Annual Report

Fish Passage Operations

at the Landsburg Dam Fish Passage Facilities

on the Cedar River from

July 2004 through June 2005

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Summary
This report summarizes the second season of fish passage operations from 7/1/04 through 6/30/05 at the Landsburg Dam fish ladder and sorting facility on the Cedar River. Seattle Public Utilities (SPU) operated the ladder and sorting facility in sorting mode from 9/7/04 through 2/13/05 to prevent sockeye from passing above the Landsburg Dam and to aid in the collection of coho for recolonization studies. It was operated in passive mode from 2/14/05 through 6/30/05, providing unhindered passage above the dam for all native fish species. While in sorting mode a total of 907 adult sockeye entered the sorting facility, of which 338 were transported to the lower Cedar River and 524 were transported to the Cedar River Sockeye Hatchery for use as broodstock. In addition, 51 adult Chinook salmon were passed above the dam from 9/17/04 to 11/16/04 and 99 adult coho were passed above the dam from 10/11/04 to 2/3/05. The sorting facility did experience some fish mortality, losing 2 coho and 45 sockeye with a majority of the losses attributed to jumping behavior.

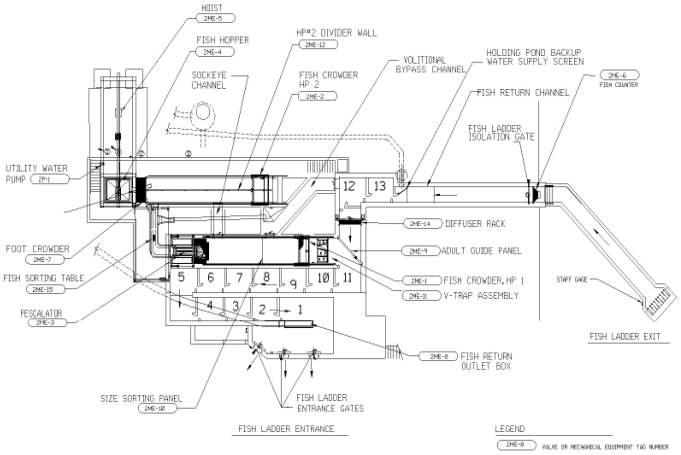
Forward
The construction of the fish ladder and sorting facility was completed as part of the comprehensive Cedar River Watershed Habitat Conservation Plan (HCP). The HCP was approved in the spring of 2000 and includes an extensive array of protective land management practices, instream flow management prescriptions, mitigation measures for the fish migration barrier at the Landsburg Diversion Dam and other habitat protection and restoration measures. The primary purpose of the HCP is to provide certainty for maintaining a safe and high quality drinking water source for the Seattle metropolitan area while protecting and restoring 83 species of fish and wildlife species and the habitats upon which they depend in the Cedar River basin. As part of the HCP, SPU constructed a fish ladder and sorting facility to provide passage above the dam for all native fish species in the Cedar River with the exception of sockeye salmon. Sockeye which spawn in the Cedar River in much greater numbers than other fish species are not passed above the dam because large numbers of decaying carcasses could pose a risk to drinking water quality and public health. The fish passage project successfully reopened more than 12.5 miles of mainstem and approximately 4.5 miles of tributary spawning and rearing habitat for the first time in more than 100 years.

Introduction
This 2005 annual report focuses on the operation of the Landsburg Dam fish ladder and sorting facility from 7/1/04 through 6/30/05; for detailed information on the other elements of fish passage at Landsburg such as the fish screens at municipal water intake, the downstream passage gate, and fish passage over the Lake Youngs aqueduct crossing, please refer to the Landsburg Fish Passage Facilities Operation and Maintenance Manual (MWH 2004) or visit the SPU website.

Fish Ladder Components
The fish ladder and sorting facility are composed of four main components the (1) lower ladder, (2) sorting and holding, (3) fish transport, and (4) upper ladder. The lower ladder includes three downward opening fish entrance gates, a series of 11 vertical slot steps in a channel that raises the water elevation in one-foot increments, and an adult guide panel gate. In general, the sorting and holding facility contain two holding ponds with mechanical crowders, a pescalator (fish lift), a sorting table, and a volitional bypass channel with a fish trap. Holding pond one is divided in half with a size sorting panel to allow smaller fish into the upper half of the pond and keep larger fish in the lower half. Holding pond two contains a mechanical crowder and a wall that divides the pond lengthwise. The fish transport component contains a foot crowder, fish hopper, a 5-ton

hoist, and parking area for the fish transport truck. The upper ladder contains 3 vertical slot steps, a fish counter, and the fish ladder exit. Figure 1 shows the schematic drawing of the fish ladder and sorting facility as well as a photograph of the sorting facility.

Figure 1: Layout of Landsburg Dam Fish Ladder and Sorting Facility



Methods and Procedures

Sorting Mode

The fish ladder and sorting facility were designed to operate in either sorting mode or passive mode. Sorting mode is used when sockeye are present at the ladder, typically from early September through December. In this mode, sockeye are sorted from Chinook or coho using a mechanical crowder in holding pond one. The crowder slowly moves fish towards a size sorting panel which passes smaller fish (mostly sockeye) into the upper half of pond one and retains Chinook and coho in the lower half. Fish retained in the lower half of holding pond one can be directed into a bypass channel. The mechanical crowder can then be used to move sockeye in the upper part of pond one to a pescalator that deposits fish on to the sorting table. The sorting table provides a work station to sort male and female sockeye into separate halves of holding pond two and move small Chinook or coho into totes or down a pipe to the bypass channel. To prepare sockeye for transport a mechanical crowder in holding pond two crowds sockeye into a hopper which can be raised with a 5-ton hoist and placed on a water filled tank on the fish truck. The hopper is designed to provide a water-to-water transfer of sockeye from the hopper to the fish truck.

Passive Mode

When the fish ladder is operated in passive mode all fish are allowed to bypass the sorting facility and move unhindered through the upper ladder and into river above the dam. The ladder was designed to be operated in this mode from late December through August (the period when sockeye are generally absent). In this mode, an electronic fish counting system in the upper ladder is designed to count and estimate the length of fish migrating upriver through the ladder. The system was installed to aid in the understanding of: run timing, the rate of passage upriver and the rate of recolonization of stream and river habitat in the watershed. The system uses a scanner unit to count fish and calculate the fish length, and an underwater camera to take up to five photographs of each fish migrating upriver. A software package allows the photographic images to be displayed alongside each unique set of fish count data (i.e., date and time of upstream passage, fish depth, fish length, swimming direction, and water temperature).

Results and Discussion

Sorting Mode

This was the first year SPU created a special assignment for Drainage and Wastewater Collection Workers to work at fish passage facility. This opportunity was developed to encourage cross training within SPU and to allow the fish passage project to recruit staff that would return to the project on an annual basis, limiting the training of new recruits and developing a technically experienced staff. From 8/26/04 through 9/6/04 the new fish passage crew received preseason training in fish identification and handling and the use of the facility's equipment. The ladder was moved into sorting mode on 9/7/04 and from that point forward the complex was staffed 7 days per week with hours of operation ranging from 7:00 AM to 5:00 PM. Fish were sorted approximately twice per day to minimize delay of upstream migrating Chinook and coho. In late December the staffing level was reduced to the fish passage operations project manager and one employee from Drainage and Wastewater. The sorting operation continued into February to get a better understanding of daily movement of coho within the ladder and to assist recolonization studies looking at coho movement and distribution within the watershed. Stream flows in the Cedar River (USGS gage 12117600 below Landsburg) during sorting mode ranged from 94 ft^3/s to 1,790 ft^3/s and the fish ladder operated as intended under these flow conditions (Fig. 2). Ambient water temperature at Landsburg ranged from 4.7 to 13.1 °C during this period (Fig 2).

Sockeye

From 9/12/04 to 12/27/04 907 sockeye entered the facility and 256 females and 620 males were collected. The daily peak of the sockeye migration at Landsburg occurred on 11/17/04 with 73 fish entering the facility (Table A2). Fish that entered the sorting facility were released back into in the Cedar River or they were moved to Cedar River Sockeye Hatchery for use as broodstock. As shown in Table 1, the facility lost roughly 5% of the sockeye that entered the facility with most mortalities attributed to fish jumping out of the holding ponds and some of the post-sort mortalities attributed to holding over ripe fish.

Table 1: Count of sockeye sorted, transported and mortality at the Landsburg Fish Passage Facility in 2004

	Entered Facility	Presort Mortality	Number Sorted	Post-sort Mortality	Transported to Hatchery	Transported to River	Total Mortality	Total Transported
Female	265	9	256	2	171	83	11	254
Male	642	22	620	12	353	255	34	608
Total	**907**	**31**	**876**	**14**	**524**	**338**	**45**	**862**

In 2004, WDFW again requested broodstock from Landsburg to spawn with fish held at the hatchery. This request was brought before the Anadromous Fish Committee (AFC) and members recommended up to 1,000 sockeye or 20% of the broodstock for the hatchery could be collected from Landsburg. The fish passage operation provided 171 female and 353 male sockeye to the hatchery.

Chinook

2004 marked the second year of a multi-year collaborative study to investigate and monitor the effects of recolonization by Chinook and coho on the Cedar River above the Landsburg Dam. Lead researchers included Peter Kiffney (NOAA), George Pess (NOAA), Joe Anderson and Tom Quinn (UW). To support the study fish passage staff collected biological data from all adult Chinook passed above Landsburg and collect tissue samples for future parentage DNA analysis. To collect biological samples Chinook were captured in a fish trap located in the volitional

bypass channel of the fish ladder. Fish were enumerated by species, sex, and the presence or absence of adipose fin; measured for length, and fin clipped on the dorsal fin to mark the fish and provide a tissue sample for future DNA analysis. A small portion of each fin clip was preserved in 100% ethanol for future genetic analysis (Table A1). The fin clips were triangle shaped and approximately 15 mm wide at the base. Each fish was examined at capture to determine if it had already been fin clipped and was recycling through the ladder. In 2004, 1 male and 1 female Chinook (adipose fin present) were found to have recycled through the ladder

Chinook salmon were passed upstream of the Landsburg Dam between 9/17/04 and 11/16/04. Table 2 shows that of the 51 adult Chinook were passed upstream a majority of the fish had adipose fins indicating that they were not of hatchery origin. This was a shift from last years Chinook count in which majority of the fish were adipose clipped. There were no Chinook mortalities in the ladder in 2004.

Table 2: Summary of Chinook passed above the Landsburg Dam on the Cedar River, 2004

	Fish Passed Upstream		
	Adipose Absent	Adipose Present	**Total**
Female	7	15	**22**
Male	10	19	**29**
Total	**17**	**34**	**51**

Coho

To support the recolonization study mentioned above, fish passage staff also collected biological data from all adult coho passed above Landsburg (same methods as with Chinook), implanted transmitters in these fish to track their movements and distribution, and collected tissue samples for future parentage DNA analysis.

Fish passage staff implanted 4 female and 45 male coho with radio transmitters for tracking with telemetry equipment. All of the fish in this study had their adipose fin and were assumed to be of natural origin fish. The implants were done with an esophageal insertion tube and the transmitters were placed in the stomach cavity. The implants were done after fish were anesthetized in a water bath containing MS222. Fish were allowed to recover for up to one hour before being released in the upper ladder. The first coho was implanted on 10/11/04 following the installation of radio tracking equipment above Landsburg. The sampling goal was to implant transmitters in as many coho as possible however Landsburg staff did have the discretion to not implant small coho.

The project encountered problems in the initial phases of tagging despite using the same methods as the previous year. Two females tagged on 10/16/04 and 10/18/04 died before exiting the fish ladder facility. These fish were discovered near the adult guide panel gate in the upper ladder. A mortality switch in one of the tagged fish allowed staff and researchers to determine the fish expired 11 hours after tagging. In addition, the first tagged female (10/11/04) remained in the large diversion pool above Dam until 10/21/04, moved to Rock Creek, and then returned to die in the diversion pool on 10/26/04, without spawning. Due to these circumstances fish passage staff and researchers stopped tagging fish and initiated discussions with outside researchers experienced in radio telemetry (E. Conner, Seattle City Light; M. Moser, NOAA Fisheries; and C. Peery, University of Idaho) and conducted an on site review with biologists experienced with

this type of tagging (P. Hahn, WDFW and E. Warner, Muckleshoot Tribe). The review process led to some the procedural changes in the tagging operation. Most notable, fish were no longer anesthetized which reduced their handling stress, only 1 in 3 females were tagged, and tagged fish were released by hand above the dam at the fish ladder exit. Unfortunately, about 10 days after initiating the new procedures another tagged female with pre-spawning mortality was discovered. From that point on only male coho were tagged. Male coho did not appear to have any pre-spawning mortalities and were successfully tracked throughout the upper Cedar River.

Table 3 shows that a total of 99 coho were passed upstream and that all but two of the fish had adipose fins, indicating that they were almost all of natural origin. The facility had 2 female coho mortalities that were probable the result of tagging. These two females were not counted in the fish passage total because they died in the ladder. In 2004, one female coho (adipose fin present) was found to have recycled through the ladder.

Table 3: Summary of Coho passed above the Landsburg Dam on the Cedar River, 2004

	Fish Passed Upstream		
	Adipose Absent	Adipose Present	**Total**
Female	32	2	**34**
Male	65	0	**65**
Total	**97**	**2**	**99**

* Two female coho mortalities are not included in the total.

Passive Mode

On 2/20/05 the fish passage operation shifted to passive mode providing fish unhindered passage above the Landsburg Dam. In passive mode, the Water Treatment Operators at Landsburg conducted routine inspections of the ladder facility to ensure there were no issues with debris, the water supply, or the fish counter/camera system. While in passive mode the fish counter/camera system installed in the upper ladder enumerated fish migrating upriver. The system was installed to aid in the understanding of run timing, the rate of passage upriver and the rate of recolonization of stream and river habitat in the watershed. The system is designed to count fish, calculate fish lengths, and take five photographs of each fish. A software package can be used to be display the photos alongside other data recorded by the system (i.e., date and time, fish depth, fish length, swimming direction, and water temperature). In some cases the imaging capabilities helped determine the species, sex, and if the fish had a clipped adipose fin. Stream flows in the Cedar River (USGS gage 12117600 below Landsburg) during passive mode ranged from 230 ft^3/s to 448 ft^3/s and the fish ladder operated as intended under these flow conditions (Fig. 3). Ambient water temperature at Landsburg ranged from 5.8 to 12.6 °C during this period (Fig 3).

Trout

A total of 185 trout were enumerated with the fish counter/camera in passive mode. The largest number of these fish migrated above Landsburg from mid April through the end of May (Fig. 3) with peak daily migration ranging from 4:00 PM to 8:00 PM (Fig. 4). Figure 5 shows the size distribution (estimated length) of trout moving above Landsburg with fairly large numbers of 20 cm to 34 cm trout moving upstream in the winter and one presumptive steelhead in the 75-79 cm range. In 2004, the fish counter/camera system was not functional from 3/3/05 – 4/2/05 and was out of the water for forebay cleaning 5/13/05 – 5/20/05. The vendor determined the problem was associated with the power supply cord and transformer, which was subsequently replaced.

Fish Passage Facility Improvements Completed in 2004

Throughout the fall and winter of 2004, the fish passage staff made changes to the facility that improved worker safety, job efficiency, and fish handling.

- An anti-fatigue and anti-slip mat was installed around the sorting table.
- Aluminum lids were installed on the top of the hopper to serve as jump protection and eliminate a fall hazard when the hopper is in the down position in the hopper bay.
- The 5-ton hoist control pendent was replaced with a Remtron remote receiver/transmitter system. This allowed staff increased mobility during loading.
- Switches were installed on overhead lights to eliminate the need to access an electrical panel to turn the lights on or off.
- An on/off switch was installed for the radiant heater to eliminate need to access an electrical panel.
- Speed bumps were installed on the truck platform to better align the fish truck for loading.
- Aluminum jump protection was installed over the drain at end of holding pond two.
- Lightweight removable floating covers were used with modest success for jump protection.
- The fish ladder access along the dam was gated and locked.
- Fish jump protection on adult guide panel was be improved providing making it easier to install and maintain.
- The facility staff will updated the SOP.

Conclusions

For the 2004 season (7/1/04 – 6/30/05), the fish ladder and sorting facility operated as intended and provided SPU and researchers with a unique opportunity to tag, enumerate, and collect biological data on Chinook and coho salmon, and trout passed above the Landsburg. The fish passage operation also aided WDFW in the broodstock collection efforts by providing male and female sockeye from the fish sorting facility. Fish mortality for all species at the fish ladder and sorting facility was reduced from the previous year, with sockeye mortalities at 5%, coho mortalities at 2%, and no chinook mortalities. The second year of operations was considered very successful in terms of fish movement into and through the ladder.

Recommendations

In future years the fish ladder and sorting facility should continue to focus on:

- Providing a safe, efficient, and timely passage for all native fish species (with the exception of sockeye) over the Landsburg Dam
- Providing a safe, efficient, and timely trap and haul operation for sockeye
- Handling fish with great care and limit the use of nets when handling fish
- Monitoring, evaluating, and maintaining the facility to reduce or limit fish mortality
- Collect relevant data from upstream migrating adult salmon to help monitor various qualitative and quantitative aspects of salmon recolonization upstream of the Landsburg.
- Providing a safe working environment for staff

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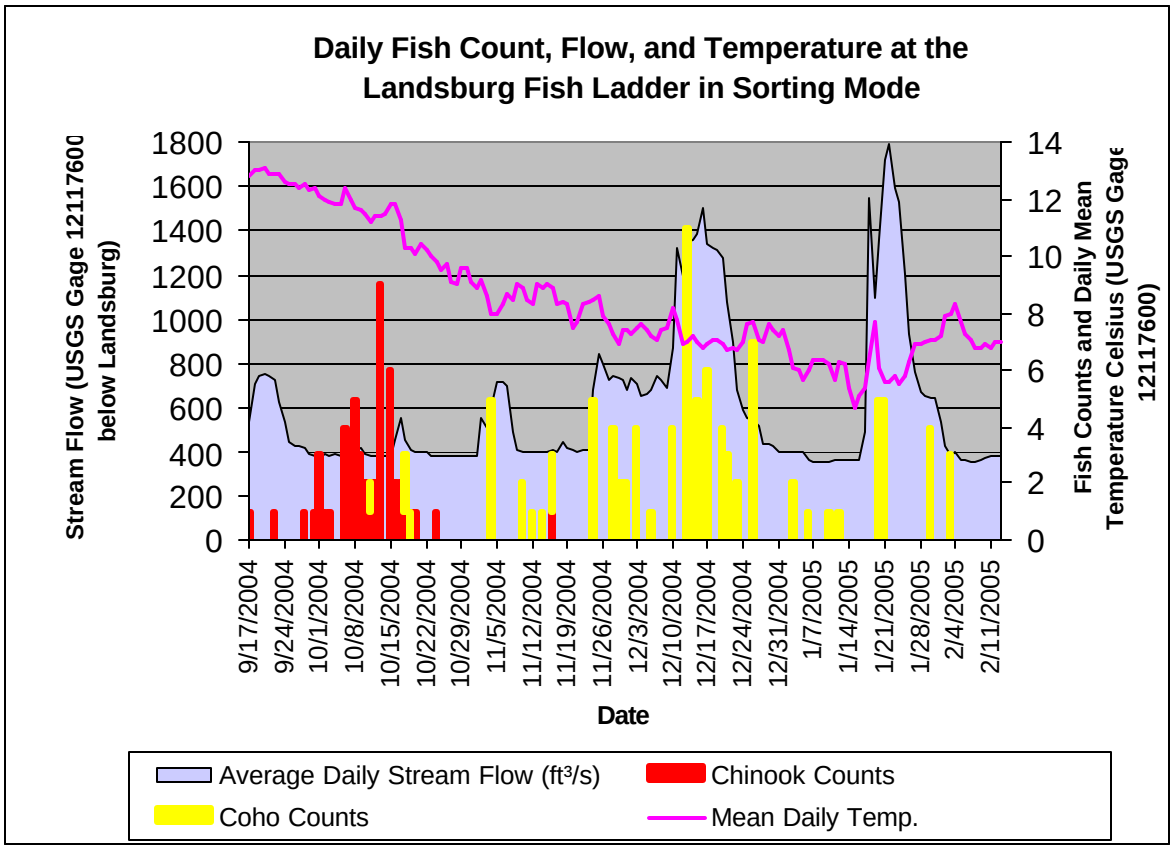

Figure 2: Daily fish count, stream flow, and temperature by week while in sorting mode at the Landsburg Fish Ladder , 2004/2005

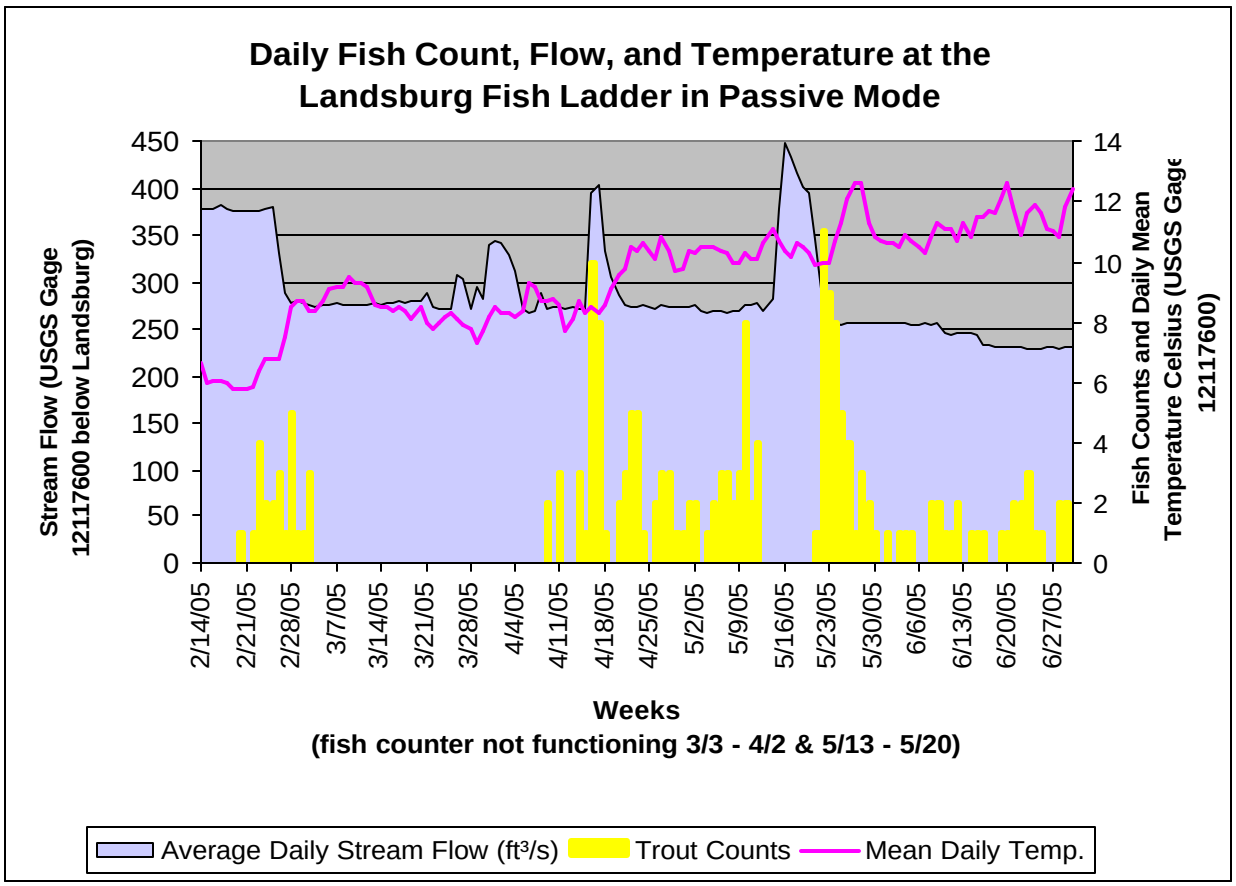

Figure 3: Daily fish count, stream flow, and temperature by week while in passive mode at the Landsburg Fish Ladder , 2005

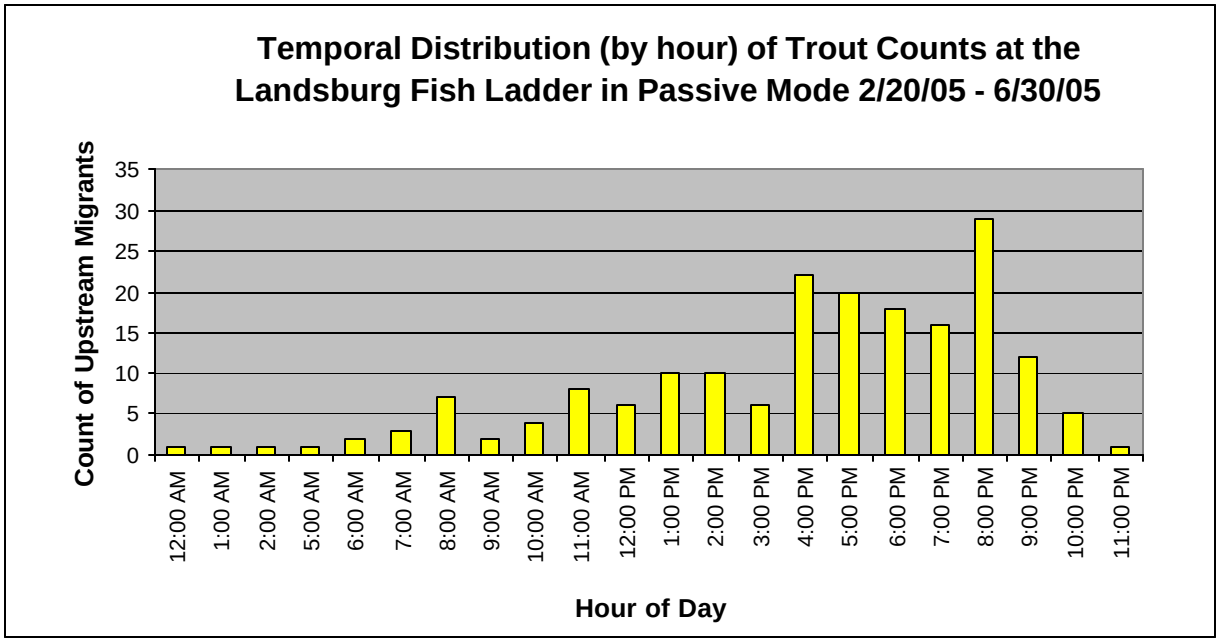

Figure 4: Temporal Distribution (by hour) of Upstream Migrants passed above the Cedar River Landsburg Dam (2/20/2005 – 6/30/2005)

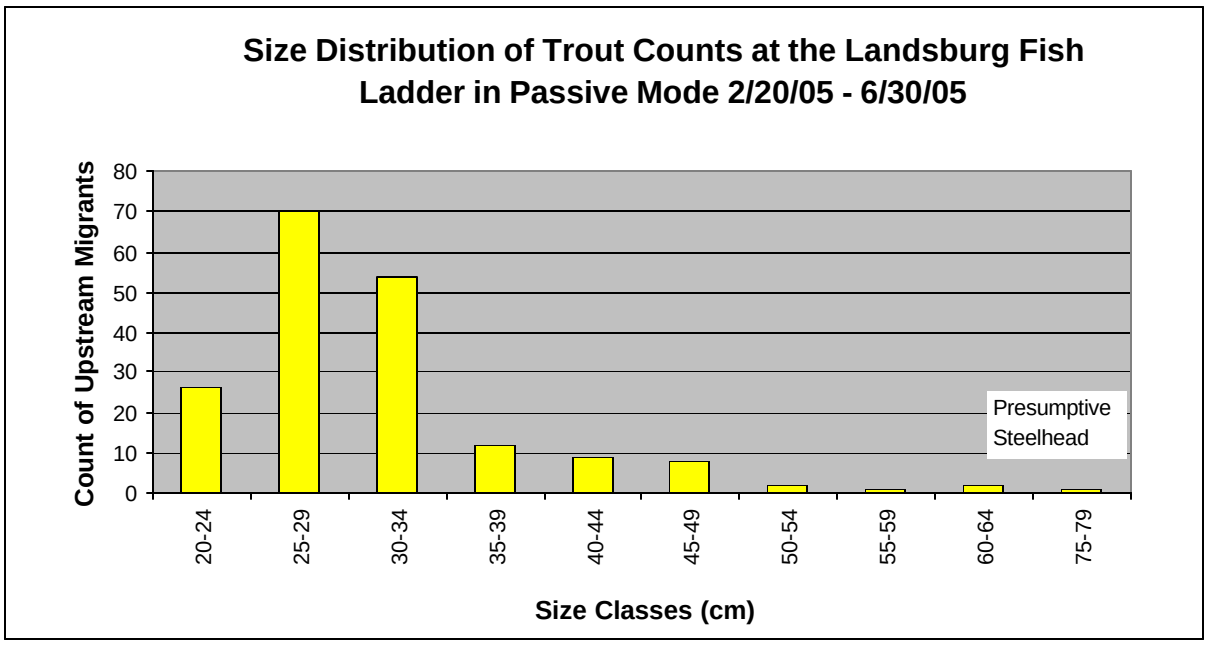

Figure 5: Size Distribution of Upstream Migrants passed above the Cedar River Landsburg Dam (2/20/2005 – 6/30/2005)

Appendix A. Fish Count Data

Table A 1: Daily Counts and Sample Numbers of Chinook and Coho passed above the Cedar River Landsburg Dam in Sorting Mode, 2004/2005

Year	Sample No.	Species	Date	Fork length (mm)	Sex	Adipose	Original length metric
2004	500	Chinook	9/17/2004	820	F	Absent	Fork Length
2004	501	Chinook	9/22/2004	685	F	Present	Fork Length
2004	502	Chinook	9/28/2004	520	M	Present	Fork Length
2004	503	Chinook	9/30/2004	1100	M	Present	Fork Length
2004	504	Chinook	10/1/2004	850	F	Absent	Fork Length
2004	505	Chinook	10/1/2004	845	M	Present	Fork Length
2004	507	Chinook	10/1/2004	793	F	Present	Fork Length
2004	508	Chinook	10/2/2004	970	M	Present	Fork Length
2004	509	Chinook	10/3/2004	590	M	Absent	Fork Length
2004	510	Chinook	10/6/2004	840	F	Absent	Fork Length
2004	511	Chinook	10/6/2004	895	M	Present	Fork Length
2004	512	Chinook	10/6/2004	830	F	Absent	Fork Length
2004	513	Chinook	10/6/2004	830	M	Absent	Fork Length
2004	514	Chinook	10/7/2004	880	F	Present	Fork Length
2004	515	Chinook	10/7/2004	910	M	Present	Fork Length
2004	516	Chinook	10/8/2004	780	M	Absent	Fork Length
2004	517	Chinook	10/8/2004	480	M	Present	Fork Length
2004	518	Chinook	10/8/2004	440	M	Absent	Fork Length
2004	519	Chinook	10/8/2004	835	F	Present	Fork Length
2004	520	Chinook	10/8/2004	960	M	Absent	Fork Length
2004	522	Chinook	10/9/2004	910	M	Absent	Fork Length
2004	523	Chinook	10/9/2004	770	M	Absent	Fork Length
2004	524	Chinook	10/9/2004	850	M	Absent	Fork Length
2004	525	Chinook	10/10/2004	870	M	Absent	Fork Length
2004	527	Chinook	10/10/2004	800	M	Absent	Fork Length
2004	528	Chinook	10/11/2004	830	F	Absent	Fork Length
2004	529	Coho	10/11/2004	630	F	Present	Fork Length
2004	530	Chinook	10/12/2004	950	F	Absent	Fork Length
2004	531	Chinook	10/12/2004	540	M	Present	Fork Length
2004	532	Chinook	10/13/2004	890	F	Absent	Fork Length
2004	533	Chinook	10/13/2004	860	F	Absent	Fork Length
2004	534	Chinook	10/13/2004	900	F	Present	Fork Length
2004	535	Chinook	10/13/2004	980	F	Absent	Fork Length
2004	536	Chinook	10/13/2004	575	M	Absent	Fork Length
2004	537	Chinook	10/13/2004	790	F	Present	Fork Length
2004	538	Chinook	10/13/2004	820	F	Absent	Fork Length
2004	539	Chinook	10/13/2004	940	M	Absent	Fork Length
2004	540	Chinook	10/13/2004	950	M	Absent	Fork Length
2004	541	Chinook	10/15/2004	880	F	Absent	Fork Length
2004	542	Chinook	10/15/2004	620	M	Absent	Fork Length
2004	543	Chinook	10/15/2004	900	M	Absent	Fork Length
2004	544	Chinook	10/15/2004	780	M	Absent	Fork Length
2004	545	Chinook	10/15/2004	700	F	Absent	Fork Length
2004	546	Chinook	10/15/2004	900	F	Absent	Fork Length
2004	547	Chinook	10/16/2004	910	F	Absent	Fork Length
2004	549	Chinook	10/16/2004	710	M	Present	Fork Length
2004	550	Chinook	10/17/2004	855	M	Absent	Fork Length

Year	Sample No.	Species	Date	Fork length (mm)	Sex	Adipose	Original length metric
2004	551	Chinook	10/17/2004	870	F	Present	Fork Length
2004	553	Coho	10/18/2004	650	M	Present	Fork Length
2004	554	Coho	10/18/2004	620	M	Present	Fork Length
2004	555	Chinook	10/18/2004	880	M	Absent	Fork Length
2004	556	Coho	10/19/2004	665	M	Present	Fork Length
2004	557	Chinook	10/20/2004	950	M	Absent	Fork Length
2004	558	Chinook	10/24/2004	635	M	Present	Fork Length
2004	559	Coho	11/4/2004	730	M	Present	Fork Length
2004	560	Coho	11/4/2004	720	M	Present	Fork Length
2004	561	Coho	11/4/2004	510	F	Present	Fork Length
2004	562	Coho	11/4/2004	630	F	Present	Fork Length
2004	563	Coho	11/4/2004	770	M	Present	Fork Length
2004	564	Coho	11/10/2004	690	M	Present	Fork Length
2004	565	Coho	11/10/2004	530	F	Absent	Fork Length
2004	566	Coho	11/12/2004	760	M	Present	Fork Length
2004	567	Coho	11/14/2004	690	F	Present	Fork Length
2004	568	Coho	11/16/2004	510	F	Absent	Fork Length
2004	569	Chinook	11/16/2004	710	F	Absent	Fork Length
2004	570	Coho	11/16/2004	780	M	Present	Fork Length
2004	571	Coho	11/24/2004	720	M	Present	Fork Length
2004	572	Coho	11/24/2004	670	M	Present	Fork Length
2004	573	Coho	11/24/2004	670	M	Present	Fork Length
2004	574	Coho	11/24/2004	730	M	Present	Fork Length
2004	575	Coho	11/24/2004	590	F	Present	Fork Length
2004	576	Coho	11/28/2004	720	M	Present	Fork Length
2004	577	Coho	11/28/2004	670	F	Present	Fork Length
2004	578	Coho	11/28/2004	720	F	Present	Fork Length
2004	579	Coho	11/28/2004	580	M	Present	Fork Length
2004	751	Coho	11/29/2004	790	M	Present	Fork Length
2004	752	Coho	11/29/2004	510	F	Present	Fork Length
2004	753	Coho	11/30/2004	680	F	Present	Fork Length
2004	754	Coho	11/30/2004	660	M	Present	Fork Length
2004	755	Coho	12/1/2004	710	M	Present	Fork Length
2004	756	Coho	12/1/2004	700	F	Present	Fork Length
2004	757	Coho	12/3/2004	860	M	Present	Fork Length
2004	758	Coho	12/3/2004	720	F	Present	Fork Length
2004	759	Coho	12/3/2004	650	M	Present	Fork Length
2004	760	Coho	12/3/2004	680	M	Present	Fork Length
2004	761	Coho	12/6/2004	690	M	Present	Fork Length
2004	762	Coho	12/10/2004	730	M	Present	Fork Length
2004	763	Coho	12/10/2004	760	M	Present	Fork Length
2004	764	Coho	12/10/2004	700	F	Present	Fork Length
2004	765	Coho	12/10/2004	690	F	Present	Fork Length
2004	766	Coho	12/13/2004	730	M	Present	Fork Length
2004	767	Coho	12/13/2004	770	M	Present	Fork Length
2004	768	Coho	12/13/2004	820	M	Present	Fork Length
2004	769	Coho	12/13/2004	780	M	Present	Fork Length
2004	770	Coho	12/13/2004	770	M	Present	Fork Length
2004	771	Coho	12/13/2004	690	M	Present	Fork Length

Year	Sample No.	Species	Date	Fork length (mm)	Sex	Adipose	Original length metric
2004	772	Coho	12/13/2004	670	M	Present	Fork Length
2004	773	Coho	12/13/2004	700	M	Present	Fork Length
2004	774	Coho	12/13/2004	700	F	Present	Fork Length
2004	775	Coho	12/13/2004	710	M	Present	Fork Length
2004	776	Coho	12/13/2004	720	F	Present	Fork Length
2004	777	Coho	12/15/2004	670	M	Present	Fork Length
2004	778	Coho	12/15/2004	740	M	Present	Fork Length
2004	779	Coho	12/15/2004	730	M	Present	Fork Length
2004	780	Coho	12/15/2004	700	F	Present	Fork Length
2004	781	Coho	12/15/2004	700	M	Present	Fork Length
2004	782	Coho	12/17/2004	740	M	Present	Fork Length
2004	783	Coho	12/17/2004	750	F	Present	Fork Length
2004	784	Coho	12/17/2004	740	M	Present	Fork Length
2004	785	Coho	12/17/2004	620	M	Present	Fork Length
2004	786	Coho	12/17/2004	690	M	Present	Fork Length
2004	787	Coho	12/17/2004	780	M	Present	Fork Length
2004	788	Coho	12/20/2004	710	F	Present	Fork Length
2004	789	Coho	12/20/2004	760	F	Present	Fork Length
2004	790	Coho	12/20/2004	650	M	Present	Fork Length
2004	791	Coho	12/20/2004	640	M	Present	Fork Length
2004	792	Coho	12/21/2004	670	F	Present	Fork Length
2004	793	Coho	12/21/2004	700	M	Present	Fork Length
2004	794	Coho	12/21/2004	760	F	Present	Fork Length
2004	795	Coho	12/23/2004	710	M	Present	Fork Length
2004	796	Coho	12/23/2004	600	M	Present	Fork Length
2004	797	Coho	12/26/2004	650	M	Present	Fork Length
2004	798	Coho	12/26/2004	780	M	Present	Fork Length
2004	799	Coho	12/26/2004	680	M	Present	Fork Length
2004	800	Coho	12/26/2004	700	M	Present	Fork Length
2004	801	Coho	12/26/2004	650	F	Present	Fork Length
2004	802	Coho	12/26/2004	640	F	Present	Fork Length
2004	803	Coho	12/26/2004	680	F	Present	Fork Length
2004	804	Coho	1/3/2005	640	M	Present	Fork Length
2004	805	Coho	1/3/2005	620	F	Present	Fork Length
2004	806	Coho	1/6/2005	680	F	Present	Fork Length
2004	807	Coho	1/10/2005	740	M	Present	Fork Length
2004	808	Coho	1/12/2005	670	M	Present	Fork Length
2004	809	Coho	1/20/2005	780	M	Present	Fork Length
2004	810	Coho	1/20/2005	570	F	Present	Fork Length
2004	811	Coho	1/20/2005	600	F	Present	Fork Length
2004	812	Coho	1/20/2005	540	M	Present	Fork Length
2004	813	Coho	1/20/2005	680	M	Present	Fork Length
2004	814	Coho	1/21/2005	630	M	Present	Fork Length
2004	815	Coho	1/21/2005	730	M	Present	Fork Length
2004	816	Coho	1/21/2005	700	M	Present	Fork Length
2004	817	Coho	1/21/2005	680	F	Present	Fork Length
2004	818	Coho	1/21/2005	800	M	Present	Fork Length
2004	819	Coho	1/29/2005	600	M	Present	Fork Length
2004	820	Coho	1/29/2005	650	M	Present	Fork Length

Year	Sample No.	Species	Date	Fork length (mm)	Sex	Adipose	Original length metric
2004	821	Coho	1/29/2005	770	F	Present	Fork Length
2004	822	Coho	1/29/2005	720	F	Present	Fork Length
2004	823	Coho	2/3/2005	680	F	Present	Fork Length
2004	824	Coho	2/3/2005	490	M	Present	Fork Length
2004	828	Coho	2/3/2005	650	M	Present	Fork Length

Table A 2: Sockeye counts from the Cedar River Landsburg Dam Fish Passage Facility in 2004

Date	Sockeye Female Presort Mortality	Sockeye Male Presort Mortality	Sockeye Female Sorted	Sockeye Male Sorted	Sockeye Female Postsort Mortality	Sockeye Male Postsort Mortality	Sockeye Female to Hatchery	Sockeye Male to Hatchery	Sockeye Female to RM 13	Sockeye Male to RM 13
9/1/2004	0	0	0	0	0	0	0	0	0	0
9/2/2004	0	0	0	0	0	0	0	0	0	0
9/3/2004	0	0	0	0	0	0	0	0	0	0
9/4/2004	0	0	0	0	0	0	0	0	0	0
9/5/2004	0	0	0	0	0	0	0	0	0	0
9/6/2004	0	0	0	0	0	0	0	0	0	0
9/7/2004	0	0	0	0	0	0	0	0	0	0
9/8/2004	0	0	0	0	0	0	0	0	0	0
9/9/2004	0	0	0	0	0	0	0	0	0	0
9/10/2004	0	0	0	0	0	0	0	0	0	0
9/11/2004	0	0	0	0	0	0	0	0	0	0
9/12/2004	1	0	6	9	0	0	0	0	0	0
9/13/2004	1	3	0	0	0	0	0	0	0	0
9/14/2004	0	2	3	6	0	0	0	0	9	15
9/15/2004	0	0	0	0	0	0	0	0	0	0
9/16/2004	0	0	0	0	0	0	0	0	0	0
9/17/2004	0	0	4	5	0	0	0	0	0	0
9/18/2004	0	0	0	0	0	0	0	0	0	0
9/19/2004	1	0	3	11	0	0	0	0	0	0
9/20/2004	0	0	1	1	0	0	0	0	0	0
9/21/2004	0	0	0	0	0	0	8	17	0	0
9/22/2004	0	0	0	0	0	0	0	0	0	0
9/23/2004	1	0	0	0	0	0	0	0	0	0
9/24/2004	0	0	9	15	0	0	0	0	0	0
9/25/2004	0	0	1	6	0	0	0	0	0	0
9/26/2004	0	0	0	0	0	0	0	0	0	0
9/27/2004	0	0	9	15	0	0	0	0	0	0
9/28/2004	0	1	2	4	1	0	20	0	0	40
9/29/2004	0	0	4	3	0	0	0	0	0	0
9/30/2004	0	2	7	15	0	0	0	0	10	13
10/1/2004	0	0	5	12	0	0	0	0	0	0
10/2/2004	0	0	0	4	0	0	0	0	6	21
10/3/2004	0	0	0	0	0	0	0	0	0	0
10/4/2004	0	0	0	0	0	0	0	0	0	0
10/5/2004	0	0	1	4	1	4	0	0	0	0
10/6/2004	0	0	5	10	0	0	0	0	0	0
10/7/2004	1	0	4	7	0	0	0	0	9	17

Date	Sockeye Female Presort Mortality	Sockeye Male Presort Mortality	Sockeye Female Sorted	Sockeye Male Sorted	Sockeye Female Postsort Mortality	Sockeye Male Postsort Mortality	Sockeye Female to Hatchery	Sockeye Male to Hatchery	Sockeye Female to RM 13	Sockeye Male to RM 13
10/8/2004	1	0	2	2	0	0	0	0	0	0
10/9/2004	1	0	5	10	0	0	0	0	0	0
10/10/2004	0	2	5	4	0	0	0	0	12	16
10/11/2004	0	0	0	0	0	0	0	0	0	0
10/12/2004	0	0	0	0	0	0	0	0	0	0
10/13/2004	0	0	0	0	0	0	0	0	0	0
10/14/2004	0	0	0	0	0	0	0	0	0	0
10/15/2004	0	1	3	5	0	0	0	0	0	0
10/16/2004	0	0	0	0	0	0	0	0	0	0
10/17/2004	0	0	0	0	0	0	0	0	0	0
10/18/2004	0	0	0	0	0	1	0	0	0	0
10/19/2004	0	0	0	0	0	0	0	0	0	0
10/20/2004	0	0	8	13	0	0	0	0	11	17
10/21/2004	0	0	2	10	0	0	0	0	0	0
10/22/2004	0	0	0	0	0	0	0	0	0	0
10/23/2004	0	0	0	0	0	0	0	0	0	0
10/24/2004	0	0	3	15	0	0	0	0	0	0
10/25/2004	0	0	0	0	0	0	0	0	0	0
10/26/2004	0	0	5	12	0	1	0	0	10	36
10/27/2004	0	0	0	0	0	0	0	0	0	0
10/28/2004	0	0	8	21	0	0	0	0	0	0
10/29/2004	0	0	0	0	0	2	0	0	0	0
10/30/2004	0	0	0	0	0	0	0	0	0	0
10/31/2004	0	3	9	11	0	2	17	28	0	0
11/1/2004	0	0	5	16	0	0	0	0	0	0
11/2/2004	0	3	10	17	0	0	0	0	0	0
11/3/2004	0	1	10	19	0	1	25	51	0	0
11/4/2004	0	0	0	0	0	0	0	0	0	0
11/5/2004	0	0	0	0	0	0	0	0	0	0
11/6/2004	0	0	12	27	0	0	0	0	0	0
11/7/2004	0	0	1	11	0	0	13	38	0	0
11/8/2004	0	0	4	15	0	0	0	0	0	0
11/9/2004	0	0	2	15	0	0	0	0	0	0
11/10/2004	0	0	0	0	0	0	0	0	0	0
11/11/2004	0	0	0	0	0	0	0	0	0	0
11/12/2004	0	0	20	42	0	0	0	0	0	0
11/13/2004	0	1	12	42	0	1	0	0	0	0
11/14/2004	0	0	7	21	0	0	45	134	0	0
11/15/2004	0	0	0	0	0	0	0	0	0	0
11/16/2004	0	0	0	0	0	0	0	0	0	0
11/17/2004	1	0	21	52	0	0	0	0	0	0
11/18/2004	0	0	4	10	0	0	25	62	0	0
11/19/2004	0	0	0	0	0	0	0	0	0	0
11/20/2004	0	0	7	20	0	0	0	0	0	0
11/21/2004	0	1	2	3	0	0	9	23	0	0
11/22/2004	0	0	0	0	0	0	0	0	0	0
11/23/2004	0	0	0	0	0	0	0	0	0	0
11/24/2004	0	2	1	11	0	0	0	0	0	0

Date	Sockeye Female Presort Mortality	Sockeye Male Presort Mortality	Sockeye Female Sorted	Sockeye Male Sorted	Sockeye Female Postsort Mortality	Sockeye Male Postsort Mortality	Sockeye Female to Hatchery	Sockeye Male to Hatchery	Sockeye Female to RM 13	Sockeye Male to RM 13
11/25/2004	0	0	0	0	0	0	0	0	0	0
11/26/2004	1	0	5	12	0	0	0	0	0	0
11/27/2004	0	0	0	3	0	0	0	0	0	0
11/28/2004	0	0	3	8	0	0	9	0	0	34
11/29/2004	0	0	0	0	0	0	0	0	0	0
11/30/2004	0	0	0	2	0	0	0	0	0	0
12/1/2004	0	0	0	0	0	0	0	0	0	0
12/2/2004	0	0	1	11	0	0	0	0	0	0
12/3/2004	0	0	0	0	0	0	0	0	0	0
12/4/2004	0	0	0	0	0	0	0	0	0	0
12/5/2004	0	0	1	11	0	0	0	0	0	0
12/6/2004	0	0	0	0	0	0	0	0	0	0
12/7/2004	0	0	0	0	0	0	0	0	2	24
12/8/2004	0	0	4	6	0	0	0	0	0	0
12/9/2004	0	0	4	5	0	0	0	0	0	0
12/10/2004	0	0	1	4	0	0	0	0	0	0
12/11/2004	0	0	0	0	0	0	0	0	0	0
12/12/2004	0	0	0	0	0	0	0	0	0	0
12/13/2004	0	0	0	0	0	0	0	0	9	15
12/14/2004	0	0	0	0	0	0	0	0	0	0
12/15/2004	0	0	4	5	0	0	0	0	0	0
12/16/2004	0	0	0	0	0	0	0	0	0	0
12/17/2004	0	0	0	0	0	0	0	0	0	0
12/18/2004	0	0	0	0	0	0	0	0	0	0
12/19/2004	0	0	0	0	0	0	0	0	0	0
12/20/2004	0	0	0	0	0	0	0	0	0	0
12/21/2004	0	0	0	0	0	0	0	0	4	5
12/22/2004	0	0	0	0	0	0	0	0	0	0
12/23/2004	0	0	0	0	0	0	0	0	0	0
12/24/2004	0	0	0	0	0	0	0	0	0	0
12/25/2004	0	0	0	0	0	0	0	0	0	0
12/26/2004	0	0	1	1	0	0	0	0	1	1
12/27/2004	0	0	0	1	0	0	0	0	0	1
12/28/2004	0	0	0	0	0	0	0	0	0	0
12/29/2004	0	0	0	0	0	0	0	0	0	0
12/30/2004	0	0	0	0	0	0	0	0	0	0
12/31/2004	0	0	0	0	0	0	0	0	0	0
Subtotal	9	22	256	620	2	12	171	353	83	255
Total	31		876		14		524		338	

Table A 3: Fish counts from the electronic fish counter by date and length for species passed above the Cedar River Landsburg Dam in 2005

Date/Time	Depth [mm]	Length [cm]	Species
2/20/2005 18:05	50	30	Trout
2/22/2005 15:27	80	48	Trout
2/23/2005 17:31	42	25	Trout
2/23/2005 18:01	52	31	Trout
2/23/2005 18:01	55	33	Trout
2/23/2005 21:59	42	25	Trout
2/24/2005 15:38	60	36	Trout
2/24/2005 17:56	52	31	Trout
2/25/2005 18:17	52	31	Trout
2/25/2005 20:49	65	39	Trout
2/26/2005 13:01	40	24	Trout
2/26/2005 18:14	40	24	Trout
2/26/2005 18:21	55	33	Trout
2/27/2005 22:17	76	45	Trout
2/28/2005 11:08	82	49	Trout
2/28/2005 17:24	37	22	Trout
2/28/2005 18:20	37	22	Trout
2/28/2005 19:39	45	27	Trout
2/28/2005 23:17	70	42	Trout
3/1/2005 16:39	55	33	Trout
3/2/2005 11:01	52	31	Trout
4/3/2005 19:23	40	24	Trout
4/3/2005 19:25	50	30	Trout
4/3/2005 19:52	47	28	Trout
4/9/2005 7:04	82	49	Trout
4/9/2005 16:46	45	27	Trout
4/11/2005 2:37	40	24	Trout
4/11/2005 10:17	45	27	Trout
4/11/2005 16:46	42	25	Trout
4/14/2005 17:49	35	21	Trout
4/14/2005 18:33	42	25	Trout
4/14/2005 19:38	42	25	Trout
4/15/2005 17:20	77	46	Trout
4/16/2005 10:23	50	30	Trout
4/16/2005 11:56	47	28	Trout
4/16/2005 13:02	37	22	Trout
4/16/2005 13:21	45	27	Trout
4/16/2005 16:32	37	22	Trout
4/16/2005 16:33	40	24	Trout
4/16/2005 16:41	47	28	Trout
4/16/2005 18:44	50	30	Trout
4/16/2005 19:32	42	25	Trout
4/16/2005 19:41	40	24	Trout
4/17/2005 7:39	45	27	Trout
4/17/2005 10:41	100	60	Undecided
4/17/2005 13:44	52	31	Trout
4/17/2005 14:02	42	25	Trout
4/17/2005 15:33	52	31	Trout
4/17/2005 16:25	50	30	Trout
4/17/2005 19:44	45	27	Trout

Date/Time	Depth [mm]	Length [cm]	Species
4/17/2005 20:03	45	27	Trout
4/18/2005 18:41	45	27	Trout
4/20/2005 14:59	45	27	Trout
4/20/2005 17:18	45	27	Trout
4/21/2005 16:38	72	43	Trout
4/21/2005 17:11	55	33	Trout
4/21/2005 20:17	42	25	Trout
4/22/2005 8:07	47	28	Trout
4/22/2005 11:06	95	57	Trout
4/22/2005 11:11	45	27	Trout
4/22/2005 12:28	67	40	Trout
4/22/2005 22:26	72	43	Trout
4/23/2005 8:01	52	31	Trout
4/23/2005 11:56	62	37	Trout
4/23/2005 13:56	65	39	Trout
4/23/2005 15:25	47	28	Trout
4/23/2005 19:52	52	31	Trout
4/24/2005 8:42	65	39	Trout
4/26/2005 11:38	55	33	Trout
4/26/2005 21:00	47	28	Trout
4/27/2005 14:23	55	33	Trout
4/27/2005 17:29	47	28	Trout
4/27/2005 20:32	42	25	Trout
4/28/2005 8:36	37	22	Trout
4/28/2005 11:48	62	37	Trout
4/28/2005 17:35	55	33	Trout
4/29/2005 21:22	45	27	Trout
4/30/2005 20:48	40	24	Trout
5/1/2005 17:49	57	34	Trout
5/1/2005 20:34	47	28	Trout
5/2/2005 20:12	70	42	Trout
5/2/2005 20:28	47	28	Trout
5/4/2005 20:55	42	25	Trout
5/5/2005 5:14	125	75	Presumptive Steelhead
5/5/2005 20:49	45	27	Trout
5/6/2005 7:17	65	39	Trout
5/6/2005 18:27	42	25	Trout
5/6/2005 20:49	42	25	Trout
5/7/2005 14:16	62	37	Trout
5/7/2005 18:19	45	27	Trout
5/7/2005 21:19	47	28	Trout
5/8/2005 12:49	85	51	Trout
5/8/2005 20:57	45	27	Trout
5/9/2005 6:27	65	39	Trout
5/9/2005 17:57	42	25	Trout
5/9/2005 20:47	42	25	Trout
5/10/2005 8:10	72	43	Trout
5/10/2005 9:24	37	22	Trout
5/10/2005 10:29	45	27	Trout
5/10/2005 12:24	45	27	Trout
5/10/2005 14:19	67	40	Trout
5/10/2005 16:48	72	43	Trout
5/10/2005 17:20	47	28	Trout

Date/Time	Depth [mm]	Length [cm]	Species
5/10/2005 20:51	45	27	Trout
5/11/2005 17:01	105	63	Undecided
5/11/2005 20:56	42	25	Trout
5/12/2005 9:34	45	27	Trout
5/12/2005 18:42	52	31	Trout
5/12/2005 21:16	47	28	Trout
5/12/2005 21:20	50	30	Trout
5/21/2005 21:22	42	25	Trout
5/22/2005 12:18	40	24	Trout
5/22/2005 14:01	45	27	Trout
5/22/2005 14:01	52	31	Trout
5/22/2005 15:04	42	25	Trout
5/22/2005 16:13	55	33	Trout
5/22/2005 16:27	60	36	Trout
5/22/2005 17:08	52	31	Trout
5/22/2005 17:27	52	31	Trout
5/22/2005 17:27	52	31	Trout
5/22/2005 19:02	47	28	Trout
5/22/2005 20:52	55	33	Trout
5/23/2005 0:09	42	25	Trout
5/23/2005 13:13	60	36	Trout
5/23/2005 13:30	50	30	Trout
5/23/2005 13:56	42	25	Trout
5/23/2005 16:18	47	28	Trout
5/23/2005 16:53	55	33	Trout
5/23/2005 18:24	50	30	Trout
5/23/2005 19:25	47	28	Trout
5/23/2005 21:46	37	22	Trout
5/24/2005 14:17	55	33	Trout
5/24/2005 16:04	47	28	Trout
5/24/2005 16:44	35	21	Trout
5/24/2005 16:44	45	27	Trout
5/24/2005 17:45	45	27	Trout
5/24/2005 18:12	50	30	Trout
5/24/2005 20:32	42	25	Trout
5/24/2005 21:58	42	25	Trout
5/25/2005 16:08	40	24	Trout
5/25/2005 16:36	50	30	Trout
5/25/2005 17:39	70	42	Trout
5/25/2005 17:39	77	46	Trout
5/25/2005 22:00	50	30	Trout
5/26/2005 16:54	42	25	Trout
5/26/2005 19:14	40	24	Trout
5/26/2005 21:51	35	21	Trout
5/26/2005 22:03	55	33	Trout
5/27/2005 22:06	32	19	Trout
5/28/2005 14:40	37	22	Trout
5/28/2005 19:37	50	30	Trout
5/28/2005 20:47	52	31	Trout
5/29/2005 19:48	52	31	Trout
5/29/2005 20:57	45	27	Trout
5/30/2005 20:32	62	37	Trout
6/1/2005 15:41	52	31	Trout

Date/Time	Depth [mm]	Length [cm]	Species
6/3/2005 13:45	50	30	Trout
6/4/2005 20:55	47	28	Trout
6/5/2005 21:03	45	27	Trout
6/8/2005 16:33	47	28	Trout
6/8/2005 20:36	50	30	Trout
6/9/2005 16:30	75	45	Trout
6/9/2005 18:40	52	31	Trout
6/10/2005 8:33	47	28	Trout
6/11/2005 12:42	47	28	Trout
6/12/2005 1:39	82	49	Trout
6/12/2005 8:32	47	28	Trout
6/14/2005 6:47	40	24	Trout
6/15/2005 20:57	45	27	Trout
6/16/2005 19:43	42	25	Trout
6/19/2005 20:09	50	30	Trout
6/20/2005 20:36	50	30	Trout
6/21/2005 16:25	55	33	Trout
6/21/2005 20:38	47	28	Trout
6/22/2005 12:30	52	31	Trout
6/22/2005 17:13	52	31	Trout
6/23/2005 14:11	85	51	Trout
6/23/2005 18:55	50	30	Trout
6/23/2005 20:06	50	30	Trout
6/24/2005 20:25	52	31	Trout
6/25/2005 20:24	50	30	Trout
6/28/2005 13:45	35	21	Trout
6/28/2005 18:45	35	21	Trout
6/29/2005 19:23	52	31	Trout
6/29/2005 21:00	37	22	Trout