Eagle Creek Radio Telemetry Report

Title: Distribution and Migration Behavior of Juvenile Hatchery Coho Salmon and Steelhead Trout in Eagle Creek and Clackamas River in North West Oregon.

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Introduction

Eagle Creek National Fish Hatchery (NFH) spawns and raises juvenile coho salmon (*Oncorhynchus kisutch*) and juvenile steelhead trout (*Oncorhynchus mykiss*) that are released into Eagle Creek within the Clackamas River basin. The purpose of the program is to mitigate fish losses in the Columbia River Basin caused by federal dams, to provide commercial, sport, and tribal harvest, and to support tribal restoration programs upstream of Bonneville Dam. Spring volitional releases occur March through May for coho and April through May for steelhead (Eagle Creek Hatchery and Genetic Management Plan).

Eagle Creek NFH currently operates as part of the Columbia River Fisheries Development Program and is funded through the Mitchell Act - a program administered by NOAA Fisheries (NMFS). This program is a part of the mitigation for habitat loss resulting from flooding, siltation, and fluctuating water levels caused by Bonneville Dam. The Columbia River Fish Management Plan under U.S. v Oregon is currently under renegotiation, however, current production goals are generally consistent with the production goals in the expired plan. In addition, Eagle Creek NFH production is consistent with court adopted management agreements for upper Columbia River fall Chinook, steelhead, and coho that specifically identifies production from Eagle Creek NFH for tribal restoration programs (Eagle Creek HGMP).

Eagle Creek NFH produces juvenile coho salmon for release as well as for transfer to other groups and agencies, while the juvenile steelhead are released on station. Recent transfers include: eyed coho eggs to the Nez Perce Tribe (600-800 thousand), the state of Idaho (700 thousand), the state of Oregon (5 thousand), yearling coho to the Nez Perce tribe (550 thousand) for the Clearwater River, and to the CEDC (500 thousand) in April and again in May to put in net pens. The on station release of coho and steelhead is 500 thousand and 150 thousand fish per year.

Movements of coho and steelhead from the hatchery to the Willamette River have never been monitored and have been identified as an information need in the HGMP. A unique opportunity arose for the Hatchery Assessment Team in the Columbia River Fisheries Program Office to document the downstream migration of these two species. Ninety-two radio tags were available for surgical implantation and equally divided between juvenile coho and juvenile steelhead. The objective of this study is to:

> Determine migration timing of hatchery juvenile coho salmon and juvenile steelhead trout through Eagle Creek and Clackamas River, Oregon.

Methods

Two members of the Hatchery Assessment Team in the Columbia River Fisheries Program Office were trained at the Abernathy Fish Technology Center to surgically implant radio tags into the abdomens of fish. Forty-five radio tags were inserted into the juvenile coho on 13

March 2003 and forty-seven into the juvenile steelhead 14 March 2003 at Eagle Creek NFH. Lengths and weights of fish and tag weights were recorded. All fish were held 24 hours in the indoor raceways to recover from the surgical process. They were then placed in their respective ponds or raceways for the start of the volitional release.

The radio tags implanted into the fish were purchased from Lotek Wireless and were 2000 codeset with a burst cycle every seven seconds. The tags were spread over four frequencies or channels with an individual code for each.

Prior to the start of the volitional release, three sites for fixed telemetry stations were chosen (Figure 1): immediately downstream of the hatchery, the mouth of Eagle Creek, and near the mouth of the Clackamas River. Only two logging Lotek telemetry receivers were available so the hatchery and Eagle Creek mouth sites were the first to be setup. The hatchery receiver was moved to the Clackamas River site when radio tagged fish were logged as having moved past the lower Eagle Creek site. Hobo® temperature loggers were placed in the volitional release pond and near the mouth of Eagle Creek in order to monitor daily fluctuations and potentially document a connection between temperature and fish movement.

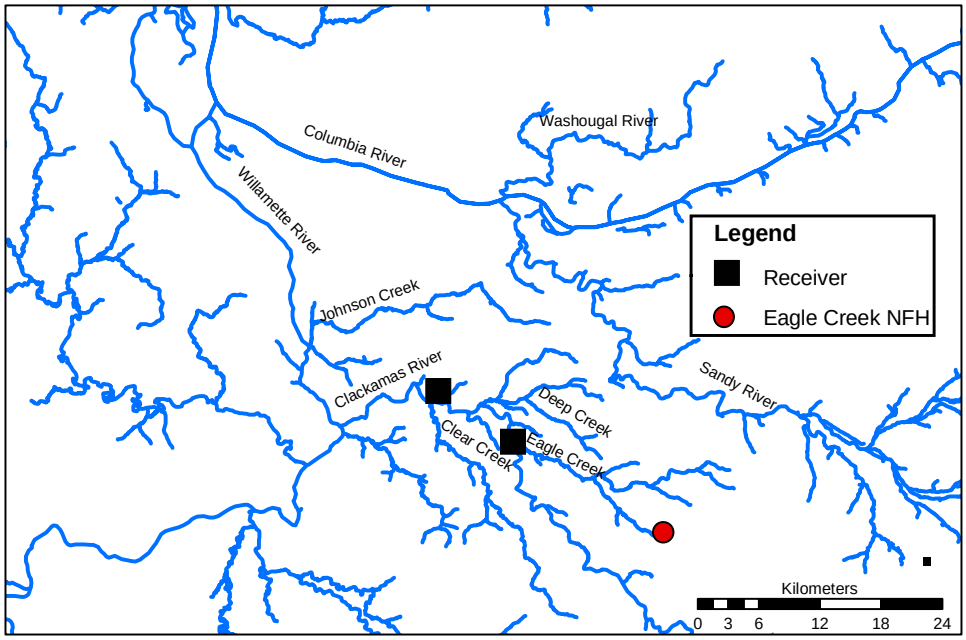

Figure 1. GIS map of telemetry area identifying receiver placement and Eagle Creek NFH.

CRFPO staff downloaded the receivers and mobile-tracked the fish two or three times per week from the end of March through the end of May to document movements downstream. The receivers were deactivated at the end of May and the fish were mobile-tracked once per week until the end of June.

Results and Discussion

Juvenile coho were generally smaller and much more uniform in size and weight than the juvenile steelhead (Figure 2 and 3). General descriptive statistics for the juvenile coho and

steelhead radio tagged are displayed in Table 1. The frequency histograms include fish that were rejected for radio tag insertion but still weighed and measured.

Table 1. Descriptive statistics for coho and steelhead radio tagged at Eagle Creek National Fish Hatchery.

Length			*Weight*		
	Coho	Steelhead		Coho	Steelhead
Mean	144.7	174.4	Mean	35.4	54.3
Standard Error	0.75	1.89	Standard Error	0.59	1.82
Median	145	175	Median	35.2	53.1
Mode	142	160	Mode	35.4	48.1
Standard Deviation	5.12	12.93	Standard Deviation	3.97	12.48
Sample Variance	26.2	167.3	Sample Variance	15.7	155.9
Kurtosis	3.16	0.28	Kurtosis	2.17	0.089
Skewness	1.09	0.41	Skewness	1.19	0.60
Range	29	57	Range	18.7	54
Minimum	135	150	Minimum	30.2	31.6
Maximum	164	207	Maximum	48.9	85.6
Sum	6657	8198	Sum	1629.1	2550.7
Count	46	47	Count	46	47
Confidence Level(95.0%)	1.52	3.80	Confidence Level(95.0%)	1.18	3.67

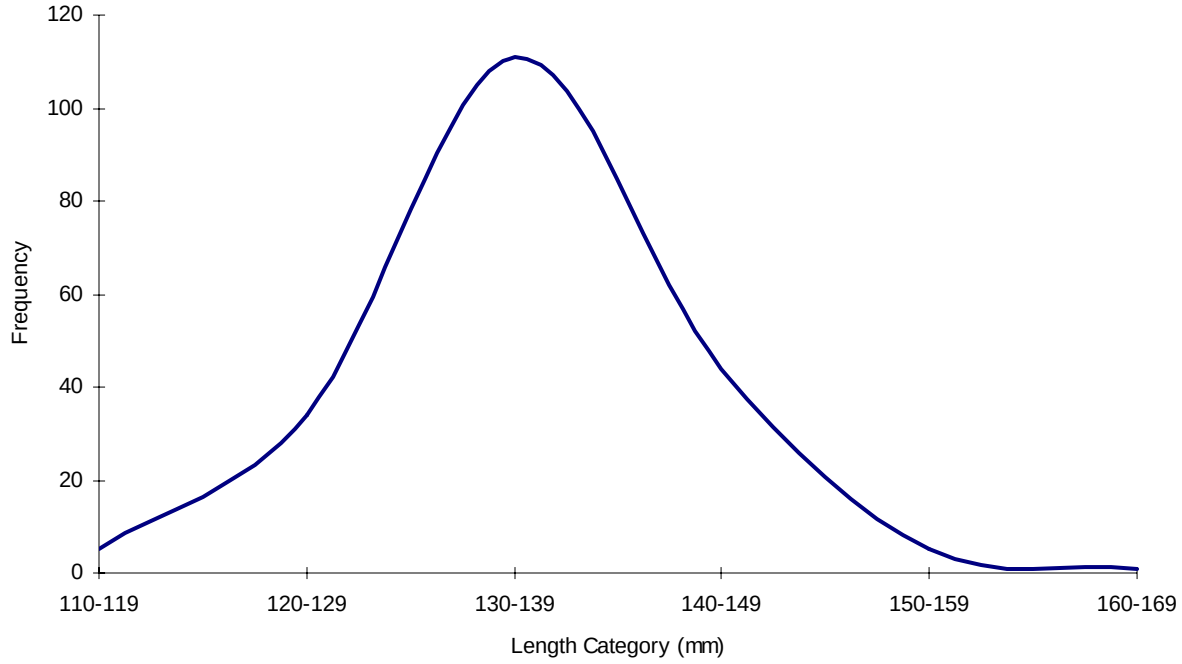

Figure 2. Frequency histogram of juvenile coho salmon released from Eagle Creek NFH, spring 2003.

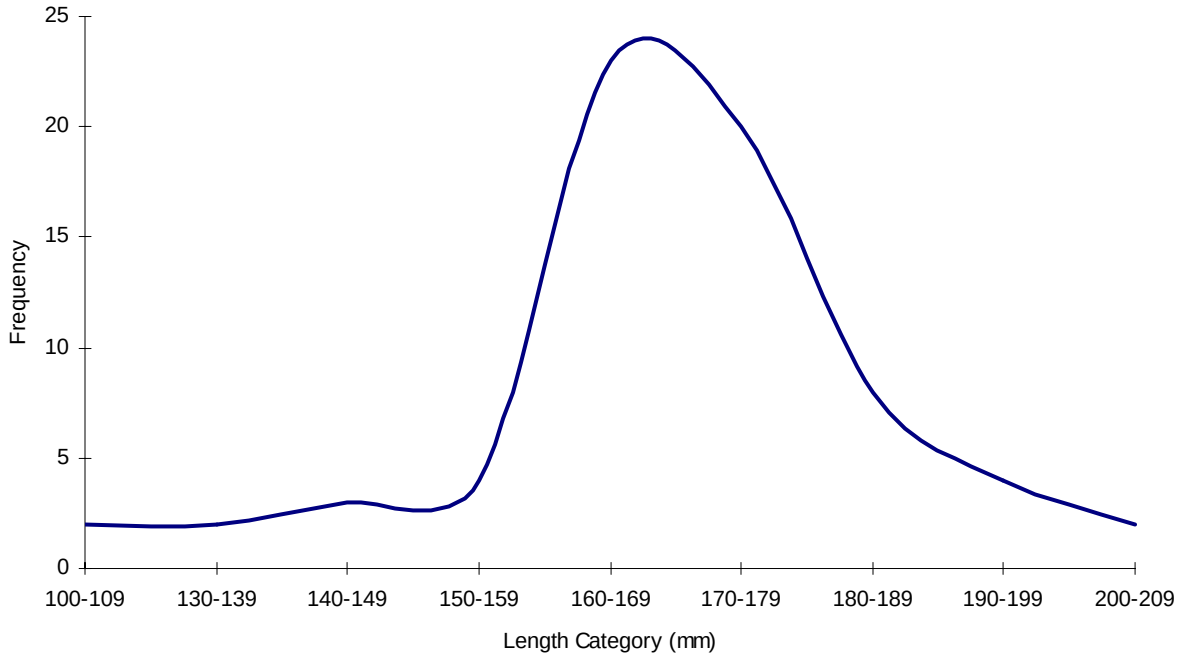

Figure 3. Frequency histogram of juvenile steelhead trout from Eagle Creek NFH, spring 2003.

One radio tagged coho died as an indirect result of surgery. The radio tag was removed and subsequently placed in an additional steelhead. Four coho shed their tags in the release pond, however all steelhead retained their tags while in the hatchery raceways.

Some coho moved out of the volitional pond immediately upon initiation of the volitional release (Table 2). Unfortunately, individual radio tagged coho at the beginning of the release were difficult to decipher due to excessive noise picked up by the receiver. Overhead powerlines, boat and car motors, and interference can cause a noise signal. Also, large numbers of tags can also interfere with each other also causing a noise signal. If there are few tags, the chance is reduced that two tags will be on the exact same burst rate. However, a large number of tags increase the chance that two or more tags are on the same cycle. If this happens, the receiver cannot decipher the tag code and displays a noise value. A 255 value in the code column of the download file indicates the receiver picked up something, but it could not tell what it was. Typically, these 255 noise codes are deleted, but we know that fish passed the hatchery receiver because they were subsequently detected at the Eagle Creek receiver. Other quirks of the telemetry software are that a tag closer to the receiver may drown out a tag farther away and one that is very close to the receiver may actually be picked up on a different frequency. A detailed summary of radio tracking information is included at the end of the document (Appendix A).

Table 2. Summary of coho and steelhead radio tag information.

	Number Tagged	Retained Tags	Detected at Eagle Cr.	Detected at Clackamas R.	Mobile Tracked*	Number not Detected	Percentage**
Coho	45	41	22	24	8	10	**22.2%**
Steelhead	47	47	16	16	16	15	**31.9%**
	92	**95.7%**	**41.3%**	**43.5%**	**26.1%**	**27.2%**	

* Indicates fish detected with the mobile tracker but not logged on either receiver.

**Percentage of each species not detected. Total not detected is below previous column.

The noise signal created a problem in that 26.1% of the fish were mobile-tracked, but not picked up on either receiver. This includes fish that were tracked in Eagle Creek above the receiver, but also includes fish (2 coho, 2 steelhead) tracked in the Willamette River. Another problem is that more fish were detected at the Clackamas River site than the Eagle Creek mouth site (Table 2). There were 11 fish (1 coho, 10 steelhead) that were still in the immediate vicinity of the hatchery and 4 more (1 coho, 3 steelhead) that were still in Eagle Creek at the end of June when radio tracking ended. In other words, a total of two coho and 13 steelhead did not leave the system by the end of June. There was no difference in length, weight, or radio tag weight between the fish that stayed, left the system, or were never tracked for both steelhead and coho.

Typically, juvenile coho leave Eagle Creek NFH more quickly than the juvenile steelhead (pers. comm., Douglas Dysart). Radio telemetry data also indicated that the coho traveled much more quickly through Eagle Creek and the Clackamas River than the steelhead (Table 3). The mean length of time it took radio tagged coho to pass from the Eagle Creek receiver to the Clackamas receiver was 14.2 hours (n=21 fish), while the tagged steelhead mean 40.1 hours (n=8 fish).

Table 3. Descriptive statistics for juvenile coho salmon and juvenile steelhead migration timing from Eagle Creek NFH, spring 2003.

Hours between Receivers		
	Coho Salmon	**Steelhead Trout**
Mean Length of Time (hours)	14.2	40.1
Standard Error of the mean	3.93	17.81
Median	4	20.75
Mode	2	
Standard Deviation	17.99	50.38
Sample Variance	323.59	2538.32
Kurtosis	3.38	-0.06
Skewness	1.86	1.36
Range	66	120.5
Minimum	2	4.5
Maximum	68	125
Sum	299	320.5
Count	21	8
Confidence Level(95.0%)	8.19	42.12

The mean number of hours between receivers was significantly different for coho and steelhead ($p<0.05$, Table 4). Fewer steelhead (n=8) passed both receivers than coho (n=21). It was not unexpected that steelhead were tracked above the Eagle Creek receiver and had not moved downstream by the end of the project. Hatchery steelhead will sometimes stay in a stream before migrating and may even residualize. However, the potential number of steelhead residualizing was surprising with 13 still detected in Eagle Creek at the end of June. Conversely, it was unusual for coho to still be in Eagle Creek at the end of June. Either these two fish just delayed migration for brief period or the tags were possibly shed.

Table 4. Comparison of migration timing between juvenile coho salmon and juvenile steelhead released from Eagle Creek NFH, spring 2003.

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3863.420	1	3863.420	4.303	**0.048**	4.210
Within Groups	24240.028	27	897.779			
Total	28103.448	28				

Temperature loggers were placed in the volitional release pond and at the mouth of Eagle Creek to provide a profile of daily minimum and maximum temperatures (Figures 4 and 5). The volitional release ended 5 May and fish were pushed out of the release pond and raceways. At this point, the hatchery temperature logger was pulled, but the Eagle Creek logger remained until the end of May. The temperature profile in Eagle Creek was less variable than in the volitional release pond. Maximum temperatures were 10.6 ºC in the coho pond and 20.4 ºC in Eagle Creek.

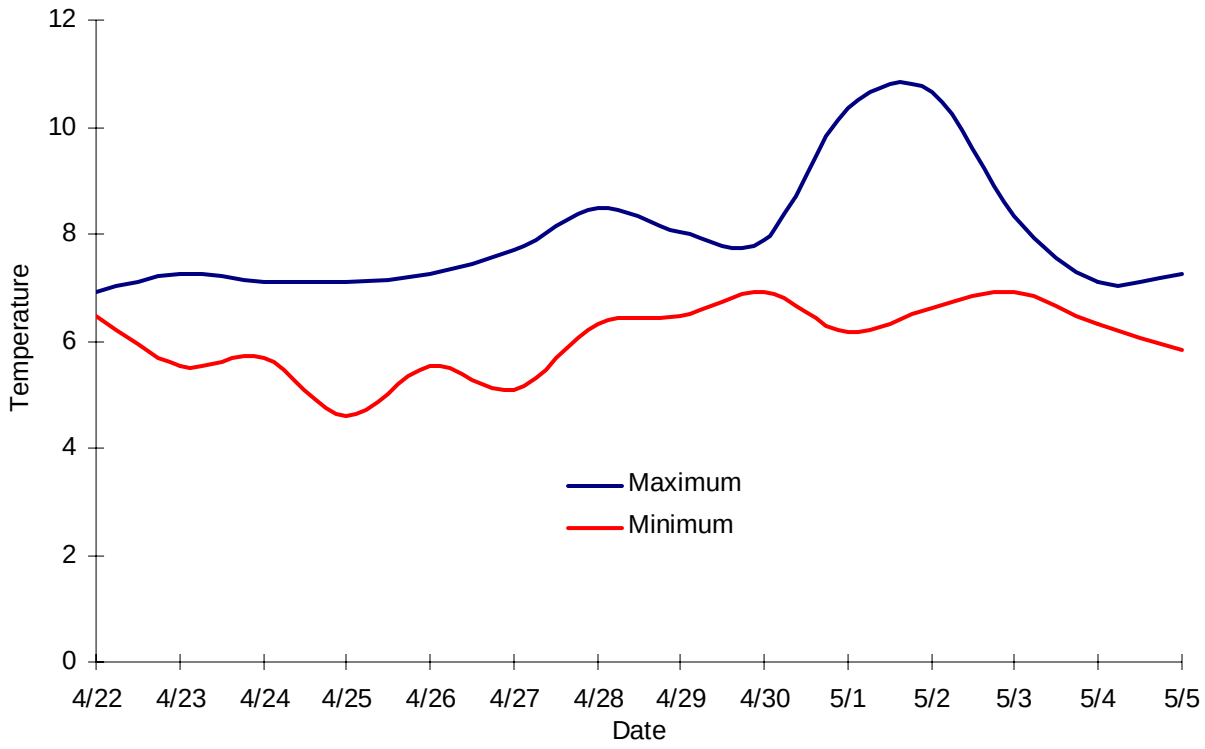

Figure 4. Daily temperature profile in the volitional release pond at Eagle Creek NFH, spring 2003.

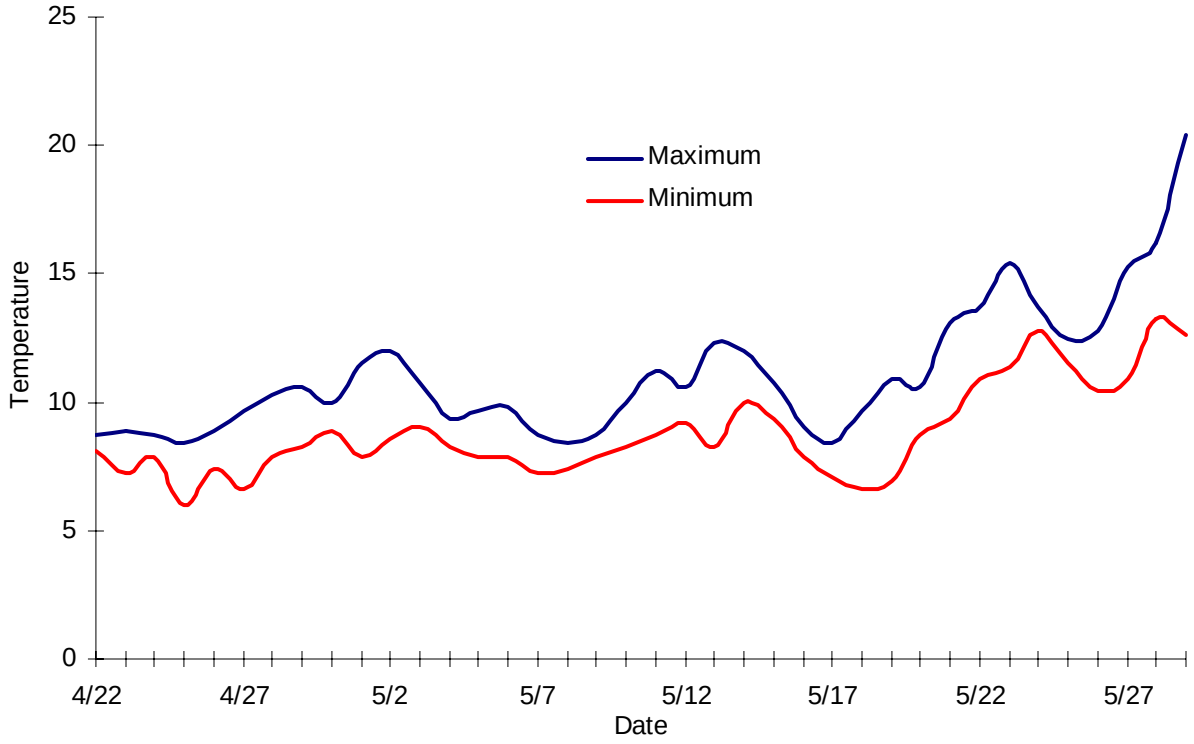

Figure 5. Daily temperature profile of Eagle Creek, April-May 2003.

Future Considerations

One important piece of information that was not collected this spring was the timing from the hatchery to the mouth of the Clackamas River. The data collected this year indicates timing from the mouth of Eagle Creek to the mouth of the Clackamas River, but residence time within Eagle Creek can give more of an indication of potential interactions with resident and naturally producing anadromous salmonids (resident rainbow trout, wild steelhead, coastal cutthroat trout, and mountain whitefish). Data this year indicates hatchery juvenile steelhead spend at least part of the summer residing in Eagle Creek. Documentation of preferred habitat characteristics of

hatchery juvenile steelhead would be beneficial in determining hatchery and wild fish interactions.

A similar study in 2004 with some modifications will provide important information as to the behavior of juvenile coho salmon and juvenile steelhead within Eagle Creek. Not nearly as many fish need to be radio tagged in 2004 as were in 2003. A maximum of 20 to 25 coho and/or steelhead would be sufficient. A receiver will be placed at the hatchery to give precise times that fish are leaving. A second receiver near the mouth of Eagle Creek or the Clackamas River will provide information on timing in Eagle Creek. Once fish seem to have picked a spot to reside (they are logged in the same place for one week), snorkelers will observe the fish and document microhabitat parameters and habits. Observations will also be made of any wild fish in the area.

Acknowledgements

We would like to thank Doug Dysart and Steve Turner from Eagle Creek National Fish Hatchery for allowing us to tag some of their hatchery fish. We would also like to thank Eric and Nancy Thompson and Chris and Kelly Brown for allowing us to install radio telemetry antennas, receivers, and water temperature monitoring equipment on their property. This project would have been extremely difficult without their consideration.

Details of coho movements in Eagle Creek and Clackamas River.

	Eagle Creek		Clackamas River		
	Date fish logged		Date fish logged		
Channel-Code	Julian	Calender	Julian	Calender	Comment
3-1					Last tracked 5/19/03 upstream of Meldrum Bar
3-2	37727	04/17/2003			
3-3	37730	04/20/2003	37730	04/20/2003	6:07 at Eagle creek; 22:40 at Clackamas
3-4	37722	04/12/2003			
3-5	37740	04/30/2003	37741	05/01/2003	
3-6					
3-8					
3-9					Last tracked 6/9/03 at Meldrum Bar
3-10	37732	04/22/2003	37734	04/24/2003	Last tracked 5/19/03 upstream of Meldrum Bar
3-11	37741	05/01/2003	37741	05/01/2003	1:06 at Eagle Creek; 21:33 at Clackamas
3-12	37734	04/24/2003	37735	04/25/2003	
3-13	37738	04/28/2003	37739	04/29/2003	
3-14	37732	04/22/2003	37732	04/22/2003	21:34 at Eagle Creek; 23:43 at Clackamas
3-15	37734	04/24/2003	37735	04/25/2003	
3-16					Last tracked 6/27/03 at Eagle Fern Park
3-17					fish died; inserted tag into steelhead
3-18					
3-19	37736	04/26/2003	37736	04/26/2003	00:11 at Eagle Creek; 2:18 at Clackamas
3-22	37737	04/17/2003	37737	04/27/2003	21:24 at Eagle Creek; 23:30 at Clackamas
3-23					
3-24	37740	04/30/2003	37741	05/01/2003	
3-25	37740	04/30/2003	37741	05/01/2003	
4-1					Last tracked 6/27/03 at Meldrum Bar
4-2					Last tracked 6/20/03 at hatchery bridge
4-3					**shed tag**
4-4					
4-6	37735	04/25/2003	37735	04/25/2003	Last tracked 6/27/03 at Meldrum Bar
4-7					
4-8					Last tracked 5/12/03 downstream of PGE ladder
4-9	37740	04/30/2003	37740	04/30/2003	00:20 at Eagle Creek; 6:59 at Clackamas
4-10					
4-11	37741	05/01/2003	37742	05/02/2003	
4-12					**shed tag**
4-13	37741	05/01/2003	37741	05/01/2003	1:31 at Eagle Creek; 22:37 at Clackamas
4-14	37737	04/27/2003	37738	04/28/2003	
4-16					
4-17	37734	04/24/2003	37735	04/25/2003	
4-18					
4-19					**shed tag**
4-20					
4-21					**shed tag**
4-22	37741	05/01/2003	37743	05/03/2003	
4-23					Last tracked 5/19/03 at SE Eagle Creek Road bridge
4-24	37736	04/26/2003	37736	04/26/2003	3:32 at Eagle Creek; 5:32 at Clackamas
4-25	37740	04/30/2003			
5-1	37737	04/27/2003	37739	04/29/2003	

Details of steelhead movements in Eagle Creek and Clackamas River.

	Eagle Creek		*Clackamas River*		
	Date fish logged		Date fish logged		
Channel-Code	Julian	Calender	Julian	Calender	Comment
3-17					
5-2					Last tracked 6/9/03 at hatchery bridge
5-3	37731	4/21/03	37731	4/21/03	1:58 at Eagle Creek;22:29 at Clackamas
5-4	37746	5/6/03	37750	5/10/03	
5-6					
5-7					
5-8					Last tracked 6/9/03 at hatchery bridge
5-9					Last tracked 5/29/03 at Meldrum Bar
5-10					Last tracked 5/29/03 at Meldrum Bar
5-11					
5-12	37741	5/1/03			
5-13	37737	4/27/03			Last tracked 6/27/03 upstream of Meldrum Bar
5-16					Last tracked 6/9/03 just downstream of hatchery
5-17					
5-18			37760	5/20/03	Last tracked 5/12/03 downstream of PGE ladder
5-19					Last tracked 6/9/03 at hatchery
5-20	37744	5/4/03			Last tracked 6/27/03 at Meldrum Bar
5-21					
5-22					
5-23					
5-24					Last tracked 5/8/03 at Eagle Fern park
5-25					
6-1	37725	4/15/03			
6-2	37758	5/18/03	37759	5/19/03	Last tracked 5/12/03 at Eagle Fern Camp
6-3	37741	5/1/03			
6-4					Last tracked 6/9/03 at hatchery bridge
6-5					Last tracked 5/5/03 at Eagle Fern Park
6-6					
6-7					Last tracked 6/9/03 at Hatchery
6-8					Last tracked 6/20/03 at Hatchery
6-9					
6-10					
6-11	37749	5/9/03	37750	5/10/03	
6-12					
6-13	37744	5/4/03	37745	5/5/03	
6-14					Last tracked 6/20/03 at hatchery bridge
6-15					Last tracked 5/8/03 upstream of PGE ladder
6-16					Last tracked 6/20/03 at hatchery
6-17					
6-18	37731	4/21/03	37736	4/26/03	
6-19	37747	5/7/03			Last tracked at Barton Bridge
6-20					Last tracked 6/20/03 at hatchery bridge
6-21					
6-22	37713	4/3/03	37714	4/4/03	
6-23	37727	4/17/03	37728	4/18/03	
6-24	37756	5/16/03			
6-25					Last tracked 5/19/03 at Eagle Fern Park pedestrian bridge