater Creek basin in the fall of 2011. We applied PIT tags to 64 juvenile steelhead in 2012 and recaptured 17 (26.6%) of them. They were at large for 15 to 238 days and during that time they grew -1 to 38 mm (-0.02 to 0.32 mm/day). We also captured one juvenile steelhead that was tagged by NSA in 2011 that was at large 335 days and grew 37 mm (0.11 mm/day). We also captured two steelhead that were tagged at the HFAC weir in 2011 that were at large 243 and 256 days and grew 35 mm (0.14 mm/day) and 55 mm (0.22 mm/day) respectively. We applied PIT tags to 14 cutthroat trout in 2012 and recaptured one (7.1%) of them. It was at large for 14 days and grew 1 mm (0.07 mm/day). We also recaptured four cutthroat trout that were tagged by other projects and/or in other locations in the Freshwater Creek basin. It is likely that some of the cutthroat trout captured by our project were resident adult fish.

Wood Creek

Wood Creek July 2012 to June 2013

From July to December 2012 we captured 17 sub yearling coho salmon while minnow trapping in Wood Creek. Our peak catch of eight fish occurred in December. We also captured 15 sub-yearling coho by seine in Wood Creek pond. All pond coho were captured in December. Their mean FL increased from 55 in July/August to 72 mm in November/December. We did not capture any other salmonid species.

From January to June 2013 NSA captured 65 yearling coho salmon in Wood Creek. We captured them every month but April and our peak catch of 30 occurred in February. Their monthly mean FL ranged from 81 mm to 90 mm in with no apparent pattern. We captured one cutthroat trout in May and it was 108 mm FL. In Wood Creek pond we captured 237 yearling coho, 75 sub yearling coho, one steelhead, and one cutthroat trout. We captured yearling coho from January to April and our peak catch of 195 occurred in March. Their monthly mean FL increased from 74 mm in February to 84 mm in April. We captured sub yearling coho in May and June with a peak catch of 58 in May. Their monthly mean FL was 40 mm in May and 50 mm in June. We captured the steelhead in February and the cutthroat in April and their FL's were 71 mm and 104 mm respectively.

PIT Tag Antenna 2012/2013- Between October 2012 and June 2013 NSA detected 75 coho salmon at the pond antenna. Individual coho were first detected on 11/30/12 and last detected on 5/11/13, though most had left the pond by the end of April. Of the 75 coho detected in the pond, 42 (56%) were tagged by NSA and released into the pond, 11 (15%) were NSA tagged fish from Wood Creek (10 tagged in 2013 and one tagged in 2012), six (8%) were NSA tagged fish from Freshwater Creek Slough, two (3%) were from Ryan Creek, and 14 (19%) were tagged upstream in Freshwater Creek basin by AFRAMP during the fall of 2012 (Table 2). Thirty two of the fish were detected in the pond on more than one day. These 32 fish had an average time between first and last detection (a surrogate for residence time) of 16 days (range 1-93 days).

Table 2. Origin of PIT tagged juvenile coho salmon tagged in Freshwater Creek (FW) basin detected at Wood Creek pond and tidegate antennas during January to September 2010, October 2010 to October 2011, October 2011 to July 2012, and October 2012 through June 2013.

Fish Origin	Pond 2010	Pond 10/11	Pond 11/12	Pond 12/13	Tide Gate 2010	Tide Gate 10/11	Tide Gate 11/12	Tide Gate 12/13
Stream-Estuary Ecotone	7	1		1	9	30		11
Lower Mainstem	11	6	26	2	11	49	75	29
Middle Mainstem		11	16	1		79	51	31
Upper Mainstem	7	6	12	4	10	59	34	25
Little Freshwater Cr	12				13			
Cloney Gulch	9	4	6	4	8	45	23	32
So. Fork Freshwater Cr		0	10	2		13	31	23
Freshwater Creek (total)	46	28	70	14	51	275	214	151
Wood Cr Pond	74	8	199	42	33	3	138	16
Wood Cr (tagged 2013)		-	-	10	-	-	-	83
Wood Cr (tagged 2012)	-	-	12	1	-	-	44	6
Wood Cr (tagged 2011)	-	16	8	0	-	30	25	0
Wood Cr (tagged 2010)	26	3	0	0	47	5	0	0
Wood Cr (tagged 2009)	1	0	0	0	1	0	0	0
Ryan Sl/Cr	0	0	7	2	26	5	71	38*
FW Sl (tagged 2013)	-	-	-	0	-	-	-	74
FW Sl (tagged 2012)	-	-	5	6	-	-	31	12
FW Sl (tagged 2011)	-	0	3	0	-	2	36	0
FW Sl (tagged 2010)	0	0	0	0	2	8	0	0
FW Sl (tagged 2009)	5	0	0	0	9	0	0	0
HFAC Weir (tagged 2013)	-	-	-	0	-	-	-	220*
HFAC Weir (tagged 2012)	-	-	2	0	-	-	156	1
HFAC Weir (tagged 2011)	-	0	0	0	-	122	0	0
HFAC Weir (tagged 2010)	0	0	0	0	163	1	1**	0
HFAC Weir (tagged 2009)	1	0	0	0	2	0	0	0
Estuary Ecotone (total)	107	27	236	61	283	176	502	450
Grand Total	153	55	306	75	334	451	716	601

* We still have 83 unidentified PIT tags collected during 2012/13. We anticipate many of the tags will be comprised of coho tagged at HFAC Weir and in Ryan Creek during the spring of 2013.

** This was likely an adult coho returning to Freshwater Creek basin.

At the tide gate antenna we detected 601 coho salmon, three juvenile steelhead, 12 cutthroat trout, four Pacific lamprey, and 83 PIT tags waiting to be identified. Individual coho were first detected on 9/13/12 and last detected on 6/28/13. Most coho were first detected from April to May 2013 (61%) and another 26% were first detected in November and December 2012 illustrating that a substantial redistribution of juvenile coho occurs in the fall after the first rains followed by a large spring out migration of coho salmon smolts. Of the 601 coho detected at the tide gate, 221 (37%) were tagged by AFRAMP and NSA at the HFAC weir (220 in 2013 and one in 2012), 151 (25%) were tagged by AFRAMP upstream in Freshwater Creek basin during the fall of 2012, 89 (15%) were tagged by NSA and released into Wood Creek (83 tagged in 2013 and six tagged in 2012), 86 (14%) were tagged by NSA in Freshwater Creek Slough (74 tagged in 2013 and 12 tagged in 2012), 38 (6%) were tagged by NSA or Green Diamond Co. in Ryan Creek, and 16 (3%) were tagged by

NSA and released into the newly constructed off channel pond at Wood Creek (Table 2).

Ryan Creek

Ryan Creek July 2012 to June 2013

In Ryan Creek from July to December 2012 we captured 12 yearling coho, 303 sub yearling coho, 53 juvenile steelhead, 60 cutthroat trout, and one unidentified sub yearling trout. We captured sub yearling coho in every month and our peak catch of 98 occurred in October. Their monthly mean FL increased from 67 to 83 mm from July to October and dropped slightly to 80 and 78 mm in November and December. We captured juvenile steelhead in every month except December and our peak catch of 13 occurred in July. Their FL ranged from 53 to 156 mm. We captured cutthroat trout every month and their peak catch of 15 occurred in October. Their FL ranged from 84 to 163 mm.

In the wetlands adjacent to Ryan Creek from July to December 2012 we captured nine sub yearling coho salmon in December and their FL ranged from 63 to 83 mm.

From January to June 2013 we captured 455 yearling coho, two sub yearling coho, 25 juvenile steelhead, and 38 cutthroat trout in Ryan Creek. We captured yearling coho every month and our peak catch of 166 occurred in April. Their monthly mean FL increased from 85 to 102 mm from January to May and dropped slightly to 100 mm in June. We captured two sub yearling coho in June and they were 64 and 67 mm FL. We captured juvenile steelhead in every month and their peak catch of nine occurred in May. Their FL's ranged from 73 to 154 mm. We captured cutthroat trout every month and their peak catch of 11 occurred in June. Their FL's ranged from 91 to 190 mm.

In the wetlands adjacent to Ryan Creek we captured 183 yearling coho salmon. We captured them every month but June and their peak catch of 67 occurred in February. Their monthly mean FL increased from 74 to 87 mm from January to May.

PIT Tag Results for 2012- We applied PIT tags to 229 sub yearling coho salmon and recaptured 59 (25.8%) of them. The recaptured coho were at large 13 to 99 days and their mean residence time was 37 days. They grew -2 to 25 mm and their mean growth rate was 0.14 mm/day (range -0.14 to 0.37 mm/day). We applied PIT tags to 134 yearling coho salmon and recaptured 16 (11.9%) of them. The recaptured coho were at large 11 to 110 days and their mean residence time was 48 days. They grew 1 to 31 mm and their mean growth rate was 0.22 mm/day (range 0.03 to 0.57 mm/day). We also captured five yearling coho that we marked in Ryan Slough in 2011 as sub yearling coho. They were at large 53 to 225 days. They grew 3-26 mm and their growth rate ranged from 0.06 to 0.15 mm/day. We applied PIT tags to 54 juvenile steelhead and recaptured 16 (29.6%) of them. The recaptured steelhead were at large 13 to 125 days and their average residence time was 57 days. They grew 0 to 27 mm and their mean growth rate was 0.24 mm/day (range 0 to 0.69 mm/day). We also captured one steelhead that we marked in Ryan Slough in

2011. It was at large 83 days and grew 0 mm. We applied PIT tags to 65 cutthroat trout and recaptured 18 (27.7%) of them. The recaptured cutthroat were at large 12 to 155 days and their average residence time was 66 days. They grew 3 to 42 mm and their mean growth rate was 0.26 mm/day (range 0.07 to 0.57 mm/day).

We are still analyzing PIT tag information for 2013 and these results will be reported in our project's 2013/14 SFRA Annual Report.

PIT Tag Antenna 2012/2013- NSA operated a PIT tag antenna array on Ryan Creek Slough near the mid-point of our sampling area from February 19 to June 7, 2013. Due to equipment problems we lost data from May 22-30 and then the system crashed on June 7. NSA detected 163 coho salmon, 22 juvenile steelhead, 25 cutthroat trout, and 494 unknown tag codes at the antenna. Most of the of the unknown tag codes are likely coho salmon tagged by Green Diamond Resource Co. biologists at their screw trap upstream of our sampling area.

Individual coho were first detected on 3/7/13 and last detected on 6/6/13. Of the 163 identified coho detected, 125 (77%) were tagged by NSA and released into Ryan Creek Slough, 15 (9%) were NSA tagged fish from Freshwater Creek Slough (all tagged in 2013), 12 (7%) were tagged upstream in Freshwater Creek basin by AFRAMP during the fall of 2012, nine (6%) were fish tagged and released into the wetland adjacent to Ryan Creek Slough by NSA, one was an NSA tagged fish from Wood Creek, and one was tagged by AFRAMP at the HFAC weir in the spring of 2013. The 134 coho initially tagged in Ryan Creek Slough and the adjacent wetland and detected at the antenna site had a mean residence time of 108 days (range 3 to 348 days) in the stream-estuary ecotone of Ryan Creek Slough. All 151 coho initially tagged in the Freshwater-Wood-Ryan stream-estuary ecotone had a mean ecotone residence time of 122 days (range 3 to 348 days).

Individual steelhead were first detected on 2/25/13 and last detected on 5/31/13. All the steelhead were originally tagged by NSA in Ryan Creek Slough. They had a mean residence time of 206 days (range 70 to 314 days). Individual cutthroat trout were first detected on 3/8/13 and last detected on 6/4/13. Twenty four of the cutthroat trout were originally tagged by NSA in Ryan Creek Slough. They had a mean residence time of 165 days (range 1 to 327 days). One cutthroat was tagged by NSA in Freshwater Creek Slough in 2012 and had been at large for 197 days when detected by the antenna in Ryan Creek Slough.

Hookton Slough/Salmon Creek

Salmon Creek July 2012 to June 2013

The Humboldt Bay National Wildlife Refuge completed construction of a new enlarged stream channel and four off channel ponds in the fall of 2011 on Salmon Creek and one additional off channel pond in the fall of 2012. From July to December 2012 we did not capture any juvenile salmonids. From January to June 2013 we captured 14 yearling coho and one juvenile steelhead when seining the new ponds. We captured 10 (71%) of the coho in the two upstream most ponds where

freshwater conditions persisted longer than the other ponds. We captured yearling coho in March, April and May and their peak monthly catch of eight occurred in May. We recaptured one yearling coho containing a PIT tag. It was at large 27 days (3/7 to 4/3/13) and grew 22 mm (0.81 mm/day). We captured the steelhead in April. The coho FL's ranged from 73 to 117 mm and the steelhead FL was 97 mm. We did not capture. We did not capture any juvenile salmonids in the old stream channel or any juvenile salmonids using baited minnow traps.

PIT Tag Results for 2012- In 2012 we applied PIT tags to 94 yearling coho and recaptured nine (9.6%) of them. This includes fish collected by seining and in minnow traps. The coho were at large 11 to 15 days and grew 5-10 mm (0.40-0.67 mm/day). All nine recaptured coho were tagged and recaptured in the new off channel ponds. We applied PIT tags to 13 juvenile steelhead and did not recapture any of them. We did recapture one steelhead in a pond that we marked in the old Salmon Creek stream channel in June 2011. It was at large 223 days and grew 87 mm (0.39 mm/day).

We are still analyzing PIT tag information for 2013 and these results will be reported in our project's 2013/14 SFRA Annual Report.

PIT Tag Antenna 2012- We installed a PIT tag antenna at the opening of the second most upstream pond in December of 2011. Between December 2011 and June 2012 NSA detected 80 coho salmon and 16 steelhead at the antenna site. Individual coho were first detected on 1/17/12 and last detected on 7/6/12. Of the 80 coho detected in the pond, 71 were tagged and released into the pond, seven were tagged in the adjacent pond downstream, one was tagged in the second pond downstream, and one was tagged in the old Salmon Creek stream channel in 2011. Seventy of the coho were detected in the pond on more than one day. These fish had an average time between first and last detection (a surrogate for residence time) of 17 days (range 1-83 days). All of the coho were originally tagged in the estuary so these fish had an average estuarine residence time of 18 days (range 1-104 days). Individual steelhead were first detected on 12/28/11 and last detected on 5/25/12. Of the 16 steelhead detected in the pond, nine were tagged and released into the pond, one was tagged in the adjacent pond downstream, and six were tagged in the old Salmon Creek stream channel in 2011. Fourteen of the steelhead were detected in the pond on more than one day. These fish had an average time between first and last detection (a surrogate for residence time) of 36 days (range 1-130 days). All of the steelhead were originally tagged in the estuary so these fish had an average estuarine residence time of 125 days (range 3-315 days).

From January to June 2013 we detected one yearling coho in the pond. It was tagged by NSA on 3/7/13 and detected at our antenna on 3/14/13.

Jacoby Creek Pond

We sampled Jacoby Creek pond and one site in Jacoby Creek with minnow traps monthly from October 2012 to June 2013. We did not capture any fish in the pond.

However, we did capture 16 sub yearling coho and four juvenile steelhead from October to December 2012 in Jacoby Creek, with 15 coho and three steelhead captured in November. The sub yearling coho ranged from 71-98 mm FL and the steelhead were 93-154 mm FL. From January to June 2013 we captured two yearling coho and five juvenile steelhead in Jacoby Creek. We captured two steelhead in February and the rest of the fish in May. The coho were 101 and 116 mm FL and the steelhead were 113 to 149 mm FL.

Off Channel Pond Water Quality

NSA found similar water quality patterns in off channel ponds in Wood and Salmon Creeks. The off channel ponds contained brackish water up to 25 ppt in Salmon Creek and 15 ppt in Wood Creek until high winter stream flows flushed the salt water from the ponds in the winter. The ponds remained primarily fresh water during the winter and spring until low stream flows allowed saltwater to once again reach the ponds in the late spring and summer. The ponds stratified so that brackish water was found along the bottom while remaining fresh near the surface. Water salinity tended to be higher and more persistent in the more downstream ponds on Salmon Creek. Water temperatures in the ponds also followed a seasonal pattern in that they were cool in the winter and spring but became too warm to support juvenile salmonids in the summer. Dissolved oxygen was often extremely low in the warm brackish layer of the pond during the summer and fall, especially in Wood Creek. The ponds provide good water quality during the winter and spring but become too warm and brackish with low dissolved oxygen during much of the summer and fall.

Jacoby Creek pond was dry until the first significant rains of the year occurred in November 2012. Even after rain and high stream flows filled the pond dissolved oxygen levels were too low to support salmonids in November and December but did become adequate from January to March 2013, marginal in April, and inadequate by May.

Summary of Project Results (2012-13):

- Fewer juvenile coho salmon moved into the newly constructed off channel ponds in Salmon Creek in 2012/13 compared to 2011/12. This suggests the annual variation of juvenile coho use of estuarine habitat.
- Most of the coho salmon captured in the off channel ponds on Salmon Creek were captured in the newly constructed pond upstream of the original four ponds. This continues the pattern of coho using the most upstream pond with the most persistent freshwater habitat.
- Preliminary findings by this project using newly installed PIT tag antenna arrays have documented the long term use of newly constructed off-channel ponds in Salmon Creek by juvenile coho salmon and juvenile steelhead.
- These antenna arrays also suggest a fall redistribution of juvenile coho from Salmon Creek downstream to the stream-estuary ecotone to rear during the winter and spring in most years similar to what has been documented in Freshwater Creek
- In 2012/13 NSA physically captured and detected fewer juvenile coho in the

Wood Creek off channel pond than in 2011/12, which continued the variable catches of coho in Wood Creek. This suggests the annual variation of juvenile coho use of estuarine habitat

- Long term trends in estimates of juvenile salmonid production from river basins are probably inaccurate without considering production originating from stream-estuary ecotone. Therefore, trends in marine survival rates of salmonids are likely inaccurate without considering role of stream-estuary ecotone.

Management Recommendations:

Juvenile salmonids in stream-estuary ecotone of Humboldt Bay should continue to be monitored on a year-round basis to determine seasonal and annual variation in their use of this habitat.

Fish monitoring stations should be established at the upstream and downstream borders of the freshwater/estuary ecotone to estimate coho salmon abundance (i.e. mark-recapture study) prior to the traditional smolt outmigration from Freshwater Creek. 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 sub yearling coho salmon and other estuarine organisms. The establishment of cool freshwater habitat at the mouths of small streams entering the stream-estuary ecotone (presently behind tidegates) could potentially increase the rearing area for sub yearling coho salmon during the summer and probably more importantly provide rearing habitat for yearling coho in the winter and early spring.

Habitat adjacent to Humboldt Bay tributaries in the stream-estuary ecotone should be restored as the opportunity arises since juvenile salmonids will use tidal sloughs, off channel ponds, and very small tributary habitat adjacent to the mainstem streams and sloughs if it is available.

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

Habitat restoration projects designed to improve the connectivity of adjacent watersheds, especially between larger streams containing "source" populations of salmonids and smaller adjacent streams should be designed and completed.

Literature Cited

California Department of Fish and Game. 2004. Recovery Strategy for California Coho Salmon. Report to the California Fish and Game Commission. February 2004.

Humboldt Bay Watershed Advisory Committee. 2005. Humboldt Bay Watershed Salmon and Steelhead Conservation Plan. Prepared for California Department of Fish and Game and the California Coastal Conservancy by the Humboldt Bay Watershed Advisory Committee and the Natural Resources Services Division of Redwood Community Action Agency. 232pp.

National Marine Fisheries Service. 2012. Public Draft Recovery Plan for Southern Oregon/Northern California Coast Coho Salmon (*Onchorynchus kisutch*). National Marine Fisheries Service. Arcata, CA.

7. Discuss differences:

The PIT tag antennas at Wood, Salmon, and Ryan Creeks were inoperable during parts of the survey season due to various electrical and computer problems. The components were succumbing to effects of water, salt, and inclement weather. Project personnel researched the problem and have replaced worn parts, upgraded electrical connections, and increased weather protection on the units.

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

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