PROJECT STATUS REPORT- February 2005

TITLE: Movements of coastal cutthroat trout (*Oncorhynchus clarki*) in the lower Columbia River: tributary, main-stem and estuary use

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PRELIMINARY DATA – DO NOT CITE

INTRODUCTION

It is the goal of this study to monitor and evaluate the basic life history and habitat use of various life history stages of coastal cutthroat trout in the Columbia River Basin. The objectives are 1) identify timing of smolt emigration and adult return, 2) identify areas of mainstem habitat use by emigrating smolts and migratory adults, 3) describe physiological and morphological characters of smolting, and 4) review spatial patterns of historical catch data. This project received initial funding in February 2002 and tasks completed in 2002 and 2003 addressed all four objectives and were reported in previous project status reports. Tasks in 2004 were 1) continued efforts to identify timing of smolt and adult migratory patterns using long-range PIT tag technology and 2) implementation of initial efforts to identify areas of mainstem habitat use by migrating adult coastal cutthroat trout. Preliminary findings to date are presented in this status report, but a more comprehensive analysis of the results of this phase of the coastal cutthroat trout project will be presented in a final report completed subsequent to the 2005 field season.

BACKGROUND

The life history of the coastal cutthroat trout is arguably the most complex of the Pacific salmonids (Northcote 1997) and is unquestionably the least studied. Little is known of the migratory pathways of these fish because they are thought to make only modest estuary migrations and are not a commercially important species. The evaluation of habitat use of coastal cutthroat trout through all life history stages is necessary to gauge any potential impacts of anthropogenic activity in the main-stem and estuary of the lower Columbia River. Anadromous populations of coastal cutthroat have plummeted in recent years and therefore such activities should consider the relative impacts on this species.

The declines of Upper Columbia River salmonid stocks are understandably linked to the through passage and flow regime impacts of dams (PNRC 1978, Deriso et al. 1996, Deriso 2001). This shift in hydrological character influences main-stem flows, plume structure, salinity profiles, tidal range and productivity. Other projects on the main-stem and estuary, such as maintenance and deepening of the navigation channel, also perturb these physical factors that define fluvial habitat. Coastal cutthroat trout are thought to make extensive use of the main-stem and estuary (as both juveniles and adults) and are believed to be more susceptible to changes in productivity than any other Pacific salmonid (Giger 1972, Pearcy 1997). This study is aimed at providing information toward spatial and temporal use of the main-stem and estuary to gauge potential impacts of activities associated with channel deepening.

A full understanding of the cutthroat trout life history is challenged by the behavioral specializations within a population. Sympatric individuals can be resident or migratory within a given watershed (June 1981, Johnston 1982, Hall et al. 1997). Additionally, those fish that do leave their natal streams may be potadromous (remaining in fresh water) or anadromous (entering seawater; Tommasson 1978). Further confounding this complexity is the apparent mixing of these life history characters through an individual's lifetime.

Migratory cutthroat trout generally emigrate from fresh water at age II or III in the spring (Giger 1972, Sumner 1972, Trotter 1989). Though some coastal cutthroat trout have been caught off shore, conventional wisdom prescribes that anadromous forms do not venture far from the estuary (Pearcy 1997). Though largely uncharacterized, juveniles are thought to undergo a parr-smolt transformation process similar to other salmonids. However, there are no clear morphological distinctions between juveniles that are resident or anadromous (Tomasson 1978, Fuss 1982). The current lack of a smolt index (Johnson et al. 1999) makes biochemical evaluation impossible.

Most anadromous cutthroat trout, having migrated in spring, return to their natal stream to spawn in the following year. Spawning starts in December, continues through June, reaching a peak in February (Pauley et al. 1989, Trotter 1989). Spawning usually occurs in streams with low gradients and low flow (i.e., less than 0.3 m^3/sec during the summer; Johnston 1982). Spawning usually occurs upstream of coho and steelhead spawning habitat with some overlap (Lowry 1965, Johnston 1982). In addition, cutthroat trout are iteroparous. Because larger females produce larger eggs, it is hypothesized that the reproductive contribution of second and third time spawners may be considerably greater (through both fecundity and egg-juvenile survival) than first time spawners (Johnson et al.1999). For this reason, the trend towards a decreased frequency of repeat spawners and younger age at first spawning, though weakly supported, is of concern (Pearcy 1997).

Cutthroat trout have been impacted by anthropogenic practices such as logging (Holtby 1987, Johnson et al. 1999), over-harvest (Giger 1972, Ricker 1981, Gresswell and Harding 1997), and artificial propagation (Campton 1985, Flagg et al. 1995). The extensive use of estuaries by coastal cutthroat trout also makes them more susceptible to changes in productivity than any other Pacific salmonid (Giger 1972, Pearcy 1997). It is likely that changes in physical attributes of the lower Columbia River, resulting from activities such as channel deepining, would impact both juvenile and adult life history stages. Efforts to evaluate populations of coastal cutthroat trout will draw on information regarding migration timing and habitat use for both adults and juveniles. This information is currently incomplete and is necessary for management, restoration, and recovery efforts.

I. Identify timing of smolt and adult coastal cutthroat trout migratory patterns

Approach

Three tributaries (Chinook River (rkm 6), Abernathy Creek (rkm 76), and Gee Creek (rkm 128)) in the lower Columbia River are being monitored to identify timing of smolt and adult coastal cutthroat trout migratory patterns (Figure 1). These streams were chosen because populations of coastal cutthroat trout were known to exist, there are sites on these waterways that are amenable to the construction of passive integrated transponder (PIT) tag interrogation systems,

Figure 1. Map of Lower Columbia River showing tributaries identified for studies. A - Chinook River, B - Mill, Abernathy and Germany Creeks, C - Gee Creek.

and they represent a portion of the geographical range for coastal cutthroat trout in the lower Columbia River.

An innovative technique using 23 mm PIT tags (23 mm long, 3.84 mm diameter, 0.6 g) was initiated with this project to monitor emigration and immigration of coastal cutthroat trout from lower Columbia River tributaries. This long-range PIT tag technology was previously developed to monitor movements and stream use of juvenile Atlantic salmon (Zydlewski G. et al. 2001) and has been used to monitor steelhead in Abernathy Creek in the lower Columbia River (BPA project No. 2001-012-00). The stationary detection system can monitor the entire width and depth of a stream for PIT tagged fish, even under high water conditions. This allows virtually continuous monitoring past a single point in a stream without obstructing the path of the fish. Antenna arrays were constructed using open coil inductor loops with multi-strand wire strung through PVC pipe. The readers, power supplies, and PCs necessary to collect and record data were placed in weather-proof boxes near the sites.

Location of these stationary antennae arrays in each of the three tributaries prior to 2004 has been discussed in previous status reports. In 2004, another site was identified on the Chinook River (at approximately Chinook River km 3.5) for a third antennae array. The location is a culvert that passes under Lingenfelter Road near the intersection with Chinook Valley Road in Chinook, WA. Operation of the array at this site began in February 2004. However, problems with the power supply and use of a PDA to store data have prevented this site from collecting reliable data. The current installation of a hard-wired power source will resolve this problem by allowing the use of a computer in place of the PDA. Multiplexor transceiver units were installed at the upper site at Abernathy Fish Technology Center on Abernathy Creek and the lower site at the mouth of the Chinook River in 2004. This new type of transceiver allowed the synchronization of the three antennae present at each of these sites so that they could all be operated at the same time. This advance in technology has increased the reliability and efficiency of the data collected on each of the tribuataries.

Initial tagging of juvenile cutthroat in the Chinook River, Abernathy Creek and Gee Creek took place from September through October 2002. Subsequent PIT tagging efforts have been conducted in fall of 2003 and 2004 through electrofishing on all three tributaries and in spring of 2003 and 2004 through smolt trap operations on Chinook River (Sea Resources) and Abernathy Creek (Washington Department of Fish and Wildlife). When coastal cutthroat trout are tagged, data collected includes tag ID, capture location, fork length, weight, scale sample and genetic sample. Samples for anticipated stable isotope analysis were also collected from a subsample of individuals during fall 2004 electrofishing.

The data presented here includes data collected for all years of the project and represents some of the first of such data collected for coastal cutthroat trout .

Chinook River

A total of 2,046 coastal cutthroat trout have been PIT tagged through fall 2004. Of these, 1,137 were collected electrofishing and 909 were collected from smolt trap operations (Table 1). The total number of individuals tagged through electrofishing efforts in 2002

Table 1. Coastal cutthroat trout tagged in Chinook River by capture method and year.

	2002	2003	2004	total
Electrofishing	443	310	384	1137
Smolt trap				
River mouth (MST)	53	26	13	92
Hatchery (HST)	230	250	337	817
Total	726	586	734	2046

Table 2. Fork length (mm) and weight(g) of Chinook River coastal cutthroat trout captured and tagged electrofishing 2002-2004.

	2002		2003		2004	
	FL	W	FL	W	FL	W
Median	131	20.5	129.5	19	129	21.1
min	102	7	100	9	100	10.3
max	293	232	250	160	289	247.5
25%	120	16	118	14	118	16.4
75%	147	29	148.75	29	146	30.45

and 2004 are comparable whereas the number in 2003 is approximately 25% fewer (Table 1). This is also true when the number of recaptured fish is considered (see below). Though not quantified, the prevalence of beaver ponds in the lower part of the river was higher in 2003 relative to the other two years. This most likely reduced electrofishing efficiency and therefore the number of captured fish. Coastal cutthroat trout tagged during electrofishing ranged from 100 mm fork length (FL) to 293 mm FL and 7.0 to 247.5 g (Table 2, Figure 2). Median FL and median weight are not significantly different among years.

Different trends have occurred at the two smolt traps between 2002 and 2004. There has been a reduction in number of fish tagged at the mouth smolt trap (MST) whereas we witnessed an increase in the number tagged at the hatchery smolt trap (HST) (Table 1). The median FL of fish tagged at the MST changed minimally over the three years. However, 2002 fish were significantly larger than those tagged in 2003 (Table 3, Figure 3). No significant size difference is evident between other years at this site. The median size fish tagged at the HST are significantly different between all years (Table 3, Figure 4) with 2004 fish the largest and 2002 fish the smallest.

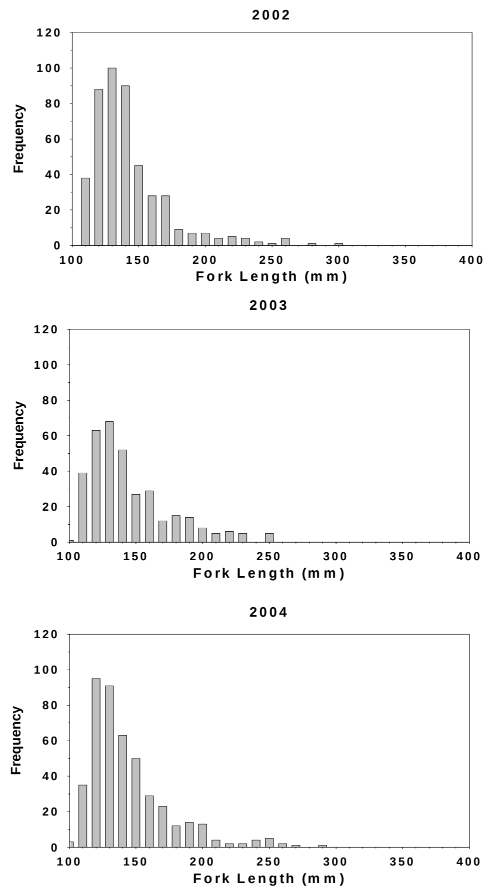

Figure 2. Chinook River length-frequency histograms of fish tagged during electrofishing 2002-2004.

Table 3. Median fork lengths of coastal cutthroat trout captured and tagged at Chinook River smolt traps. Fork lengths (mm) with 25% and 75% in brackets.

	2002	2003	2004
Mouth smolt trap (MST)	218[x] (191, 239)	196[x] (183, 207)	209 (189, 245)
Hatchery smolt trap (HST)	141[y] (118,165)	128[y] (116,151)	150[y] (122,184)

[x] Significant difference between years of fish captured at mouth smolt trap (t-test, P<0.05)
[y] Significant difference between years of fish captured at hatchery smolt trap (Kruskal-Wallis ANOVA on ranks and Dunn's multiple comaparison, P<0.05))

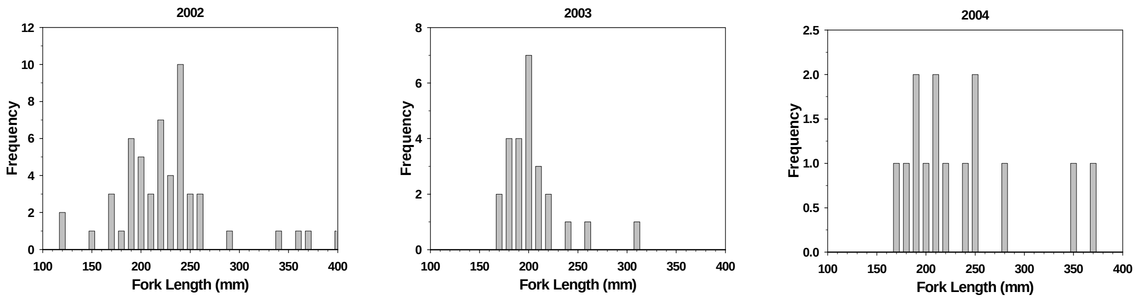

Figure 3. Chinook River length-frequency histograms of coastal cutthroat trout captured at the mouth smolt trap (MST) 2002-2004.

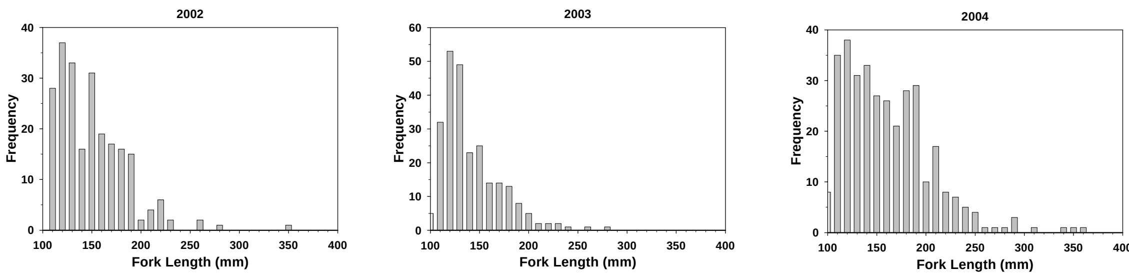

Figure 4. Chinook River length-frequency histograms of coastal cutthroat trout captured at the hatchery smolt trap (HST) 2002-2004.

Detections of tagged cutthroat trout at stationary antennae arrays have increased in each year of the study (Table 4). It must be noted that the upper and lower antenna arrays were installed in September and November 2002, respectively, and detections reported for 2002 are for the last part of the year only. Regardless, detections increased from 2003 to 2004 at both sites. Most notably, detections at the lower site more than doubled. This most probably resulted from improved efficiency due to installation of a multiplexer unit at this site in March 2004.

Detections of coastal cutthroat trout by date and by tagging cohort at both antenna arrays allow us to describe patterns of movement (Figure 5). Peak movement occurs in April and May past the lower array with 103 of 109 detections during this time. Movement was slightly more protracted at the upper array. Peak movement occurred there between March and May with 80% of individuals first detected at this time. Some tagged fish appear to have a delayed migration from the Chinook River (Figure 5). Of fish tagged during fall 2002, 9 of 50 (18%) detected individuals delayed migration to spring 2004 whereas a majority migrated in

Table 4. Individual coastal cutthroat trout detected at the Chinook River upper and lower antenna arrays by year.

	Upper array	Lower array
2002*	91	1
2003	399	82
2004	417	176

* the upper and lower antennae arrays were installed in September and November 2002, respectively

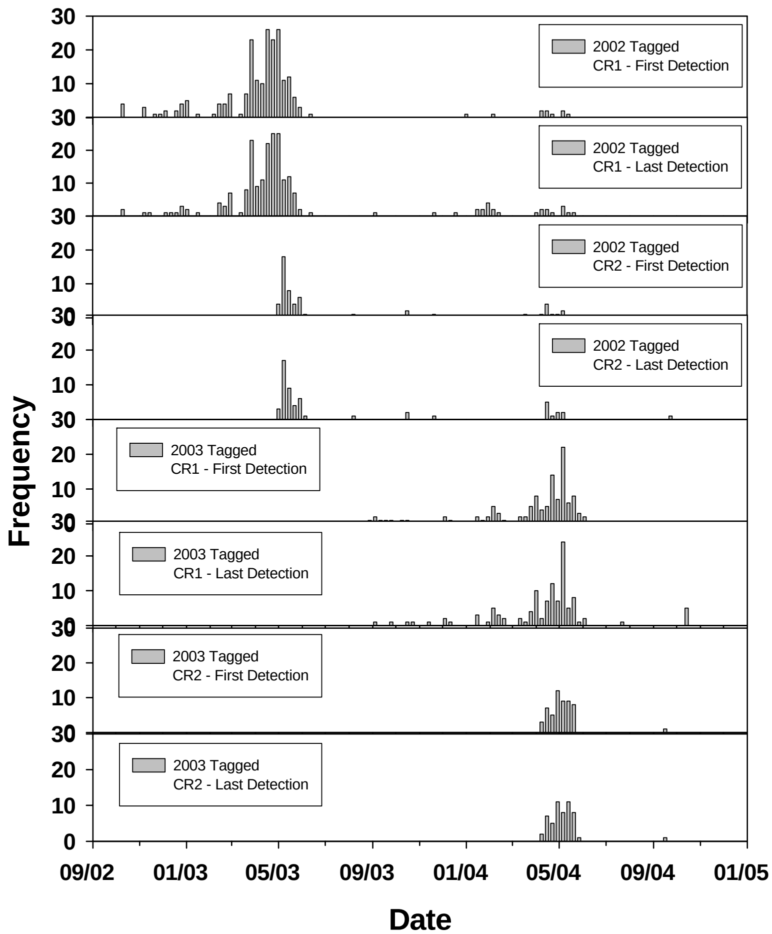

Figure 5. Detections of coastal cutthroat trout at the upper (CR1) and lower (CR2) Chinook River antennae arrays by date and tagging cohort.

2003. We compared these two groups to determine if size difference at tagging might account for delayed migration. We standardized this test by comparing only those individuals that we successfully determined to be age one through scale analysis. Although fish that delayed migration were both shorter (mean 125 mm vs. 119 mm) and lighter (mean 18.5 g vs. 15.4 g), there is insufficient statistical power to determine a difference between the groups.

There were more detections at the upper antenna array for two reasons. First, detection efficiency is near 100% at this upper array due to redundancy of antennas, smaller antenna dimension and the lack of increased water salinity that attenuates signals at the lower array. The second reason is the proximity of the upper array to tagging location. This site is approximately 40 m downstream of where fall electrofishing begins so fish must travel a shorter distance for detection.

All tagged fish recaptured or detected can be traced back to the site of capture, tag and release. Migrant fish are represented in most electrofished reaches suggesting that there is not a distinct separation between migratory and resident fish. However, when comparing proportion of tagged fish that migrated (proportion migratory) to their original release location, there is a significant negative relationship for 2002 tagged fish (Figure 6). A relationship for fish tagged in 2003 could not be determined due to low statistical power (Figure 7). However, when we combine proportion migrants from fish tagged in 2002 and 2003, we again find a significant negative relationship between migration and original tag location (Figure 8). There are at least two possible reasons for such a pattern. First, the negative slope of this relationship may be the result of differential survival with fish higher in the system incurring greater mortalities between the period of tagging and the period of migration. A second possibility is a cline in life history traits. If this is true, a greater proportion of fish lower in the system would be exhibiting an anadromous life history while more fish in the upper part of the system would be resident.

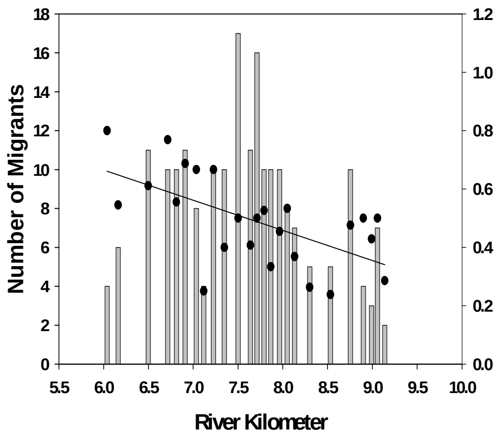

Figure 6. Chinook River migrant coastal cutthroat trout tagged in 2002 by river reach. Bars represent number of migrants by reach. Points represent proportion migrants in each reach.

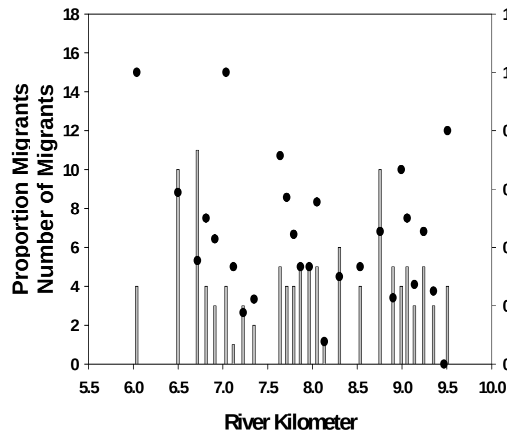

Figure 7. Chinook River migrant coastal cutthroat trout tagged in 2003 by river reach. Bars represent number of migrants by reach. Points represent proportion migrants in each reach.

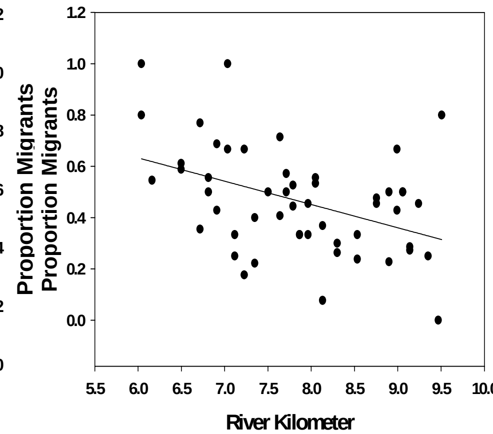

Figure 8. Chinook River migrant coastal cutthroat trout tagged in 2002-2003 by river reach. Points represent proportion migrants in each reach.

If there is indeed a cline in life history traits, the proportion of coastal cutthroat trout recaptures in subsequent years of electrofishing should exhibit a positive relationship with respect to river kilometer of original capture and tagging. Electrofishing recapture events occurred in both fall 2003 and fall 2004. In 2003, fish tagged during fall 2002 electrofishing were recaptured, and in 2004, fish tagged in both 2002 and 2003 electrofishing were recaptured (Table 5). These recaptures have allowed determination of number of recaptures and proportion recaptures with respect to river kilometer of original capture and tagging (Figures 9 and 10). Unfortunately, the number of electrofishing recaptures is not adequate to test a relationship between proportion of

Table 5. Chinook River coastal cutthroat trout electrofishing recaptures by year.

	Year Tagged	
Year Recaptured	2002	2003
2003	18	
2004	2	17
Total individuals	20	17

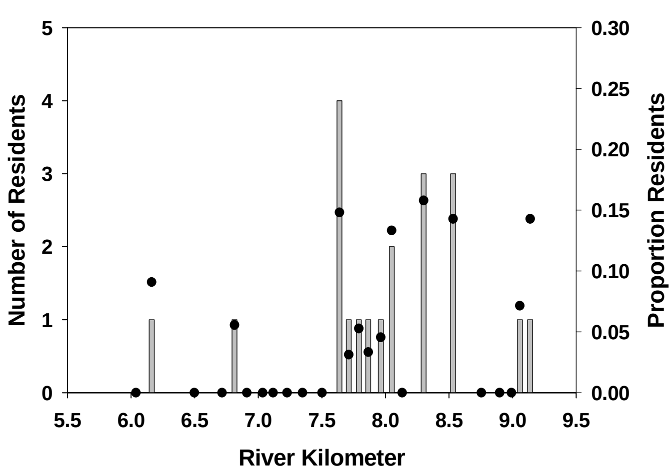

Figure 9. Chinook River resident coastal cutthroat trout tagged in 2002 by river reach. Bars represent number of residents by reach. Points represent proportion residents in each reach.

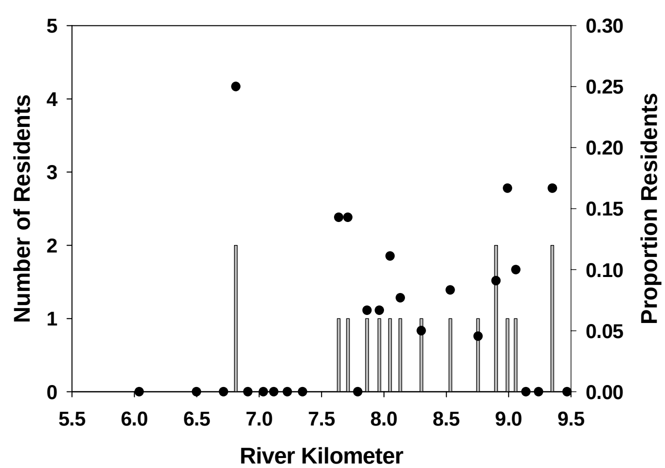

Figure 10. Chinook River resident coastal cutthroat trout tagged in 2003 by river reach. Bars represent number of residents by reach. Points represent proportion residents in each reach.

resident tagged fish and original release location. That withstanding, the data collected from migratory individuals is the first of such evidence for a clinal variation in life history trait in coastal cutthroat trout without an impassable barrier present.

Data on returning migrants is sparse. To date, ten individuals have been detected that left the system and subsequently returned (Table 6). Two of these fish were tagged at the HST, five were tagged at the MST, and three were tagged during fall electrofishing efforts. The HST collected fish were tagged March 2002 at rkm 6. They were detected at the lower antenna array (rkm 0), in spring of 2003 and detected at the upper array in December 2003 and March 2004. The MST collected fish were tagged in March 2002 at rkm 0 and subsequently detected at the upper antenna array (rkm 6) between December 2002 and March 2003. These individuals were collected at the river mouth during the time of typical spring out migration. The electrofishing collected fish were tagged in October 2002 between rkm 6 and 9.5. These individuals were detected at the upper array in March 2002, presumably during spring out migration (smolting). They were later detected at the lower antenna array (rkm 0) before detection a final time at the upper array in January 2004. Since all of these fish were detected at the lower array, it is likely these individuals exited the river in the spring and returned during the following winter.

Table 6. PIT tag antennae array detection dates for migratory cutthroat trout tagged in the Chinook River. The Chinook River hatchery smolt trap (HST) is just downstream of the upper array. The Chinook River mouth smolt trap (MST) is downstream of all antenna arrays. Tagged fish from electrofishing (EF) are captured upstream of all antennae arrays (n/d = no detection).

Capture Method	Capture Date	Detection date upper array First	Last	Detection date lower array First	Last
HST	3/2002	11/2002	3/2004	4/2003	5/2003
	3/2002	11/2002	12/2003	5/2003	10/2003
MST	3/2002	12/2002	1/2003	1/2003	1/2003
	3/2002	12/2002	12/2002	n/d	n/d
	3/2002	1/2003	1/2003	n/d	n/d
	3/2002	3/2003	3/2003	n/d	n/d
	3/2002	3/2003	3/2003	n/d	n/d
EF	10/2002	3/2003	1/2004	5/2003	9/2004
	10/2002	3/2003	1/2004	10/2003	10/2003
	10/2002	4/2003	1/2004	11/2003	11/2003

Using data from returning migrants, we calculated proportion of returning fish for those tagged in 2002. The proportion of returns is defined as the number of tags detected at the upper array on return divided by number of tagged fish that exited the river. Return estimates were calculated separately for each collection method. For fish collected by the HST and through electrofishing, the number of tagged fish that exited the river is defined as number of tags detected at the lower antenna. For fish collected at the MST, the total number of fish tagged was used in the analysis. Return estimates for year 2002-tagged fish are 5.5% for electrofishing collected fish (3 of 55), 9.4% for MST collected fish (5 of 53) and 15.4 % for HST collected fish (2 of 13).

Abernathy Creek

From fall 2001 through fall 2004, 2,301 coastal cutthroat trout were implanted with PIT tags in Abernathy Creek, WA. Of these, 1,846 were collected electrofishing and 455 were collected at a smolt trap during spring out migration (Table 7). Fish tagged during electrofishing range from 100 mm to 390 mm FL and from 8.6 and 680 g (Table 8, Figure 11). Significant differences were found between median length and median weight for 2004 tagged fish and those of 2002 and 2003 tagged fish. These differences could be the result of reduced capture rates of larger fish in 2004. Other explanations include actual depression of size at age or differences in spawning or hatching time (see percentiles in Table 8).

Table 7. Coastal cutthroat trout tagged in Abernathy Creek by capture method and year.

	2001	2002	2003	2004	total
Electrofishing	470	498	533	345	1846
Smolt trap		200	107	148	455
total	470	698	640	493	2301

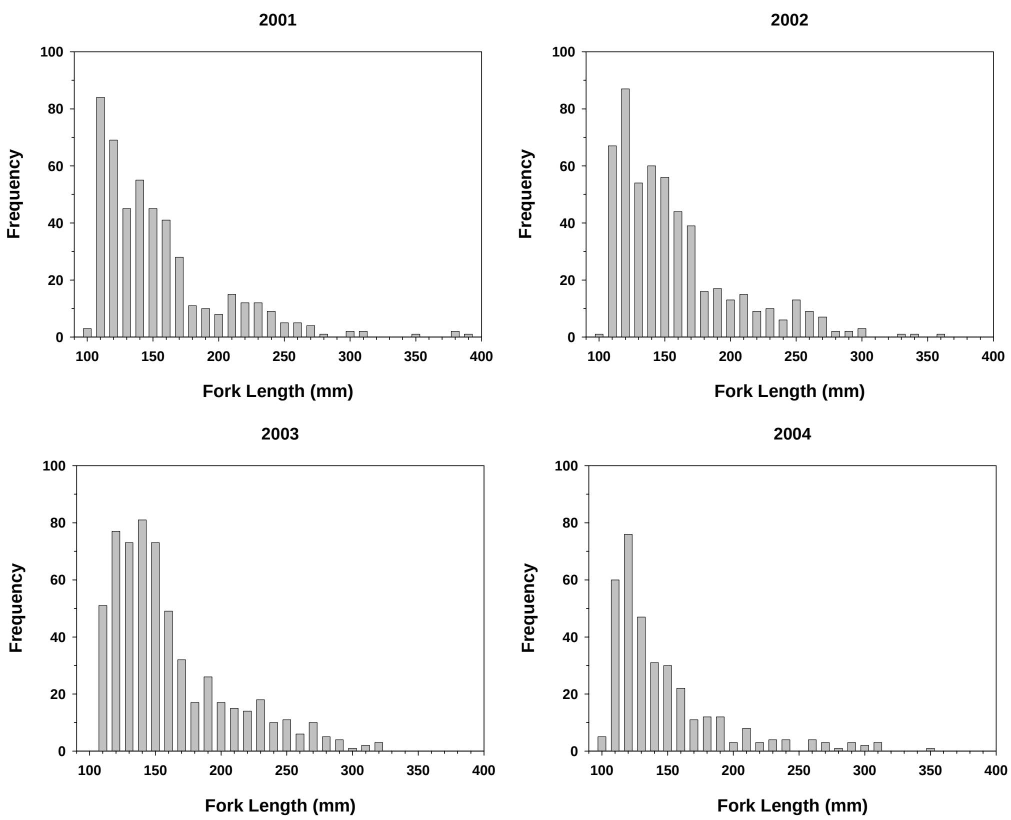

Figure 11. Abernathy Creek length-frequency histograms for 2001-2004.

Table 8. Fork length (mm) and weight (g) of Abernathy Creek coastal cutthroat trout captured and tagged electrofishing 2001-2004. Median values sharing superscript letters are significantly different (Kruskal-Wallis ANOVA on ranks and Dunn's multiple comparison, P<0.001).

	2001		2002		2003		2004	
	FL	W	FL	W	FL	W	FL	W
Median	137	24.3	138^{w}	24.2^{x}	138^{y}	24.9^{z}	128^{wy}	19.85^{xz}
min	100	8.9	100	9.6	101	8.7	100	8.6
max	390	680	352	514.6	316	319.7	345	434.6
25%	115	14.8	117	15.2	121	17	113	14.1
75%	164	41.7	164	40.2	165.5	42.3	155	36.5

The number of fish tagged each year varies without any obvious trend. Conditions during fall 2004 electrofishing were not ideal for high catch efficiency. The low number of fish tagged in fall 2004 may be the result of two factors. Water levels were high due to unusually high precipitation causing many areas to be difficult to wade. In addition, the presence of ESA listed fall tule Chinook in the river limited electrofishing in some reaches. These Chinook were present higher up the system than previous years probably due to the high water.

Similarly, for different years, the number of fish collected and tagged at the smolt trap has varied without obvious trends. Differences in length and weight of these fish exist among years (Table 9). Fish tagged in spring 2003 were significantly shorter on average than those tagged in either 2002 or 2004. Fish tagged in 2004 were significantly heavier than those tagged in either 2002 or 2003. When we compare condition factor ($CF = W / FL^3$), we find that the condition factor of 2002 fish is significantly less than 2003 or 2004 fish.

Table 9. Fork length (mm) and weight (g) of Abernathy Creek coastal cutthroat trout captured and tagged during spring smolt trap operation. Median values sharing superscript letters are significantly different (Kruskal-Wallis ANOVA on ranks and Dunn's multiple comparison, P<0.001).

	2002		2003		2004	
	FL	W	FL	W	FL	W
Median	181^{w}	41.8^{x}	173^{wy}	43.9^{z}	182^{y}	51.9^{xz}
min	128	17.1	135	22.2	134	20.3
max	258	120.2	221	85.1	233	115.8
25%	168	33.2	162	37.2	166	37.6
75%	194	52.0	186	55.5	198	68.2

In Abernathy Creek, yearly detections of tagged coastal cutthroat trout at stationary antenna arrays have not shown the steady increase as was witnessed at the Chinook River. The lowest number of detections at both arrays was in 2002 and the highest in 2003 (Table 10). Though the number of fish tagged each year during electrofishing is consistently less in the Chinook River then in Abernathy Creek, we consistently get fewer detections at the Abernathy Creek antennas. This may partly be the result of lower antenna efficiency at the Abernathy Creek arrays but probably reflects the difference in the proportion of migratory fish between the two systems.

Table 10. Individual coastal cutthroat trout detected at the Abernathy Creek upper and lower antennae arrays by year.

	Upper array	Lower array
2001	2	0
2002	24	31
2003	51	43
2004	43	37

Detections of tagged coastal cutthroat trout grouped by date and tagging cohort allow us to examine patterns of movement (Figure 12). Detections from both the upper and lower antenna arrays are combined to represent total number of migrants. This was possible due to the narrow migration window obvious from both arrays as compared to the protracted movement evident at the upper Chinook River antennas. As found at the Chinook River lower antennae array, peak movement occurs in April and May with 105 of 142 detections during this time. Again we see a migration delay of some individuals. Of fish tagged in fall 2001, 4 of the 36 (11%) migrants delayed an added year. This occurred again with 2002 tagged fish where 4 of the 49 (8%) delay migration until spring 2004. The groups of individuals who delayed were compared to those that migrated in the first spring to see if size difference at tagging might account for the delayed migration. In all cases, the group of fish that delayed migration was shorter and lighter than the group that left in the first spring subsequent to tagging (Table 11). Unfortunately, there is insufficient statistical power to determine differences between the groups.

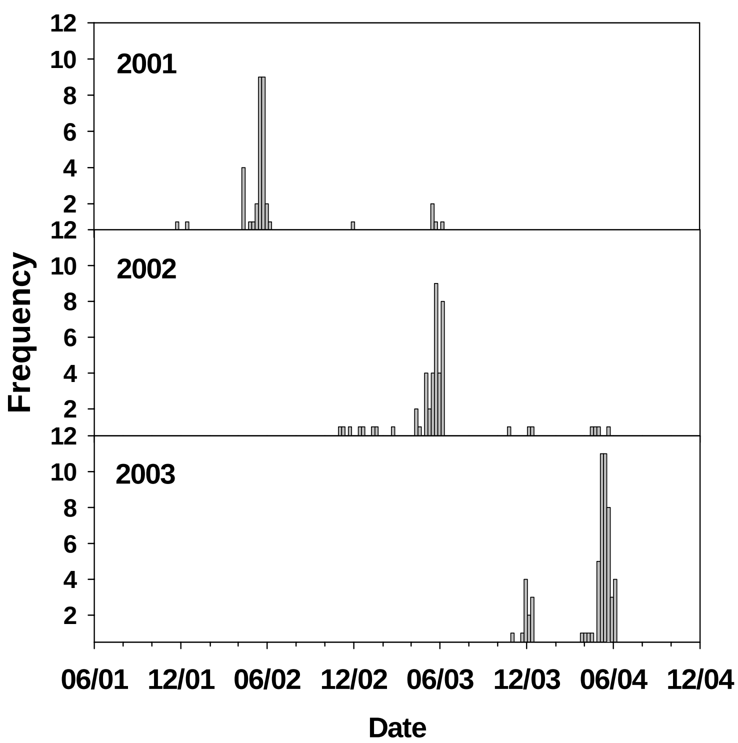

Figure 12. Detections of coastal cutthroat trout at the Abernathy Creek antennae arrays by date and tagging cohort.

All tagged coastal cutthroat trout recaptured or detected can be traced back to the site of capture, tag and release. Migrant fish are represented in most electrofished reaches in all years suggesting that there is not a distinct geographic separation between migratory and resident fish (Figures 13, 14 and 15). Linear regression models fit to data consistently show a negative

Table 11. Fork length (mm) and weight (g) of migrant Abernathy Creek coastal cutthroat trout captured and tagged through electrofishing efforts. Fish that migrated the first spring subsequent to tagging are compared to those that delayed an additional year.

	Tagged 2001				Tagged 2002			
	2002 migrants		2003 migrants		2003 migrants		2004 migrants	
	FL	W	FL	W	FL	W	FL	W
Median	138	25.1	110.5	13.2	134	23.0	117	15.0
min	110	13.4	104	10.8	105	11.0	107	11.8
max	204	77.5	119	16.6	176	52.5	119	16.4
25%	126	19.1	107	11.9	125	19.5	112	13.3
75%	146	31.2	115	15.0	153	31.9	118	15.8

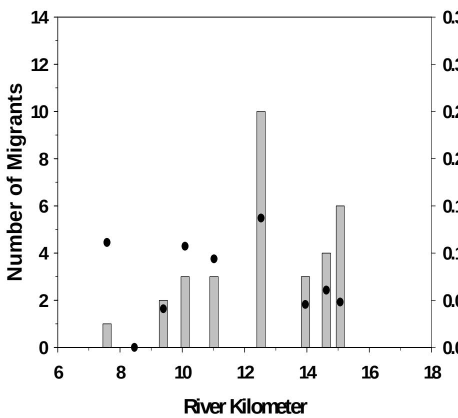

Figure 13. Abernathy Creek migrant coastal cutthroat trout tagged in 2001 by river reach. Bars represent number of migrants by reach. Points represent proportion of migrants in each reach.

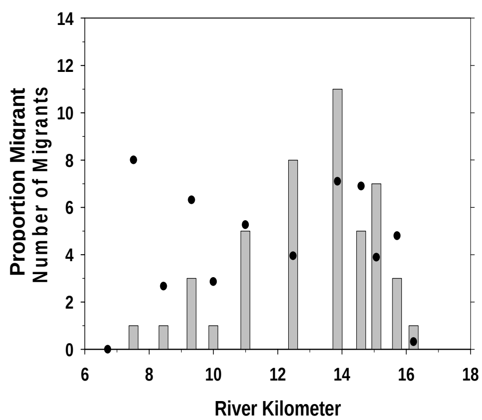

Figure 14. Abernathy Creek migrant coastal cutthroat trout tagged in 2002 by river reach. Bars represent number of migrants by reach. Points represent proportion of migrants in each reach.

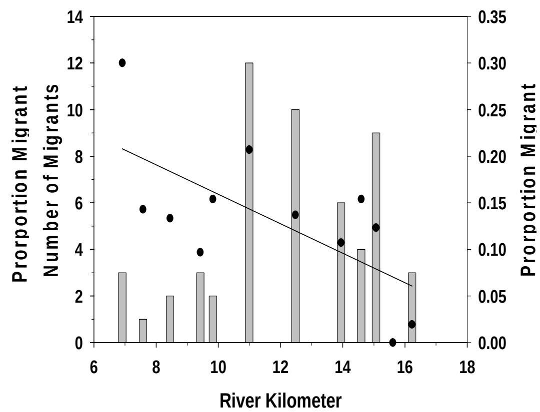

Figure 15. Abernathy Creek migrant coastal cutthroat trout tagged in 2003 by river reach. Bars represent number of migrants by reach. Points represent proportion of migrants in each reach.

slope suggesting a relationship between where a fish was tagged in the system and the likelihood of becoming migrant. Unfortunately, we were unable to determine a relationship between proportion of tagged fish that were migrant and the original tagging river kilometer due to insufficient statistical power.

Electrofishing recapture events occurred in fall 2002, 2003 and 2004. Coastal cutthroat trout tagged in each year were recaptured in following years

Table 12. Abernathy Creek coastal cutthroat trout electrofishing recaptures by year. Total events and total individuals are different due to multiple recaptures of the same individual.

	Year Tagged		
Year Recaptured	2001	2003	2003
2002	41		
2003	11	51	
2004	2	8	30
Total events	54	59	30
Total individuals	45	57	30

(Table 12). These recaptures have allowed determination of number of recaptures and proportion recaptures with respect to river kilometer of original capture and tagging (Figures 16, 17 and 18). Tagged individuals were recaptured from most of the electrofishing reaches. However, as with recaptures in the Chinook River, the number of recaptures is not sufficient to test relationships between proportion of resident tagged fish and original release location.

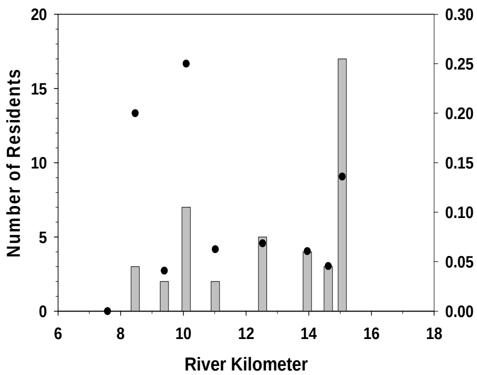

Figure 16. Abernathy Creek resident coastal cutthroat trout tagged in 2001 by river reach. Bars represent number of residents by reach. Points represent proportion of residents in each reach.

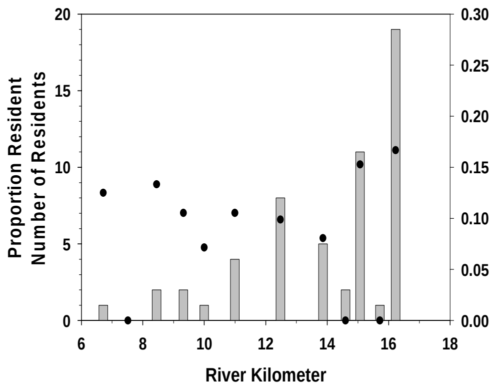

Figure 17. Abernathy Creek resident coastal cutthroat trout tagged in 2002 by river reach. Bars represent number of residents by reach. Points represent proportion of residents in each reach.

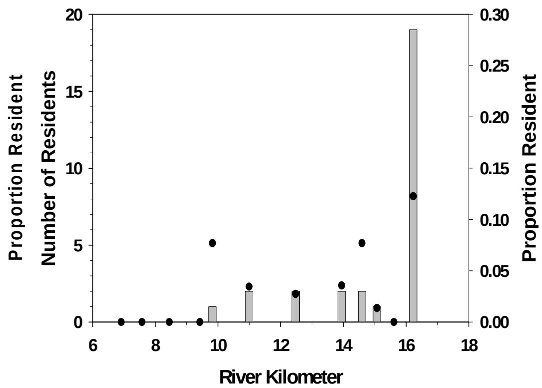

Figure 18. Abernathy Creek resident coastal cutthroat trout tagged in 2003 by river reach. Bars represent number of residents by reach. Points represent proportion of residents in each reach.

To date, sixteen individual coastal cutthroat trout have exhibited migratory behavior including return to Abernathy Creek (Table 13). Ten of these fish were captured and tagged during spring smolt trap operations between 2002 and 2004. During smolt trap operation, a subgroup of tagged individuals are released above the upper antenna in an attempt to determine antenna efficiency. Detections from these individuals are evident (Table 13) when comparing tag date with first detection date at the upper antenna. The remainder of the coastal cutthroat trout were initially captured and tagged during fall electrofishing events. Return dates of migratory fish are defined as the first detection beyond spring migration. For example, the individual tagged at the smolt trap on 4/16/2002 was detected the next day at the lower antenna apparently moving downstream after release above the arrays. It was then detected 10/4/2002 at the lower antenna on its return to Abernathy Creek. From these individuals, it appears that cutthroat return to Abernathy between September and March. It should be noted that although efficiency of antenna arrays are high, some fish pass without detection. This is apparent from the second individual in Table 13 that was tagged on 9/18/2001 during electrofishing. It is first detected 5/24/2002 at the lower antenna. It is then not detected until 3/9/2003 at the upper antenna, apparently after returning to Abernathy Creek. Due to the possibility of fish passing without detection, some of our estimated return dates may be detections of individuals exiting the creek again. Additional detections of these individuals and improved efficiency of the antennae arrays will increase the resolution of this movement data.

Table 13. PIT tag antennae array detection dates for migratory cutthroat trout tagged in Abernathy Creek. The Abernathy Creek mouth smolt trap (ST) is downstream of all antenna arrays. Tagged fish from electrofishing (EF) are captured upstream of all antennae arrays.

Capture Method	Tag date	Upper antenna		Lower antenna	
		First detection	Last detection	First detection	Last detection
ST	4/16/2002			4/17/2002	10/4/2002
	5/13/2002	6/9/2002	6/10/2002	7/16/2002	10/12/2002
	6/2/2002	11/17/2002	11/17/2002	11/16/2002	11/16/2002
	6/14/2002	6/28/2002	11/20/2002		
	6/21/2002	11/21/2002	12/14/2002	11/21/2002	11/21/2002
	5/11/2003	11/12/2003	11/12/2003	11/11/2003	11/11/2003
	5/23/2003	10/8/2003	11/16/2003	3/27/2004	3/27/2004
	6/1/2003	6/2/2003	9/27/2004	6/14/2003	6/14/2003
	5/11/2004	9/19/2004	10/7/2004	9/17/2004	9/18/2004
	5/17/2004			8/22/2004	8/22/2004
EF	9/18/2001	4/27/2002	3/12/2003	4/28/2002	3/12/2003
	9/18/2001	3/9/2003	3/9/2003	5/24/2002	2/22/2003
	10/1/2001	5/11/2002	12/12/2002	5/11/2002	3/6/2003
	9/28/2002	12/5/2003	10/6/2004	12/5/2003	10/14/2004
	9/23/2003	9/30/2004	9/30/2004	4/15/2004	9/26/2004
	10/2001/2003	4/24/2004	4/25/2004	4/26/2004	7/27/2004

Gee Creek

Electrofishing efforts in Gee Creek continue to yield relatively few individuals. In 2004, 38 coastal cutthroat trout were captured and tagged in Gee Creek and five previously tagged individuals were recaptured. A total of 32 coastal cutthroat trout were captured and tagged in 2002 and 64 in 2003.

New developments from this stream include the movement of nine individuals past the PIT tag antenna array in 2004. Detections occurred between 2/4/2004 and 5/9/2004. One of these fish was tagged in 2002 (103 mm FL, 10.3 g). The remainder of these fish were tagged in 2003 and ranged in size from 188 to 258 mm FL and 63.7 to 166.2 g.

Increasing urbanization resulting in degraded habitat and water quality continues to be a concern for the continued persistence of this population. Increased sediment has impacted or eliminated potential salmonid habitats. A riparian zone rife with nonnative vegetation may only be exacerbating these problems as well. A thorough watershed analysis and subsequent watershed plan is necessary to address the health of this system and the coastal cutthroat trout population.

Portable PIT Tag Detections

Detections of tagged coastal cutthroat trout and shed PIT tags continued in 2004 using a portable PIT tag detection system (“PIT packing”). Data was collected in Abernathy Creek but has not thoroughly been analyzed to date. This information will be included in the final report to help determine more accurate estimates of migrant and resident proportions of coastal cutthroat trout in Abernathy Creek.

II. Mainstem habitat use by migrating adult coastal cutthroat trout

Approach

Coastal cutthroat trout kelts (23) were implanted with radio transmitters in Mill Creek, WA, a tributary of the lower Columbia River (rkm 87.2) during four days between 2/7/2004 and 2/15/2004 (Table 14). After regaining equilibrium, fish were released at the point of capture and allowed to recover at the capture site. The average fork length of radio-tagged kelts was 309 mm (range 254 to 402, median 310 mm). Two fish had adipose clips indicating hatchery origins, and the other fish were considered wild. Trout were caught by twenty-two volunteer anglers from the Lower Columbia River Flyfishers Club (171.25 total angling hours, 0.13 fish/angler hour). Anglers used both bait and lures or flies and were restricted to a single, barbless hook.

Cutthroat trout were tracked 2-3 days per week through September, then 1-2 days per week as fish movement declined, for a total of 116 tracking days from 2/8/2004 to 11/30/2004. Tracking was conducted by boat 64 days and by car 51 days. However, each boat tracking day included additional tracking by car en-route to the marina. In addition, one aircraft tracking day was conducted on 9/24/2004. A stationary radio telemetry receiver (CNL-S) was also operating continually at County Line Park, Cowlitz County, WA (rkm 83.4), 3.8 rkm downstream from Mill Creek. Tracking continues currently using all methods, however, is only reported through 11/30/2004 for most individuals.

Tracking routes evolved with fish movement and exploration of safe passageways for boat tracking and suitable access roads for car tracking. By June, tracking routes were generally established (Figure 19). Downriver and upriver tracking boundaries were the Astoria, OR, bridge (rkm 21.9) and the most upstream fish location, which varied from the Lord Island overhead power cables (rkm 100.0) to Fisher Island (rkm 96.5). Upriver tracking boundary exceptions occurred when fish that

Figure 19. 2004 coastal cutthroat trout radio tracking routes in the lower Columbia River. Green dots indicate car tracking. Red dots indicate

Table 14. Coastal cutthroat trout kelts radio tagged and tracking in the lower Columbia River 2004. Period of record from 2/7/2004 to 11/30/2004 unless otherwise stated. A zero final distance represents either fish not detected outside of Mill Creek or fish that returned to Mill Creek after leaving. A negative number represents a point upstream from Mill Creek. A range value greater than the other two distances for a given fish indicates detection(s) upstream as well as downstream of Mill Creek. NR - Not Recorded.

Tag Code	Fork Length (mm)	Wt (g)	Tagging Date	Date of Initial movement into Columbia River	Date movement last detected	Number of Contact Days	Distance[1] (km)		
							Final	Greatest	Range
1*	332	308.9	2/14/2004	3/31/2004	4/9/2004	96	0	-0.7	0.7
2*	258	NR	2/7/2004	None[2]	2/7/2004	101	0	0	0
4^	265	149.5	2/14/2004	4/7/2004	4/7/2004	107+	0.1	0.1	0.1
5~	310	269.5	2/14/2004	3/26/2004	4/16/2004	25	29.7	29.7	29.7
6	291	NR	2/7/2004	2/9/2004	2/20/2004	101	18.6	18.6	18.6
7^	351	NR	2/8/2004	3/10/2004	4/3/2004	70+	37.6	37.6	50.4
8*	331	NR	2/8/2004	None[2]	2/20/2004	101	0	0	0
9^	330	NR	2/8/2004	4/5/2004	4/9/2004	54+	57.1	57.1	57.1
10^	288	NR	2/8/2004	3/1/2004	3/17/2004	111+	26	26	26
11^	358	NR	2/8/2004	2/20/2004	To Present	81+	0	24.4	24.4
12^	254	143.2	2/14/2004	None[2]	To Present	104+	0	0	0
13*	283	209.6	2/14/2004	None[2]	3/17/2004	97	0	0	0
14~	276	185.9	2/15/2004	3/3/2004	3/5/2004	9	14.3	14.3	14.3
15*	300	211.3	2/14/2004	None[2]	4/7/2004	97	0	0	0
16^	318	NR	2/7/2004	2/11/2004	2/18/2004	99+	9.6	9.6	10
17^	292	NR	2/8/2004	4/9/2004	To Present	29+	39.2	39.2	39.2
18~	282	209.9	2/14/2004	4/7/2004	4/17/2004	27	3.8	3.8	9.9
19~	310	NR	2/7/2004	2/9/2004	4/24/2004	24	3.8	-12.8	16.6
20~	402	NR	2/7/2004	4/9/2004	4/23/2004	32	13.8	13.8	13.8
21^	331	NR	2/7/2004	5/21/2004	5/21/2004	109+	-9.3	-9.3	9.3
22^	286	NR	2/7/2004	3/3/2004	4/5/2004	111+	23.2	23.2	23.9
23	328	NR	2/7/2004	3/17/2004	8/13/2004	35	0	9.8	9.8
24*	340	NR	2/7/2004	None[2]	2/7/2004	103	0	0	0

[1] From tagging site.
[2] Fish not detected outside of Mill Creek.
*Tag recovered in working condition October 15, 2004.
^ Routinely encountered to present.
+ Indicates contact days beyond November 30, 2004.
~ Not encountered since March – April, 2004.

could not be located were suspected to have moved further upriver. These exceptions include a limited number of upriver car tracking trips as far up as the Cowlitz fish hatchery on the Cowlitz River (rkm 108.6) and the aerial survey in September of the lower Columbia River and selected tributaries between Vancouver, WA (rkm 170.6), and the Astoria, OR, bridge.

All fish were not detected each tracking day. The number of days a tagged fish was encountered averaged 75 (range 9 to 111). Riverbank access and the distance from shore of some tags was limiting during car tracking. Weather, water depths and initial unfamiliarity with the river were among limiting factors during boat tracking. Furthermore, water salinity, which impedes radio signals in the lower Columbia River estuary upriver of the Astoria, OR, bridge to generally near the Rice Island (rkm 35.0) area, was limiting during high tide cycles for both car and boat tracking as well as for fish that may have migrated to the ocean.

Unless otherwise noted, fish movement distance is directional fish movement once a fish entered the Columbia River from Mill Creek. Directional movement is distance upstream and downstream the lower Columbia River parallel to the shipping channel as opposed to absolute movement or distance without regard to direction.

The 23 fish tagged in Mill Creek generally fit four categories: 1) Coastal cutthroat trout not detected outside of Mill Creek; 2) Coastal cutthroat trout detected outside of Mill Creek and returning one or more times; 3) Coastal cutthroat trout detected outside of Mill Creek in the main-stem lower Columbia River continually in one location; 4) Coastal cutthroat trout detected outside of Mill Creek in the main-stem lower Columbia River and not detected again. Two notable exceptions within these groups did occur.

Coastal cutthroat trout not detected outside of Mill Creek

Six coastal cutthroat trout were not detected outside the Mill Creek drainage between February, 2004 transmitter implantation and the 11/30/2004 reporting period. Of these six fish, two, #2 and #24, were not detected ever moving within Mill Creek despite 101 and 103 tracking day detections, respectively.

Three coastal cutthroat trout were last detected moving between 2/20/2004 and 4/4/2004. Fish #8, tagged 2/8/2004, was detected 101 tracking days, and its last known movement was 2/20/2004. Fish #13 was tagged 2/14/2004 and detected 97 tracking days. Its last recorded movement was 3/17/2004. Finally, fish #15, also tagged 2/14/2004 and contacted 97 tracking days, last moved 4/7/2004.

The transmitters from the above five coastal cutthroat trout were recovered in working condition 10/15/2004. Transmitter #13 was on the bank and the other four were submerged in the stream channel. No fish carcasses were found with these transmitters.

Fish #12 was also not detected outside of the Mill Creek drainage. Tagged 2/14/2004, it was detected 104 tracking days and is presently still active within the Mill Creek drainage.

Coastal cutthroat trout detected outside of Mill Creek and returning one or more times

Four coastal cutthroat trout were detected outside of Mill Creek that returned one or more times. Three of these fish (#1, #11 and #23) were last detected in Mill Creek. An exception within this group, fish #19 was last detected in the Columbia River.

Fish #1 left Mill Creek one time then returned to stay. Tagged 2/14/2004, it was detected in Mill Creek 19 tracking days through 3/31/2004. Four subsequent tracking events during a nine-day span resulted in no contact, contact upriver in Abernathy Creek (rkm 87.7), no contact, and contact back in Mill Creek. Following the 4/9/2004 return to Mill Creek, movement was not detected again. Transmitter #1 was recovered in working condition on 10/15/2004 from a submerged debris jam. No fish carcass was found with the transmitter.

Fish #11 left Mill Creek twice and returned each time. Tagged 2/8/2004, this fish was detected in Mill Creek seven tracking days through 2/20/2004. Beginning two days later, the fish was detected by stationary and mobile receivers at County Line Park in the lower Columbia River downstream from Mill Creek for six tracking days through 2/28/2004. Its return to Mill Creek was detected 3/1/2004, where it was detected 19 tracking days through 4/21/2004. Fish #11 was detected in the lower Columbia River for the second time at CNL-S (rkm 83.4) on 4/22/2004. Three subsequent detections ending 4/28/2004 indicated a 20.6 km downstream movement with a final detection by car at west Puget Island (rkm 62.8). The fish was not located again until 7/6/2004. Through 7/19/2004, fish #11 was detected five tracking days between the proximity of the Mill Creek mouth (rkm 87.0) and Little Cape Horn (rkm 77.2). During this time, movement of this individual in the lower Columbia River was both upstream and downstream. Fish #11 returned to Mill Creek the second time on 7/21/2004 where it was detected 43 tracking days through the 11/30/2004. This fish is actively moving in Mill Creek at the present time.

Fish #23 entered the Columbia River one time then returned to Mill Creek where contact last occurred. Tagged 2/7/2004, fish #23 was detected in Mill Creek 16 tracking days through 3/17/2004. Beginning the next day, it was detected 11 times in the lower Columbia River downstream from Mill Creek through 4/7/2004. During this period, detections occurred in a four km lower Columbia River reach along the Washington shore from CNL-S downstream to Cooper Point (rkm 79.4). No contact was made for the next 18 weeks. The fish was then detected on 8/11/2004 in Mill Creek. Following ten more contact days in Mill Creek through 9/1/2004, fish #23 has not been detected again.

Fish #19 left Mill Creek for the lower Columbia River, returned to Mill Creek, and departed again to the lower Columbia River where it was last detected. Tagged 2/7/2004, fish #19 left Mill Creek and traveled upstream in the lower Columbia River to Abernathy Creek (rkm 87.9) where it was detected the following day near the Abernathy Creek smolt trap. The fish was detected in the same position six more tracking days through 2/23/2004. Two days later, fish #19 was detected back in Mill Creek for 15 tracking days through 3/29/2004. Moving again into the lower Columbia River, fish #19 was detected upstream of Mill Creek on 3/31/2004 at the Willow Grove boat ramp (rkm 93.8) and on 4/5/2004 at the Lord Island overhead power cables (rkm 100.0). After moving downstream, this fish was detected one more time on 4/24/2004 at CNL-S and has not been detected since.

Coastal cutthroat trout detected outside of Mill Creek in the main-stem lower Columbia River continually in one location

Eight coastal cutthroat trout left Mill Creek and were detected moving in the Columbia River two to 26 days, before their movement ceased. While detections presently continue to be collected for most of these individuals, the fate of these fish is unknown for certain. However, given the length of time each fish has maintained its position and certain habitat variables (i.e., water temperature) associated with some of these areas, it is suspected that these fish may be mortalities.

Fish #4, tagged 2/14/2004, was detected in Mill Creek for 20 tracking days through 4/5/2004. Two days later it was detected by car in Bradbury Slough opposite the Mill Creek mouth on the Oregon side of the lower Columbia River. Although directional distance was 0.1

km, absolute distance across the Columbia River was 2.3 km. After 4/5/2004, no further movement was detected during 87 contacts by car and boat through 11/30/2004.

Fish #6 was tagged 2/7/2004 and detected in Mill Creek for three days through 2/9/2004 before entering the lower Columbia River. Two days later, it was detected in the lower Columbia River downstream from Mill Creek at CNL-S. Located again 2/18/2004 by car in a secondary channel between the south Puget Island shore and Coffee Pot Island (rkm 69.0), the fish remained in this vicinity for the following five tracking days. By 3/5/2004, the fish had crossed the Columbia River shipping channel a distance of 1.0 km to Wauna, OR, where it was detected by boat. It remained at this location approximately 0.5 km outside of the lower Columbia River in Driscoll Slough. Between 3/5/2004 and 11/9/2004 the fish was detected in Driscoll Slough for 91 tracking days by boat and car. This fish was not detected after 11/9/2004, following possible signs of transmitter failure.

Fish #7, tagged 2/8/2004, was detected in Mill Creek for 13 tracking days through 3/10/2004. Following detections by boat and car on 3/15/2004 across the lower Columbia River from the Mill Creek mouth near Beaver Docks (rkm 86.4), the fish was detected by car on 3/17/2004 upstream in Bradbury Slough (rkm 88.5). Upstream movement continued to the Walker Island area (rkm 98.6) with two detections by car on 3/24/2004 and 3/26/2004. This upstream movement culminated 3/29/2004 when fish #7 was detected by boat at its most upstream position at the Lord Island overhead power cables (rkm 100.0). This was the most upstream position any tagged fish was detected. Interestingly, fish #7 was detected at this location only seven days before fish (#19) was detected there. Five days later, on 4/3/2004, fish #7 was detected downstream at CNL-S (rkm 83.4). Another two days later, it was detected by boat at its final and most downstream position at the northwest tip of Fitzpatrick Island (rkm 50). At this location, 52 additional contacts by boat have been made through 11/30/2004.

Fish #9 was tagged 2/8/2004 and detected in Mill Creek for 24 tracking days through 4/5/2004. It was next detected at CNL-S 4/6/2004. Three days later on 4/9/2004, it was detected by boat 38.9 km downstream near Pillar Rock (rkm 44.5). Fish #9 was not detected again until 5/24/2004 when it was detected by boat at its most downstream position near Mott Island (rkm 30.5), where it remained through 11/30/2004. This was the most downstream position any tagged fish was detected. No further movement of fish #9 was detected during 29 additional boat tracking days up to the end of November. Intermittent detection at this location is due to radio signal attenuation caused by saline water during high tide cycles.

Fish #10 was tagged 2/8/2004 and detected in Mill Creek for 11 tracking days through 3/1/2004. On 3/3/2004, it was detected twice in the lower Columbia River downstream of Mill Creek. It was detected by CNL-S then later by car 2.6 km downstream near Cooper Point (rkm 80.8). By 3/5/2004, the fish had continued downstream to the Cathlamet, WA, city dock (rkm 63.5), where it was detected six tracking days by boat and car. Fish #10 was then detected by boat on 3/22/2004 at its final and most downstream position at the mouth of Elochoman Slough mouth (rkm 61.5) near Elochoman Slough Marina (Wahkiakum County, WA). It was detected by boat and car at this location for 93 tracking days through 11/30/2004.

Fish #16 was tagged 2/7/2004 and detected in Mill Creek for four days through 2/11/04. The following three days, it was detected by boat and car in the lower Columbia River along the Washington shore near the Mill Creek. On 2/18/2004, the fish was detected downstream at CNL-S. Fish #16 was subsequently not detected for one month until 3/17/2004 when it was located downstream by car in Wallace Slough (rkm 77.6) along the Oregon shore. No movement was detected during the remaining 95 contacts by boat and car through 11/30/2004.

Fish #21 was tagged 2/7/2004 and detected in Mill Creek for 44 tracking days through 5/21/2004. Detected again three days later by car, the fish had moved upstream 13.1 km in the lower Columbia River from Mill Creek to Fisher Island Marina (rkm 96.5). This fish was not detected to move during 66 subsequent tracking days through 11/30/2004.

Fish #22 was tagged 2/7/2004 and detected in Mill Creek for 12 tracking days through 3/3/2004. The following three days movement was detected in the lower Columbia River downstream to CNL-S. The fish then moved upstream into Abernathy Creek (rkm 87.9) where it was detected by car 11 tracking days through 4/2/2004. On 4/5/2004, fish #22 was detected back in the lower Columbia River three times. That day during a four hour period, the fish was detected progressing downstream from CNL-S (rkm 83.4) to Eagle Cliff (rkm 81.3) to Cooper Point (rkm 80.5). Two days later, fish #22 was detected by car at its final and most downstream position in Cathlamet Channel near the south end of Cathlamet Bridge (rkm 64.5). It was detected at this location by boat and car 89 more tracking days through 11/30/2004.

Fish detected outside of Mill Creek in the main-stem lower Columbia River and not detected again

Five fish left Mill Creek, were detected in the Columbia River for two to 10 days and not detected again. A notable exception within this group is fish #17 due to recent detections beginning in mid-December 2004. The fate of the remaining individuals within this category is uncertain. It is possible that these fish moved beyond the Astoria, OR, bridge based on patterns of movement prior to losing contact. If that is the case, the remaining individuals may follow the pattern of fish #17 and return to a location in the lower Columbia River where they can be detected.

Fish #5 was tagged 2/14/04 and detected in Mill Creek for 17 tracking days through 3/26/2004. The next day it was detected in the lower Columbia River downstream from Mill Creek at CNL-S. From 3/29/2004 to 4/12/2004, fish #5 was detected by car and boat on seven tracking days further downstream at the upper end of Cathlamet Channel (rkm 76.3-77.4). This fish was last detected by boat on 4/16/2004 at its most downstream position near navigation marker red buoy “36” in the Welch/Tenasillahe Island area (rkm 57.5).

Fish #14 was tagged 2/15/2004 and detected in Mill Creek for eight tracking days through 3/3/2004. On 3/5/2004, it was detected twice in the lower Columbia River downstream of Mill Creek. It was detected by CNL-S then again by boat, 8.5 h later and 10.5 km further downstream near green navigation marker “7” in Cathlamet Channel (rkm 72.9). This fish was not detected again through 11/30/2004.

Tagged 2/8/2004, fish #17 was detected in Mill Creek for 26 tracking days through 4/9/2004. On 4/12/2004, detection by boat occurred in the lower Columbia River downstream from Mill Creek near Eagle Cliff (rkm 81.8). Two days later, it was detected by car further downstream along the Oregon side of Puget Island near Wauna, OR (rkm 65.8). Continuing downstream, fish #17 was contacted the following two boat tracking days. On 4/16/2004, contact was near Welch Island and red navigation marker “36” (rkm 56.5). On 4/21/2004, contact occurred further downstream near the mouth of Jim Crow Creek (rkm 48.0). No further detections were made. However, making it the exception to this category, fish #17 was encountered again nearly eight months later. On 12/14/2004, it was detected back in Mill Creek at its original release location. Fish #17 has been detected by car in Mill Creek on each tracking day since then. This fish was the second most downstream fish detected among all tagged fish and was the highest recorded distance range within this category.

Tagged 2/14/2004, fish #18 was detected in Mill Creek for 18 tracking days through 4/7/2004. On 4/9/2004, it was detected by boat in the lower Columbia River across the main channel and upstream from Mill Creek in Bradbury Slough (rkm 88.5). Three days later, it was detected by boat further upstream at the upper end of Bradbury Slough near an old cannery on the Oregon shore (rkm 93.3). On 4/16/2004, fish #18 was detected by boat downstream of its previous position, but still upstream of Mill Creek, at Crims Island near red navigation marker "82" (rkm 87.7). Final contact occurred at County Line Park (rkm 83.4) downstream from Mill Creek for seven consecutive days beginning 4/17/2004 by both stationary and mobile tracking equipment.

Fish #20 was tagged 2/7/2004 and detected in Mill Creek for 27 tracking days through 4/9/2004. The next three contacts were made by boat in the lower Columbia River downstream of Mill Creek near Eagle Cliff (rkm 82.0) on 4/12/2004, 4/16/2004 and 4/21/2004. The final position for fish #20 was recorded further downstream in Cathlamet Channel near Nasa Point Motel, WA (rkm 73.4) on 4/23/2004 by car and on 4/26/2004 by boat.

Radiotelemetry Summary

The four categories of fish outlined in our results section support conventional wisdom regarding diverse coastal cutthroat trout life history forms. Two of these groups of adult coastal cutthroat trout exhibited no movement (resident) or short-term movement (migratory resident) out of Mill Creek. The other two groups of fish exhibited long-term movement from Mill Creek and either remained in the lower Columbia River (fluvial migrants) or may have migrated to the estuary beyond the Astoria, OR, bridge or the ocean (anadromous).

The directed downstream trend in movement of some fluvial migrant fish, before movement ceased and possible mortality, suggests these fish may have been migrating to the ocean as well. For example, fish #9 was moving downstream at a maximum rate of 10 km/day before its final position in the estuary (Figure 20). Overall, 11 of 13 fluvial migrant and suspected anadromous fish exhibited a trend of downstream movement including one fish (#7) that initially moved 12.8 km upriver following its exit from Mill Creek. The median rate of speed for these 11 fish was 3.2 km/day (range 0.3 to 10 km/day).

In contrast, assuming survival of the fluvial migrant fish would indicate the presence of an alternate life history strategy. The current locations of these individuals may reveal a pattern. Of eight fish, five are presently in sloughs. The sloughs range upstream to downstream from the Fisher Island Slough (rkm 96.5) to Driscoll (rkm 68.7) and Elochoman Sloughs (rkm 61.5). The remaining three fish within this group are in lower Columbia River side channels. In previous years, juvenile cutthroat utilized two of these three side channels but were not detected in lower Columbia River sloughs. Also, juveniles were not detected in tributaries other than their natal streams while three coastal cutthroat trout kelts entered Abernathy Creek and stayed 1 to 11 days.

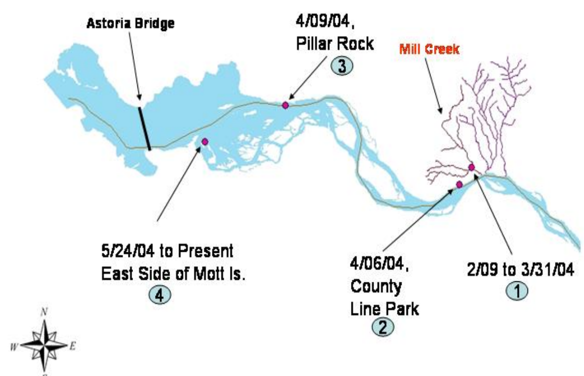

Figure 20. 2004 coastal cutthroat trout radio track individual #9.

Several suspected anadromous coastal cutthroat trout may either have been ocean bound or be in the ocean. Assuming survival in suspected anadromous individuals, and given their directed downstream movement trend, these kelts appeared to be migrating toward the estuary or ocean. For example, fish #14 was headed downstream at a rate of 7 km/day (Figure 21). Fish #17 also showed a strong trend of downstream movement at a rate of 3 km/day (Figure 22). In addition, there appeared to be a substantial number of detections placing many of these fish exhibiting large-scale downstream movements in or near the shipping channel (Figures 20, 21 and 22). However, given the duration between contacts with individuals, little is known about patterns of movement.

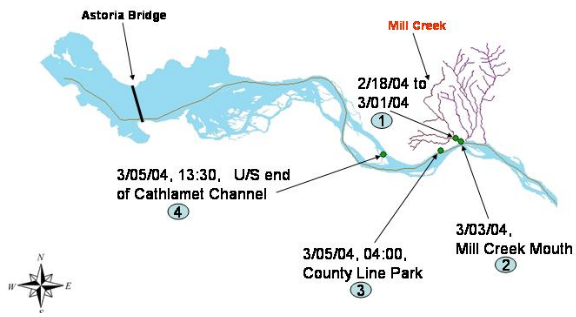

Figure 21. 2004 coastal cutthroat trout radio track individual #14.

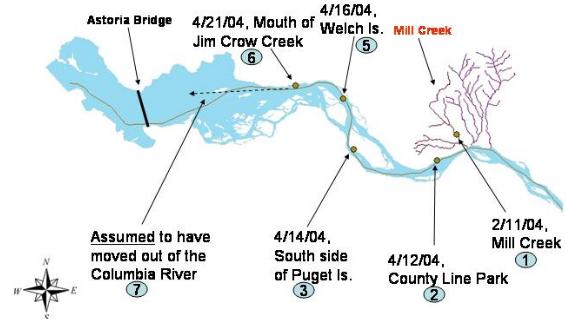

Figure 22. 2004 coastal cutthroat trout radio track individual #17.

Our 2002 data indicate that migrant coastal cutthroat trout juveniles rapidly move seaward. Median migration speeds in 2002 for coastal cutthroat trout smolts from three tributaries with radio and acoustic telemetry tags ranged from 14 to 27 km/day. Consistent with 2002 data, 2003 juvenile cutthroat radio and acoustic data demonstrated coastal cutthroat trout juveniles moved rapidly seaward and entered into the ocean subsequent to tagging. The similar downstream trend in movement among these juveniles and 2004 tagged kelts suggests similar strategies in different life stages of coastal cutthroat trout. However, the difference in rate of downstream movement between juveniles and kelts may indicate different uses of the lower Columbia River for meeting life history requirements of various life stages of this species.

In addition to the direction and rate of fish movement, timing of movement was documented. Of 17 tagged cutthroat kelts that exited Mill Creek, 16 did so between 2/9/2004 to 4/9/2004. The last exited Mill Creek on 5/21/2004. The last detected movements of all other cutthroat kelts ranged from 2/18/2004 to 4/24/2004, with the exception of seven fish. Of these, two never moved and three are presently moving. In addition, fish #21 last moved 5/21/2004 and fish #23 last moved 8/13/2004. This data will help define time frames in which migrating coastal cutthroat trout kelts may be most susceptible to environmental impacts in the main-stem Columbia River.

FUTURE DIRECTION

Information on coastal cutthroat trout populations in the lower Columbia River resulting from completion of this project will provide knowledge toward the understanding of the complex life history strategies of coastal cutthroat trout. However, there are additional questions that need to be answered to have a better understanding of how to effectively conserve and manage this sensitive fish species.

A more clear understanding of habitat utilization and movement patterns of adult coastal cutthroat trout in the lower Columbia River will be gained in 2005. Within the auspices of the current project, the approach toward radio tracking adult coastal cutthroat trout will be revised to incorporate more intensive tracking of individuals from the time they leave the tributary to the time they stop moving. The resulting higher resolution data set is expected to provide fine scale movement information of coastal cutthroat trout kelts in the lower Columbia River upstream of the Astoria, OR, bridge.

Additional information on habitat utilization and movement patterns of adult coastal cutthroat trout in the lower Columbia River estuary downstream of the Astoria, OR, bridge is needed. It is known through the experimental trawl study, implemented by Richard Ledgerwood (NMFS), that coastal cutthroat trout from Abernathy Creek are using the lower portion of the estuary. A study utilizing an acoustic telemetry approach could provide an understanding of habitat utilization and movement patterns of coastal cutthroat trout kelts in the lower portion of the river and outside the mouth of the Columbia River. This information is essential to effectively managing anadromous coastal cutthroat trout populations in the lower Columbia River basin.

Understanding the relationship among populations of coastal cutthroat trout throughout their range will also provide information toward effective conservation and management of this species. Clearly, molecular analysis of populations will provide insight on historic and current relationships and movement patterns within and among populations. However, this approach coupled with the expanded use of long-range PIT tag technology could be the ultimate management tool when little is known about interactions among populations of varying geographic proximity.

Perhaps the most important need for effective conservation and management of coastal cutthroat trout is a clear understanding of the relative health of the anadromous component of populations. Recent advances in stable isotope research and technology provide promise toward identifying anadromous individuals within a population of coastal cutthroat trout that exhibits more than one life history strategy. This approach has been taken successfully with populations of brook trout and brown trout that contain both anadromous and resident individuals (Doucett et al. 1999, McCarthy and Waldron 2000, Charles et al. 2004). This method coupled with an efficient and effective monitoring approach could not only assess the current relative health of different life history components of coastal cutthroat trout populations thoughout the range, but it could provide a means for long-term monitoring of the status of the species.

RELATIONSHIP TO OTHER WORK

This project is being conducted in cooperation with Sea Resources, WDFW, NMFS (NOAA Fisheries), the Abernathy Fish Technology Center (USFWS) and the Oregon Cooperative Fishery Research Unit, Oregon State University.

Sea Resources, directed by Robert Warren, operates smolt traps that are located downstream from the antennae arrays located on the Chinook River. Members of this non-profit organization have participated in the installation, operation and maintenance of PIT tag arrays and the tagging of fish in the Chinook drainage.

As part of a continuing study, WDFW operates smolt traps on Mill Creek and Abernathy Creek which provide opportunities for population estimates. These trapping facilities have also been used to obtain migrants for physiological testing and for telemetry subjects.

Work in the Abernathy Creek watershed has been coordinated with the behavioral physiology work group at the Abernathy Fish Technology Center, with initial support through a BPA funded project (2000-012-00). This project involved the construction of two stationary antennae systems (to monitor steelhead and coho) that are being used to monitor coastal cutthroat trout in this study without additional capital investment. Similarly, efforts have been coordinated for both electrofishing and PIT packing within this watershed.

These cooperative efforts will allow trap efficiency estimates and provide the criteria for population estimates of cutthroat trout based on previously collected trapping data. Additional information on estuarine habitat use and migration timing is being obtained through the ongoing efforts of Richard Ledgerwood of NMFS, who is experimenting with a trawl-based PIT tag interrogation system in the estuary. While a large number of captures is not expected (a single cutthroat was “captured” in 2002) even a modest number can be used to calculate minimum transport times from freshwater residence to the estuary, augmenting the radio telemetry efforts outlined in this proposal.

Acoustic and radio telemetry efforts have been closely tied to the work of Carl Schreck from Oregon Cooperative Fishery Research Unit, Oregon State University.

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