

Annual Project Performance Report

1. State:

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, 2014 through June 30, 2015

Report due date: September 30, 2015

Date prepared: August 2015

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, Freshwater Creek, 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 collecting juvenile salmonid emigration timing and relative abundance data to document pre and post restoration conditions in the tidal portion of Freshwater Creek Slough, Ryan Creek, Wood Creek, Martin Slough, Jacoby Creek, and Salmon Creek estuary by other government agencies and private and non-profit groups. Project biologist also participates in technical review teams to develop project criteria and review restoration project designs.

6. Describe how the objectives were met: During the past year CA Dept. of Fish and Wildlife's (CDFW) Natural Stocks Assessment Project (NSA) sampled the tidal portion of upper Freshwater Creek Slough, Wood Creek, Ryan Creek, Jacoby Creek, Martin Slough, and Salmon/Cattail Creek estuary to document their use by juvenile salmonids. NSA also assessed completed estuarine habitat restoration projects in Martin Slough and Wood and Salmon Creeks and pre-project conditions in Jacoby Creek by describing juvenile salmonid use and basic water quality conditions in these locations. 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 operated PIT tag antennas in Wood and Salmon Creeks to assess the performance of a newly constructed off channel ponds as over winter habitat for juvenile salmonids and operated a PIT tag antenna in Ryan Creek to better describe the use of the stream-estuary ecotone by juvenile salmonids. NSA also participated on technical review teams to develop project criteria and review restoration project designs for planned projects in Freshwater Creek, Wood Creek, Jacoby Creek, and continuing projects on Salmon/Cattail Creeks. 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.

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, Cattail Creek, and Jacoby Creek restoration sites and beginning in August 2014 in Martin Slough. We used a 30 ft X 4 ft seine net to capture fish in Freshwater Creek Slough, Martin Slough, and Cattail Creek; a 100 ft X 5 ft seine net to capture fish in the ponds of Martin Slough and Salmon and Wood Creeks; and minnow traps baited with frozen salmon roe in Ryan Creek, Wood Creek, Jacoby Creek, and sections of Martin Slough and Salmon and Cattail Creeks where we were unable to seine. 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. We operated all three antenna sites where 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. NSA coordinated tag detection efforts with CDFW's Anadromous Fisheries Resource Assessment and Monitoring Program (AFRAMP) and Green Diamond Resource Company (GDRC) who were PIT tagging juvenile salmonids upstream of our sample sites. NSA applied PIT tags to all captured healthy juvenile

salmonids ≥ 55 mm FL in 2014 and ≥ 60 mm FL in 2015 to gather residency, movement, distribution, and growth information while they were in the stream-estuary ecotone.

We conducted biweekly water quality sampling at restoration sites in Wood, Salmon, and Cattail Creeks and monthly in Martin Slough and Jacoby Creek. We collected temperature, salinity, conductivity, and dissolved oxygen data in the newly constructed ponds and adjacent slough habitat with a YSI Professional Plus handheld meter.

Results

Freshwater Creek Slough

From July-December 2014 we captured 138 young-of-the-year (yoy) coho salmon, 56 1+ coho, 47 juvenile steelhead, and 37 cutthroat trout. Catches of yoy coho varied little from July to November with a peak monthly catch-per-unit-effort (CPUE) of 1.08 fish/set in October. Their monthly mean fork length (FL) increased from 67 in July to 81 mm in December. We captured a higher than normal number of 1+ coho from July through December 2014. This is probably a result of the ongoing drought which resulted in the earlier onset of warm brackish in lower Freshwater Creek Slough blocking emigrating coho from Humboldt Bay. Their highest catch occurred in August, September, and November (n=11). Their mean FL was 106 mm and ranged from 84 to 136 mm. We captured juvenile steelhead every month from July through December and their peak CPUE was 0.50 fish/set in October. Their mean FL was 128 mm and ranged from 57 to 190 mm. We captured cutthroat trout every month but November and their peak CPUE was 0.31 fish/set in July. Their mean FL was 186 mm and ranged from 139 to 256 mm. We did not capture sub-yearling Chinook salmon during July-December 2014.

From January to June 2015 NSA captured 125 1+ coho salmon, 230 yoy coho salmon, eight yoy Chinook salmon, 44 juvenile steelhead, 14 coastal cutthroat trout, and five unidentified yoy trout. We captured 1+ coho every month but January and their peak monthly CPUE occurred in April at 1.69 fish/set. Their monthly mean FL increased from 95 mm in January to 109 mm in May. We captured all of the yoy coho April to June, and their peak monthly CPUE was in May at 4.36 fish/set. Our June catches of sub-yearling coho in 2015 was much greater than 2014 (Table 1). Their monthly mean FL increased from 41 mm in April to 62 mm in June. We captured juvenile steelhead in every month but January and their peak CPUE was 0.63 fish/set in June. Their mean FL was 116 mm and ranged from 60 to 198 mm. We also captured cutthroat trout in every month but June and their FL's ranged from 112 to 267 mm. We captured yoy Chinook salmon in April and May and their FL's ranged from 51 to 68 mm.

Wood Creek

From July to December 2014 we captured one 1+ coho salmon and two cutthroat trout while minnow trapping in Wood Creek and two yoy coho while seining the off-channel pond. All salmonids were captured in December. The yoy coho FL ranged from 69-75 mm, the 1+ coho was 95 mm, and the cutthroat trout ranged from 130 to 133 mm FL.

Table 1. Effort, number captured, and catch-per-unit-effort of young-of-the-year coho salmon in upper Freshwater Creek Slough during June, 2003-2015.

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
2014	24	9	0.38
2015	24	95	3.96

From January to June 2015 NSA captured 120 1+ coho salmon and one yoy coho salmon in Wood Creek. We captured 1+ coho every month but June and our peak catch of 66 occurred in March. Their monthly mean FL increased from 86 mm in January to 97 mm in April. We captured a yoy coho in April in the pond and it was 43 mm FL. In Wood Creek pond we captured only four yearling coho and one yoy coho, which is much fewer than past years.

PIT Tag Antenna 2014/2015- We detected PIT tagged coho salmon at the PIT tag antenna located at the pond from 10/17/14 to 5/4/15. NSA detected 34 coho salmon at the pond antenna, which is the second lowest number detected since we installed the antennas in 2010 (Table 2). The low number of detections was due to the modest redistribution of coho to the stream-estuary ecotone due to the lack of rain and low stream flows. Of the 34 coho detected in the pond, 16 (47%) were tagged by AFRAMP in Freshwater Creek upstream of the estuary, 13 (38%) were NSA tagged fish from Wood Creek, three (9%) were tagged by NSA and AFRAMP in Freshwater Creek Slough, and two (6%) were tagged by NSA and released into the off channel pond (Table 2). We also detected one PIT tagged cutthroat trout in the pond in April.

At the tide gate antenna we detected 156 coho salmon, one juvenile steelhead, nine cutthroat trout, six Pacific lamprey, and 112 PIT tags waiting to be identified. Individual coho were first detected on 8/15/14 and last detected on 6/20/15. The months with the most first detections of individual coho were November/December (n=56; 36%) and April/May (n=62; 40%) which represents the fall redistribution of juvenile coho salmon to the stream-estuary ecotone during the first big rains and stream flow events in the late fall and the traditional emigration of coho salmon smolts the following spring. Of the 156 coho detected at the tide gate, 82 (53%) were tagged by AFRAMP upstream in

Table 2. Origin of PIT tagged juvenile coho salmon tagged in Freshwater Creek basin detected at Wood Creek pond antennas during January to September 2010, October 2010 to October 2011, October 2011 to July 2012, October 2012 through June 2013, September 2013 through June 2014, and August 2014 to June 2015.

Fish Origin	2010	10/11	11/12	12/13	13/14	14/15
Stream Estuary Ecotone	7	1	-	1	0	1
Lower Mainstem Freshwater Creek	11	6	26	2	0	6
Middle Mainstem Freshwater Creek	-	11	16	1	1	4
Upper Mainstem Freshwater Creek	7	6	12	4	0	4
Little Freshwater Creek	12	-	-	-	0	-
Cloney Gulch	9	4	6	4	0	1
South Fork Freshwater Creek	-	0	10	2	0	1
Freshwater Creek (total)	46	28	70	14	1	17
Wood Creek Pond	74	8	199	42	5	2
Wood Creek	27	19	20	11	11	13
Ryan Slough/Creek	0	0	7	2	0	0
Freshwater Creek Slough	5	0	8	6	0	2
HFAC Weir	1	0	2	0	4	0
Estuary Ecotone (total)	107	27	236	61	20	17
Grand Total	153	55	306	75	21	34

Freshwater Creek basin during the fall of 2014, 44 (28%) were tagged by NSA and released into Wood Creek (43 tagged in 2015 and one tagged in 2014), 22 (14%) were tagged by NSA and AFRAMP in Freshwater Creek Slough (11 tagged in 2015, nine tagged in 2014, and two tagged in 2013), three (2%) were tagged by NSA and released into the constructed off-channel pond at Wood Creek, two (1%) were tagged by NSA or GDRC in Ryan Creek, and two (1%) were tagged by AFRAMP at the HFAC weir (Table 3). We anticipate that most of the 112 unidentified PIT tags will be comprised of fish tagged at the HFAC weir or by GDRC at their Ryan Creek screw-trap. The steelhead detected at the tide gate antennas was tagged by NSA in Ryan Slough in 2014. The nine cutthroat trout detected at the tide gate were comprised of six fish tagged by NSA in Freshwater Creek Slough (one in 2015 and five in 2014) and three fish tagged by NSA and GDRC in Ryan Creek/Slough (one in 2014 and two in 2013).

Ryan Creek

In Ryan Creek from July to December 2014 we captured 32 1+ coho, four yoy coho, 18 juvenile steelhead, and 43 cutthroat trout. We captured 1+ coho every month and our peak catch of eight occurred in August. Their mean FL was 103 mm and ranged from 87 to 123 mm. We captured yoy coho in November and December and our peak catch of three occurred in November. Their FL's ranged from 55 to 85 mm. We captured small numbers of juvenile steelhead in every month except November and December.

Table 3. Origin of PIT tagged juvenile coho salmon tagged in Freshwater Creek basin detected at Wood Creek tide gate antennas during January to September 2010, October 2010 to October 2011, October 2011 to July 2012, October 2012 through June 2013, September 2013 through June 2014, and July 2014 through June 2015.

Fish Origin	2010	10/11	11/12	12/13	13/14	14/15
Stream Estuary Ecotone	9	30	-	11	16	3
Lower Mainstem Freshwater Creek	11	49	75	29	32	25
Middle Mainstem Freshwater Creek	-	79	51	31	43	16
Upper Mainstem Freshwater Creek	10	59	34	25	35	18
Little Freshwater Creek	13	-	-	-	-	-
Cloney Gulch	8	45	23	32	30	13
South Fork Freshwater Creek	-	13	31	23	16	10
Freshwater Creek (total)	51	275	214	151	172	85
Wood Creek Pond	33	3	138	16	5	3
Wood Creek	48	35	69	89	44	44
Ryan Slough/Creek	26	5	71	38	11	2*
Freshwater Creek Slough	11	10	67	86	47	19
HFAC Weir	165	123	156	221	105	3*
Estuary Ecotone (total)	283	176	502	450	212	70
Grand Total	334	451	716	601	384	156

* We still have 112 unidentified PIT tags collected during 2014/15. We anticipate many of the tags will be comprised of coho tagged by Green Diamond Resources Co. in Ryan Creek and AFRAMP at the HFAC weir during the spring of 2015.

Their mean FL was 124 mm and ranged from 106 to 160 mm. We captured small numbers of cutthroat trout every month with a peak catch of 14 in September. Their mean FL was 133 mm and ranged from 108 to 163 mm.

From January to June 2015 we captured 94 1+ coho, four yoy coho salmon, two juvenile steelhead, and 17 cutthroat trout in Ryan Creek. We captured 1+ coho every month and our peak catch of 44 occurred in January. Their monthly mean FL increased from 97 mm in January to 113 mm in May. We captured yoy coho in May and June and our peak catch of three occurred in June. Their FL's ranged from 44 to 73 mm. We captured one juvenile steelhead in January and one in June. Their FL's ranged from 100 to 119 mm. We captured cutthroat trout every month except January and February and their peak catch of five occurred in April and May. Their FL's ranged from 118 to 174 mm.

In the wetlands adjacent to Ryan Creek we captured one 1+ coho salmon. We captured it in February and it was 96 mm FL. This is the fewest number of coho we've captured in the ponds since we began sampling Ryan Slough in 2009.

PIT Tag Antenna 2014/2015- NSA operated a PIT tag antenna array on Ryan Creek Slough near the mid-point of our sampling area. NSA detected 173 coho salmon, 13 juvenile steelhead, 45 cutthroat trout, one Pacific lamprey, and 90 unknown tag codes at the antenna. Many of the of the unknown tag codes are likely coho salmon tagged by GDRC at their screw trap on Ryan Creek upstream of our sampling area.

Individual coho were first detected on 7/7/14 and last detected on 6/27/15. Of the 173 identified coho detected, 87 (50%) were tagged by NSA and released into Ryan Creek Slough, 56 (32%) were tagged in Freshwater Creek basin by AFRAMP during the fall of 2014, 12 (7%) were tagged by NSA/AFRAMP in Freshwater Creek Slough (one tagged in 2015, eight in 2014, two tagged in 2013, and one tagged in 2012), eight (5%) were tagged by AFRAMP at the HFAC weir in the spring of 2014, three (2%) were tagged by NSA in from Wood Creek in 2015, two (1%) were fish tagged and released into the wetland adjacent to Ryan Creek Slough by NSA (one in 2015 and one in 2013), and five had unknown tag codes. The months with the most first detections of individual coho were December-February (n=54; 31%) and April/May (n=88; 51%) which represents the fall redistribution of juvenile coho salmon to the stream-estuary ecotone during the first big rains and stream flow events in the late fall and early winter and the traditional emigration of coho salmon smolts the following spring. The 86 coho initially tagged in Ryan Creek Slough and the adjacent wetland and detected at the antenna site had a mean residence time of 124 days (range 0 to 386 days) in the stream-estuary ecotone of Ryan Creek Slough. The 105 coho initially tagged in the Freshwater-Wood-Ryan stream-estuary ecotone had a mean ecotone residence time of 136 days (range 0 to 386 days).

Individual steelhead were first detected on 7/15/14 and last detected on 5/5/15. All but one steelhead were originally tagged by NSA in Ryan Creek Slough; the other was tagged by GDRC in Ryan Creek upstream of our sampling sites. The NSA tagged steelhead had a mean residence time of 240 days (range 35 to 651 days). Individual cutthroat trout were first detected on 8/15/14 and last detected on 6/25/15. Of the 45 cutthroat trout detected at the PIT tag antenna 41 (91%) were originally tagged by NSA in Ryan Creek Slough, three were tagged by NSA in Freshwater Creek Slough, and one contained a tag from an unidentified location. They had a mean residence time of 267 days (range 1 to 921 days) in the Freshwater-Wood-Ryan stream-estuary ecotone.

Salmon Creek

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 2014 we did not capture any juvenile salmonids in Salmon or Cattail Creeks.

While sampling the constructed ponds from January to June 2015 we captured 23 1+ coho and six juvenile steelhead by seine and no salmonids in the minnow traps. We

captured 20 of the coho and five steelhead in Pond 1. We captured 1+ coho March through May and their peak monthly catch of 18 occurred in April. The coho mean FL was 112 mm and ranged from 75 to 131 mm. We captured all six steelhead in April and their FL's ranged from 93 to 165 mm. We did not capture any juvenile salmonids in Cattail Creek.

PIT Tag Antenna 2014/2015- NSA operated a PIT tag antenna array at the opening of the second-most upstream constructed off channel pond (Pond 1) in the Salmon Creek estuary. NSA detected 17 coho salmon and four juvenile steelhead at the PIT tag antenna site. All tags were applied by NSA. Coho were detected between 2/11/15 and 5/11/15. One coho was tagged in the most upstream pond (Pond 0) and the rest of the fish were tagged in Pond 1. Eleven coho resided at least one day in the pond and they had a mean residence time of nine days (range 1-67 days). The four steelhead were all tagged in Pond 1 on 4/29/15 and they resided 0-1 days in the pond.

Jacoby Creek Pond

We sampled Jacoby Creek pond and one site in Jacoby Creek with minnow traps monthly from July 2014 to June 2015. We did not capture any fish in the pond and due to low water we were unable to sample the pond in August-October 2014.

However, we were able to sample Jacoby Creek from July to December 2014 and we captured four yoy coho, one 1+ coho, and 11 juvenile steelhead. We captured yoy coho in July, September, and November and their FL's ranged from 66 to 88 mm. We captured the 1+ coho in July and it was 101 mm. We captured steelhead every month but October and their mean FL was 109 mm and ranged from 68 to 136 mm.

From January to June 2015 we captured seven 1+ coho and nine juvenile steelhead in Jacoby Creek. We did not sample Jacoby Creek in April due to high water. We captured 1+ coho in January and March with their peak catch of four occurring in March. Their FL's ranged from 92-123 mm. We captured steelhead every month but May and their peak catch of five occurred in June. Their FL's ranged from 89-131 mm.

Martin Slough

Beginning August 2014 we sampled Martin Slough just upstream of the newly installed tide gate and on Eureka Municipal Golf Course property (including an off channel pond and small tributary just downstream of the pond) to just upstream of tidal influence. We used a 100ft X 5ft seine net to sample the off channel pond, a 30ft X 4ft ft seine net to sample Martin Slough, and minnow traps baited with salmon roe to sample the small tributary and any other sites that could not be seined.

From August to December 2014 we captured 16 1+ coho, two yoy coho, and six cutthroat trout in Martin Slough. All of the fish were captured at our most upstream site except for five cutthroat trout which were captured in the off channel pond. We captured 1+ coho in August, September and December and their peak catch of nine occurred in August. Their mean FL was 106 mm and ranged from 92-137 mm. We

captured two yoy coho in December and their FL's ranged from 65-69 mm. We captured six cutthroat trout, all but one captured in the pond in September. Their FL's ranged from 169-214 mm.

From January to June 2015 we captured 113 1+ coho, one juvenile steelhead, and four cutthroat trout in Martin Slough. We captured 97 coho and all of the steelhead and cutthroat trout in the pond. We captured coho every month and their peak catch of 44 occurred in May. Their monthly mean FL ranged from 124 mm in February to 145 mm in January. The mean FL of 1+ coho captured in the 17th hole pond was 138 mm and ranged from 100 to 176 mm. The size of juvenile coho captured in the pond is substantially larger than any of our other sampling sites around Humboldt Bay. We captured one steelhead in May. It was captured in the pond and was 150 mm FL. We captured four cutthroat trout, all in May. They were all captured in the pond and their FL's ranged from 158-178 mm.

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 39 ppt in Salmon Creek and 33 ppt in Wood Creek during the summer and fall of 2014 which was 6 and 8 ppt higher respectively, than last year. Due to the on-going drought, resulting in little rain and low stream flows, salinities remained elevated in the Wood and Salmon Creek ponds through November 2014. Significant rain finally occurred in December which created a layer of freshwater <1 ppt near the surface of Salmon Creek ponds and 11 ppt in the Wood Creek pond. Salinities at the surface of the ponds were < 5ppt from January until early May in Wood Creek and until mid-May in Salmon Creek. However, during this time period the bottom of the ponds in both Salmon and Wood Creeks were often brackish with salinities near 20 ppt. By June 2015 pond salinities had risen to 14-28 ppt in Wood Creek and 11 to 35 ppt in Salmon Creek. 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 and fall. Dissolved oxygen was often extremely low in the warm brackish layer of the pond during the summer and fall, especially in Wood Creek. In most years 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. This past year the ponds provided adequate salmonid rearing habitat from January to mid-May.

Jacoby Creek pond was essentially dry from August 2014 until the first significant rains of the year occurred in December 2014. Even after rain and high stream flows filled the pond dissolved oxygen levels were adequate only in April 2015 and marginal in February and March.

7. Discuss differences: The PIT tag antennas at Wood Creek 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:

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

Wallace, M. 2010. Response of juvenile salmonids and water quality to habitat restoration in Humboldt Bay estuaries. California Department of Fish and Game; 8/12/2010. Available from:
<https://nrmsecure.dfg.ca.gov/FileHandler.ashx?DocumentID=36268>.

Wallace, M. 2015. Extended periods of brackish and hyper-saline conditions in the stream estuary ecotone of Salmon Creek, Humboldt Bay 2014. Drought stressor monitoring case study. California Department of Fish and Wildlife. Available from:
<https://www.wildlife.ca.gov/Conservation/Inland-Fisheries/Projects/Salmon-Creek>

Wallace, M. and S. Allen. 2007. Juvenile salmonid use of the tidal portions of selected tributaries to Humboldt Bay, California. Final Report for contracts P0310534 and P0410504 to California Department of Fish and Game Fisheries Restoration Grants Program. June 2007. 14pp.

Wallace, M. and S. Allen. 2009. Juvenile salmonid use of the tidal portions of selected tributaries to Humboldt Bay, California 2007-2009. Final Report for contract P0610522 to California Department of Fish and Game Fisheries Restoration Grants Program. August 2009. 32pp.

Wallace, M. and S. Allen. 2012. Juvenile salmonid use of the tidal portions of selected tributaries to Humboldt Bay, California 2009-2011. Final Report for contract P0810517 to California Department of Fish and Game Fisheries Restoration Grants Program. February 2012. 45pp.

Wallace, M. and S. Allen. 2013. Juvenile salmonid use of the tidal portions of selected tributaries to Humboldt Bay, California 2011-2012. Final Report for contract P1010516 to California Department of Fish and Game Fisheries Restoration Grants Program. June 2013. 44pp.

Wallace, M., and S. Allen. 2015. Juvenile salmonid use and restoration assessment of the tidal portions of selected tributaries to Humboldt Bay, California, 2011-2012. CA Department of Fish and Wildlife Fisheries Administrative Report No. 2015-02. April 2015. 68pp.

California Department of Fish and Game. 2014. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-137-R. Project No. 67.

California Department of Fish and Game. 2013. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-137-R. Project No. 67.

California Department of Fish and Game. 2012. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-137-R. Project No. 67.

California Department of Fish and Game. 2011. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-137-R. Project No. 67.

California Department of Fish and Game. 2010. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-137-R. Project No. 67.

California Department of Fish and Game. 2009. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-122-R. Project No. 67.

California Department of Fish and Game. 2008. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-122-R. Project No. 67.

California Department of Fish and Game. 2007. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-51-R. Project No. 67.

California Department of Fish and Game. 2006. Humboldt Bay juvenile salmonids investigations. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Grant Number F-51-R-16. Project No. 67.

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