Presence, distribution and movement of select aquatic species in Tide Creek, Merrill Creek and Deer Island Slough, Columbia County, Oregon

2009 Progress Report

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March 2010

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Introduction

Multiple factors have contributed to the decline of anadromous fish throughout the Columbia River Basin. The lower Columbia River and estuary are of particular importance because all stocks of anadromous fish within the basin use the area to varying extents, especially as juvenile rearing habitat. Lower Columbia River habitats have been substantially altered by factors such as flow manipulation and reduced connectivity among the river, tidal wetlands, and the floodplain. For instance, the construction of dikes and associated tide gates as well as filling tidal wetlands has resulted in a 65% reduction of tidal marshes and swamps compared to that historically present (Bottom et al. 2005).

Restoring tidally-influenced wetlands to improve conditions for anadromous fish has been included in recovery and management plans and permit requirements, such a2 the Subbasin Plan for the Columbia Mainstem and Estuary (Lower Columbia Fish Recovery Board (LCFRB) 2004) and NOAA Fisheries' FCRPS Biological Opinions (NMFS 2008)). While the focus of many of these plans has been on salmonids (i.e., *Oncorhynchus spp.*), many of the plan components also hold true for other anadromous species such as Pacific lamprey (*Entosphenus tridentatus*) and coastal cutthroat trout (*O. clarki clarki*). Although restoring tidal wetlands (for rearing) and improving fish access (for passage) to them are major components of recovery strategies for anadromous fish, considerable uncertainty exists concerning appropriate restoration actions. Information on specific passage and habitat requirements as well as restoration needs for juvenile fish in these areas is lacking (Bottom et al. 2005). Various monitoring designs can be used to assist in alleviating uncertainties and evaluating restoration strategies (see Roni et al. 2005). In the case of the lower Columbia River, the intent of such evaluations is to improve our understanding of the habitat requirements of juvenile salmonids and assist in developing and implementing additional restoration actions.

The Deer Island area of the lower Columbia River presents a relatively unique opportunity for habitat restoration that will benefit multiple anadromous species as well as to understand the importance of tidal wetlands and sloughs to anadromous fish. Deer Island, located on the south shore of the Columbia River near the town of St. Helens, Oregon, historically consisted of tidally-influenced backwater slough habitats and relatively small tributaries, which were used by anadromous salmonids and other species. Presently, the value of these habitats for anadromous salmonids has been limited by degradation of environmental conditions and restricted fish passage due to activities such as dike construction, tide gate installation, and stream channelization. The Columbia River Fisheries Program Office (CRFPO) is participating in a partnership with the Columbia Soil and Water Conservation District, Lower Columbia River Watershed Council, Oregon Department of Fish and Wildlife, and others to develop appropriate habitat restoration strategies intended to improve conditions of aquatic habitats at Deer Island, and increase access to these habitats for anadromous fish and other species.

In spring 2009, the CRFPO conducted a biological assessment intended to contribute to developing habitat restoration strategies and provide information about the local natural resources to private landowners. The assessment focused on determining whether juvenile salmonids were able to pass existing tide gates on South Deer Island Slough and described aquatic habitats and the fish community within Deer Island Slough and lower Tide Creek, a tributary to the slough. Preliminary findings of this assessment included: 1) the presence of three species of anadromous salmonids, coho salmon (*O. kisutch*), Chinook salmon (*O.*

tshawytscha) and steelhead (*O. mykiss*), as well as coastal cutthroat trout, Pacific lamprey, western brook lamprey (*Lampetra richardsoni*) and Oregon floater mussels (*Anodonta oregonensis*); 2) of the migratory fish, coho salmon, coastal cutthroat trout, and Pacific lamprey likely spawn in Tide Creek and perhaps Merrill Creek, a tributary to lower Tide Creek; and 3) juvenile Chinook salmon are able to pass the South Deer Island Slough tide gates to an unknown degree and likely rear in Deer Island Slough.

The Oregon Department of Fish and Wildlife (ODFW) has documented the presence of four species of migratory fish within Tide Creek, Merrill Creek and Deer Island Slough (i.e., coho salmon, steelhead, coastal cutthroat trout and Pacific lamprey). However, information regarding habitat use, residency and distribution of fish species in this area is currently limited. It is reasonable to speculate that the larval and juvenile stages of anadromous fish that spawn in Tide and Merrill Creeks likely rear in the creeks, and perhaps Deer Island Slough, before ultimately moving into the Columbia River. However, uncertainties exist concerning rearing locations and times of residency (which areas are used when and by whom). Resolving these uncertainties relative to these species will not only assist the partnership in developing and prioritizing potential habitat restoration actions (e.g., considering possible actions primarily affecting stream habitat versus actions focused on slough habitat), but will also improve our understanding of life history and habitat relationships of these species in the lower Columbia River.

The CRFPO has initiated a study to address these uncertainties. The goal of this study is to better understand fish presence, distribution and temporal use of Tide and Merrill creeks, and Deer Island Slough. The objectives are to: 1) evaluate whether Pacific and western brook lamprey are present within Tide and Merrill Creeks; 2) determine coho salmon and cutthroat trout rearing duration in the creeks and Deer Island Slough; 3) determine seasonal movement patterns of coho salmon and cutthroat trout between Merrill and Tide Creek habitats, Deer Island Slough and the Columbia River; and 4) begin to monitor adult return rates of coho salmon and cutthroat trout relative to their use of Deer Island Slough.

Methods

Study Area

Tide Creek and Merrill Creek – Tide Creek is a 26 km long tributary of South Deer Island Slough. Historically, the lower 3.6 km of Tide Creek flowed north parallel to Deer Island Slough before entering the Columbia River west of the north confluence of Deer Island Slough. Presently, lower Tide Creek has been diverted from its historical floodplain into a constructed channel flowing south and then east before entering South Deer Island Slough at a point about four kilometers upstream from its confluence with the Columbia River (Figure 1). A waterfall approximately 1.2 km upstream from the Highway 30 bridge likely restricts anadromous fish use to the lower 4.8 km of Tide Creek (PSU 2001). Tide Creek extends approximately 21 km beyond this waterfall and may provide habitat for non-migratory species and possibly anadromous species if the waterfall does not prevent passage. Merrill Creek is a 12.7 km long tributary of lower Tide Creek. Merrill Creek enters Tide Creek approximately 1.8 km upstream from its confluence with South Deer Island Slough (Figure 1). Anadromous fish distribution (i.e., coho salmon), is believed to extend approximately 4.5 km upstream from the mouth of Merrill Creek (Faucera, ODFW personal comm.).

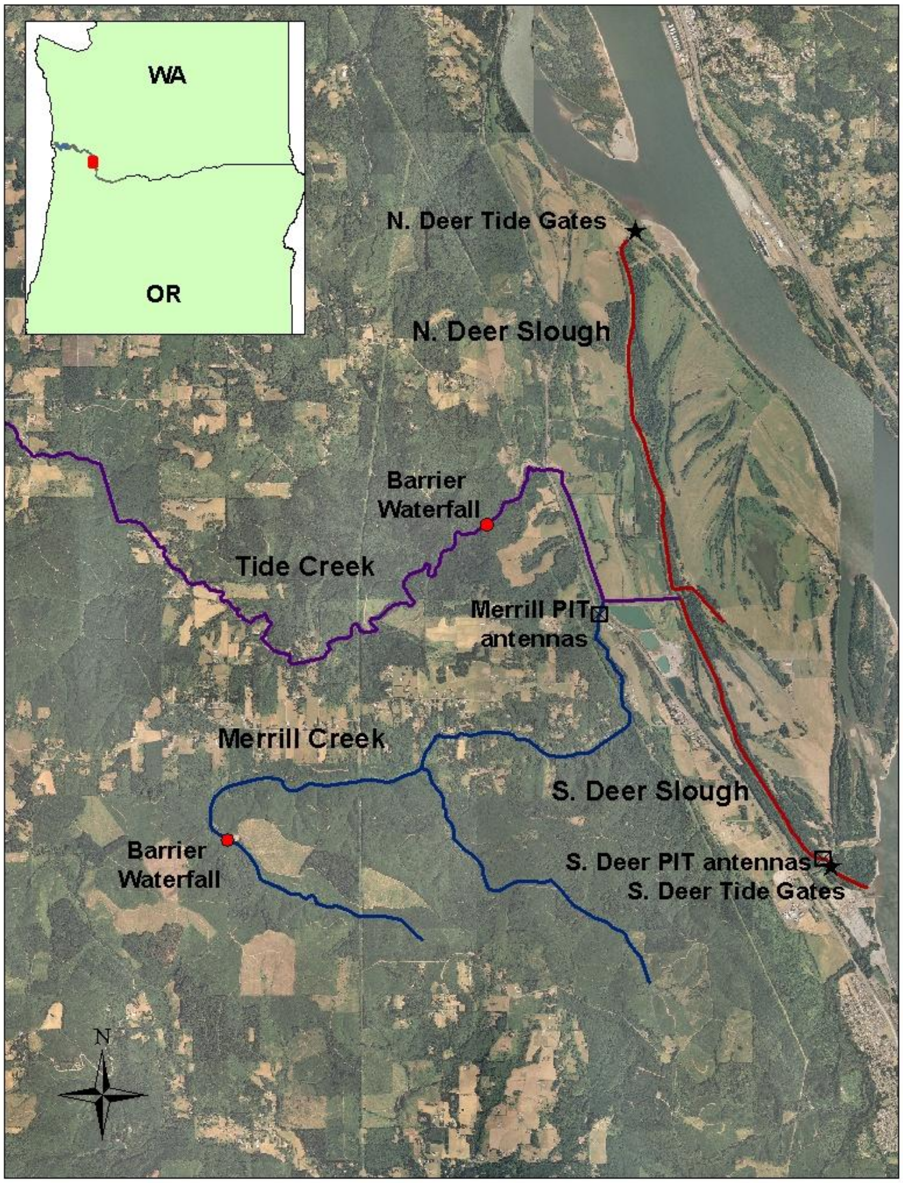

Figure1. Area map of Deer Island showing project locations (i.e., Merrill Creek, Tide Creek and South Deer Island Slough), barrier waterfalls and PIT tag antenna arrays, 2009.

Deer Island Slough – Deer Island Slough is a 9.7 km backwater channel of the Columbia River that separates the western side of Deer Island from the adjacent floodplain. Most of Deer Island and adjacent lands are enclosed within levees. A dike constructed at about the midpoint of Deer Island Slough (4.3 km from the northern confluence) completely separates the slough into northern and southern portions, which we refer to as North Deer Island Slough (NDS) and South Deer Island Slough (SDS) (Figure 1). Currently there is no direct, flowing water connection between NDS and SDS. Water levels within NDS and SDS are regulated by tide gates located on the northern-most (NDS) and southern-most (SDS) ends of the sloughs. The tide gates on SDS consist of four 1.8 m diameter, top-hinge steel gates. The gates are designed to open when the water elevation inside the slough is greater than the water elevation on the downstream (Columbia River) side of the tide gates. The tide gates on NDS are typically submerged beneath the Columbia River water elevation, even at low tide. There is very little information available regarding the design and operation of the NDS tide gates.

Lamprey

Presence/absence surveys

In Merrill Creek and Tide Creek, a randomly selected, spatially-balanced set of sample reaches was delineated using the Generalized Random Tessellation Stratified (GRTS) method (Stevens and Olsen 2004). On average, one 50 m reach was selected for every 0.5 km of stream. The GRTS method assigns numbers to the selected 50 m reaches within a stream and those numbers are then used as an unbiased method of ranking the priority of reaches for sampling. In this study, low numbered reaches within each creek were designated as the highest priority for sampling. In 2009, sampling was conducted during a 12 day period (12 August through 27 August 2009), to determine whether lampreys occupied Merrill Creek and Tide Creek. We sampled 20 of the highest priority reaches in Merrill Creek and 7 in Tide Creek (Figure 2). Reaches were sampled in non-sequential order, generally beginning with the lowest reach and moving upstream. If a given reach in a watershed unit could not be sampled (e.g., dewatered or inaccessible), the reach was omitted from the sample and the next highest priority reach was added to the sample. This technique maintained the spatial balance and randomization of the sample reaches. If lampreys were detected in any reach, the entire watershed unit was considered occupied.

Sample reaches were accessed on foot using GPS units loaded with sample reach UTMs for navigation. Once a sample reach was located, a 50 m stream reach was measured and flagged. Water temperature and conductivity were recorded in each reach. Substrate composition throughout each reach was qualitatively assigned into dominant and subdominant categories based on particle size. The entire reach was electrofished for larval lampreys using an AbP-2 backpack electrofisher. The power output settings for the AbP-2 electrofisher were adapted from Weisser and Klar (1990). Electrofishing effort was focused on areas of suitable larval rearing habitat and less time was spent in areas with bedrock and large boulder substrates or high current velocity. All larval lampreys observed were captured and placed in buckets containing stream water. At each sample reach, biological data (i.e., length, weight) were collected from a maximum of 25 larval lampreys. Lampreys were removed from the holding bucket, anesthetized in a solution of tricaine methanesulfonate (MS-222), identified to species (western brook lamprey, Pacific lamprey, or lamprey spp.) according to caudal pigmentation (Goodman et al. 2009) and classified according to developmental stage (i.e., ammocoete, macropthalmia, or adult). Lampreys were measured (total length, mm) and weighed (wet weight, g) and caudal fin tissue was collected from a subsample of up to 10 lampreys per site for genetic analysis to confirm genus identification. Lampreys were placed in a recovery bucket of fresh stream water and released into the stream after resuming normal swimming behavior.

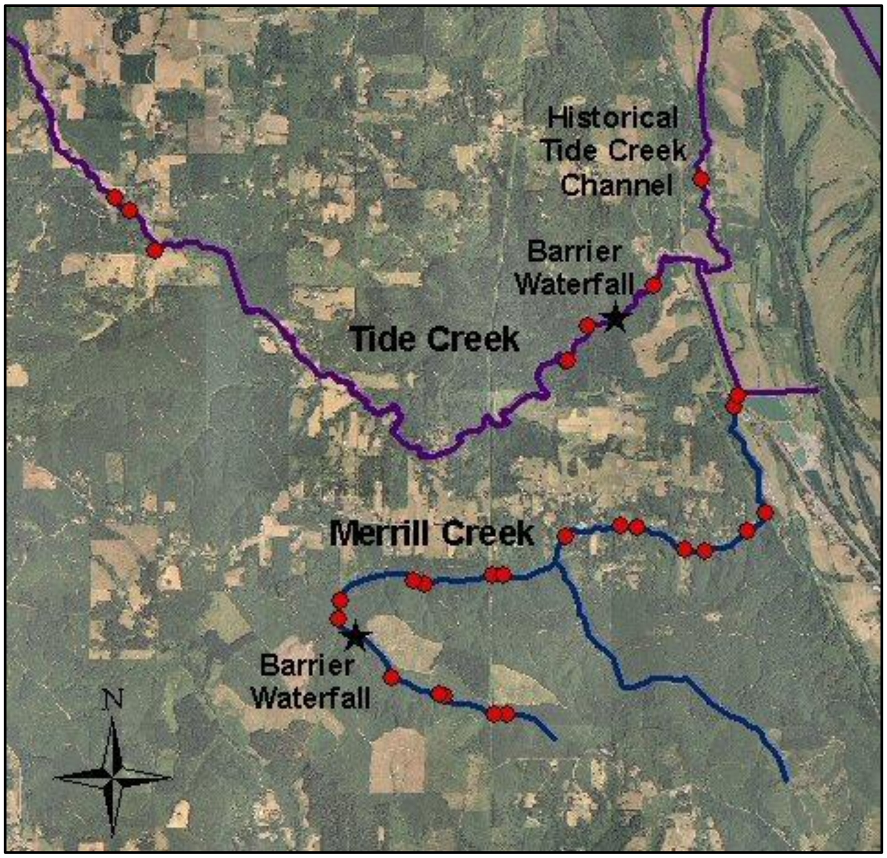

Figure 2. Area map of lamprey sample reaches and barrier waterfalls in Merrill Creek and Tide Creek, 2009.

Juvenile Coho Salmon

<u>Stream residency and movement</u>

Juvenile coho salmon were captured in Merrill Creek (29 September through 8 October 2009), using a Smith-Root model LR-24 backpack electroshocker. To minimize potential harm to the sampled fish population, surveyors made a single pass through each survey reach, focused only on those areas considered holding habitat for juvenile salmonids (i.e., pools, overhanging banks, areas with large woody debris) and modified electrofisher settings or fishing techniques as necessary depending on fish behavior or aquatic conditions. Electrofishing began at the Canaan

Road bridge (river kilometer (Rkm) 1.6) and continued upstream until a sufficient number of coho were captured to tag (10 to 20 fish), or until the crew reached private property where access was denied. At this point the sampling crew took a GPS point to signify the end of the survey reach, biologically sampled (i.e., measured, weighed and tagged) captured fish and moved upstream of the private property or continued to electrofish (moving in the upstream direction), until the target number of juvenile coho were tagged (i.e., 300 fish). A total of 21 survey reaches (covering a total distance of 3.5 km) were sampled within a 5.5 km stretch of Merrill Creek (Figure 3).

All captured fish were identified to species, measured (fork length, mm), weighed, and scanned for passive integrated transponder (PIT) tags. Newly captured juvenile coho salmon greater than 65 mm in length were anaesthetized in a 25 ppm solution of clove oil and implanted with a 12 mm full-duplex PIT tag. After full recovery within an aerated bucket, all fish were released near their point of capture.

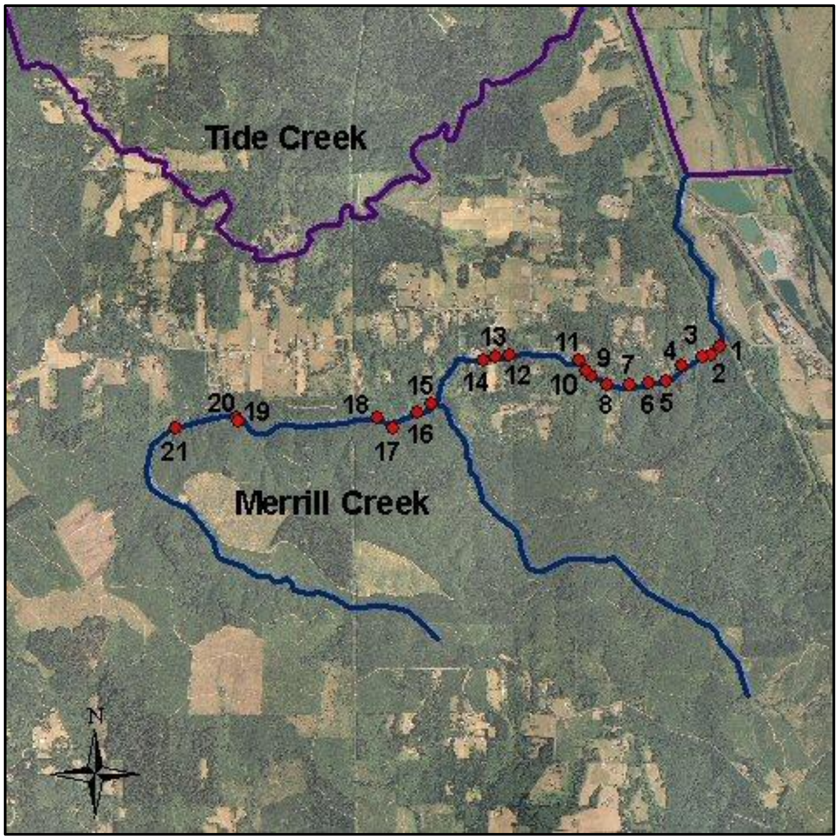

Figure 3. Area map of juvenile coho salmon sample reaches in Merrill Creek, 2009.

PIT tag antennas

To monitor the stream residency and out-migration timing of juvenile coho salmon in Merrill Creek, a PIT tag array was installed on 19 November 2009, at the upstream end of the Hwy 30 culvert (Figure 1). This array utilized two antennas to cover the entire cross-sectional area of Merrill Creek (Figure 4). To determine whether juvenile coho salmon (tagged in Merrill Creek) leave SDS, or potentially return to the slough as adults, a PIT tag array was installed at the upstream end of the SDS tide gates on 18 February 2010 (Figure 1). This array utilized four antennas, one to interrogate each of the four culverts (Figure 4). When a tagged fish swims over or through any one of the antennas, the PIT tag emits a unique code which is detected, identified and logged on a Destron Fearing FS-1001M transceiver. PIT tag detection data is downloaded from the transceiver to a computer, where the tagging date and origin of fish can be identified. The arrays are powered by two 100ah, 12v AGM batteries. The batteries are charged with two 142W PV solar panels through a three stage solar charge controller. The charge controller measures input and output power and records up to 30 days of power production.

Figure 4. PIT tag antenna arrays on Merrill Creek (left) and South Deer Island Slough (right).

Coastal Cutthroat Trout

<u>Presence</u>

Coastal cutthroat trout were captured during electrofishing surveys on Merrill Creek 29 September through 8 October 2009. Coastal cutthroat trout were measured (fork length), weighed and scales were taken for age analysis.

Results

Lamprey

<u>Presence/absence surveys</u>

A total of 20 reaches were sampled for lamprey in Merrill Creek. A potential barrier waterfall and perched culvert were found in the upper portion of the watershed approximately eight km upstream from the mouth (Figure 1). Lamprey ammocoetes were detected at all 15 sites below the waterfall while no larval lampreys were detected at five sites above this location (Table 1). A total of 62 western brook lamprey larvae and three unidentifiable lamprey larvae were detected in Merrill Creek. No confirmed Pacific lampreys were detected in Merrill Creek.

A total of seven reaches were sampled for lamprey in Tide Creek. Due to a potential barrier waterfall located approximately 1.2 km upstream from the Highway 30 bridge, sampling in the upper portion of the watershed was limited (Figure 1 and 5). Two unidentifiable lamprey larvae were detected in Tide Creek. No confirmed western brook or Pacific lampreys were detected in Tide Creek.

Of the 21 reaches sampled during 29 September through 8 October 2009, a total of eight larval and one adult western brook lamprey (WBL) were captured within six sample reaches on Merrill Creek (Table 2).

Table 1. Number of sample reaches, lamprey occupancy and total number of larval lamprey captured in Merrill Creek and Tide Creek, 2009.

Watershed	Reaches Sampled	Reaches Occupied	Western Brook Lamprey	Unidentified Lamprey
Merrill Creek	20	15	62	3
Tide Creek	5	1	0	2

Figure 5. Barrier waterfall on Tide Creek, 2009.

Juvenile Coho Salmon

<u>Stream residency and movement</u>

A total of 453 juvenile coho salmon were captured within 21 sample reaches during six days of sampling on Merrill Creek (29 September through 8 October) (Table 2). Of the total, 279 coho were subsequently marked with PIT tags. The remaining 174 juvenile coho were not marked with PIT tags due to their small size (91.4% of unmarked fish) or poor condition (i.e., severe black spot or shock burn) (8.6% of unmarked fish). Fork length of juvenile coho captured in Merrill Creek ranged from 42-121 mm (average 68 mm). The length frequency distribution of marked and unmarked coho salmon captured in Merrill Creek suggests the majority of fish belong to a single age class (age 0) (Figure 6). No adipose fin clipped coho were captured in Merrill Creek.

Table 2. Total number of fish captured and tagged by reach during sampling trials in Merrill Creek, 2009.

Sample Reach	Date	Total Coho	PIT Tagged Coho	Coho Recaps	Cutthroat Trout	Trout Fry	WBL adults	Larval WBL
1	9/29/09	7	5	0	1	0	0	1
2	9/29/09	13	9	0	2	0	0	0
3	10/1/09	10	8	0	1	0	0	0
4	10/1/09	10	7	0	0	1	0	0
5	10/1/09	19	17	0	5	0	0	0
6	10/1/09	19	17	0	6	2	0	0
7	10/1/09	23	16	0	6	0	0	0
8	10/2/09	13	8	0	0	1	0	0
9	10/2/09	20	15	0	3	0	0	1
10	10/2/09	23	13	0	3	1	0	0
11	10/2/09	43	31	0	2	0	0	2
12	10/6/09	37	18	9	5	0	0	0
13	10/6/09	25	17	0	2	0	0	0
14	10/6/09	53	30	0	2	0	0	2
15	10/7/09	18	7	0	2	0	1	1
16	10/7/09	19	13	0	0	1	0	0
17	10/7/09	10	1	0	0	0	0	0
18	10/8/09	19	8	0	0	1	0	0
19	10/8/09	17	5	0	5	1	0	0
20	10/8/09	33	22	0	0	0	0	1
21	10/8/09	31	12	0	5	1	0	0

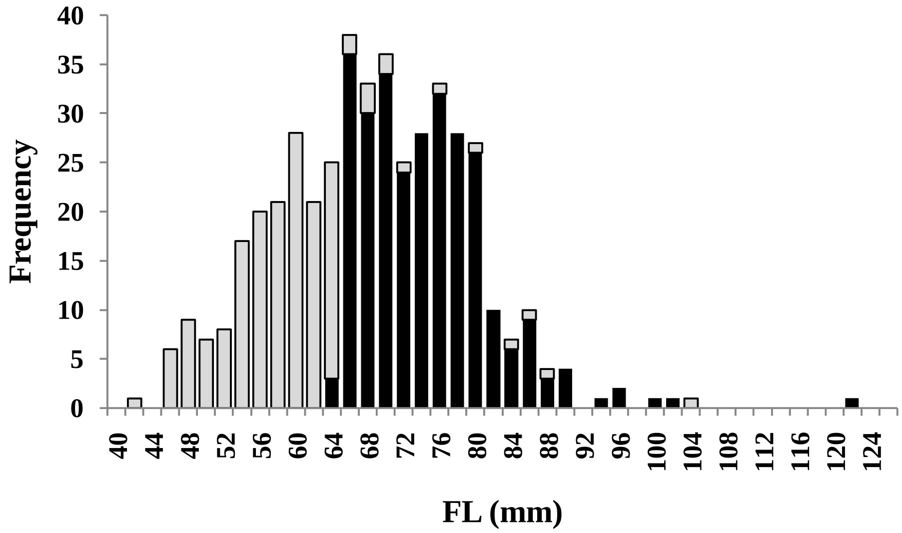

Figure 6. Length frequency of marked (black bars) and unmarked (grey bars) juvenile coho salmon captured in Merrill Creek, 2009.

The Merrill Creek PIT antenna array began operation on 19 November 2009. This array was not in operation for a five week period during the months of December and early January due to a power source failure. As of 18 February 2010, a total of 13 juvenile coho salmon have been detected at the antennas. Of the total detections, 92.3% occurred between 25 November and 28 November 2009. The most recent detection (one fish) occurred on 9, January 2010. Tag detection data indicates these fish originated from six different sampling locations and resided within Merrill Creek a total of 50 to 101 days after their initial capture (average 57 days) (Table 3).

The SDS PIT array has been in operation since 18, February 2010. As of 3 March 2010, one coho salmon has been detected at the SDS tide gate antennas. Detection data indicate this fish was tagged in reach 5, 145 days prior to its detection at the SDS tide gate antennas (Table 3).

Table 3. Original tag reach, tag date, fork length, detection date and stream residency of 14 PIT tagged juvenile coho salmon detected at Merrill Creek and SDS antenna arrays, 2009-2010.

Reach	Tag Date	Tag #	FL (mm)	Detection Date	PIT Array	Stream Residency
3	10/1/09	7053	70	2/23/10	SDS	145
3	10/1/09	7055	75	11/27/09	Merrill Cr.	58
3	10/1/09	7059	74	1/9/10	Merrill Cr.	101
3	10/1/09	7060	72	11/27/09	Merrill Cr.	58
5	10/1/09	7092	72	11/27/09	Merrill Cr.	58
11	10/6/09	9091	68	11/27/09	Merrill Cr.	53
11	10/6/09	9102	78	11/28/09	Merrill Cr.	54
12	10/6/09	9103	75	11/27/09	Merrill Cr.	53
12	10/6/09	9109	66	11/27/09	Merrill Cr.	53
12	10/6/09	9130	72	11/25/09	Merrill Cr.	51
14	10/7/09	9143	75	11/25/09	Merrill Cr.	50
17	10/8/09	9170	85	11/27/09	Merrill Cr.	51
17	10/8/09	9180	69	11/28/09	Merrill Cr.	52
17	10/8/09	9186	69	11/27/09	Merrill Cr.	51

In addition to three fish species, electrofishing crews observed live mussels in beds as well as shells of western pearlshell mussels (*Margaritifera falcate)* in Merrill Creek. Live pearlshell mussels were observed intermittently from the Canaan Road bridge upstream approximately 2 km, with the highest densities of mussels occurring immediately upstream of the Merrill Creek Road bridge.

Coastal Cutthroat Trout

<u>Presence</u>

A total of 50 cutthroat trout were captured within 15 sample reaches during six days of electrofishing on Merrill Creek (Table 2). Cutthroat trout were not marked with PIT tags during the electrofishing surveys. Fork length of cutthroat trout captured in Merrill Creek ranged from 75-276 mm (average 170 mm) (Figure 7).

A total of nine trout fry were captured within seven sample reaches during electrofishing trials on Merrill Creek (Table 2). Fork length of trout fry ranged from 47-70 mm (average 61 mm).

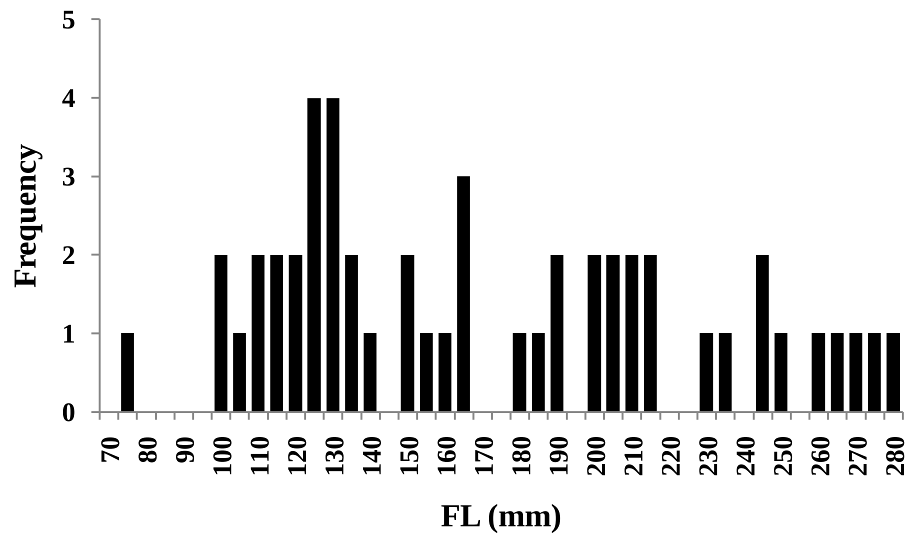

Figure 7. Length frequency of coastal cutthroat trout captured in Merrill Creek, 2009.

Findings

Lamprey

The distribution of western brook lampreys in Merrill Creek is widespread below the barrier falls. Lampreys did not appear to be as abundant in Tide Creek as they were in Merrill Creek. Physical barriers appear to be the biggest factor influencing lamprey distribution in the basin.

Based upon field identification, no Pacific lampreys were detected in Merrill Creek or Tide Creek. Adult Pacific lampreys have previously been observed in lower Tide Creek (3 individuals) (Poirier et al. 2009). However, it is unknown whether these spawned in Tide or Merrill Creeks.

Analyses of genetic samples taken from lamprey ammocoetes in Merrill Creek and Tide Creek will confirm the genus (i.e., *Lampetra* or *Entosphenus*) of animals present in the watershed.

Juvenile Coho Salmon

As of 18 February 2010, 4.6% of PIT tagged fish have been detected at the Merrill Creek antennas. The number of tagged coho that actually moved from Merrill Creek into SDS is likely more than that detected because of the five weeks when antennas were inoperable due to power loss.

The 13 juvenile coho salmon detected at the Merrill Creek antennas were presumably detected while leaving Merrill Creek. South Deer Island Slough antennas were not in operation until 18 February 2010, so it is unknown whether these fish held in Tide Creek, SDS or left the slough entirely. A single detection at the SDS tide gate antennas suggests that a portion of juvenile coho may be leaving the slough to enter the Columbia River. In the Pacific Northwest, juvenile coho salmon typically over-winter in freshwater streams after their emergence from gravel, and begin to migrate downstream toward the sea the following spring as yearling (age 1) smolts (Sandercock, 1991). The average size (fork length) of outmigrant smolts is 100 mm (Sandercock, 1991). In 2009, we observed a marked increase in the number of presumed yearling coho (size range 100-145 mm) captured by fyke net and beach seine in lower Tide Creek during the months of April and May (Poirier et al. 2009). It is likely these fish were captured while moving downstream from Tide and Merrill Creeks into SDS and possibly out to the Columbia River. Based on this information, we predict the number of PIT detections at the Merrill Creek and SDS antennas to increase in spring as the now yearling PIT-tagged coho begin their outmigration toward the lower Columbia River estuary.

Coastal Cutthroat Trout

Coastal cutthroat trout were captured within a 5.5 km stretch of Merrill Creek. The presence of trout fry suggests cutthroat trout are successfully reproducing in Merrill Creek.

2010 Tasks

- Sample (i.e., fyke nets, pot traps, spawning ground surveys) to confirm adult Pacific lamprey use and whether spawning occurs in the watershed.
- Install and maintain PIT antenna array in Tide Creek.
- Monitor Merrill Creek mussel bed(s) for evidence of mussel reproduction, and collect information on environmental variables that may be associated with timing of reproduction. (March – July 2010).
- Conduct fall electrofishing to PIT-tag juvenile coho salmon and coastal cutthroat trout in Merrill Creek and Tide Creek (September 2010).

Acknowledgements

Special thanks go out to all of the landowners at Deer Island Slough, Merrill Creek and Tide Creek for graciously allowing us access through their property and for providing us with invaluable information regarding historical fish use in the area. We also want to thank Tyler Joki with the Soil and Water Conservation District, and Margaret Magruder with the Lower Columbia Watershed Council for facilitating communication with landowners. Finally, we want to thank Howard Shaller, Amy Horstman and Donna Allard with the USFWS CRFPO, the Columbia Soil & Water Conservation District, Lower Columbia Watershed Council, Oregon Department of Fish and Wildlife and Dyno Nobel for their continued support of this project.

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