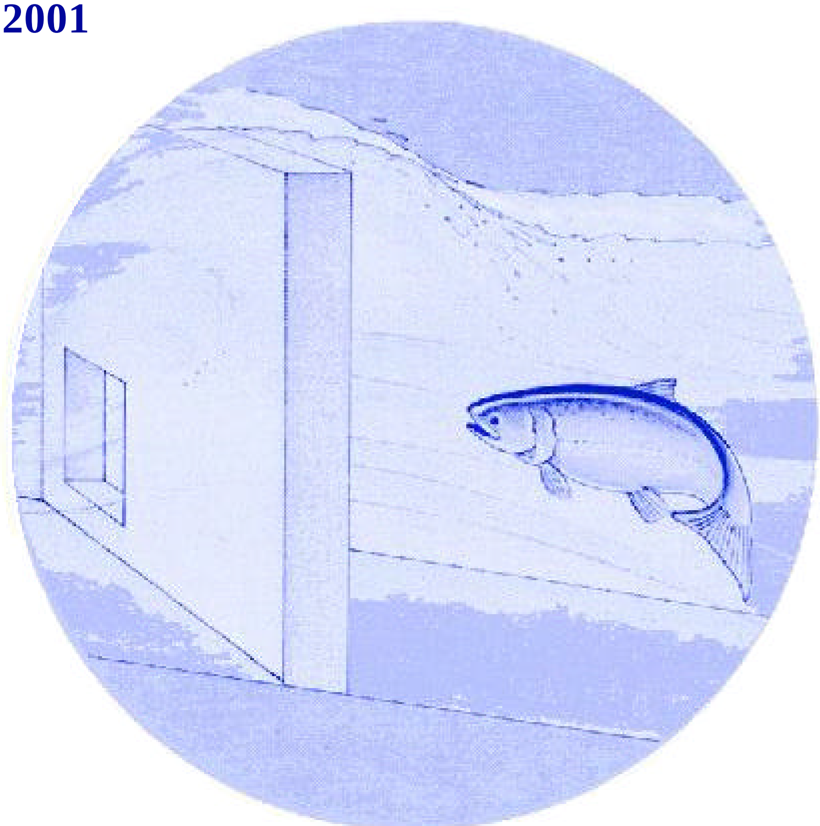
Adult Chinook Salmon Abundance Monitoring in Lake Creek, Idaho

Annual Report
2001



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Adult Chinook Salmon Abundance Monitoring in Lake Creek, Idaho, 2001

2001 Annual Report

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ABSTRACT

Underwater time-lapse video technology has been used to monitor adult spring and summer chinook salmon (*Oncorhynchus tshawytscha*) escapement into the Secesh River and Lake Creek, Idaho, since 1998. Underwater time-lapse videography is a passive methodology that does not trap or handle this Endangered Species Act listed species. Secesh River chinook salmon represent a wild spawning aggregate that has not been directly supplemented with hatchery fish. The Secesh River is also a control stream under the Idaho Salmon Supplementation study.

This project has successfully demonstrated the application of underwater video monitoring to accurately quantify chinook salmon abundance in Lake Creek in 1998, 1999 and 2001. The adult salmon spawner escapement estimate into Lake Creek in 2001 was 697 fish, the largest escapement since the project began. Jack salmon comprised 10% of the spring migration. Snow pack in the drainage was 38% of the average during the winter of 2000/2001. The first fish passage on Lake Creek was recorded on June 9, 19 days after installation of the fish counting station and two weeks earlier than previously reported. Peak net upstream movement of 52 adults occurred on June 22. Peak of total movement activity was July 3. The last fish passed through the Lake Creek fish counting station on September 6.

Redd count expansion methods were compared to underwater video determined salmon spawner abundance in Lake Creek in 2001. Expanded index area redd count point estimates and intensive area redd counts in 2001, estimated from 1.3 percent fewer to 56 percent greater number of spawners than underwater video determined spawner abundance. Redd count expansion values had unknown variation associated with the point estimates. Fish per redd numbers in Lake Creek have varied widely. In 2001 there were 2.07 fish per redd. In 1999, there were 3.58 fish per redd, and in 1998, with no jacks returning to spawn, there were 1.02 fish per redd.

Migrating salmon in Lake Creek exhibited two behaviorally distinct segments of fish movement in 2001. Mainly upstream only movement characterized the first segment. The second segment consisted of upstream and downstream movement with less net upstream movement. The fish counting stations did not impede salmon movements, nor was spawning displaced downstream. Fish moved freely upstream and downstream through the fish counting structures. There appeared to be a segment of “nomadic” males that moved into and out of the spawning area, apparently seeking other mates to spawn with. The downstream movement of salmon afforded by this fish counting station design may be an important factor in the reproductive success of listed salmon.

This methodology provides more accurate salmon spawner abundance information than single-pass and multiple-pass spawning ground surveys. Accurate adult escapement information would allow managers to determine if recovery actions benefited listed chinook salmon in tributary streams. A major project recommendation is to locate an adult salmon abundance monitoring site on the Secesh River that would assess the total Lake Creek and the Secesh River spawning area. This would provide a measure of the recovery actions being implemented on listed chinook salmon in the Snake River basin.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

The Bonneville Power Administration provided funding for this project. We would like to thank Tom Bumstead for engineering design, and Nez Perce Department of Fisheries Resources Management personnel Shawn Blount, Mike Busby, Mitch Daniel, Dan Felt, Rob Hill, Rick Orme, Toby Tabor Jason Vogel, Erika Whitaker and Karen Zelch for project operations and structure placement. John Hintz of the Nez Perce Tribe furnished the map of the Secesh River drainage. We also appreciate the Nez Perce Tribe for administration of this project.

INTRODUCTION

Salmon recovery within the Columbia River basin has become a focal point in the Pacific Northwest. Congress directed an independent scientific review of the Northwest Power Planning Council's (NWPPC) Fish and Wildlife Program activities because earlier programs were criticized as being a list of separate unrelated measures without any underlying scientific foundation (Independent Scientific Group 1993, Williams et al. 1998**)**. Large amounts of time, effort and funding have been spent to improve fish passage conditions, augment flows, enhance and restore habitat, constrain harvest and use hatchery supplementation to increase salmon populations. Despite these efforts, salmon populations have continued to decline. The National Marine Fisheries Service has issued a Biological Opinion for the operation of the federal Columbia River power system (NMFS 2000) that attempts to define reasonable and prudent actions and criteria/population levels that would ensure continued existence of critical fish stocks. Recovery abundance levels are defined in terms of numbers of naturally spawning adult salmon returning to spawning areas. Therefore, accurate determination of adult salmon spawner abundance is of utmost importance to fisheries managers. Within the South Fork Salmon River, Secesh River spring and summer chinook salmon (*Oncorhynchus tshawytscha*) represent a wild salmon spawning aggregate. The Secesh River is currently used as a control system for the Idaho Salmon Supplementation studies (Bowles and Leitzinger 1991).

Spring and summer chinook salmon in the entire Snake River basin, including the Secesh River, are listed as threatened under the Endangered Species Act (ESA) (NMFS 1992). The Biological Opinion for operation of the federal Columbia River power system (NMFS 2000) recommended that accurate assessment of spawner escapement of listed Evolutionary Significant Units (ESU) are required for determining the characteristics, viability, recovery status, and delisting of ESU's under ESA. NMFS (2000) further defined the degree to which species-level biological requirements must be met: "At the species level, NMFS considers that the biological requirements for survival, with an adequate potential for recovery, are met when there is a high likelihood that the species population will remain above critical escapement thresholds over a sufficiently long period of time. The particular thresholds, recovery levels, and time periods must be selected depending upon the characteristics and circumstances of each salmon species under consultation (NMFS 2000)". The recovery metric for listed ESUs is the likelihood that the 8-year geometric mean abundance of natural spawners in a population will be equal to or greater than an identified recovery abundance level (NMFS 2000). NMFS interim abundance and productivity targets for South Fork Salmon River chinook salmon are 9,204 adults and a geometric mean cohort replacement rate that exceeds one, during the eight years immediately prior to delisting (NMFS 2000).

The NMFS recommended characterizing populations by abundance/productivity, diversity (viability), spatial structure, and habitat capacity (NMFS 2000), most of which rely on some quantitative measure of adult abundance. Adult abundance determination is also a necessary component of proposed short-term stock performance measures that focus on life history stages (NMFS 2000). The Validation Monitoring Panel (Botkin et al. 2000) provided a science-based analysis for monitoring of salmon for conservation plans. The panel also identified the need for accurate adult salmon abundance information in relation to conservation and restoration plans.

Determination of adult spawner abundance information is a critical aspect of a viable population management strategy (Foose et al. 1995, Botkin et al. 2000), which is recognized within the scientific community and in recovery planning efforts (NMFS 2000). Currently, there is limited quantitative information available to determine spawner abundance of spring and summer chinook salmon in tributary streams of the Snake River basin. Therefore, we cannot measure the effectiveness of conservation actions for a threatened species (Botkin et al. 2000). Quantifying adult salmon spawner abundance will provide a direct measurement of benefits of the Northwest Power Planning Council's Fish and Wildlife Program projects (funded by BPA) and efforts of recovery alternatives.

Traditional chinook salmon index area redd count surveys conducted in Idaho since the mid 1950's have relied upon one-time counts at the peak of spawning (Elms-Cockrum 1999). The purpose of these redd counts was to provide an index of relative abundance and population trend information over time. Recent surveys on some streams have used multiple ground counts of spawning activities for more accurate assessment of salmon redds (Kucera 1987, Cowley and Kucera 1989, Kucera and Banach 1991, Kucera and Blenden 1994, Kucera and Blenden 1999). Expansion of redd counts to spawner numbers are influenced by measurement error and uncertainty of assumptions regarding estimates of fish per redd, relative numbers in surveyed and unsurveyed areas, prespawning mortality rates, age composition, and hatchery fish composition (Beamesderfer et al. 1998). Neither of these redd count survey techniques was intended to provide accurate spawner abundance information. In addition, unknown error (variation) is associated with the redd count expansion.

Existing adult weirs are another potential source of adult spawner abundance information. The primary purpose of permanent and temporary adult weirs is for hatchery broodstock collection. Adult broodstock collection weirs are not sited for monitoring adult spawner abundance in streams. They most often provide either a minimum spawner estimate or a mark recapture spawner estimate derived from marked fish carcass recovery from spawning grounds. These estimates are also affected by measurement error and uncertainty of assumptions.

This investigation began in 1991 with planning and conceptual engineering design of an adult fish counting facility on the lower Secesh River (Fish Management Consultants 1991) funded through the Pacific Salmon Commission. Listing of the species under the Endangered Species Act in 1992, and concerns with a permanent facility and handling of fish, prompted the search for a site where temporary facilities could be used. Preliminary design work followed in 1994 (River Masters Engineering 1994). The Nez Perce Tribe has worked cooperatively with the Idaho Department of Fish and Game (IDFG) and the U.S. Forest Service (USFS) in the planning and developmental stages of this project.

Technology is available that may improve the accuracy of salmon spawner escapement estimates. Time-lapse video has been used primarily to enumerate adults at fish counting/viewing windows at hydroelectric projects (Hatch et al. 1994a, 1994b). In some cases, cameras have been submerged in fish ladders to evaluate fish passage (USFWS, unpublished data). Limited studies have used cameras underwater in a natural setting. Holubetz and Leth (1996) experimentally operated a similar natural stream, remote video recorder system on Running Creek, in the headwaters of the Selway River

Information collected from this project will provide accurate salmon spawner abundance information to managers necessary to fulfill requirements of the NMFS 2000 Biological Opinion (NMFS 2000) and will allow comparison to redd count survey data to assess if redd count information provides reliable indices of adult salmon escapement.

The goal of this project is to accurately assess the spring and summer chinook salmon spawning migration in the Secesh River and Lake Creek drainages. This is a goal of the Nez Perce Tribe for all anadromous waters within their ceded territory. The goal emphasizes collection of accurate spawner abundance information. Presently, an index of relative abundance is estimated from index area or intensive redd count data in the Secesh River and Lake Creek.

The objectives of the study were to:

1) Accurately determine adult spring and summer chinook salmon spawner abundance in the Secesh River and Lake Creek on an annual basis.
2) Determine the timing of adult spring and summer chinook salmon spawning migration into the Secesh River and Lake Creek drainages.
3) Determine the accuracy of redd count methodology compared to the underwater video escapement enumeration technique.

DESCRIPTION OF PROJECT AREA

The Secesh River subwatershed, in west central Idaho, covers about 688 square km. The Secesh River is formed at the junction of Summit and Lake creeks, and traverses 45 km to the southeast where it flows into the main stem South Fork Salmon River about two km downstream of the East Fork South Fork of the Salmon River (Figure 1). Headwaters of Lake Creek are in the mountains above Burgdorf at an elevation of 2,417 m. Lake Creek drains an area of approximately 90 square km, is 25 km in length and is approximately 15 m wide at the fish counting station. Elevation drops to 1,838 m where Lake Creek joins Summit Creek to form the Secesh River. Elevation of the Secesh River then drops to 1,110 m where it flows into the South Fork Salmon River. Channel gradients range from less than one percent along Lake Creek and the upper Secesh Meadows to over ten percent in canyon sections. Average gradient in the vicinity of the fish counting stations was 0.5 percent. The Secesh River fish counting station was located 30 km upstream from the South Fork Salmon River at the U. S. Forest Service's Chinook Campground. The Lake Creek fish counting station was located 45 km upstream from the South Fork Salmon River and 100 m upstream from the mouth of Lake Creek. Chinook salmon and steelhead trout (O. mykiss) are present in the Secesh River drainage along with cutthroat (*O. clarki lewisi*), bull (*Salvelinus confluentus*), brook (*S. fontinalis*) and rainbow (*O. mykiss*), trout, mountain whitefish (*Prosopium williamsoni*), longnose dace (*Rhinichhys cataractae*) and sculpin (*Cottus sp.*). There was minimal chinook salmon spawning habitat from the mouth upstream 27.5 km to the upper end of the canyon area. About 2.5 km of limited spawning habitat was available from the upper end of the canyon, upstream to the fish counting station. The major chinook salmon spawning area was located upstream of the fish counting station in Secesh Meadows. Spawning habitat was available in lower Grouse and Summit creeks. A mixture of good and scattered spawning habitat existed in Lake Creek from Burgdorf Meadows upstream to Willow Creek. Additional spawning area existed upstream of Willow Creek.

METHODS AND MATERIALS

TIMING AND ABUNDANCE

Equipment

This project involved an ESA listed species that has a population trend in long-term decline. It was important to allow these fish to migrate and spawn without harassment. Underwater video used a passive, non-invasive system that allowed complete freedom of upstream and downstream movement of fish. Fish were not trapped, handled or held at any time. Primary system components were the temporary structure and the video equipment. The structure included tripod supported upstream and downstream picket guide fences and a counting chamber (Figures 2 and 3). The structures were shaped like two "V"s connected at their apexes by the counting chamber (Figure 3). The two downstream wings were angled at 30 to 45 degrees to the bank to orient and direct upstream migrating fish into the counting chamber, where their picture was taken. The two upstream wings did the same for downstream moving fish. The counting chamber was located in the thalweg, which was believed to be the preferred migration route. The entrance to the counting chamber was 0.86 m wide by, 0.71 m high. Upstream and downstream migrating adults were able to move freely into and through the counting chambers. The structures were installed as soon as possible after the peak of spring runoff to have the fish counting chambers in place prior to the arrival of the first upstream migrating chinook salmon. Due to the light spring snowpack in 2001 (38% of normal), structures were installed prior to snowmelt.

Construction of the temporary fish guiding structure was modeled after the standard Alaska picket weir (Figure 4). Structure tripods were constructed of 3.81 cm galvanized steel pipe with Kee Klamp® structural pipe fittings. Support brackets were attached to a tripod leg to support the picket stringers. Picket stringers were constructed of 0.64 cm aluminum angle with 2.54 cm holes punched 5.08 cm on center. After the tripods, support brackets and stringers were set in their final positions, 2.54 cm aluminum conduit pickets were installed in the stringers. The fish counting chambers were constructed of angle aluminum with dimensions of 0.91 m wide by 1.22 m long by 0.91 m high (Figure 5) when viewed from the upstream or downstream end. Aluminum pickets were placed in the counting chamber frames above the passageway to prevent movement through the counting chambers above the viewing area. A transition section was located on both ends of the counting chambers to direct fish into the chambers. Transitions tapered from 0.91 m wide by 1.37 m high at the counting chambers to 2.13 m wide by 1.37 m high at the outer edge. Distance from the counting chambers to the outer edge of the transition was 0.76 m. The guide fences were attached to the counting chambers and transitions with adjustable wing panels located at each outer corner of the transitions. Installation of the guide fences at any angle between 30 and 45 degrees was possible with the hinged wing panels.

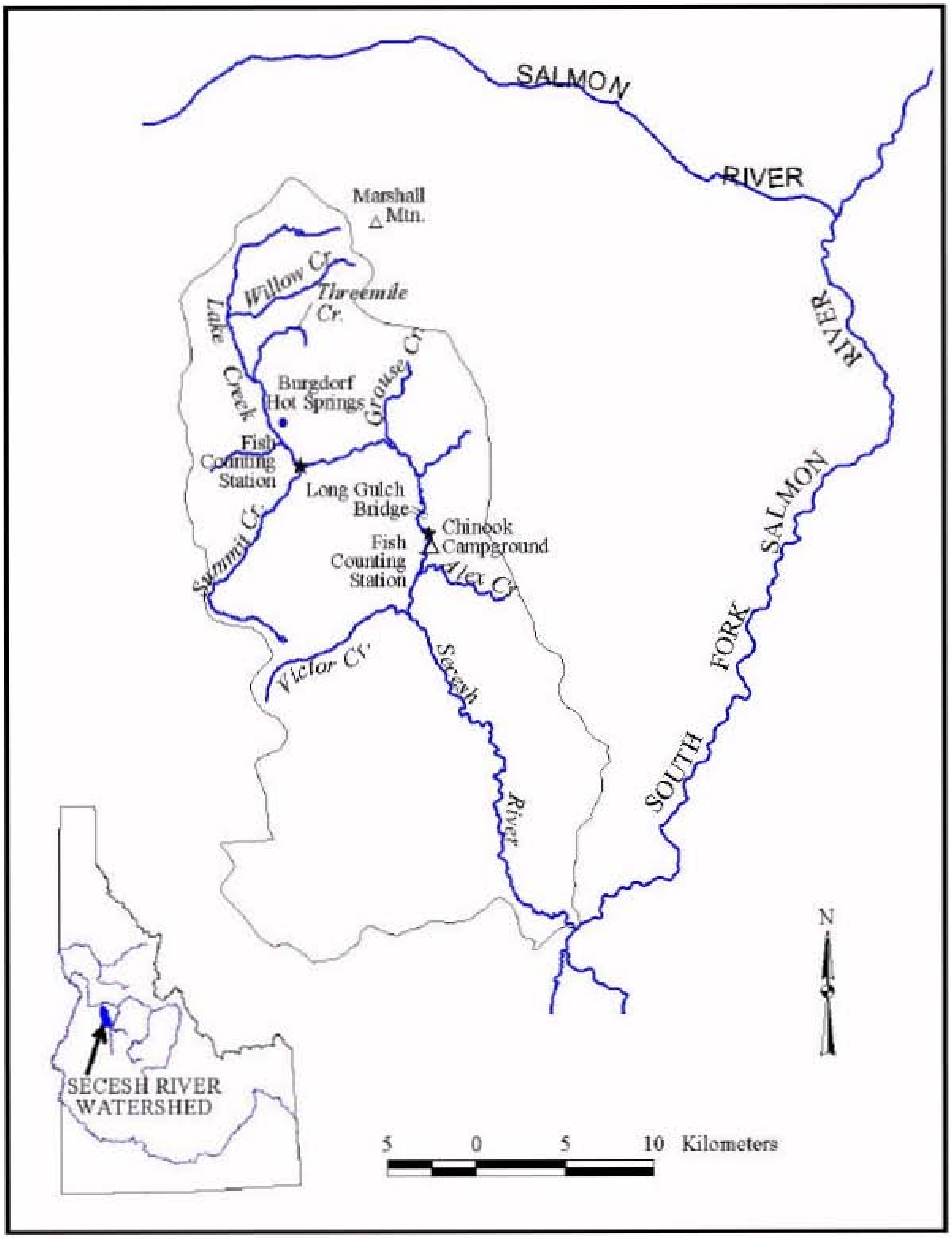

Figure 1. Map of the Secesh River drainage and locations of the fish counting stations (*denotes fish counting station).

Figure 2. Artist's rendition of the underwater video fish counting station demonstrating the 0.86 by 0.71 m fish passage opening.

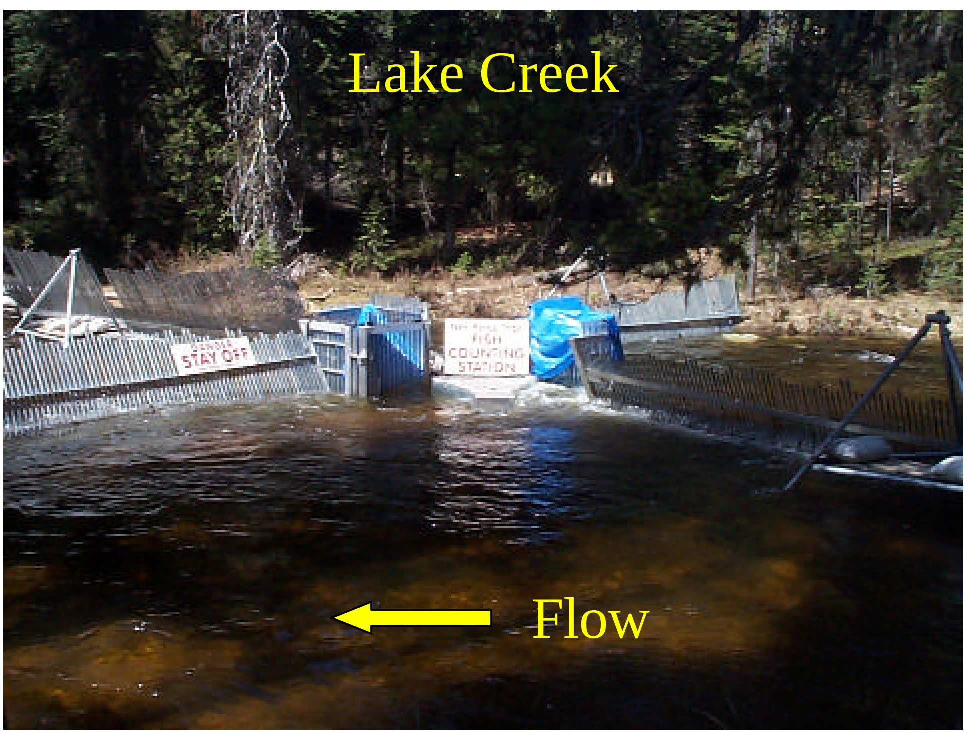

Figure 3. Lake Creek underwater video fish counting station.

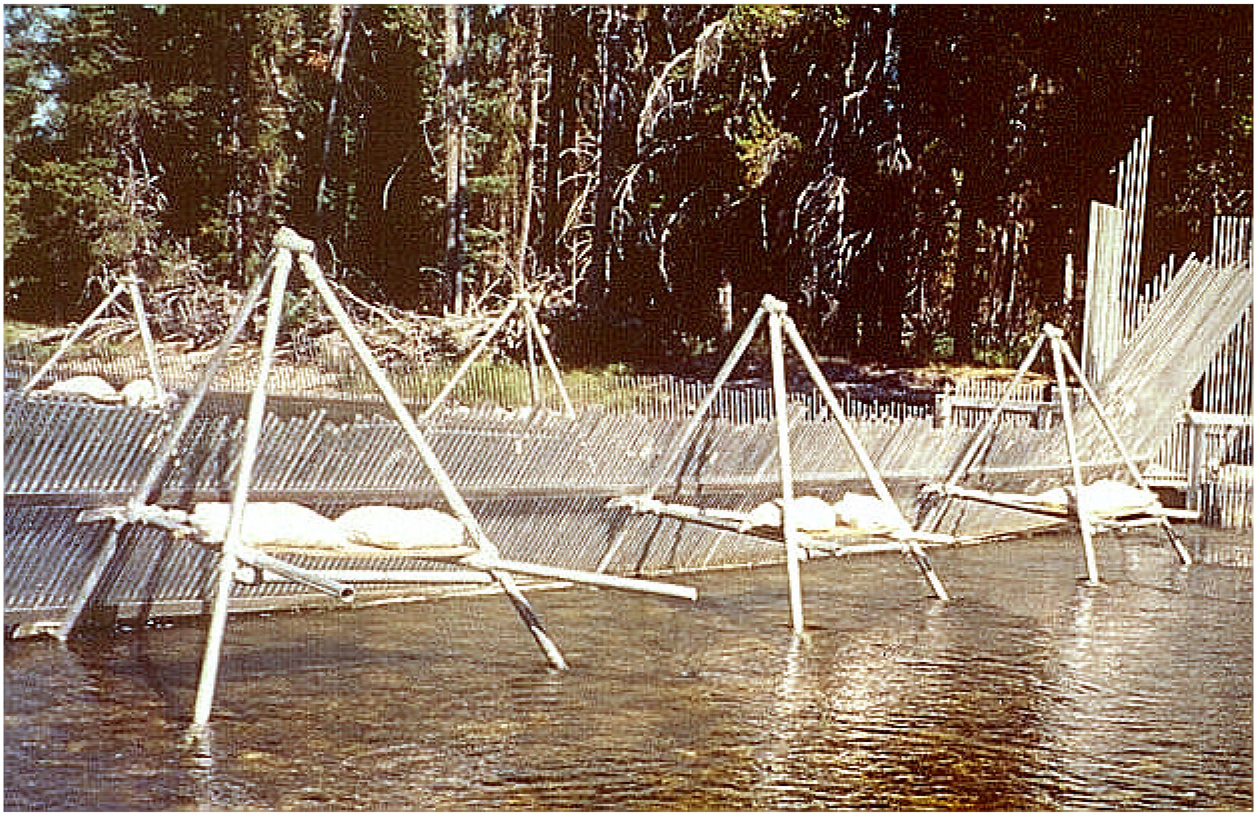

Figure 4. Temporary tripods, pickets and stringers used on the fish guiding fence.

An adjustable camera platform was located on the side of the counting chamber (Figure 6). This adjustable platform allowed the camera to be moved up, down, forward and / or backward as the water level fluctuated to ensure the entire field of view in the counting chambers was recorded on the tape. Positioning the camera as close to the bottom, still including the entire field of view, provided the best view of fish moving through the counting chamber. Photographs of individual salmon were taken through a clear Plexiglas® window mounted on the lower half of the counting chamber on the near side. On the far side of the counting chamber, an aluminum sheet, painted off white, was mounted on the lower half of the chamber to create a contrasting background for the photos.

Fish images were recorded in time-lapse (2 frames per second) on 8 mm videotape. Recording occurred continuously while the counting stations were operating. Artificial red light was provided by two to four arrays of 36 LEDs (Light Emitting Diodes). The LEDs illuminated in the red portion of the light spectrum (approximately 690 nm). All electrically powered equipment used 12 volt DC due to the remote location. All connectors were waterproof O-ring sealed type. Two six-volt golf cart batteries in series supplied power to the system. Photographs of individual salmon (Figures 7, 8 and 9) were recorded in time-lapse (2 frames/sec) on 8 mm videotape.

Figure 5. Counting chamber structure.

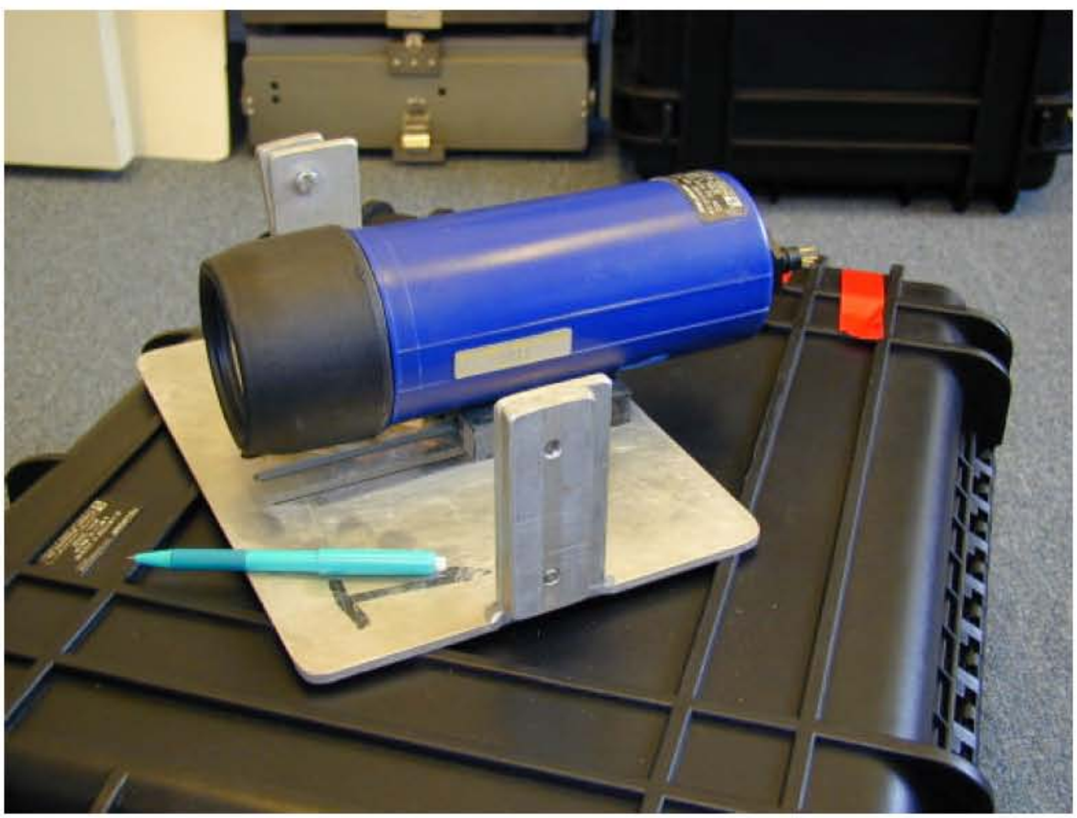

Figure 6. Camera and adjustable mounting bracket.

Procedure

Personnel replaced videotapes and cleaned the weir structure daily. Videotapes were capable of recording about 32 hours of information, but were changed daily. Batteries were replaced as necessary to ensure efficient project operation. In 2001, completed Lake Creek videotapes were taken immediately to the office where they were manually reviewed for proper operation and data obtained. The computerized editing system for video monitoring of fish passage described in Hatch et al. (1998) did not work again for our system in 2001. Data obtained was species, number of adult chinook salmon, date of passage, time of day of passage, direction of passage, estimated length and gender, and other marks such as fin clips or unique scars to identify individual fish (Figures 7, 8 and 9). A VHS master tape of just the actual fish passages was produced for further review and verification of data. The date-time stamp on the videotape provided date and time of passage. Direction of fish movement was noted as upstream or downstream.

Species identification was fairly simple. All adult chinook salmon were 50 cm or larger. The only other fish to reach that size were whitefish, which were not a problem to differentiate from videotape images, and bull trout. Bull trout and jack chinook salmon were differentiated by the longer anal fin and flattened body form of bull trout. Secondary identification characteristics were the squarer tail and erect dorsal fin of bull trout. Movements of bull trout 40 cm and larger were noted. Fish species identification of fish smaller than 40 cm was difficult and their movements were not recorded.

Fish lengths reported here were determined by measuring the fish against a 10 cm grid system that was marked on the bottom and back plates of the counting chamber. The resulting accuracy was ±10 cm. Lasers were used to measure some fish lengths in 2000 and 2001. Two lasers mounted parallel, 5 cm apart, produced marks on fish as they swam through the counting chamber (Figures 10 and 11). Fish length was determined by using proportions (Distance between the two laser marks measured on the monitor/Actual distance between the two lasers (5 cm)) = (Fish length measured on the monitor/Actual fish length) and solving for the unknown Actual fish length.

Fin clips were noted to determine the number and percentage of hatchery chinook salmon in the run. Ventral fin clips from South Fork Salmon River hatchery smolt releases were hard to detect, especially those on the side away from the camera. In 2001, the incidence of poor adipose fin clips appeared to be less than in 1998 and 1999 and we estimated the occurrence of missing adipose fins to document straying. Incomplete adipose fin clips had been observed in 1998 and 1999. For this reason, no attempt was made to quantify the amount of straying in 2000.

Equipment failure was experienced, on occasion, during the 2001 field season. Most of this was due to clogged heads early in the morning, a few hours before the daily changing of tapes. Outages were relatively short and passage correction factors were easily calculated (Appendix Table A-4). Equipment is getting old and should be replaced prior to next season.

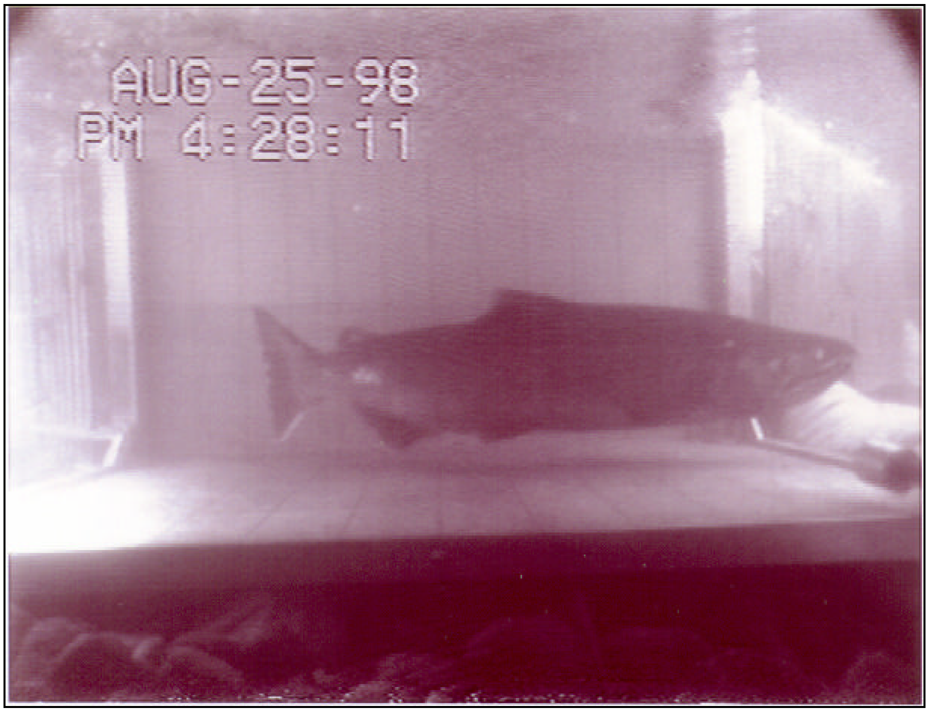

Figure 7. Underwater video photograph of a male chinook salmon migrating through the fish counting chamber in daylight.

Figure 8 Underwater video photograph of chinook salmon migrating through the fish counting chamber at night.

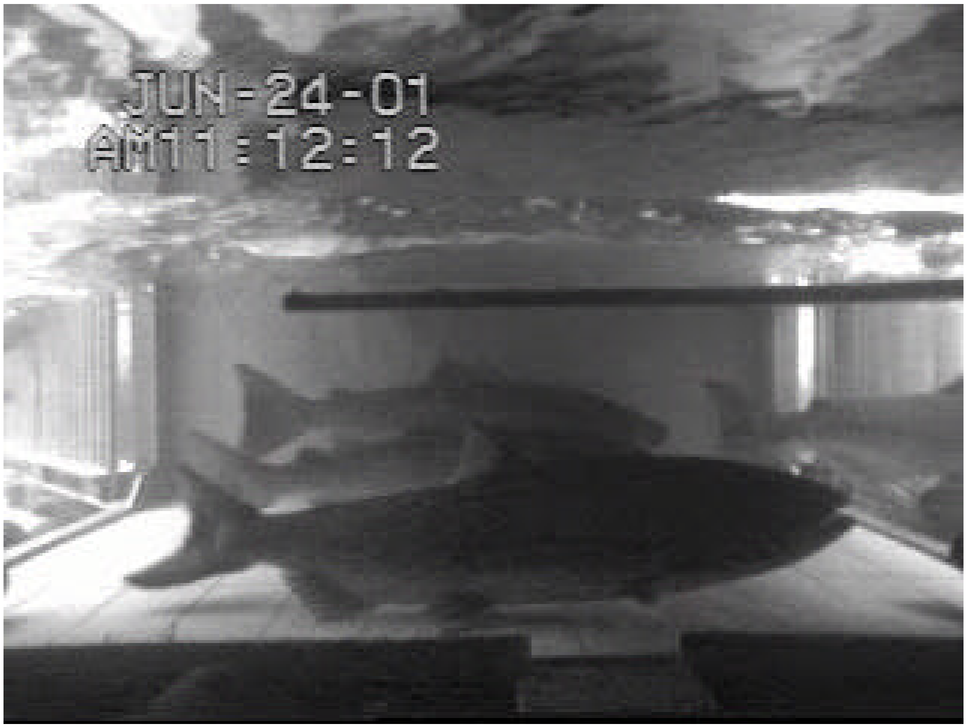

Figure 9. Underwater video photograph of multiple (4) chinook salmon migrating through the fish counting chamber. The salmon in the foreground is missing the adipose fin.

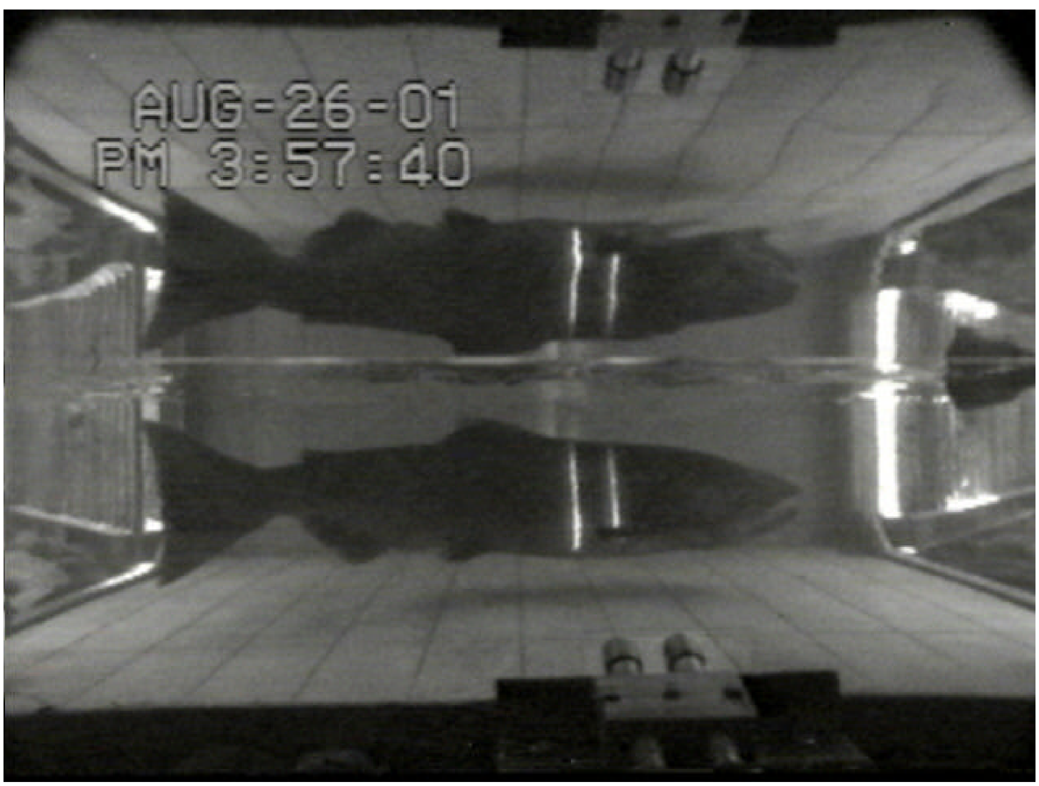

Figure 10. Adult chinook salmon with narrow laser lines. Upside down image is a reflection from the water surface.

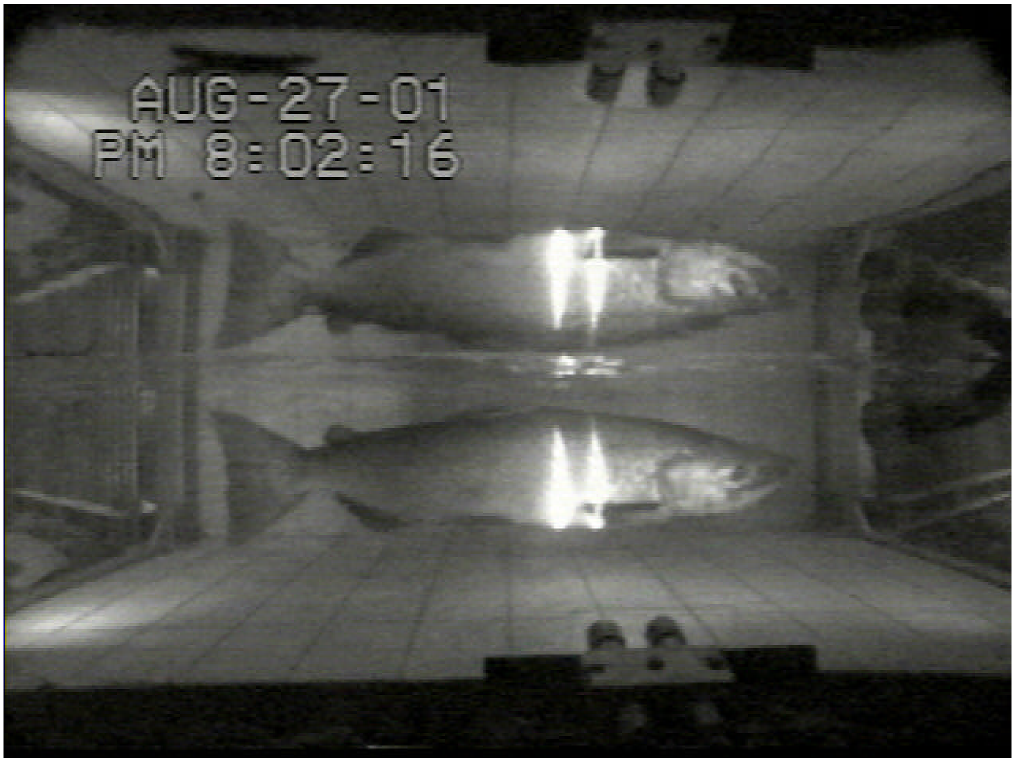

Figure 11. Adult chinook salmon with wide laser lines.

Corrections for downtime were made by using an hourly average of fish passages, during the hours of the outage, two days prior to and two days after the outage. This hourly average was then multiplied by the number of hours of the outage. The downtime correction was applied as it occurred. Fish numbers discussed in this report have had the downtime correction applied.

A correction for tape-viewer-efficiency was determined for passages missed by the observer. Net escapement observed by the reader was compared to the complete net escapement. Weekly, a day of the week was randomly drawn from a hat and that videotape was read by two other tape readers. The combination of results of the three observers produced a complete net escapement. Since upstream and downstream fish passages may not have been "missed" equally, the efficiency factor was applied to net upstream movement. The tape-viewer efficiency correction number was applied at the end of the season and is not used for discussions. This correction was not determined in 1998, 1999 and 2000 reports. Corrections to 1998, 1999 and 2000 results have been applied in this years report.

Sex composition of migrating adult salmon could not be determined positively early in the season. Visual characteristics were used for sex determination. The primary characteristic was the shape of the head and the development of the male kype. These characteristics became more pronounced as the migration progressed. Male chinook salmon have a tendency to a larger adipose fin. This was sometimes used to aid gender determination.

Determination of net escapement during the course of the upstream migration was simply a matter of adding to the total as a fish passed upstream, and subtracting as a fish moved downstream. Downstream movement in chinook salmon has been documented in the Kenai

River (Bosch and Burwen 1999), Deep Creek (Iverson 1996), Yukon River (Ransom et al. 1998) and Lake Creek and the Secesh River (Faurot and Kucera 1999, Faurot et al. 2000, Faurot and Kucera 2001a, Faurot and Kucera 2001b and this report) and at dams (fallback) (Bjornn et al.1999 and 2000). To minimize the impact of fish wandering while searching for a suitable spawning location, fish counting stations were placed downstream of as much spawning area as feasible. To determine the final number of fish that contributed to production it was assumed males could regenerate sperm. Males that dropped out of the system after the peak of spawning, whether they were dying or attempting to locate another female, were assumed to have spawned and included in the total net escapement. Females upstream of the fish counting station during the time of spawning were all assumed to have contributed to spawning. Thus, the greatest number of fish above the fish counting station after spawning commenced was considered to have contributed to spawning.

DESIGN AND PLACEMENT CRITERIA

Operation of the fish counting station structure was compared to water depth and velocity criteria recommended by Hevlin and Rainey (1993). These criteria were examined relative to safety and structural integrity of the facility given the hydrologic conditions at the site. If the recommended criteria could not be safely met the facility could be removed and installed when the criteria were achievable. More importantly, the structure could determine what the criteria actually should be for the specific installation site. Total snow pack, rate of snow melt, and debris load all affect installation of the fish counting stations.

RESULTS AND DISCUSSION

OPERATIONS

As this project dealt with a threatened species, special efforts were made to reduce potential impacts to the resources. Everything was designed to have minimal impact to the resources and the landscape. Fish were never trapped, handled or held. Structures were temporary and could be installed and removed in a day. In NMFS standards for barrier/trap installations, Hevlin and Rainey (1993) describe numerous unanticipated adverse fish impacts associated with standard fish barriers and traps. These included trap rejection, fallback downstream and spawning below the barrier. In rare instances, spawning has been displaced to another tributary. These structures are usually constructed perpendicular to the stream bank with a small entrance, to prevent fish from escaping the trap once they had entered. The design of our temporary weir funneled fish into the passage opening from upstream and downstream with an opening 0.86 m wide. Fish were not restricted in passage, upstream or downstream. Each year there were fish that made multiple passages (greater than 10), upstream and downstream, over a period of several days (Faurot and Kucera 1999, Faurot et al. 2000, Faurot and Kucera 2001a and Faurot and Kucera 2001b). This design has demonstrated that fish movement was not impeded and should be incorporated in future weir designs where possible.

In 1999, we installed Lake Creek and Secesh River structures prior to spring runoff and both failed due to the high water and heavy debris load. The basic structure may have been able to withstand stream flows. However, the high water recruited a heavy debris load that had accumulated from previous lower flow years. Debris accumulated on the basic structure (tripods etc.) and it failed. Very little damage occurred to the structure. Most of the tripods did not fail, but instead were tipped over and dislodged. Anchoring the front leg of the tripods to the substrate may prevent this.

The South Fork Salmon River drainage (Secesh River and Lake Creek) has a high percentage of surface fine sediments that may affect salmon reproductive success. Over the past 20 years, the Payette National Forest has restricted activities that would contribute to sedimentation. Sandbags are routinely used to add weight to tripods, seal open areas between the substrate and pickets, fill the space between end of the pickets and the undercut banks, reinforce banks to prevent sloughing, and build entrance and exit areas to the stream. We used sandbags filled with spawning size gravel. Bags that broke or deteriorated contributed spawning gravel to the stream instead of fine sediment. Impacts to the riparian area were minimized by utilizing distinct pathways covered with bark chips.

Power was not available at our remote location. We initially used 12 volt deep draw batteries. This required constant recharging in the shop and transport, or onsite charging with a generator. Numerous power outages were experienced with this method. We then tried alternative sources of energy. A hydrogenerator (basically a propeller) was used in 1998. This worked early in the spring during high flows, but was not sufficient as the water level dropped and current velocity was reduced. A minimum current velocity of 0.9 m/s was required to produce a charge to the batteries. Batteries are now being charged on-site, with three 75 watt solar panels. On a sunny day, charge rates above 14 amps per hour have been seen. It takes about three days of rain and overcast skies to require a battery change. An entire season with no battery change required has occurred. Twelve-volt deep draw marine type batteries were not satisfactory for our use. Initially several 12 volt batteries in parallel were used to power the system. We have since changed to two 6 volt golf cart batteries in series to provide more amperage.

Red LED lights were chosen to provide nighttime lighting in the counting chamber. Infrared lighting has been advocated, however, infrared light dissipates rapidly in water and we have not used it. White light was not used because of the amperage draw of 5 amps per hour compared to ½ amp per hour for the red LED's and to eliminate possible fish avoidance of white light. In 1997 and 1998, two LED light arrays were mounted beside the camera, approximately four to five feet from the fish. Since 1999, LED arrays have been attached on the inside of the Plexiglas viewing window, facing the back plate, for better illumination of the counting chamber. Lights could be positioned on the bottom and middle of the counting chamber at the entrance and exit. Four light arrays are now used at high water levels. The top two lights are removed when the water level recedes below them. This provides much better viewing and appears to be a requirement for operation of the computer editing system.

Initially, T-120 8mm videotapes were used with the 8mm time-lapse recorders. A videotape lasted about 30 hours at 2 frames per second. The 8mm recorders were replaced by VHS recorders. We now use T-160 VHS videotapes capable of recording about 32 hours of information, in the extended play mode, at 4.5 frames per second. Both systems were reliable, although VHS videotapes were less expensive and provided more frames of fish passage. Videotapes were taken immediately to the office where they were manually reviewed for proper operation and data obtained. With both Lake Creek and the Secesh River fish counting stations in operation, the manual review process was too time consuming and review of one station's videotapes would gradually fall behind. However, both videotapes were checked to ensure lights were operating at night and the video recorder was operating properly. Malfunctions could then be quickly corrected.

The computerized editing system for video monitoring of fish passage described in Hatch et al. (1998) did not work again for our system in 2001. It has been a constant struggle to provide bright, even lighting at night and to prevent bright uneven lighting during the day. Lighting in the counting chamber must be kept as even and constant as possible. The editing system is triggered by a change in contrast of the background, as when a fish passes in front of the white panel background. Early in the season, high flows caused turbulence and bubbles that triggered the system. A piece of plywood floated on the surface in the counting chamber reduced the turbulence. Salmon used this as cover and stayed in the counting chamber for excessive times, thus defeating the purpose of the editing system. At low sun angles, shafts of bright sunlight entering the counting chamber triggered the system. The entire counting chamber area is now covered by parachute rip stop nylon to diffuse areas of bright light. Daum (USFWS Fairbanks, personal communication) has used clear Lexan® to cover the fish passage area.

Fish lengths have been determined by measuring the fish against a 10 cm grid system that was marked on the bottom and back plates of the counting chamber. This involved interpretation. Fish appeared larger by obscuring more grid marks the closer they were to the camera. Trying to project a line from the fish's nose and tail to the bottom grid marks became more difficult as the fish move up from the bottom plate. There was a difference in fish length determinations between readers. The resulting ±10 cm accuracy was unsatisfactory. In 2000, lasers were purchased to determine lengths using proportions. These lasers produced a dot. Most fish swam above, below, right or left of the laser dots. One of the lasers was not waterproof and malfunctioned. In 2001, we purchased a better quality underwater laser with line generating optics. When mounted, these produced two parallel lines over an 80 degree arc. Using proportions, fish lengths could be calculated. Shortly after installing the line generating lasers, the lines started randomly changing in width from thin to broad (Figures 10 and 11) and results were not consistently reliable. The problem was corrected after the season. We expect fish lengths determined by lasers to be negatively biased. A true length measurement would require the fish to be perfectly perpendicular to the camera and lasers. Any curve in the fish's body as it swims or fish swimming toward or away from the camera would result in a shorter fish presented to the camera and a shorter calculated fish length. No fish were captured to validate the accuracy.

ABUNDANCE AND MIGRATION TIMING

Fish that enter the Secesh River are believed to belong to two spawning aggregates, Secesh River and Lake Creek. Lake Creek fish must migrate upstream through the Secesh River to get to Lake Creek. Lake Creek fish are believed to enter first, move upstream to colder headwater areas, and begin spawning early to mid-August (NPT unpublished data). Observations from this project in 1998 and 1999 have indicated males may spawn with both Lake Creek and Secesh River spawning aggregates. This was not as noticeable in 2000 and 2001. The Secesh River/Lake

Creek spawning aggregate has been in a long-term decline (Elms-Cockrum 1999), although the last two years have evidenced higher adult returns.

The winter of 2000/2001 had a very light snowfall (38% of normal) and spring runoff was low. The Lake Creek fish counting station was installed prior to spring runoff, in 2001 in an attempt to ensure early operation of the facility. Installation of the structure occurred on May 21 and operation began immediately. The first upstream migrating adult salmon passed the site on June 9, 19 days after the initiation of underwater videotaping (Table 1). This period of no fish passage leads to the conclusion that video coverage of the first fish passage of the adult salmon spawning migration occurred in 2001. Net escapement was low the first week, increased rapidly the next three weeks, then slowed around July 7 and continued at a low rate for the duration of the season (Figures 12 and 13).

One task within the original project was to estimate the number of hatchery strays into the system. All hatchery-reared chinook salmon were adipose fin-clipped. The requirement to enumerate strays was not accomplished in 1998 and 1999 (Faurot et al. 2000) due to the difficulty distinguishing between poor/partial fin clips and small or naturally damaged fins. This did not seem to be a problem in 2001 and adipose-clipped fish were counted. Of the net escapement, 7.5 % were missing the adipose fin.

Lake Creek

The Lake Creek fish counting station was installed on May 21, 2001 prior to peak spring runoff, and operation began immediately (Table 1). There was a net escapement of 697 spring and summer chinook salmon that contributed to spawning in Lake Creek in 2001 (Figure 12). The Lake Creek fish counting station videotaped 648 adult spawners migrating into Lake Creek in 2001. A correction for periods of downtime, using average passage information from the same time period two days prior and two days after the outage (Faurot and et al. 2000, Faurot and Kucera 2001a and Faurot and Kucera 2001b), added 40 fish. A correction for reader efficiency added another 9 fish. This escapement was about ten times greater than the 1998 and 1999 escapements (Figure 12) and twice the size of the 2000 escapement. The run size was much larger, as also evidenced by the greater number of fish passages through the fish counting chamber (221 in 1998, 418 in 1999 1,294 in 2000 and 1,828 in 2001) (Table 1) and the greater number of redds counted. Nez Perce Tribe index area redd counts (296) and intensive area redd counts (337) (NPT unpublished data) were the highest since 1960 (195) (Elms-Cockrum 1999, IDFG unpublished data). The final number of spawning chinook salmon used for comparisons to redd counts in Lake Creek in 2001 was 697. The fish count above the fish counting station decreased slightly at the end of the season as dying fish drifted out of the area. The last fish passed downstream on September 6. When operations ended on September 14, a minimum of 678 fish remained above the fish counting station.

The first fish in 2001 was observed on June 9, 19 days after operation commenced (Table 1). This was the earliest starting-date of operations since the inception of the project. The first fish arrived on July 9 in 1998, July 11 in 1999 and prior to June 22 in 2000. Snow pack in the spring of 2001 was one of the lowest on record (38% of normal) and the arrival of the first fish was the earliest of the four years of project operation. This early arrival in 2001 was probably the result of the low snow runoff. Net escapement increased slowly the first week of the migration (June

Table 1. Summary of major chinook salmon escapement dates in Lake Creek, 1998 to 2001.

Activity	1998	1999	2000	2001
Installation	22 June	9 July	22 June	21 May
First fish	8 July	11 July	Prior to 22 June	9 June
Peak net upstream movement	18 July (6)	20 July (14)	27 June (27)	22 June
Median net upstream passage	18 July	21 July	Undetermined	29 June
Peak of activity	6 August (29)	19 August (34)	7 August (113)	22June
Last fish	26 August	3 September	31 August	6 September
Operation ceased	15 September	13 September	12 September	14 September
Number of fish passages	221	418	1294	1828
Escapement	51	86	>325	697

9-16) and increased rapidly the next three weeks (June 17 to July 5). Net escapement increased slowly the rest of the season, with a slight decrease at the end of the season (Figure 13). Peak of net upstream migration occurred on June 22, 13 days after the arrival of the first fish. The single day peak of net escapement occurred on June 22, when a net of 52 chinook salmon passed upstream through the fish counting station (Figure 12, Table 1). The maximum escapement for the season occurred on August 30, when an estimated 688 chinook salmon had migrated upstream through the Lake Creek fish counting station (Appendix Table A-1). The height of adult chinook salmon spawning in Lake Creek in 2001 occurred between August 9 and 23 (Lockhart NPT, unpublished data). Arrival of the first fish, the median passage and the peak of net upstream movement, in 1998 and 1999, were all within two to three days of each other (Table 1). Snow pack in the springs of 1998 (72% of normal) and 1999 (148% of normal) represented substantially different runoff years. Data from those two years of operation had led us to believe the run timing of the Lake Creek spawning aggregate was fairly rigid. However, results from 2000 and 2001 indicated that salmon migration timing in natural production areas can vary as much as three weeks. In 2001, the date of median passage and peak of net upstream movement occurred earlier than the date of the first fish arrival in 1998 and 1999. The pattern of migration into Lake Creek in 2001 was different than 1998 and 1999 and more similar to 2000 (Figure 12). Net escapement into Lake Creek increased throughout the season in 2001 and 2000. In 1998 and especially 1999, net escapement decreased during the second segment of the run (Figure 12). We suggested this decrease was attributed to males that had spawned in Lake Creek and were dropping downstream to ma te with later spawning Secesh River fish. There was a large component of jacks and a small component of females in 1999 that might have contributed to this movement.

The adult spring and summer chinook salmon count over Lower Granite Dam in 2001 was 185,693 fish. Of these, 28,951 were estimated to be wild fish. Escapement into Lake Creek represented approximately 2.2% of the wild run over Lower Granite Dam (Table 2). About 65 (10.0%) of the spawner escapement in 2001 were jacks. This is the largest number of jacks

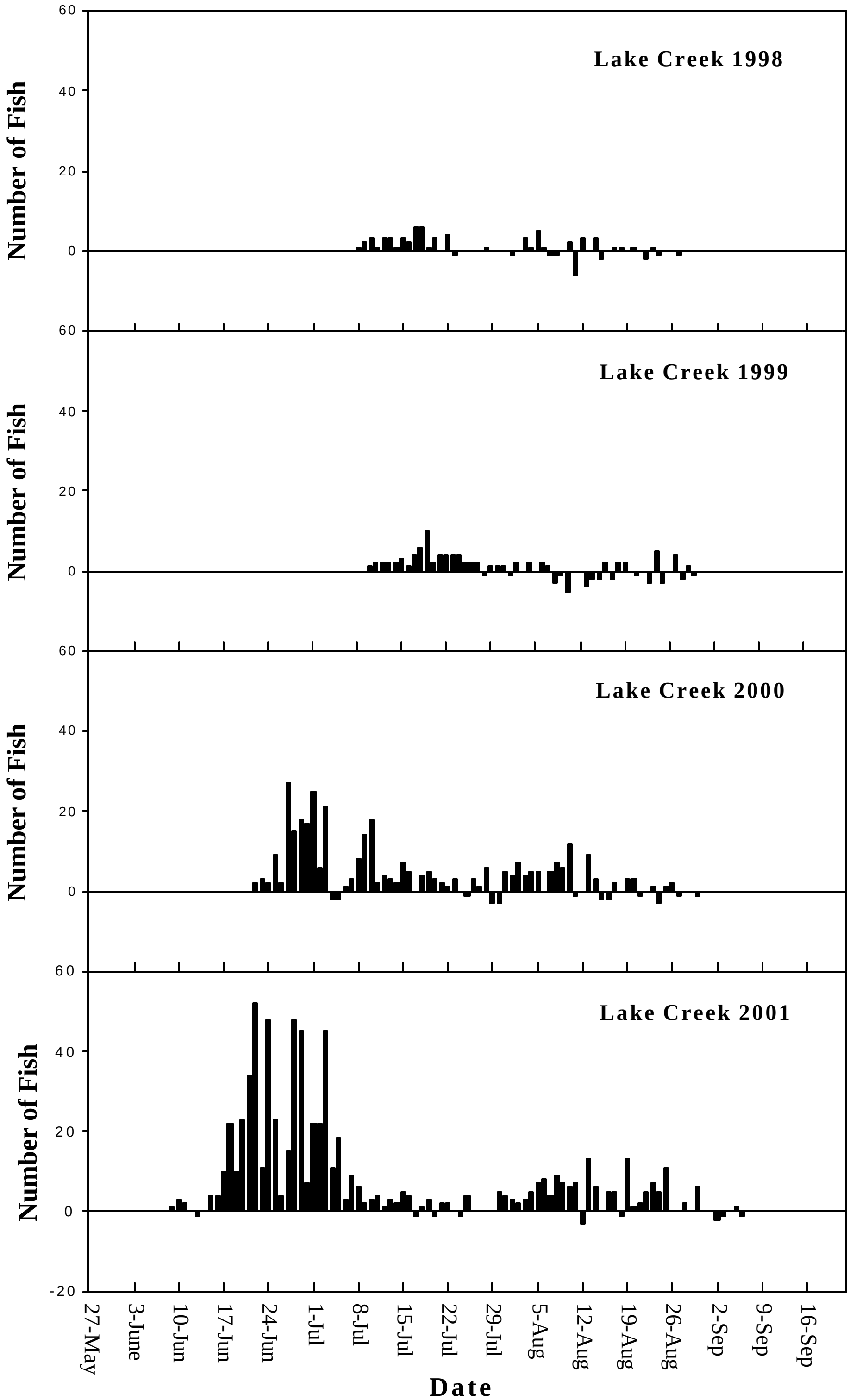

Figure 12. Net upstream spawning migration of adult spring and summer chinook salmon migrating through the Lake Creek fish counting station from 1998 to 2001.

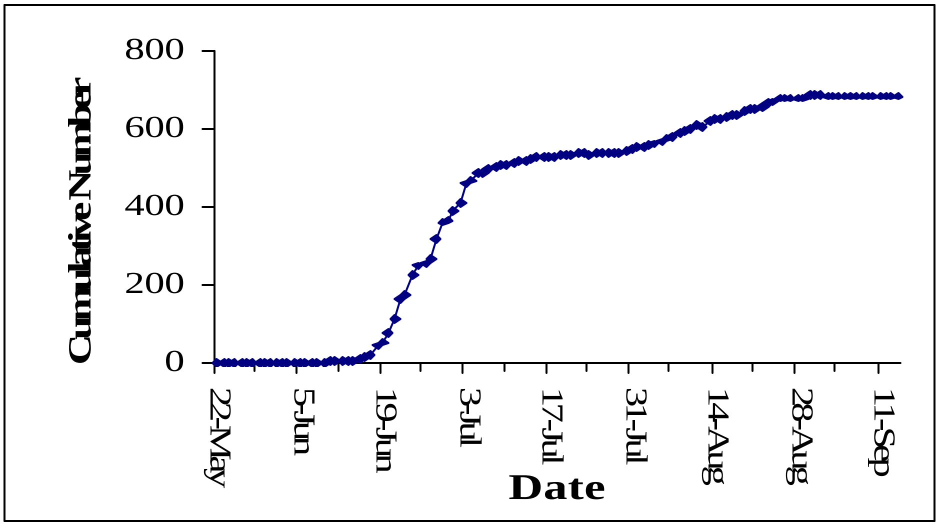

Figure 13. Cumulative observed adult spring and summer chinook salmon spawner escapement at the Lake Creek fish counting station in 2001.

Table 2. Percent of wild adult spring and summer chinook salmon counted over Lower Granite Dam that spawned in Lake Creek and the Secesh River watershed, in 1998 to 2001 (TAC Biological Assessment Tables, corrected).

Lower Granite Dam Wild Fish Count		Lake Creek		Secesh River	
Year	Number	%	(Number)	%	(Number)
1998	8,002	0.6	(52)	1.8	(>152)
1999	2,688	2.0	(86)	4.4	(>144)
2000	7,333	4.2	(>325)	8.7	(>777)
2001	28,951	2.2	697	Not sampled	

observed in Lake Creek during the operation of the project (Table 3). The 18 jacks that migrated in 1999 represented a larger proportion (20.9%) of the spawning population.

In Lake Creek in 2001, as in 1998 through 2000, there appeared to be two behaviorally distinct segments to the spawning migration (Figures 12 and 14). Rapid upstream migratory movement of both sexes characterized the first segment. Increased upstream and downstream movement of males which appeared to be associated with spawning activity characterized the second segment. This behavior (increased total activity) is illustrated in Figure 14 and Appendix Table A-3. In 2001, the separation between the two segments occurred from July 6 to 30 (Figures 12 and 14, Table 4). On July 6, 2001 net upstream movements and total movements decreased and remained low until July 30 (Figures 12 and 14, Appendix Table A-3). On July 31 there was a very definite increase in total movements that continued until fish started dying (Appendix Table A-3). Net escapement continued to increase slightly during the second segment (Figure 13).

In our first year of operation at Lake Creek, 1998, the fish counting station was installed June 22 and the first fish arrived July 8. Snow pack was low in 1998 (72% of normal), which allowed the county to plow open Secesh Summit earlier than the usual Memorial Day weekend opening. Even though 17 days elapsed without an adult chinook salmon passage, there were questions concerning an early spawning segment that might have arrived prior to structure installation.

Table 3. Number and proportion of jacks in the Lake Creek spawning migration 1998 to 2001.

Year	Escapement Videotaped	Jack Numbers	Jack Proportion (%)
1998	52	0	0
1999	65	18	27.7
2000	293	27	9.2
2001	648	65	10.0

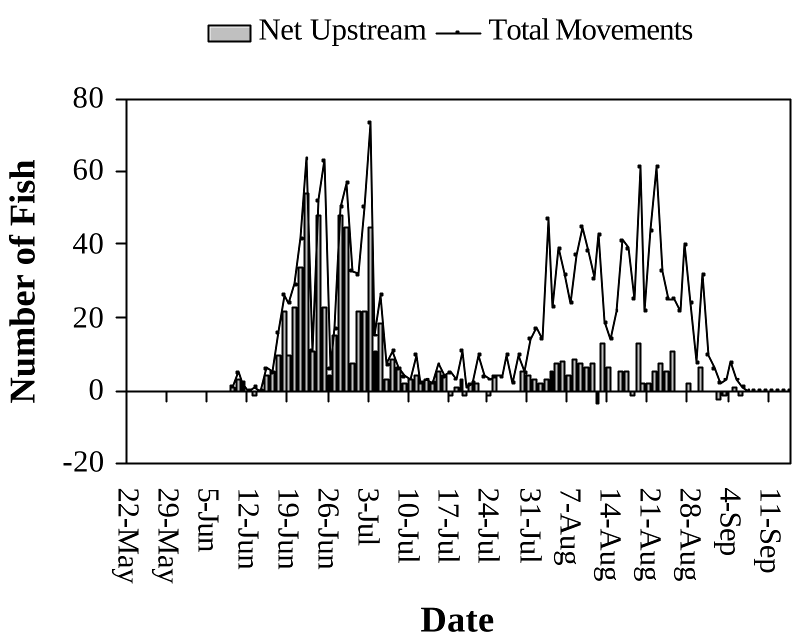

Figure 14. Daily net upstream and total movements of adult spring and summer chinook salmon through the Lake Creek fish counting station in 23001.

In 1999, an above normal snow pack year (148% of normal), we decided to install the basic structure (no pickets) prior to spring runoff. The road was not open so materials were hauled in over the snow by snowmobile. Lake Creek installation occurred April 29. Spring runoff peaked in mid to late May. The basic structure may have been able to withstand stream flows. However, the high water recruited a heavy debris load that had accumulated from previous lower flow years. Debris accumulated on the basic structure (tripods etc.) and it failed on May 26 (Figure 15). The structure was recovered and the complete structure was reinstalled on July 9. Fish were not recorded on July 9 or 10. We assumed the first fish passage we documented on July 11 was the first fish of the run. This led us to believe the run timing at Lake Creek was fairly rigid. In 2000, the complete Lake Creek structure was installed June 22, 16 days earlier than the arrival of our fish in the first two years of operation. Fish were recorded moving past the fish counting station immediately, indicating run timing could vary as much as three weeks. The fish counting station was installed during peak runoff in 2001. This was a low flow year (38% of normal) and stream discharge at the time of installation was approximately 150 cfs. Installation occurred on May 22 and the first fish was not documented until June 22. This led us to believe there was not an earlier segment to the spawning migtation.

Table 4. Approximate dates of change between the first and second segments of the chinook salmon spawning migration in Lake Creek and the Secesh River, 1998 – 2001.

Year	Lake Creek	Secesh River
1998	July 25 – August 4	July 29 August 5
1999	July 30- August 6	July 30 – August 6
2000	July 11 – July 28	July 20 – July 29
2001	July 6 – July 30	*

* not sampled

Secesh River

The original goal of this project in 1997 was to accuately assess the spring and summer chinook salmon spawning migration into the Secesh River. One of the objectives was to test the remote application of the temporary fish counting station. The temporary structure was placed in the stream, on private property, below most of the major spawning areas. High water prevented installation of the facility in time to photograph the first adult salmon passage. We had not tested the capability of the temporary fish counting facility. In 1998, the fish counting station on the Secesh River was moved 1,000 meters downstream from the 1997 site to a better location on U. S. Forest Service land. This site was downstream of more spawning area, and was wider and shallower for earlier high water installation. And, in 1998, a second fish counting station was installed on Lake Creek, a headwater tributary of the Secesh River (Faurot et al. 2000). Lake Creek is a smaller stream, is easier to work in, and is assumed to be a separate spawning aggregate of chinook salmon. Both fish counting stations were operated in 1998, 1999 and 2000. The basic structures were installed prior to spring runoff in 1999. Like the Lake Creek structure (see above), the Secesh River structure failed during high spring flows (Figure 15).

Figure 15. Failed Secesh River fish counting station.

We were not able to install the Secesh River fish counting station in time to photograph the first fish passage in any year. In 2001, the Secesh River fish counting station was not installed due to a lack of success in the previous four years. To be successful, it is imperative the fish counting station be operational in time to document the first fish passage of the season. The temporary fish counting station, in its present configuration, does not fulfill that need on the Secesh River. Increased size and discharge of the Secesh River provided more challenge. We need to find an efficient way to determine salmon abundance in the Secesh River each year. Other potential methods of documenting the first fish passage in the Secesh River were evaluated in 2001. The desire was to use temporary structures and fish friendly methods. Most of the solutions involved newer technologies such as hydroacoustics, acoustic imaging, resistivity and electronic counters. A quad multiplexed split-beam hydroacoustic array in conjunction with underwater time-lapse video was selected as the method that would best estimate fish abundance on the Secesh River. This would provide four independent hydroacoustic estimates during high flows. As flows dropped the video equipment would be installed and would be the primary abundance estimator. When both technologies were operational, results would be compared

POTENTIAL SOURCE OF ERRORS IN UNDERWATER VIDEO MONITORING

Potential sources of errors in determination of spawner abundance by the underwater video methodology are listed in Table 5 and are described in Faurot et al. (2000). Corrections were made for downtime (turbidity, equipment) and videotape reader efficiency (missed passages). A total of 40 fish (5.7%) were estimated to have passed the Lake Creek fish counting station during downtime (Appendix Table A-4). Video recording was 97.0% operational (78.37 hours of downtime) while the fish counting station was in place. A tape-viewer-efficiency was determined for passages missed by the observer. Net escapement observed by the reader was compared to net escapement determined by multiple readings of 10% of the videotapes, selected randomly. The tape reader correctly observed 98.4% of the actual adult net escapement. This correction amounted to an addition of 9 adult chinook salmon (1.3%) to the Lake Creek escapement. It was felt that no fish passed undetected before installation, around the ends or under the fish guiding fences. All uncorrected sources of error were minimal, in 2001.

Table 5. Potential sources of error in video abundance estimation methodology in Lake Creek in 2001.

Concern	Potential Effect
Fish passed before installation	None
Fish escaped under the pickets of counting station	None
Fish escaped around the ends of the fish guiding fences	None
Fish passed during high turbidity and periods of down time	Corrected
Tape observers missed fish passages	Corrected

COMPARISON TO REDD COUNTS

Reliable and accurate spawner abundance estimates from unsupplemented salmon spawning aggregates are a necessary tool to monitor ESA listed species. Index area salmon redd count information is subject to a variety of potential sources of error (e. g. environmental and hydraulic conditions, observer experience, interobserver variation, single versus multi-pass, date of survey). Those errors are compounded and new errors are introduced when redd counts are expanded. Expansion of redd counts using an **average** fish per redd number, such as PATH (2.31) (Beamesderfer et al. 1998) or ISS (3.2) (Walters et al. 2000), over an entire drainage do not account for year to year variations or differences among tributaries. At low population levels, unbalanced age structure (e.g. no jacks in Lake Creek in 1998) makes an average fish per redd number much less reliable. Index area redd counts in Idaho provide valuable trend information, but they were not designed to provide escapement estimates (Kiefer et al. 2001). To try to force them to provide this information can be misleading especially when dealing with an ESA listed species.

The third objective of this study was to determine the accuracy of redd count methodology compared to the underwater video adult abundance estimate. Each method should be scrutinized based on their intended purpose, advantages and disadvantages, so that managers better understand what they base decisions upon. Each method must stand on its own merits. Underwater video provides actual chinook salmon abundance numbers. Actual abundance is used with other information to provide accurate fish per redd numbers, spawner to spawner ratios, recruits per spawner and population growth rates. "Index redd counts conducted by the IDFG are used for trend information, not escapement estimates" (Keifer et al. 1996). Ortmann (1966) reported: "Redd counts….while providing our best yearly trend information, introduce considerable positive bias when used to estimate the number of fish in an escapement, and should be recognized as trend indicators only". Redd counts vary tremendously by observer and conditions. Dunham et al. (2001) found observer redd counts ranged between 28% and 254% of the best estimates of bull trout redd numbers. Redd counts are then expanded by a fish per redd factor that varies greatly and is influenced by a variety of errors and inaccuracies. "Expansion of redd counts to spawner and recruit numbers are influenced by measurement error and uncertainty of assumptions regarding estimates of fish per redd, ….." (Beamesderfer et al. 1998). Further error is introduced by using an average fish per redd value of 2.31 fish per redd (Plan for Analyzing and Testing Hypothesis (PATH) (Beamesderfer et al. 1998), or 3.2 fish per redd (Idaho Salmon Supplementation Studies (ISS) (Walters et al. 2000) each year, for the South Fork Salmon River. Redd counts, in general, have provided valuable long-term population trend information and biological data from carcasses. There are too many salmon streams in Idaho to use video or other high technology methods on all of them. Index or intensive area redd counts and trend information are appropriate for most of these.

Adult salmon spawner abundance data in Lake Creek for 1998, 1999 and 2001 was compared to expanded redd count information (intensive surveys and index area) from these same years to examine the differences between adult estimation methods. Fish per redd numbers used by PATH (Beamesderfer et al. 1998) and ISS (Walters et al. 2000) represented the range in fish per redd values used for redd count expansions. Within the South Fork Salmon River, PATH used a 2.31 fish per redd number, while ISS used a 3.2 fish per redd value each year. These fish per redd numbers were applied to expand intensive survey redd counts and index area redd counts into estimated adult numbers. The expanded area intensive surveys would be expected to produce higher population estimates compared to the index area surveys.

Intensive survey redd count expansions to estimate spawner abundance were examined first, using PATH and ISS fish per redd numbers, because it provided the most comparable information to the underwater video determined abundance. Intensive survey expansion abundance estimates for 1998, 1999 and 2001 have varied from 214% greater to 36% fewer fish than video based spawner abundance estimates. Underwater video technology determined an adult spawner abundance of 697 fish in Lake Creek in 2001 (Table 1). Intensive redd count surveys during that same year totaled 337 redds (NPT - unpublished data). Application of the PATH fish per redd numbers estimated 778 spawners in Lake Creek in 2001, which is 12% higher than the actual spawner abundance (Figure 16). The ISS approach estimated 55% more spawners (1078 fish) in Lake Creek. In 1999, underwater video technology determined an adult spawner abundance of 86 fish in Lake Creek (Table 1). Intensive redd count surveys during that same year totaled 24 redds (NPT - unpublished data). Application of the PATH fish per redd

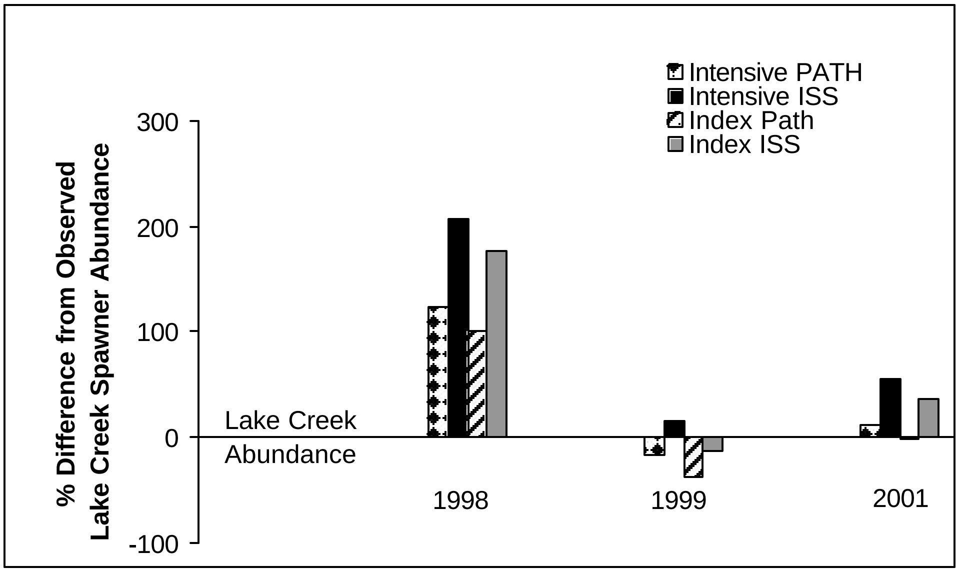

Figure 16. Estimated percent difference of various chinook salmon redd count expansion methods when compared to Lake Creek spawner abundance estimates in 1998, 1999 and 2001.

numbers estimated 55 spawners in Lake Creek in 1999, which is 36% lower than the actual spawner abundance (Figure 16). The ISS approach estimated 11% more spawners (77 fish) in Lake Creek. Intensive survey redd count expansions in Lake Creek in 1998 (Figure 16) proved much more variable than the 1999 or 2001 data. Salmon spawner abundance in Lake Creek in 1998 was 51 adults (Faurot et al. 2000). Intensive survey salmon redd counts during that same year counted 50 redds (NPT - unpublished data). The PATH estimated spawner abundance in Lake Creek in 1998 was 116 salmon. This was 126% greater than the spawner abundance determined with underwater video (Figure 16). ISS estimated spawner abundance was 214% greater (160 fish) than the actual spawner abundance.

Typically, managers have used index area redd count expansions to estimate salmon spawner abundance because this time series of information extends back into the mid 1950's. IDFG conducts a single pass redd count, at the peak of spawning, for this trend information. NPT uses multi-pass survey information has been used for the following analysis because it is more accurate. Using index area survey expansion, 1998, 1999 and 2001 abundance estimates have varied from 182% more to 46% fewer fish than video based spawner abundance estimates. Underwater video technology determined an adult spawner abundance of 697 fish in Lake Creek in 2001 (Table 1). Index redd count surveys during that same year totaled 296 redds. Application of the PATH fish per redd numbers estimated 684 spawners in Lake Creek in 2001, which is 1.8% lower than the actual spawner abundance. The ISS approach estimated 36% more spawners (947 fish) in Lake Creek (Figure 16). Underwater video technology determined an adult spawner abundance of 86 fish in Lake Creek in 1999 (Table 1). Index area redd count surveys during that same year totaled 20 redds (NPT - unpublished data). Application of the PATH fish per redd numbers estimated 46 spawners in Lake Creek in 1999, which is 46% lower than the actual spawner abundance (Figure 16). The ISS approach estimated 26% fewer spawners (64 fish) in Lake Creek (NPT - unpublished data). Forty-five redds were counted in the Lake Creek index area in 1998 (Elms-Cockrum 1999). The PATH expansion of index area redd counts (104 adults) (Figure 16) was 104% higher than the actual spawner abundance in Lake Creek in 1998. The ISS approach estimated 144 spawners and was 182% higher than the underwater video estimated spawner abundance (Figure 16).

Chinook salmon redd counts from index areas, which are part of the larger intensive survey area, are generally less than the intensive survey area count. Index area and intensive survey counts are conducted by different observers, at different times and by varying methods (aerial and ground, and single-pass and multiple-pass counts). Beamesderfer et al. (1998), Faurot et al. (2000), Roger and Schwartzberg (1986) and Schwartzberg and Roger (1986) all discussed sources of error and variation in spawning ground survey redd counts. Expansion of redd counts to spawner numbers are influenced by measurement error and uncertainty of assumptions regarding estimates of fish per redd, relative numbers in surveyed and unsurveyed areas, prespawning mortality rates, age composition, and hatchery fish composition (Beamesderfer et al. 1998). The purpose of annual chinook salmon redd count information was to provide an index of relative abundance and to examine population trends over time. Variation inherent in chinook salmon redd count data makes it difficult to compare data within a stream across years, between streams within a year, and between streams across years. It appears that annual variation in redd count accuracy and fish per redd numbers, within a fluctuating population, makes it difficult to use average fish per redd numbers for expansion of redd count data into estimated salmon spawner abundance.

Accurate spawner abundance estimates from unsupplemented salmon spawning aggregates are a necessary tool to monitor ESA listed species. Spawning ground survey redd count trend information is subject to a variety of potential sources of error. Expansion of redd count data into salmon spawner abundance estimates serves to magnify this variation. The underwater video technology provided an accurate assessment of spawner abundance and a benchmark to compare the redd count expansion methods. We felt video methodology provided an accurate abundance estimate for Lake Creek in 1998, 1999 and 2001. But, we do not feel that an abundance estimate obtained by expanding redd count data with an average expansion value based either on PATH or ISS would be accurate enough to satisfy the Biological Opinion (NMFS 2000) ESU recovery goal metrics for ESU index stocks

Fish Per Redd

The Lake Creek fish counting station estimated a net upstream movement of 697 spawning chinook salmon. Based on the number of salmon that migrated into Lake Creek and intensive extended area Nez Perce Tribe redd counts, we calculated a 2.07 fish per redd value which included jacks (Table 6). The fish per redd values in Lake Creek in 1999 and 1998, respectively, were 3.58 and 1.02 fish per redd, including jacks. In 1998, no jacks passed the fish counting stations into spawning areas of Lake Creek. The lack of a male dominated year class (jacks) resulted in approximately the same number of redds, without the extra attending males. The absence of jacks in 1998 would appear to be the cause of the low fish per redd number. In 1999, jacks comprised about half of the male spawning population.

Using the total number of spawners that migrated into Lake Creek in 2001 (697), and the index area redd count (296), there were 2.35 fish per redd. In 1999, there were 4.3 fish per redd in the index area only and in 1998, there were 1.13 fish per redd in the index area. Fish per redd numbers for index areas were higher, in every case, than fish per redds calculated from intensive area redd counts because not all redds were located within the index area.

Table 6. Fish per redd in Lake Creek intensive survey area compared to intensive survey data from the Imnaha River and Lookingglass Creek.

Location	Group	Fish/redd
Lake Creek 1998	NPT	1.02
Lake Creek 1999	NPT	3.58
Lake Creek 2001	NPT	2.07
Imnaha River 1990-94, 1996-98[1]	ODFW	1.6 – 6.8
Lookingglass Creek 1967-1971	ODFW	2.3 – 4.5

[1] Hatchery influenced system

Oregon Department of Fish and Wildlife (unpublished data) reported fish per redd information in Lookingglass Creek from 1967 to 1971. The average was 2.54 adults per redd with a range of 2.09 – 3.01). Oregon Department of Fish and Wildlife (unpublished data) reported fish per redd information in the Imnaha River, a hatchery influenced system, from 1985 to 2000 from expanded redd count and from an adult weir broodstock collection site (Table 6). To estimate mean fish per redd, we used a regression of redds versus fish numbers and determined a slope (fish per redd) of 3.25 (SE = 0.52, $r^2 = 0.73$, $p < 0.0001$, 95% CI of slope = 2.12 – 4.38). Variation around the fish per redd estimate is due in part to annual natural variation in jack returns, pre-spawn mortality, and female to male ratios. However, there is added uncertainty in the fish per redd estimate due to potential bias and errors in annual redd count and adult population estimates. Errors associated with redd counts are not measured and remain unknown. In 2001 and 1999, the fish per redd numbers from Lake Creek were within the range of the Imnaha River and Lookingglass Creek data. The 1998 Lake Creek fish per redd numbers were low compared to Imnaha River and Lookinggglass Creek data.

MOVEMENT

Diel Movement

Diel movement information was obtained from the videotapes. Net upstream movement (upstream minus downstream) past the Lake Creek site occurred day and night. In 2001, 37 % of the net upstream movement occurred between 10:00 p.m. and 4:00 a.m. This is lower than previous years. From 1998 to 2000, during this study, 42-82% of the net upstream movement occurred between 10:00 p.m. and 4:00 a.m. There was no clear-cut pattern, but net movement appeared to be lowest from in the morning from 7:00 to 9:00 a.m. (Figure 17). In previous years a lower rate of net movement during daylight hours was more pronounced.

Movements of adults through the fish counting station occurred day and night. Activity (upstream plus downstream movements) at the Lake Creek site was lowest between 6:00 a.m. and 2:00 p.m. (Figure 18, Appendix Table A-2). Fifty-three percent of the movement occurred during daylight and 46% during darkness. Later in the season, males dominated most of the observed movement.

Fish counters at main stem Columbia River and lower Snake River dams have typically discontinued counting anadromous adults at night between 9:00 p.m. and 5:00 a.m. because of low passage rates. Because fish passageways at dams are upstream only, dam passage information is comparable to upstream only migration at the fish counting station. Hatch et al. (1994a) monitored the migration of adult sockeye (*O. nerka*) and chinook salmon at the fish-viewing window at Tumwater Dam on the Wenatchee River in Washington using a time-lapse video recorder system. They found nighttime upstream migration past the dam (between 10:00 p.m. and 4:00 a.m.) to be from 6.7 to 16.2 percent of the daily passage. At Lower Granite Dam on the main stem Snake River, Hatch et al. (1994b) counted 6.4 percent of the fish migrating upstream at nighttime. Calvin (1975) also found low rates of nighttime upstream migration movement at main stem Columbia River dams. The diel timing of spring and summer chinook salmon in this spawning tributary system was quite different than those observed above. In 2001, 30 % of the upstream only movement occurred between 10:00 p.m. and 4:00 a.m. This is lower than previous years. From 1998 to 2000, 44-60% of the net upstream movement occurred between 10:00 p.m. and 4:00 a.m. It appears that in smaller rivers and streams closer to spawning areas, that movement activity occurred more during periods of darkness as compared to movement at dams lower in the system.

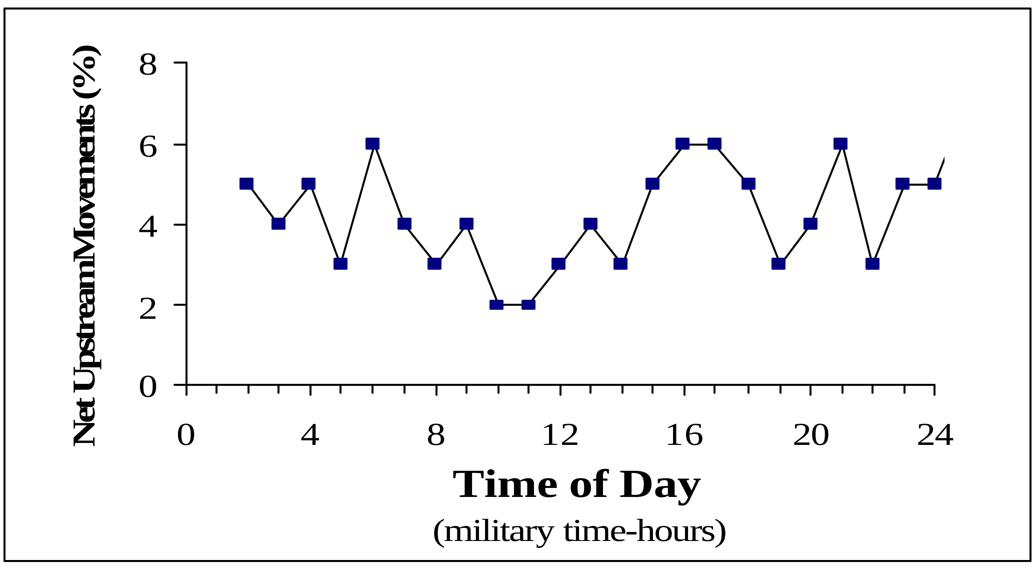

Figure 17. Diel timing of net upstream movement (upstream minus downstream) of adult spring and summer chinook salmon through the Lake Creek fish counting station in 2001.

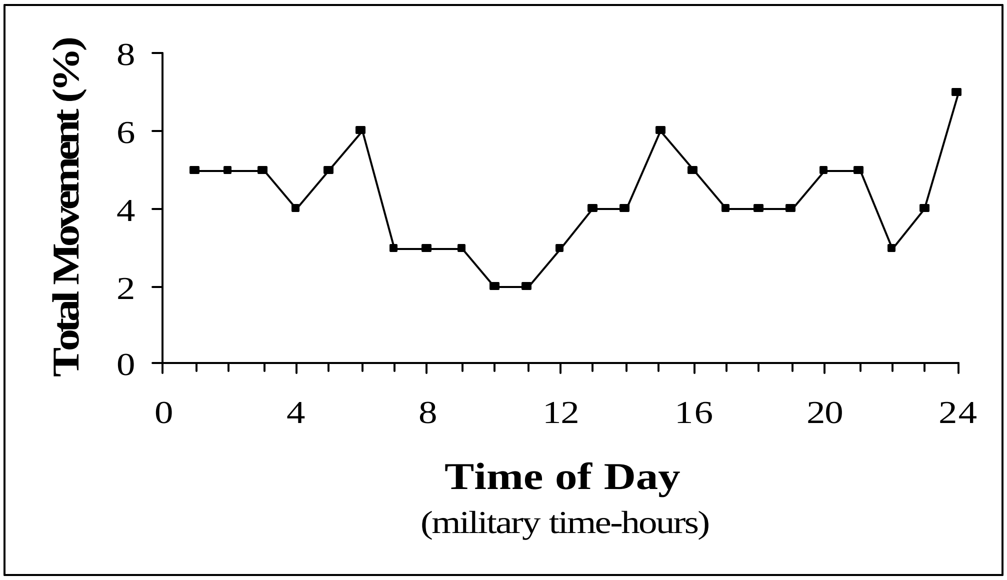

Figure 18. Diel timing of activity (upstream plus downstream movements) of adult spring and summer chinook salmon through the Lake Creek fish counting station in 2001.

Upstream/Downstream Movement

Higher adult chinook salmon scapement in 2001 produced more upstream and downstream movement at the Lake Creek site. There were a total of 1,828 videotaped passages past the Lake Creek fish counting station. The majority of total fish movement activity at Lake Creek was from June 17 to July 5 and July 31 to August 30 (Figure 14). On average there were 2.8 fish passages for every net upstream salmon movement over the entire run.

Once spawning commenced (second segment) there were 7.1 movements for each net upstream migrating salmon. This compares to 21.2 and 10.8 passages for each net upstream passage in 2000 and 1998, and 18.5 passages for each net downstream passage in 1999 (There was a decrease in net escapement during the second segment of the 1999 spawning migration.). One distinctly marked individual male skewed the number for 2000. That male tried to defend two redds, one immediately upstream of the Lake Creek fish counting station and one immediately downstream. Videotapes recorded 239 passages by this one individual, including times when he was chasing and fighting with other males. In previous years, there was only one period of increased activity and that was during the second segment of the run, around spawning time. In 2001, there was an early period of major activity associated with the large number of adult chinook salmon migrating upstream (average of 36 movements per day). There were very few downstream movements during this activity period. The second activity period consisted mainly of male salmon (average of 31 per day) moving upstream and downstream during the active spawning period. There does not appear to be a pattern to the timing of these movements. In 2001, the average net movement during the height of total fish movement activity time was 4.6 adult salmon upstream per day, compared to an average net upstream movement of 0, 0.5 and 4.2 in 1998, 1999 and 2000 respectively.

DESIGN AND PLACEMENT CRITERIA

It appears that the fish counting stations can be safely installed and maintained in their present locations at an approximate river discharge of 200 cfs in Lake Creek and 400 cfs in the Secesh River sites. These sites were chosen for easier, early season installation. Suitable sites would usually be on straight stretches of stream that did not have areas too deep or water velocities to swift to safely wade. Riffles were avoided. In the past, fish appeared to be more wary of a structure in the shallower water and tended to accelerate through the opening. The ability to hold a fish counting station in place depended on the debris load as well as the stream discharge.

We have been unable to install the Secesh River fish counting station in time to photograph the first fish in any year. Increased size and discharge of the Secesh River provided more challenge. By the time Sesech River discharge subsided to 400 cfs in most years, the first fish had already passed. Other potential methods of documenting the first fish passage in the Secesh River were evaluated in 2001. The desire was to use temporary structures and fish friendly methods.

FORK LENGTHS

Estimated visual fish lengths were taken using the 10 cm grid system painted on the back and bottom plates of the fish counting chamber. Position and orientation of the adult salmon in the counting chamber affected estimated fish length. Lengths were not accurate to ± 5 cm and were rounded to the nearest 10 cm. Length assignments appeared to vary by video observer. This system was not satisfactory to record accurate fish length data. However, jacks could be visually distinguished without the grid system. Another method to determine fish length using line generating lasers was installed on the fish counting chamber in 2001 (see Methods). If accurate laser determined lengths can be obtained from a majority of the spawning migration, they can be compared to aged fish from carcass samples for more accurate run reconstruction (age structure and spawner to spawner ratios). Due to equipment malfunction, this method was not reliable throughout the season. Laser equipment has been repaired and will be used in 2002.

The run appeared to be mainly comprised of jacks and four year old fish. Approximately 66 jack salmon migrated upstream past the Lake Creek fish counting station in 2001. We estimated 25 jacks in 2000, and 20 in 1999. There were no jacks recorded in 1998.

RECOMMENDATIONS

- Install the Lake Creek video fish counting station as soon as water levels recede to safe working conditions in order to record the first fish passage in 2002.
- Provide extensive training to personnel. Early operation of the fish counting station would allow training of personnel with the new recording equipment before fish start actively migrating. This should reduce down time due to operator error and, with the additional experience, operators would be able to quickly identify and trouble shoot equipment malfunctions.
- Improve the lighting conditions in the fish counting chambers. The computerized editing system is triggered by contrast along transect lines on the videotape. Cover the fish counting

chamber with a light diffusing material to eliminate bright spots within the counting chamber. Uneven sunlight and turbulence bubbles that reflect artificial night light trigger the editing system.

- Use the computerized system for editing videotapes. With improvements in the software and more even lighting conditions in the counting chamber, the computerized editing system may be workable. Manual editing will be the primary method and provide a quality control. Fish passages would be directly edited/collapsed (at slow speed) onto another tape as time permits. Compare the results of the two methods. Determine reader efficiency on a weekly basis.
- Emphasize the modification, installation and operation of laser equipment to determine accurate fish lengths for comparison to aged fish from carcass samples for run reconstruction.
- Upon approval of the 2002 Bonneville Power Administration proposal, 1) prepare the Secesh River site for initial installation and testing of a quad multiplexed hydroacoustic system jointly operated with Pacific Northwest National Laboratory (PNNL), 2) purchase a trailer to transport and house the hydroacoustic equipment on site, 3) hire an assistant project leader to assist with hydroacoustic technology and 4) coordinate NEPA with the Payette National Forest.
- Implement annual adult abundance monitoring on the Secesh River at Chinook Campground to determine salmon abundance for the entire Secesh River and Lake Creek subpopulation. This will provide information on the only unsupplemented salmon subpopulation in the South Fork Salmon River.
- Adult salmon abundance monitoring on the Secesh River will provide a measure of salmon recovery actions (NMFS 2000) and population rebuilding.

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APPENDIX A

Table A-1. Run timing and direction of the spring and summer chinook salmon spawner migration in Lake Creek in 2001.

Date 2001	Time (hours)	Estimated Length (cm)	Adipose Fin (yes/no)	Direstion (up/down)	Net Upstream Movement
9-Jun	18:36	70	yes	up	1
10-Jun	7:32	75	yes	up	2
10-Jun	12:52	?	yes	down	1
10-Jun	21:55	65	yes	up	2
10-Jun	21:55	78	yes	up	3
10-Jun	23:08	75	yes	up	4
11-Jun	1:14	80	yes	up	5
11-Jun	23:12	70	yes	up	6
13-Jun	1:15	65	yes	down	5
15-Jun	0:08	80	yes	up	6
15-Jun	0:11	80	yes	down	5
15-Jun	0:15	80	yes	up	6
15-Jun	0:24	80	yes	up	7
	Correction for outage 6/15, 9:20 to 6/15, 12:00 (+1)				8
15-Jun	1:44	70	yes	up	9
	Correction for outage 6/16, 12:00 to 6/16, 16:58 (+2)				11
16-Jun	18:18	85	no	up	12
16-Jun	18:34	85	yes	up	13
17-Jun	1:12	70	yes	up	14
17-Jun	2:42	70	yes	up	15
17-Jun	2:48	80	yes	up	16
17-Jun	3:06	70	yes	down	15
17-Jun	3:11	70	yes	up	16
17-Jun	10:23	80	yes	up	17
17-Jun	10:51	80	no	up	18
17-Jun	14:33	75	yes	up	19
17-Jun	14:33	80	yes	up	20
17-Jun	15:45	85	no	up	21
17-Jun	16:21	80	yes	up	22
17-Jun	16:28	85	yes	down	21
17-Jun	16:28	70	yes	up	22
17-Jun	17:00	85	yes	up	23
17-Jun	17:08	80	yes	down	22
17-Jun	19:15	75	yes	up	23

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
18-Jun	0:40	80	yes	up	24
18-Jun	1:04	70	yes	up	25
18-Jun	3:04	70	yes	up	26
18-Jun	4:12	80	yes	up	28
18-Jun	4:22	70	yes	up	29
18-Jun	4:38	65	no	up	30
18-Jun	4:56	70	yes	up	31
18-Jun	5:06	70	yes	up	32
18-Jun	5:33	70	yes	down	31
18-Jun	5:35	70	yes	up	32
18-Jun	5:36	70	yes	down	31
18-Jun	5:57	70	yes	up	32
18-Jun	5:59	75	yes	up	33
18-Jun	13:14	80	yes	up	34
18-Jun	14:57	80	yes	up	35
18-Jun	15:04	85	yes	up	36
18-Jun	15:29	70	yes	up	37
18-Jun	15:29	85	yes	up	38
18-Jun	17:50	70	no	up	39
18-Jun	18:00	80	yes	up	40
18-Jun	22:56	75	yes	up	41
18-Jun	23:06	70	no	up	42
18-Jun	23:42	75	no	up	43
18-Jun	23:45	65	yes	up	44
18-Jun	23:58	75	no	up	45
19-Jun	1:27	60	yes	up	46
19-Jun	1:27	70	yes	up	47
19-Jun	1:27	70	yes	up	48
19-Jun	1:43	75	yes	up	49
19-Jun	2:17	65	yes	up	50
19-Jun	7:17	80	yes	down	49
19-Jun	7:19	75	yes	up	50
19-Jun	7:22	75	yes	down	49
19-Jun	7:24	75	yes	up	50
19-Jun	7:45	70	yes	down	49
19-Jun	7:46	75	yes	up	50
19-Jun	7:50	75	yes	down	49
19-Jun	8:54	80	no	down	48

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
19-Jun	8:56	80	no	up	49
19-Jun	9:01	80	no	down	48
19-Jun	9:05	80	no	up	49
19-Jun	9:07	80	no	down	48
19-Jun	15:40	80	yes	up	49
19-Jun	17:08	80	yes	up	50
19-Jun	17:08	75	yes	up	51
19-Jun	19:40	65	yes	up	52
19-Jun	19:40	80	yes	up	53
19-Jun	19:44	80	yes	up	54
20-Jun	2:31	75	yes	down	55
20-Jun	2:46	75	yes	up	56
19-Jun	22:45	75	yes	up	55
20-Jun	2:25	75	yes	up	56
20-Jun	3:31	80	yes	up	57
20-Jun	3:48	75	yes	up	58
20-Jun	3:50	70	no	up	59
20-Jun	5:09	75	no	up	60
20-Jun	5:21	70	no	up	61
20-Jun	5:42	70	yes	up	62
20-Jun	9:53	75	yes	up	63
20-Jun	9:58	75	yes	down	62
20-Jun	10:00	75	yes	up	63
20-Jun	14:00	75	yes	up	64
20-Jun	14:27	80	yes	up	65
20-Jun	14:32	70	yes	up	66
20-Jun	14:32	80	yes	up	67
20-Jun	14:32	75	yes	up	68
20-Jun	14:43	70	yes	up	69
20-Jun	14:43	70	yes	up	70
20-Jun	20:15	75	yes	up	71
20-Jun	20:15	70	yes	up	72
20-Jun	20:28	70	yes	up	73
20-Jun	21:18	70	yes	up	74
20-Jun	21:27	70	no	up	75
20-Jun	21:31	75	yes	up	76
20-Jun	21:31	75	yes	up	77
20-Jun	23:19	65	yes	up	78

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
20-Jun	23:41	70	yes	down	77
20-Jun	23:45	80	yes	up	78
21-Jun	0:36	70	no	up	79
21-Jun	0:41	65	yes	down	78
21-Jun	0:43	75	yes	up	79
21-Jun	0:45	70	yes	down	78
21-Jun	2:13	75	yes	up	79
21-Jun	2:17	75	yes	down	78
21-Jun	2:20	80	yes	up	79
21-Jun	2:20	70	yes	up	80
21-Jun	2:27	75	yes	up	81
21-Jun	2:29	70	no	up	82
21-Jun	5:33	85	yes	up	83
21-Jun	5:44	65	no	down	82
21-Jun	13:17	70	yes	up	83
21-Jun	13:39	75	yes	up	84
21-Jun	13:48	65	yes	up	85
21-Jun	13:49	65	yes	up	86
21-Jun	13:55	70	yes	up	87
21-Jun	14:15	70	yes	up	88
21-Jun	14:17	75	yes	up	89
21-Jun	14:49	65	yes	up	90
21-Jun	14:55	70	yes	up	91
21-Jun	14:55	65	yes	up	92
21-Jun	15:42	70	yes	up	93
21-Jun	15:47	80	yes	up	94
21-Jun	15:50	70	yes	up	95
21-Jun	15:50	75	yes	up	96
21-Jun	15:51	70	yes	up	97
21-Jun	16:09	70	no	up	98
21-Jun	16:09	75	yes	up	99
21-Jun	16:32	90	yes	up	100
21-Jun	16:38	75	yes	up	101
21-Jun	21:54	70	yes	up	102
21-Jun	21:58	70	yes	up	103
21-Jun	23:06	75	yes	up	104
21-Jun	23:07	80	yes	up	105
21-Jun	23:30	75	yes	up	106

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
21-Jun	23:47	75	yes	up	107
21-Jun	23:52	75	yes	up	108
21-Jun	23:53	80	yes	up	109
21-Jun	23:55	70	yes	up	110
21-Jun	23:58	75	yes	up	111
21-Jun	23:58	75	yes	up	112
22-Jun	0:12	75	yes	up	113
22-Jun	0:19	80	no	up	114
22-Jun	0:30	75	no	up	115
22-Jun	0:46	80	yes	up	116
22-Jun	1:20	75	yes	down	115
22-Jun	1:26	70	yes	up	116
22-Jun	2:04	70	no	up	117
22-Jun	4:49	80	yes	up	118
22-Jun	4:49	75	yes	up	119
22-Jun	5:05	75	yes	up	120
22-Jun	5:23	75	yes	down	119
22-Jun	5:51	75	yes	up	120
22-Jun	6:02	75	yes	up	121
22-Jun	6:06	75	yes	up	122
22-Jun	8:31	70	no	up	123
22-Jun	8:32	70	yes	up	124
Correction for outage 6/22, 9+:41 to 6/22, 12:05 (+3)					127
22-Jun	12:08	75	no	up	128
22-Jun	12:14	75	no	down	127
22-Jun	14:37	75	yes	up	128
22-Jun	14:37	75	no	up	129
22-Jun	14:41	75	no	up	130
22-Jun	14:41	75	yes	up	131
22-Jun	14:48	70	yes	up	132
22-Jun	14:52		yes	down	131
22-Jun	14:53	70	no	down	130
22-Jun	14:54	70	no	up	131
22-Jun	15:51		yes	up	132
22-Jun	15:51	70	yes	up	133
22-Jun	15:56	70	yes	up	134
22-Jun	15:56	75	no	up	135
22-Jun	15:56	70	yes	up	136

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
22-Jun	16:00	70	yes	up	137
22-Jun	16:10	70	yes	up	138
22-Jun	16:40	70	no	up	139
22-Jun	16:59	70	yes	up	140
22-Jun	17:06	65	no	up	141
22-Jun	17:13	65	yes	up	142
22-Jun	20:04	70	yes	up	143
22-Jun	20:32	70	yes	up	144
Correction for outage 6/22, 21:00 to 6/23, 12:58 (+20)					164
23-Jun	13:02	70	yes	up	165
23-Jun	13:30	75	yes	up	166
23-Jun	16:26	90	yes	up	167
23-Jun	16:57	75	yes	up	168
23-Jun	19:13	70	yes	up	169
23-Jun	19:16	70	yes	up	170
23-Jun	19:32	75	yes	up	171
23-Jun	19:32	70	yes	up	172
23-Jun	22:35	80	yes	up	173
23-Jun	22:45	75	yes	up	174
23-Jun	23:01	75	yes	up	175
24-Jun	0:29	70	yes	up	176
24-Jun	0:31	70	yes	up	177
24-Jun	0:45	50	yes	up	178
24-Jun	0:54	70	yes	up	179
24-Jun	1:13	90	yes	up	180
24-Jun	1:51	65	yes	up	181
24-Jun	3:35	75	yes	down	180
24-Jun	4:13	75	yes	up	181
24-Jun	4:13	80	yes	up	182
24-Jun	4:14	75	yes	up	183
24-Jun	4:25	75	yes	down	182
24-Jun	5:53	70	yes	up	183
24-Jun	6:27	75	yes	up	184
24-Jun	10:23	75	yes	up	185
24-Jun	11:05	70	yes	up	186
24-Jun	11:05	70	no	up	187
24-Jun	11:10	70	yes	up	188
24-Jun	11:11	70	yes	up	189

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
24-Jun	11:29	70	yes	up	190
24-Jun	11:49	70	no	up	191
24-Jun	11:53	75	yes	up	192
24-Jun	12:52	75	yes	up	193
24-Jun	12:54	70	yes	up	194
24-Jun	17:13	70	yes	up	195
24-Jun	17:16	65	yes	up	196
24-Jun	18:24	75	no	up	197
24-Jun	18:38	80	yes	up	198
24-Jun	18:39	70	yes	up	199
24-Jun	18:51	70	yes	up	200
24-Jun	18:53	70	yes	up	201
24-Jun	19:01	80	yes	up	202
24-Jun	19:05	75	yes	up	203
24-Jun	19:05	75	yes	up	204
24-Jun	19:06	70	yes	up	205
24-Jun	19:10	70	yes	up	206
24-Jun	19:10	75	no	up	207
24-Jun	19:18	80	yes	up	208
24-Jun	19:31	80	yes	up	209
24-Jun	22:09	80	yes	up	210
24-Jun	22:12	70	yes	up	211
24-Jun	22:13	75	yes	up	212
24-Jun	22:14	75	yes	up	213
24-Jun	22:20	75	yes	up	214
24-Jun	22:21	80	yes	up	215
24-Jun	22:22	75	yes	up	216
24-Jun	22:49	70	yes	up	217
24-Jun	22:52	75	yes	up	218
24-Jun	22:58	75	yes	up	219
24-Jun	23:09	75	yes	up	220
24-Jun	23:16	75	yes	up	221
24-Jun	23:26	55	yes	up	222
24-Jun	23:53	75	yes	up	223
25-Jun	0:09	75	yes	up	224
25-Jun	0:14	70	yes	up	225
25-Jun	0:23	75	yes	up	226
25-Jun	1:11	70	yes	down	225

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no	Direction (up/down)	Net Upstream Movement
25-Jun	1:17	80	yes	up	226
25-Jun	1:20	80	yes	down	225
25-Jun	1:41	70	yes	up	226
25-Jun	1:51	85	yes	up	227
25-Jun	1:56	80	yes	up	228
25-Jun	2:05	75	yes	up	229
25-Jun	2:14	70	yes	up	230
25-Jun	2:56	80	yes	up	231
25-Jun	3:13	75	yes	up	232
25-Jun	3:58	70	yes	down	231
25-Jun	4:04	70	yes	up	232
25-Jun	4:09	75	yes	down	231
25-Jun	4:13	80	yes	down	230
25-Jun	4:17	80	yes	up	231
25-Jun	4:18	70	yes	down	230
25-Jun	4:25	75	yes	up	231
25-Jun	4:39	85	yes	up	232
25-Jun	4:59	70	yes	down	231
25-Jun	4:59	70	yes	down	230
25-Jun	5:02	70	yes	up	231
25-Jun	5:03	60	yes	down	230
25-Jun	5:05	65	yes	up	231
25-Jun	5:08	70	yes	down	230
25-Jun	5:38	80	yes	down	229
25-Jun	5:40	65	yes	down	228
25-Jun	11:15	70	yes	up	229
25-Jun	11:33	75	yes	up	230
25-Jun	11:36	80	no	up	231
25-Jun	11:46	70	yes	up	232
25-Jun	11:46	70	yes	up	233
25-Jun	11:57	70	yes	up	234
25-Jun	11:58	65	yes	up	235
25-Jun	11:58	70	yes	up	236
25-Jun	12:02	70	yes	up	237
25-Jun	15:11	80	yes	up	238
25-Jun	15:11	70	yes	up	239
25-Jun	15:29	70	yes	down	238
25-Jun	15:37	70	yes	up	239

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
25-Jun	15:37	75	yes	up	240
25-Jun	16:11	75	yes	up	241
25-Jun	16:12	80	yes	up	242
25-Jun	16:13	75	yes	up	243
25-Jun	16:23	75	yes	up	244
25-Jun	16:38	70	yes	up	245
25-Jun	17:02	70	yes	down	244
25-Jun	17:05	70	yes	up	245
25-Jun	18:00	75	yes	down	244
25-Jun	18:19	75	yes	down	243
25-Jun	18:23	75	yes	up	244
25-Jun	18:34	75	yes	up	245
25-Jun	18:41	75	yes	down	244
25-Jun	18:42	75	yes	up	245
25-Jun	19:30	70	yes	up	246
25-Jun	20:12	75	yes	down	245
25-Jun	20:12	75	yes	up	246
25-Jun	20:14	85	yes	up	247
25-Jun	20:15	75	yes	up	248
25-Jun	20:31	70	yes	down	247
25-Jun	22:16	75	yes	down	246
26-Jun	1:36	75	yes	up	247
26-Jun	3:06	75	yes	up	248
26-Jun	3:11	75	yes	down	247
26-Jun	5:39	75	yes	up	248
26-Jun	16:37	75	no	up	249
26-Jun	18:03	80	yes	up	250
27-Jun	0:27	85	yes	up	251
27-Jun	0:50	80	yes	up	252
27-Jun	7:23	85	yes	up	253
27-Jun	9:14	75	yes	up	254
27-Jun	9:15	70	yes	up	255
27-Jun	9:39	80	yes	up	256
27-Jun	9:53	80	yes	up	257
27-Jun	11:58	75	yes	up	258
27-Jun	12:01	70	yes	up	259
27-Jun	12:03	75	yes	up	260
27-Jun	18:18	80	no	up	261

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
27-Jun	18:19	80	yes	up	262
27-Jun	21:44	55	yes	up	263
27-Jun	22:18	?	?	down	262
Correction for outage 6/27, 22:24 to 6/28, 7:54 (+3)					265
28-Jun	7:54	65	?	up	266
28-Jun	9:01	70	?	up	267
28-Jun	13:00	75	yes	up	268
28-Jun	13:00	75	yes	up	269
28-Jun	13:06	80	no	up	270
28-Jun	13:09	80	yes	up	271
28-Jun	13:11	85	yes	up	272
28-Jun	13:22	80	yes	up	273
28-Jun	13:35	50	yes	up	274
28-Jun	13:36	75	yes	up	275
28-Jun	13:38	80	yes	up	276
28-Jun	13:42	80	yes	up	277
28-Jun	13:43	85	yes	up	278
28-Jun	13:45	85	yes	up	279
28-Jun	13:50	85	yes	up	280
28-Jun	13:50	70	yes	up	281
28-Jun	13:50	80	yes	up	282
28-Jun	14:04	85	yes	up	283
28-Jun	14:11	80	yes	up	284
28-Jun	14:11	80	yes	up	285
28-Jun	14:12	75	yes	up	286
28-Jun	14:15	75	yes	up	287
28-Jun	14:20	75	yes	up	288
28-Jun	14:33	80	yes	up	289
28-Jun	14:35	70	no	up	290
28-Jun	14:35	80	yes	up	291
28-Jun	14:46	75	yes	up	292
28-Jun	15:09	80	yes	up	293
28-Jun	15:12	75	yes	up	294
28-Jun	15:18	70	yes	up	295
28-Jun	15:19	85	yes	up	296
28-Jun	15:23	75	yes	up	297
28-Jun	15:28	80	yes	up	298
28-Jun	15:29	80	no	up	299

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
28-Jun	15:35	70	yes	up	300
28-Jun	15:43	80	yes	up	301
28-Jun	15:43	70	yes	up	302
28-Jun	15:43	80	yes	up	303
28-Jun	15:43	80	yes	up	304
28-Jun	16:09	85	yes	up	305
28-Jun	16:31	80	yes	up	306
28-Jun	16:32	90	yes	up	307
28-Jun	16:56	75	yes	up	308
28-Jun	18:11	75	yes	up	309
28-Jun	18:17	75	yes	up	310
28-Jun	18:27	70	yes	up	311
28-Jun	18:30	80	yes	up	312
28-Jun	22:37	55	yes	up	313
28-Jun	23:12	60	yes	down	312
28-Jun	23:33	80	yes	up	313
29-Jun	3:27	75	yes	down	312
29-Jun	3:56	70	yes	up	313
29-Jun	4:15	75	yes	up	314
29-Jun	4:30	70	yes	up	315
29-Jun	4:50	75	yes	up	316
29-Jun	5:24	80	yes	up	317
29-Jun	5:27	70	yes	up	318
29-Jun	5:32	75	yes	up	319
29-Jun	5:45	75	yes	up	320
29-Jun	6:03	70	yes	down	318
29-Jun	6:18	75	yes	up	319
29-Jun	7:08	85	yes	down	318
29-Jun	7:08	80	yes	down	317
29-Jun	7:11	85	yes	up	318
29-Jun	7:33	85	yes	up	319
29-Jun	8:32	80	yes	up	320
29-Jun	9:06	75	yes	up	321
29-Jun	10:44	90	yes	up	322
29-Jun	11:03	80	yes	up	323
29-Jun	11:04	85	yes	up	324
29-Jun	11:15	80	yes	up	325
29-Jun	12:28	80	yes	up	326

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
29-Jun	12:29	80	yes	up	327
29-Jun	12:51	80	yes	up	328
29-Jun	13:07	75	yes	up	329
29-Jun	13:24	75	yes	up	330
29-Jun	14:17	80	yes	up	331
29-Jun	14:17	75	yes	up	332
29-Jun	15:23	65	yes	up	333
29-Jun	15:32	75	yes	up	334
29-Jun	15:51	80	yes	up	335
29-Jun	16:24	75	yes	up	336
29-Jun	17:32	80	yes	up	337
29-Jun	17:32	60	yes	up	338
29-Jun	17:39	75	yes	up	339
29-Jun	17:58	90	yes	up	340
29-Jun	19:03	70	yes	up	341
29-Jun	19:08	75	yes	up	342
29-Jun	19:13	80	yes	up	343
29-Jun	19:19	80	yes	up	345
29-Jun	19:48	70	yes	up	346
29-Jun	19:54	80	yes	up	347
29-Jun	19:54	75	yes	up	348
29-Jun	20:03	80	yes	up	349
29-Jun	20:03	75	yes	up	350
29-Jun	20:03	90	yes	up	351
29-Jun	20:25	70	yes	up	352
29-Jun	20:27	65	yes	up	353
29-Jun	20:36	70	yes	up	354
29-Jun	20:43	75	yes	down	353
29-Jun	20:44	70	yes	up	354
29-Jun	20:45	75	yes	up	355
29-Jun	20:46	70	yes	up	356
29-Jun	20:54	70	yes	up	357
29-Jun	20:58	75	yes	down	356
29-Jun	22:19	70	yes	up	357
29-Jun	23:35	70	yes	up	358
30-Jun	0:46	75	yes	down	357
30-Jun	0:49	80	yes	up	358
30-Jun	0:54	90	yes	up	359

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
30-Jun	0:55	70	yes	down	358
30-Jun	0:59	75	yes	up	359
30-Jun	1:19	70	yes	down	358
30-Jun	2:20	65	yes	down	357
30-Jun	2:22	65	yes	up	358
30-Jun	2:32	65	yes	down	357
30-Jun	10:05	70	no	up	358
30-Jun	10:07	75	yes	up	359
30-Jun	10:07	70	yes	up	360
30-Jun	10:15	70	yes	up	361
30-Jun	10:23	80	yes	up	362
30-Jun	10:27	75	yes	up	363
30-Jun	19:20	80	yes	down	362
30-Jun	19:22	80	yes	up	363
30-Jun	19:32	80	yes	down	362
30-Jun	21:33	90	yes	up	363
30-Jun	21:37	70	yes	up	364
30-Jun	22:03	75	yes	up	365
30-Jun	22:32	65	yes	up	366
30-Jun	22:33	65	yes	down	365
30-Jun	23:30	75	yes	down	364
30-Jun	23:35	80	yes	up	365
30-Jun	23:37	55	yes	up	366
30-Jun	23:43	65	yes	down	365
30-Jun	23:44	80	yes	up	366
30-Jun	23:45	80	yes	down	365
30-Jun	23:48	80	yes	up	366
30-Jun	23:49	80	yes	down	365
30-Jun	23:49	80	yes	down	364
30-Jun	23:59	70	yes	up	365
1-Jul	2:26	70	yes	up	366
1-Jul	2:36	70	yes	down	365
1-Jul	2:43	80	yes	up	366
1-Jul	2:46	70	yes	up	367
1-Jul	3:00	75	yes	down	366
1-Jul	3:15	80	yes	down	365
1-Jul	3:18	80	yes	up	366

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
1-Jul	3:19	80	yes	down	365
1-Jul	4:34	75	yes	up	366
1-Jul	4:37	85	yes	up	367
1-Jul	4:42	80	yes	up	368
1-Jul	5:11	75	no	up	369
1-Jul	5:12	65	yes	up	370
1-Jul	5:20	75	yes	up	371
1-Jul	5:22	75	no	up	372
1-Jul	7:36	90	yes	up	373
1-Jul	7:36	90	yes	up	374
1-Jul	11:44	80	yes	up	375
1-Jul	13:24	85	no	up	376
1-Jul	13:25	50	yes	up	377
1-Jul	13:25	50	yes	down	376
1-Jul	14:23	80	yes	up	377
1-Jul	15:04	50	yes	up	378
1-Jul	20:01	90	yes	up	379
1-Jul	20:10	90	no	up	380
1-Jul	21:40	75	yes	up	381
1-Jul	23:11	75	yes	up	382
1-Jul	23:16	75	yes	up	383
1-Jul	23:43	80	yes	up	384
1-Jul	23:49	70	yes	up	385
1-Jul	23:52	?	?	up	386
1-Jul	23:59	90	yes	up	387
2-Jul	0:32	80	yes	down	386
2-Jul	0:36	80	yes	up	387
2-Jul	0:46	70	yes	down	386
2-Jul	1:06	70	yes	up	387
2-Jul	1:12	75	yes	down	386
2-Jul	1:15	75	yes	up	387
2-Jul	1:19	75	yes	down	386
2-Jul	2:33	80	yes	up	387
2-Jul	2:37	80	yes	up	388
2-Jul	2:52	70	no	up	389
2-Jul	3:29	90	yes	up	390
2-Jul	3:32	85	yes	down	389
2-Jul	3:32	80	yes	down	388

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
2-Jul	3:49	80	yes	up	389
2-Jul	3:52	75	yes	up	390
2-Jul	3:50	80	yes	up	391
2-Jul	4:19	90	yes	up	392
2-Jul	4:22	90	yes	down	391
2-Jul	4:26	80	yes	up	392
2-Jul	5:31	75	yes	down	391
2-Jul	5:55	85	yes	up	392
2-Jul	5:56	80	yes	up	393
2-Jul	6:12	85	yes	up	394
2-Jul	9:01	100	yes	up	395
2-Jul	9:02	90	yes	up	396
2-Jul	9:09	80	yes	up	397
2-Jul	9:23	90	yes	up	398
2-Jul	9:54	80	yes	up	399
2-Jul	9:57	100	yes	up	400
2-Jul	10:53	80	yes	up	401
2-Jul	10:53	80	yes	up	402
2-Jul	10:57	80	yes	up	403
2-Jul	10:58	85	yes	up	404
2-Jul	11:03	80	yes	up	405
2-Jul	11:03	80	yes	up	406
2-Jul	11:42	80	yes	down	405
2-Jul	11:43	80	yes	up	406
2-Jul	11:45	80	yes	down	405
2-Jul	11:47	75	yes	up	406
2-Jul	14:09	85	yes	up	407
2-Jul	16:57	70	yes	down	406
2-Jul	16:59	70	yes	up	407
2-Jul	17:01	75	yes	down	406
2-Jul	17:03	75	yes	up	407
2-Jul	17:09	75	yes	down	406
2-Jul	17:51	80	yes	down	405
2-Jul	21:37	80	yes	up	406
2-Jul	21:52	75	yes	up	407
2-Jul	21:52	80	yes	up	408
2-Jul	21:54	80	yes	up	409
3-Jul	1:14	75	yes	down	408

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
3-Jul	1:17	80	yes	up	409
3-Jul	1:20	80	yes	up	410
3-Jul	1:27	80	yes	down	409
3-Jul	1:35	80	yes	down	408
3-Jul	1:45	80	yes	up	409
3-Jul	1:57	80	yes	down	408
3-Jul	2:02	80	yes	up	409
3-Jul	2:21	75	yes	down	408
3-Jul	3:03	80	yes	up	409
3-Jul	3:15	70	yes	up	410
3-Jul	3:39	95	yes	up	411
3-Jul	3:58	80	yes	up	412
3-Jul	4:08	75	yes	up	413
3-Jul	4:09	80	yes	up	414
3-Jul	4:18	70	no	up	415
3-Jul	4:32	70	yes	up	416
3-Jul	4:53	75	yes	up	417
3-Jul	4:55	85	yes	up	418
3-Jul	5:17	75	yes	up	419
3-Jul	5:37	85	yes	up	420
3-Jul	5:38	80	yes	up	421
3-Jul	6:50	80	yes	up	422
3-Jul	7:18	90	yes	up	423
3-Jul	8:02	90	yes	up	424
3-Jul	8:39	80	yes	up	425
3-Jul	8:42	80	yes	up	426
3-Jul	8:42	80	yes	up	427
3-Jul	9:25	80	yes	up	428
3-Jul	9:43	90	yes	up	429
3-Jul	10:01	80	yes	up	430
3-Jul	10:33	85	yes	up	431
3-Jul	11:00	80	yes	up	432
3-Jul	11:53	75	yes	down	431
3-Jul	11:54	75	yes	up	432
3-Jul	12:01	80	yes	up	433
3-Jul	12:08	75	yes	up	434
3-Jul	12:09	80	yes	up	435
3-Jul	12:23	75	yes	up	436

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
3-Jul	12:51	75	yes	down	435
3-Jul	12:56	75	yes	down	434
3-Jul	12:56	75	yes	up	435
3-Jul	12:56	75	yes	up	436
3-Jul	12:57	75	yes	down	435
3-Jul	12:58	75	yes	up	436
3-Jul	12:59	75	yes	down	435
3-Jul	14:53	75	yes	up	436
3-Jul	15:00	75	yes	up	437
3-Jul	15:01	75	yes	up	438
3-Jul	15:07	75	yes	up	439
3-Jul	15:18	75	yes	up	440
3-Jul	15:19	70	yes	up	441
3-Jul	15:25	75	yes	up	442
3-Jul	15:25	70	yes	up	443
3-Jul	15:28	75	yes	up	444
3-Jul	15:32	80	yes	up	445
3-Jul	18:57	75	yes	up	446
3-Jul	19:00	85	yes	up	447
3-Jul	19:19	65	no	up	448
3-Jul	19:29	75	yes	up	449
3-Jul	19:32	85	yes	up	450
3-Jul	19:45	75	yes	up	451
3-Jul	19:48	70	yes	up	452
3-Jul	19:49	75	yes	up	453
3-Jul	19:50	65	yes	up	454
3-Jul	19:50	75	yes	up	455
3-Jul	21:45	80	yes	down	454
3-Jul	21:47	75	yes	up	455
3-Jul	21:51	75	yes	down	454
3-Jul	21:54	75	yes	up	455
3-Jul	21:57	70	yes	down	454
3-Jul	23:27	60	yes	down	453
3-Jul	23:44	75	yes	up	454
4-Jul	3:20	70	yes	up	455
4-Jul	3:48	70	yes	up	456
4-Jul	4:03	80	yes	up	457
4-Jul	5:04	75	yes	up	458

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
4-Jul	5:56	60	yes	down	457
4-Jul	5:57	60	yes	down	456
4-Jul	6:13	75	yes	up	457
4-Jul	8:53	75	yes	up	458
4-Jul	9:15	75	no	up	459
4-Jul	14:20	85	yes	up	460
4-Jul	14:25	75	yes	up	461
4-Jul	16:16	55	yes	up	462
4-Jul	22:06	55	yes	up	463
4-Jul	22:35	90	yes	up	464
4-Jul	23:04	80	yes	up	465
5-Jul	3:28	70	yes	up	466
5-Jul	4:07	75	?	up	467
5-Jul	4:09	75	yes	up	468
5-Jul	6:21	75	yes	up	469
5-Jul	6:53	70	yes	down	468
5-Jul	6:55	75	yes	up	469
5-Jul	7:00	70	yes	down	468
5-Jul	7:00	70	yes	up	469
5-Jul	7:08	80	yes	down	468
5-Jul	8:06	75	yes	up	469
5-Jul	13:36	75	yes	up	470
5-Jul	13:51	75	yes	up	471
5-Jul	14:12	75	yes	up	472
5-Jul	16:00	80	yes	up	473
5-Jul	17:02	85	yes	up	474
5-Jul	17:04	80	yes	up	475
5-Jul	17:10	75	yes	up	476
5-Jul	15:12	75	yes	up	477
5-Jul	17:47	75	yes	up	478
5-Jul	17:47	80	yes	up	479
5-Jul	22:28	85	yes	up	480
5-Jul	22:54	75	yes	down	479
5-Jul	22:59	50	yes	up	480
5-Jul	23:07	80	?	up	481
5-Jul	23:28	65	yes	up	482
5-Jul	23:43	75	yes	up	483
6-Jul	0:11	70	yes	up	484

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
6-Jul	0:31	75	yes	up	485
6-Jul	0:44	55	yes	up	486
6-Jul	1:24	75	yes	down	485
6-Jul	3:11	50	yes	down	484
6-Jul	19:56	85	yes	up	485
6-Jul	21:51	75	yes	up	486
7-Jul	0:12	55	yes	up	487
7-Jul	2:15	75	yes	down	486
7-Jul	6:39	80	no	up	487
7-Jul	7:38	75	yes	up	488
7-Jul	7:55	60	yes	up	489
7-Jul	7:55	60	yes	up	490
7-Jul	8:31	80	yes	up	491
7-Jul	8:31	75	yes	up	492
7-Jul	12:45	80	yes	up	493
7-Jul	17:20	75	no	up	494
7-Jul	21:47	75	yes	up	495
8-Jul	0:39	75	yes	up	496
8-Jul	4:26	70	yes	up	497
8-Jul	6:11	75	yes	up	498
8-Jul	13:25	80	yes	up	499
8-Jul	22:56	40	yes	up	500
8-Jul	23:15	75	yes	up	501
9-Jul	6:07	80	yes	up	502
9-Jul	18:59	55	yes	up	503
9-Jul	23:03	55	yes	down	502
9-Jul	23:10	75	yes	up	503
10-Jul	0:52	80	yes	up	504
10-Jul	1:27	80	yes	up	505
10-Jul	7:20	80	yes	up	506
11-Jul	1:03	70	yes	up	507
11-Jul	1:18	50	yes	up	508
11-Jul	1:51	50	yes	down	507
11-Jul	3:57	75	yes	up	508
11-Jul	4:31	75	yes	down	507
11-Jul	5:10	80	yes	up	508
11-Jul	5:16	80	yes	down	507
11-Jul	5:21	80	yes	up	508

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
11-Jul	12:15	80	yes	up	509
11-Jul	21:08	85	yes	up	510
Correction for outage 7/12, 1:33 to 7/12, 9:00 (+1)					511
13-Jul	4:53	75	yes	up	512
13-Jul	5:21	80	yes	up	513
13-Jul	5:53	90	no	up	514
14-Jul	1:00	70	no	up	515
14-Jul	3:27	75	yes	up	516
15-Jul	2:23	70	yes	up	517
15-Jul	4:11	80	yes	up	518
15-Jul	5:28	90	yes	up	519
15-Jul	5:28	75	yes	up	520
15-Jul	9:23	90	yes	up	521
15-Jul	23:43	70	yes	up	522
15-Jul	23:45	70	yes	down	521
16-Jul	0:51	60	yes	up	522
16-Jul	1:58	80	yes	up	523
16-Jul	3:41	60	yes	up	524
16-Jul	18:45	70	yes	up	525
17-Jul	0:13	70	yes	down	524
17-Jul	3:12	80	yes	up	525
17-Jul	4:32	80	yes	down	524
17-Jul	5:41	60	yes	down	523
17-Jul	17:17	75	yes	up	524
18-Jul	5:17	45	yes	up	525
18-Jul	22:26	75	yes	up	526
18-Jul	23:57	75	yes	down	525
19-Jul	0:02	75	yes	up	526
19-Jul	0:13	60	yes	up	527
19-Jul	1:03	75	yes	up	528
19-Jul	1:33	75	yes	down	527
19-Jul	1:38	75	yes	up	528
19-Jul	1:39	75	yes	down	527
19-Jul	1:43	70	yes	up	528
19-Jul	1:53	70	yes	down	527
19-Jul	1:57	70	yes	up	528
19-Jul	2:05	70	yes	up	529
19-Jul	2:14	70	yes	down	528

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
20-Jul	4:34	70	yes	down	527
21-Jul	0:08	80	yes	up	528
21-Jul	21:35	75	yes	up	529
22-Jul	3:06	70	yes	up	530
22-Jul	5:22	70	yes	down	529
22-Jul	5:29	70	yes	up	530
22-Jul	5:33	70	yes	down	529
22-Jul	5:35	70	yes	up	530
22-Jul	20:41	70	yes	down	529
22-Jul	20:45	70	yes	up	530
22-Jul	20:48	70	yes	down	529
22-Jul	22:20	70	yes	up	530
22-Jul	23:17	70	yes	up	531
23-Jul	5:04	70	yes	down	530
23-Jul	5:09	70	yes	up	531
23-Jul	5:10	70	yes	down	530
23-Jul	23:00	70	yes	up	531
24-Jul	2:29	50	yes	up	532
24-Jul	3:49	50	yes	down	531
24-Jul	20:21	85	yes	down	530
25-Jul	18:16	90	yes	up	531
25-Jul	21:44	80	yes	up	532
25-Jul	22:30	75	yes	up	533
25-Jul	23:22	55	yes	up	534
26-Jul	4:29	80	yes	down	533
26-Jul	4:33	75	yes	up	534
26-Jul	5:22	70	yes	down	533
26-Jul	20:44	80	yes	up	534
27-Jul	4:59	80	yes	down	533
27-Jul	5:07	80	yes	up	534
27-Jul	5:09	80	yes	down	533
27-Jul	5:12	80	yes	up	534
27-Jul	5:55	80	yes	down	533
27-Jul	6:18	80	yes	down	532
27-Jul	6:25	80	yes	up	533
27-Jul	7:40	80	yes	down	532
27-Jul	7:42	80	yes	up	533
27-Jul	8:04	80	yes	up	534

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
28-Jul	0:35	80	yes	down	533
28-Jul	0:39	80	yes	up	534
29-Jul	0:02	70	yes	up	535
29-Jul	0:11	80	yes	down	534
29-Jul	0:16	80	yes	up	535
29-Jul	1:56	80	yes	down	534
29-Jul	2:21	80	yes	down	533
29-Jul	3:42	80	yes	up	534
29-Jul	5:31	70	yes	down	533
29-Jul	18:25	80	yes	up	534
29-Jul	22:48	75	yes	up	535
29-Jul	23:57	80	yes	down	534
30-Jul	0:04	80	yes	up	535
30-Jul	4:30	75	yes	up	536
30-Jul	9:54	70	yes	up	537
30-Jul	13:50	80	yes	up	538
30-Jul	23:04	55	yes	up	539
31-Jul	0:47	70	yes	down	538
31-Jul	0:51	70	yes	up	539
31-Jul	1:43	60	yes	up	540
31-Jul	2:44	75	yes	up	541
31-Jul	5:58	75	yes	down	540
31-Jul	6:03	60	yes	down	539
31-Jul	6:07	60	yes	up	540
31-Jul	6:48	60	yes	down	539
31-Jul	6:52	60	yes	up	540
31-Jul	6:53	70	yes	down	539
31-Jul	7:29	65	yes	up	540
31-Jul	8:47	75	yes	up	541
31-Jul	15:08	75	yes	up	542
31-Jul	23:16	75	yes	up	543
1-Aug	0:14	70	yes	down	542
1-Aug	0:24	70	yes	up	543
1-Aug	3:24	75	yes	down	542
1-Aug	3:37	65	yes	up	543
1-Aug	3:43	70	yes	down	542
1-Aug	5:19	70	yes	down	541
1-Aug	6:39	75	yes	up	542

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
1-Aug	6:51	70	yes	up	543
1-Aug	17:23	70	no	up	544
1-Aug	18:41	70	yes	up	545
1-Aug	19:23	75	yes	down	544
1-Aug	17:27	75	yes	up	545
1-Aug	17:28	75	yes	down	544
1-Aug	21:58	70	yes	up	545
1-Aug	22:33	70	yes	up	546
1-Aug	23:11	65	yes	down	545
1-Aug	23:24	65	yes	up	546
2-Aug	0:23	65	yes	up	547
2-Aug	2:29	75	yes	down	546
2-Aug	2:52	75	yes	down	545
2-Aug	2:55	70	yes	up	546
2-Aug	2:59	70	yes	up	547
2-Aug	4:02	75	yes	down	546
2-Aug	4:09	75	yes	up	547
2-Aug	5:11	70	yes	down	546
2-Aug	5:17	70	yes	up	547
2-Aug	8:18	70	yes	down	546
2-Aug	8:19	75	yes	up	547
2-Aug	19:56	70	yes	up	548
2-Aug	22:26	65	yes	down	547
2-Aug	22:31	75	yes	up	548
3-Aug	0:02	70	yes	up	549
3-Aug	0:14	70	yes	down	548
3-Aug	0:25	70	yes	up	549
3-Aug	1:50	70	yes	down	548
3-Aug	1:50	75	yes	up	549
3-Aug	1:51	75	yes	down	548
3-Aug	2:47	75	yes	up	549
3-Aug	3:22	75	yes	down	548
3-Aug	3:40	75	yes	up	549
3-Aug	4:19	70	yes	up	550
3-Aug	4:40	60	yes	down	549
3-Aug	4:47	60	yes	up	550
3-Aug	4:50	60	yes	down	549
3-Aug	4:54	70	yes	up	550

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
3-Aug	5:25	75	yes	down	549
3-Aug	5:30	70	yes	up	550
3-Aug	5:38	75	yes	down	549
3-Aug	5:49	65	yes	up	550
3-Aug	5:52	65	yes	down	549
3-Aug	6:03	65	yes	down	548
3-Aug	6:33	65	yes	up	549
3-Aug	13:16	75	yes	up	550
3-Aug	13:22	75	yes	down	549
3-Aug	13:24	75	yes	up	550
3-Aug	13:34	65	yes	up	551
3-Aug	13:39	65	yes	up	552
3-Aug	14:42	70	yes	down	551
3-Aug	14:57	70	yes	up	552
3-Aug	18:13	65	yes	down	551
3-Aug	18:18	75	yes	up	552
3-Aug	19:54	75	yes	down	551
3-Aug	19:55	65	yes	up	552
3-Aug	19:56	75	yes	down	551
3-Aug	19:56	70	yes	up	552
3-Aug	19:58	75	yes	down	551
3-Aug	19:59	65	yes	up	552
3-Aug	20:02	65	yes	down	551
3-Aug	20:05	65	yes	up	552
3-Aug	20:05	65	yes	down	551
3-Aug	20:07	65	yes	up	552
3-Aug	20:07	60	yes	up	553
3-Aug	20:08	65	yes	down	552
3-Aug	21:11	50	yes	down	551
3-Aug	21:14	65	yes	up	552
3-Aug	21:34	65	yes	down	551
3-Aug	21:58	75	yes	down	550
3-Aug	22:32	70	yes	up	551
4-Aug	1:46	85	yes	up	552
4-Aug	2:43	75	yes	down	551
4-Aug	3:09	75	yes	up	552
4-Aug	3:41	70	yes	down	551
4-Aug	5:05	75	yes	up	552

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
4-Aug	5:30	75	yes	up	553
4-Aug	6:24	75	yes	down	552
4-Aug	6:42	75	yes	down	551
4-Aug	6:49	85	yes	up	552
4-Aug	7:13	65	yes	up	553
4-Aug	7:38	75	yes	up	554
4-Aug	11:36	75	yes	up	555
4-Aug	12:03	75	yes	up	556
4-Aug	12:06	75	yes	down	555
4-Aug	17:06	60	yes	down	554
4-Aug	17:24	60	yes	up	555
4-Aug	17:25	60	yes	down	554
4-Aug	20:24	75	yes	up	555
4-Aug	21:35	70	yes	up	556
4-Aug	21:46	70	yes	up	557
4-Aug	22:00	70	yes	down	556
4-Aug	22:24	70	yes	up	557
4-Aug	23:25	70	yes	down	556
5-Aug	0:56	70	yes	down	555
5-Aug	1:02	70	yes	up	556
5-Aug	1:03	70	yes	up	557
5-Aug	1:05	70	yes	down	556
5-Aug	1:05	75	yes	down	555
5-Aug	1:06	75	yes	up	556
5-Aug	1:07	70	yes	up	557
5-Aug	1:30	70	yes	up	558
5-Aug	1:31	70	yes	down	557
5-Aug	1:34	75	yes	down	556
5-Aug	2:39	75	yes	up	557
5-Aug	4:05	75	yes	down	556
5-Aug	5:03	75	yes	up	557
5-Aug	5:23	75	yes	up	558
5-Aug	7:09	70	yes	up	559
5-Aug	8:09	70	yes	down	558
5-Aug	8:12	70	yes	up	559
5-Aug	8:13	65	yes	down	558
5-Aug	8:13	70	yes	up	559
5-Aug	8:13	65	yes	down	558

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
5-Aug	8:20	75	yes	down	557
5-Aug	16:45	55	yes	up	558
5-Aug	16:53	75	yes	up	559
5-Aug	18:13	65	yes	down	558
5-Aug	18:57	55	yes	up	559
5-Aug	19:18	75	yes	up	560
5-Aug	19:19	70	yes	up	561
5-Aug	20:36	60	yes	up	562
5-Aug	20:43	60	yes	down	561
5-Aug	20:47	70	yes	down	560
5-Aug	20:59	45	yes	down	559
5-Aug	21:00	65	yes	up	560
5-Aug	21:01	75	yes	down	559
5-Aug	21:22	70	yes	up	560
5-Aug	21:42	70	yes	up	561
5-Aug	22:53	70	yes	down	560
5-Aug	23:09	75	yes	up	561
5-Aug	23:15	70	yes	up	562
5-Aug	23:28	50	yes	up	563
6-Aug	0:13	60	yes	down	562
6-Aug	1:37	80	yes	up	563
6-Aug	2:20	65	yes	up	564
6-Aug	2:31	75	yes	up	565
6-Aug	2:32	70	yes	down	564
6-Aug	2:47	75	yes	up	565
6-Aug	2:59	50	yes	up	566
6-Aug	3:07	75	yes	up	567
6-Aug	4:02	60	yes	up	568
6-Aug	4:26	70	yes	down	567
6-Aug	5:07	75	yes	down	566
6-Aug	5:14	70	yes	up	567
6-Aug	5:18	75	yes	down	566
6-Aug	5:20	50	yes	down	565
6-Aug	7:26	80	yes	up	566
6-Aug	7:53	70	yes	up	567
6-Aug	8:18	70	yes	down	566
6-Aug	12:56	55	yes	up	567
6-Aug	13:57	70	yes	up	568

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
6-Aug	14:57	80	yes	up	569
6-Aug	16:11	80	yes	down	568
6-Aug	17:20	85	yes	up	569
6-Aug	17:22	80	yes	up	570
6-Aug	20:15	80	yes	up	571
6-Aug	20:19	80	yes	down	570
6-Aug	20:41	80	yes	down	569
6-Aug	20:47	80	yes	down	568
6-Aug	21:31	80	yes	up	569
6-Aug	21:56	85	yes	up	570
6-Aug	23:03	75	yes	down	569
6-Aug	23:18	70	yes	up	570
6-Aug	23:37	55	yes	up	571
7-Aug	1:29	80	yes	up	572
7-Aug	3:04	70	yes	down	571
7-Aug	3:37	70	yes	up	572
7-Aug	4:15	60	yes	up	573
7-Aug	5:35	70	yes	down	572
7-Aug	6:51	75	yes	down	571
7-Aug	10:40	80	yes	up	572
7-Aug	12:32	60	yes	down	571
7-Aug	12:47	70	yes	up	572
7-Aug	13:43	85	yes	down	571
7-Aug	14:57	70	yes	up	572
7-Aug	15:38	70	yes	up	573
7-Aug	15:50	60	yes	down	572
7-Aug	17:33	80	yes	up	573
7-Aug	17:39	80	yes	up	574
7-Aug	18:10	65	yes	up	575
7-Aug	19:36	80	yes	down	574
7-Aug	19:47	75	yes	down	573
7-Aug	20:02	85	yes	up	574
7-Aug	20:16	70	yes	up	575
7-Aug	21:40	80	yes	down	574
7-Aug	22:04	80	yes	up	575
7-Aug	23:17	70	yes	down	574
7-Aug	23:29	70	yes	up	575
8-Aug	0:34	80	yes	up	576

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
8-Aug	0:36	85	yes	down	575
8-Aug	0:39	85	yes	up	576
8-Aug	0:40	85	yes	down	575
8-Aug	1:42	70	yes	down	574
8-Aug	1:52	80	yes	up	575
8-Aug	2:07	80	yes	up	576
8-Aug	2:12	80	yes	down	575
8-Aug	2:47	70	yes	up	576
8-Aug	3:14	85	yes	down	575
8-Aug	3:15	80	yes	up	576
8-Aug	3:29	75	yes	down	575
8-Aug	3:37	80	yes	up	576
8-Aug	4:43	80	yes	down	575
8-Aug	5:36	60	yes	up	576
8-Aug	5:58	75	yes	up	577
8-Aug	7:09	60	yes	up	578
8-Aug	7:28	90	yes	up	579
8-Aug	7:43	85	yes	up	580
8-Aug	9:06	85	yes	up	581
8-Aug	9:23	80	yes	up	582
8-Aug	11:24	75	yes	down	581
8-Aug	12:04	75	yes	up	582
8-Aug	12:55	80	yes	up	583
8-Aug	13:13	65	yes	down	582
8-Aug	13:51	80	yes	down	581
8-Aug	13:53	80	yes	up	582
8-Aug	14:15	80	yes	down	581
8-Aug	14:21	80	yes	up	582
8-Aug	14:23	85	yes	up	583
8-Aug	15:12	90	yes	down	582
8-Aug	20:30	70	yes	down	581
8-Aug	20:58	70	yes	up	582
8-Aug	20:58	80	yes	up	583
8-Aug	22:24	75	yes	down	582
8-Aug	23:01	70	yes	up	583
8-Aug	23:43	65	yes	up	584
9-Aug	0:50	85	yes	down	583
9-Aug	1:17	75	yes	up	584

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
9-Aug	1:32	75	yes	down	583
9-Aug	2:40	75	yes	up	584
9-Aug	3:20	60	yes	up	585
9-Aug	4:32	70	yes	down	584
9-Aug	5:50	75	yes	up	585
9-Aug	6:38	70	yes	up	586
9-Aug	6:40	80	yes	up	587
9-Aug	6:41	85	yes	up	588
9-Aug	6:41	65	yes	up	589
9-Aug	8:32	75	yes	down	588
9-Aug	8:32	90	yes	down	587
9-Aug	8:39	70	yes	up	588
9-Aug	8:39	90	yes	up	589
9-Aug	8:40	70	yes	down	588
9-Aug	8:41	90	yes	down	587
9-Aug	11:30	85	yes	up	588
9-Aug	12:47	80	yes	up	589
9-Aug	12:53	80	yes	up	590
9-Aug	13:01	70	yes	down	589
9-Aug	13:06	80	yes	down	588
9-Aug	13:17	80	yes	down	587
9-Aug	13:28	70	yes	up	588
9-Aug	13:30	75	yes	up	589
9-Aug	14:03	80	yes	down	588
9-Aug	14:41	85	yes	up	589
9-Aug	15:04	75	yes	down	588
9-Aug	15:32	80	yes	down	587
9-Aug	15:39	80	yes	down	586
9-Aug	15:48	80	yes	up	587
9-Aug	15:56	90	yes	up	588
9-Aug	16:23	75	yes	up	589
9-Aug	18:35	75	yes	up	590
9-Aug	19:26	80	yes	down	589
9-Aug	19:53	75	yes	up	590
9-Aug	19:57	75	yes	up	591
9-Aug	20:05	70	No	up	592
9-Aug	20:43	75	yes	down	591
9-Aug	21:48	75	yes	up	592

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
9-Aug	22:09	50	yes	up	593
9-Aug	22:41	75	yes	up	594
9-Aug	22:44	75	yes	down	593
9-Aug	23:05	60	yes	down	592
9-Aug	23:39	75	yes	down	591
10-Aug	1:08	75	yes	up	592
10-Aug	2:00	75	yes	up	593
10-Aug	2:33	80	yes	up	594
10-Aug	3:52	80	yes	down	593
10-Aug	4:03	80	yes	up	594
10-Aug	4:09	70	yes	up	595
10-Aug	5:21	80	No	up	596
10-Aug	5:57	80	yes	up	597
10-Aug	6:46	75	yes	down	596
10-Aug	8:40	75	yes	up	597
10-Aug	11:31	75	No	up	598
10-Aug	11:40	75	yes	down	597
10-Aug	11:55	75	yes	up	598
10-Aug	12:08	75	yes	down	597
10-Aug	13:19	80	yes	up	598
10-Aug	13:49	70	yes	down	597
10-Aug	14:44	80	yes	up	598
10-Aug	15:12	75	yes	up	599
10-Aug	15:48	75	yes	down	598
10-Aug	15:56	75	No	down	597
10-Aug	15:57	80	yes	down	596
10-Aug	15:57	75	No	up	597
10-Aug	15:57	75	No	down	596
10-Aug	19:21	75	yes	up	597
10-Aug	19:21	75	yes	down	596
10-Aug	19:24	80	No	up	597
10-Aug	19:25	80	yes	up	598
10-Aug	19:26	80	No	down	597
10-Aug	19:26	80	yes	down	596
10-Aug	19:26	80	yes	up	597
10-Aug	19:27	80	yes	down	596
10-Aug	19:29	80	No	up	597
10-Aug	19:29	80	yes	up	598

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
10-Aug	19:30	75	No	down	597
10-Aug	19:30	80	yes	down	596
10-Aug	20:12	75	yes	up	597
10-Aug	20:50	75	yes	down	596
10-Aug	21:58	75	yes	up	597
11-Aug	0:02	75	yes	up	598
11-Aug	1:44	75	yes	down	597
11-Aug	2:52	75	yes	down	596
11-Aug	3:10	85	yes	up	597
11-Aug	4:07	75	yes	up	598
11-Aug	5:57	65	yes	up	599
11-Aug	6:00	65	yes	down	598
11-Aug	6:04	65	yes	up	599
11-Aug	6:35	75	yes	up	600
11-Aug	14:59	80	yes	down	599
11-Aug	15:09	80	yes	up	600
11-Aug	15:28	90	yes	up	601
11-Aug	15:28	90	yes	down	600
11-Aug	15:29	85	yes	up	601
11-Aug	15:29	90	yes	up	602
11-Aug	16:38	75	yes	up	603
11-Aug	16:44	75	yes	down	602
11-Aug	17:18	80	No	up	603
11-Aug	17:21	70	yes	up	604
11-Aug	17:40	75	yes	down	603
11-Aug	17:49	80	yes	down	602
11-Aug	17:52	75	yes	up	603
11-Aug	18:08	90	yes	up	604
11-Aug	18:37	75	yes	down	603
11-Aug	20:21	60	yes	down	602
11-Aug	20:50	75	yes	up	603
11-Aug	21:54	80	yes	down	602
11-Aug	23:20	75	yes	up	603
11-Aug	23:30	85	yes	up	604
11-Aug	23:33	85	yes	down	603
11-Aug	23:38	85	yes	up	604
12-Aug	0:52	65	yes	up	605
12-Aug	0:53	65	yes	down	604

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
12-Aug	0:57	65	yes	up	605
12-Aug	1:11	65	yes	up	606
12-Aug	1:29	65	yes	down	605
12-Aug	1:34	70	yes	up	606
12-Aug	2:24	80	yes	down	605
12-Aug	2:28	70	yes	down	604
12-Aug	3:47	70	yes	down	603
12-Aug	4:38	?	?	down	602
12-Aug	6:08	75	yes	up	603
12-Aug	6:30	70	yes	up	604
12-Aug	6:31	75	yes	down	603
12-Aug	7:24	75	yes	up	604
12-Aug	9:06	80	yes	down	603
12-Aug	10:07	70	yes	up	604
12-Aug	10:07	75	yes	up	605
12-Aug	10:17	75	yes	down	604
12-Aug	10:22	80	yes	up	605
12-Aug	13:53	70	yes	down	604
12-Aug	14:52	85	yes	up	605
12-Aug	15:15	85	yes	down	604
12-Aug	15:33	80	yes	down	603
12-Aug	17:00	85	yes	down	602
12-Aug	18:06	85	yes	up	603
12-Aug	18:08	85	yes	down	602
12-Aug	18:13	80	yes	up	603
12-Aug	18:14	80	yes	up	604
12-Aug	18:15	85	yes	down	603
12-Aug	21:04	70	yes	up	604
12-Aug	21:42	70	yes	down	603
12-Aug	22:14	75	yes	down	602
12-Aug	22:19	75	yes	up	603
12-Aug	22:23	70	yes	down	602
12-Aug	22:30	70	yes	up	603
12-Aug	22:30	70	yes	down	602
12-Aug	22:33	70	yes	up	603
12-Aug	22:49	70	yes	up	604
12-Aug	22:50	75	yes	down	603
12-Aug	22:56	85	yes	up	604

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no	Direction (up/down)	Net Upstream Movement
12-Aug	22:58	80	yes	down	603
12-Aug	23:13	75	yes	down	602
12-Aug	23:18	70	yes	down	601
13-Aug	0:12	75	yes	up	602
13-Aug	0:16	75	yes	down	601
13-Aug	0:32	75	yes	up	602
13-Aug	0:54	75	yes	up	603
13-Aug	1:11	75	yes	up	604
13-Aug	2:00	70	yes	up	605
13-Aug	2:02	70	yes	down	604
13-Aug	2:04	70	yes	up	605
13-Aug	2:06	65	yes	up	606
13-Aug	2:10	55	yes	up	607
13-Aug	2:35	80	yes	up	608
13-Aug	4:54	65	yes	up	609
13-Aug	6:52	75	yes	up	610
13-Aug	6:59	75	yes	up	611
13-Aug	9:41	75	yes	up	612
13-Aug	11:04	70	yes	up	613
13-Aug	14:01	70	yes	down	612
13-Aug	15:25	70	yes	up	613
13-Aug	23:16	55	yes	up	614
14-Aug	0:55	60	yes	up	615
14-Aug	0:58	60	yes	down	614
14-Aug	5:54	70	yes	up	615
14-Aug	6:39	70	yes	down	614
14-Aug	7:51	65	yes	up	615
14-Aug	8:37	75	yes	up	616
14-Aug	14:15	75	yes	up	617
14-Aug	14:48	80	yes	up	618
14-Aug	18:16	65	yes	up	619
14-Aug	18:41	75	yes	up	620
14-Aug	18:54	70	yes	down	619
14-Aug	19:34	70	yes	down	618
14-Aug	19:56	70	yes	up	619
14-Aug	20:18	65	yes	up	620
15-Aug	4:15	50	yes	down	619
15-Aug	6:34	55	yes	up	620

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
15-Aug	11:54	75	yes	up	621
15-Aug	12:11	75	yes	down	620
15-Aug	12:13	75	yes	up	621
15-Aug	12:14	75	yes	down	620
15-Aug	14:15	65	yes	down	619
15-Aug	17:11	70	yes	up	620
15-Aug	17:14	75	yes	up	621
15-Aug	20:06	70	yes	down	620
15-Aug	20:12	60	yes	up	621
15-Aug	20:14	60	yes	down	620
15-Aug	20:17	65	yes	up	621
15-Aug	20:40	65	yes	down	620
15-Aug	20:49	60	yes	up	621
15-Aug	23:17	70	yes	down	620
15-Aug	23:21	60	yes	up	621
15-Aug	23:22	65	yes	down	620
15-Aug	23:29	65	yes	up	621
15-Aug	23:31	65	yes	down	620
15-Aug	23:37	65	yes	up	621
15-Aug	23:37	65	yes	down	620
16-Aug	1:31	75	yes	up	621
16-Aug	2:02	75	yes	down	620
16-Aug	2:17	70	yes	up	621
16-Aug	6:06	65	yes	up	622
16-Aug	9:12	75	yes	up	623
16-Aug	9:46	75	yes	down	622
16-Aug	9:47	75	yes	up	623
16-Aug	9:49	70	yes	down	622
16-Aug	9:48	70	yes	down	621
16-Aug	9:51	70	yes	up	622
16-Aug	9:51	70	yes	up	623
16-Aug	9:52	70	yes	down	622
16-Aug	9:52	70	yes	down	621
16-Aug	9:53	70	yes	up	622
16-Aug	9:53	70	yes	up	623
16-Aug	9:54	70	yes	down	622
16-Aug	9:54	70	yes	down	621
16-Aug	10:03	70	yes	up	622

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
16-Aug	10:05	70	yes	down	621
16-Aug	15:12	75	yes	up	622
16-Aug	16:05	80	yes	up	623
16-Aug	16:08	70	yes	up	624
16-Aug	16:13	70	yes	down	623
16-Aug	16:16	70	yes	up	624
16-Aug	17:18	70	yes	up	625
16-Aug	17:28	70	yes	down	624
16-Aug	18:45	70	yes	down	623
16-Aug	20:12	70	yes	up	624
16-Aug	20:13	70	yes	down	623
16-Aug	20:14	70	yes	up	624
16-Aug	20:14	70	yes	down	623
16-Aug	20:32	70	yes	up	624
16-Aug	23:09	70	yes	up	625
16-Aug	23:16	55	yes	down	624
16-Aug	23:19	55	yes	up	625
16-Aug	23:23	55	yes	down	624
16-Aug	23:28	55	yes	up	625
16-Aug	23:35	55	yes	down	624
16-Aug	23:43	70	yes	up	625
16-Aug	23:45	70	yes	down	624
16-Aug	23:49	60	yes	up	625
17-Aug	5:35	70	yes	up	626
17-Aug	5:50	65	yes	down	625
17-Aug	7:21	50	yes	up	626
17-Aug	7:31	80	yes	down	625
17-Aug	7:35	80	yes	up	626
17-Aug	7:42	70	yes	down	625
17-Aug	7:48	70	yes	up	626
17-Aug	11:00	70	yes	up	627
17-Aug	11:09	70	yes	down	626
17-Aug	11:12	70	yes	up	627
17-Aug	11:12	70	yes	down	626
17-Aug	11:15	70	yes	up	627
17-Aug	13:14	70	yes	down	626
17-Aug	14:27	70	yes	down	625
17-Aug	16:56	70	yes	up	626

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
17-Aug	17:17	65	yes	up	627
17-Aug	17:17	75	yes	up	628
17-Aug	17:30	75	yes	down	627
17-Aug	18:03	80	yes	down	626
17-Aug	18:11	80	yes	up	627
17-Aug	18:16	80	yes	down	626
17-Aug	18:17	80	yes	up	267
17-Aug	18:17	80	yes	down	626
17-Aug	18:44	80	yes	up	627
17-Aug	18:47	80	yes	down	626
17-Aug	19:00	80	yes	up	627
17-Aug	19:01	80	yes	down	626
17-Aug	19:14	80	yes	up	627
17-Aug	19:15	70	yes	up	628
17-Aug	19:17	70	yes	down	627
17-Aug	19:19	70	yes	up	628
17-Aug	19:35	70	yes	down	627
17-Aug	19:45	65	yes	up	628
17-Aug	20:02	65	yes	down	627
17-Aug	20:42	65	yes	up	628
17-Aug	20:58	65	yes	up	629
17-Aug	23:36	65	yes	up	630
17-Aug	23:38	65	yes	down	629
17-Aug	23:41	60	yes	up	630
18-Aug	3:41	80	yes	up	631
18-Aug	3:43	80	yes	down	630
18-Aug	3:46	80	yes	up	631
18-Aug	7:00	75	yes	up	632
18-Aug	7:41	75	yes	down	631
18-Aug	7:50	75	yes	up	632
18-Aug	7:51	75	yes	down	631
18-Aug	8:49	65	yes	up	632
18-Aug	12:01	70	yes	down	631
18-Aug	12:05	75	yes	down	630
18-Aug	12:07	70	yes	up	631
18-Aug	12:07	75	yes	up	632
18-Aug	12:20	70	yes	down	631
18-Aug	12:25	75	yes	down	630

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
18-Aug	12:28	70	yes	up	631
18-Aug	12:28	75	yes	up	632
18-Aug	13:19	80	yes	down	631
18-Aug	13:29	80	yes	up	632
18-Aug	14:00	55	yes	down	631
18-Aug	14:00	75	yes	down	630
18-Aug	14:06	75	yes	up	631
18-Aug	14:11	75	yes	down	630
18-Aug	15:47	75	yes	down	629
18-Aug	23:42	55	yes	down	628
18-Aug	23:49	65	yes	up	629
19-Aug	2:28	80	yes	up	630
19-Aug	2:29	75	yes	down	629
19-Aug	2:30	75	yes	up	630
19-Aug	2:32	70	yes	down	629
19-Aug	2:33	65	yes	up	630
19-Aug	2:37	70	yes	down	629
19-Aug	2:38	70	no	up	630
19-Aug	2:46	75	yes	up	631
19-Aug	2:48	65	yes	up	632
19-Aug	3:36	75	yes	up	633
19-Aug	4:05	55	yes	up	634
19-Aug	7:01	75	yes	up	635
19-Aug	8:01	70	yes	down	634
19-Aug	8:07	80	yes	up	635
19-Aug	8:07	75	yes	down	634
19-Aug	8:12	70	yes	up	635
19-Aug	8:13	70	yes	down	634
19-Aug	12:02	70	yes	down	633
19-Aug	12:05	55	yes	down	632
19-Aug	12:31	80	yes	up	633
19-Aug	12:31	80	yes	down	632
19-Aug	12:31	80	yes	up	633
19-Aug	12:31	70	yes	up	634
19-Aug	12:43	70	yes	down	633
19-Aug	12:47	70	yes	down	632
19-Aug	12:57	75	yes	up	633
19-Aug	13:01	65	yes	down	632

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
19-Aug	13:04	70	yes	up	633
19-Aug	13:07	55	yes	up	634
19-Aug	13:07	70	yes	up	635
19-Aug	13:07	60	yes	down	634
19-Aug	13:07	75	yes	down	633
19-Aug	13:08	50	yes	up	634
19-Aug	13:08	80	yes	up	635
19-Aug	13:09	70	yes	down	634
19-Aug	13:52	75	yes	up	635
19-Aug	13:55	70	yes	up	636
19-Aug	14:01	75	yes	up	637
19-Aug	14:29	70	yes	down	636
19-Aug	14:48	75	yes	up	637
19-Aug	14:48	50	yes	up	638
19-Aug	16:38	75	yes	up	639
19-Aug	18:22	55	yes	up	640
19-Aug	18:53	75	yes	up	641
19-Aug	19:12	75	yes	up	642
19-Aug	19:26	70	yes	down	641
19-Aug	20:16	75	yes	up	642
19-Aug	21:01	65	yes	up	643
19-Aug	21:01	65	yes	up	644
19-Aug	21:04	65	yes	down	643
19-Aug	21:05	65	yes	down	642
19-Aug	21:52	65	yes	up	643
19-Aug	22:32	55	yes	down	642
19-Aug	22:41	55	yes	up	643
19-Aug	22:42	55	yes	down	642
19-Aug	23:10	70	yes	down	641
19-Aug	23:18	75	yes	up	642
19-Aug	23:20	70	yes	down	641
19-Aug	23:25	70	yes	up	642
19-Aug	23:27	65	yes	down	641
19-Aug	23:31	75	yes	up	642
Correction for outage 8/20,0:49 to 8/20,12:43 (+2)					644
20-Aug	12:53	75	yes	up	645
20-Aug	14:04	75	yes	down	644
20-Aug	14:19	75	yes	down	643

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
20-Aug	14:43	70	yes	up	644
20-Aug	15:52	70	yes	down	643
20-Aug	16:12	75	yes	up	644
20-Aug	16:31	70	yes	down	643
20-Aug	16:33	70	yes	up	644
20-Aug	16:35	70?	yes	down	643
20-Aug	16:35	70	yes	down	642
20-Aug	16:37	70	yes	up	643
20-Aug	16:37	70	yes	down	642
20-Aug	16:48	75	yes	down	641
20-Aug	16:49	75	yes	down	640
20-Aug	17:50	80	yes	down	639
20-Aug	17:52	70	yes	up	640
20-Aug	18:06	70	yes	up	641
20-Aug	19:04	45	yes	up	642
20-Aug	21:36	75	yes	up	643
21-Aug	0:11	55	yes	up	644
21-Aug	0:25	65	yes	down	643
21-Aug	0:35	70	yes	up	644
21-Aug	0:52	70	yes	down	643
21-Aug	1:08	70?	yes	down	642
21-Aug	1:09	70	yes	up	643
21-Aug	1:33	75	yes	up	644
21-Aug	2:00	75	yes	up	645
21-Aug	3:03	70	yes	up	646
21-Aug	3:50	75?	yes	down	645
21-Aug	4:48	70	yes	up	646
21-Aug	5:00	70	yes	up	647
21-Aug	12:26	80	yes	down	646
21-Aug	12:53	75	yes	up	647
21-Aug	13:19	70	yes	down	646
21-Aug	13:48	80	yes	up	647
21-Aug	14:00	50	yes	down	646
21-Aug	14:01	50	yes	up	647
21-Aug	14:19	55	yes	down	646
21-Aug	14:29	55	yes	up	647
21-Aug	14:30	55	yes	down	646
21-Aug	14:30	80	yes	up	647

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
21-Aug	14:43	55	yes	up	648
21-Aug	14:49	85	yes	down	647
21-Aug	15:18	75	yes	up	648
21-Aug	16:27	50	yes	down	647
21-Aug	16:33	60	yes	up	648
21-Aug	17:04	50	yes	down	647
21-Aug	17:06	50	no	up	648
21-Aug	17:15	75	yes	down	647
21-Aug	17:48	55	yes	down	646
21-Aug	17:48	55	no	up	647
21-Aug	17:49	55	yes	down	646
21-Aug	17:52	90	yes	down	645
21-Aug	20:35	55	yes	down	645
21-Aug	20:45	70	yes	down	643
21-Aug	20:51	70	yes	up	644
21-Aug	22:26	70	yes	down	643
21-Aug	22:39	55	yes	up	644
21-Aug	22:46	55	yes	down	643
21-Aug	22:47	55	yes	up	644
21-Aug	22:49	55	yes	down	643
21-Aug	22:53	55	yes	up	644
21-Aug	23:16	85	yes	up	645
22-Aug	4:09	80	yes	up	646
22-Aug	4:18	75	yes	up	647
22-Aug	4:34	50	yes	up	648
22-Aug	6:22	55	yes	down	647
22-Aug	7:46	50	yes	up	648
22-Aug	7:53	55	yes	up	649
22-Aug	8:08	70	yes	up	650
22-Aug	8:41	55	yes	down	649
22-Aug	9:20	55	yes	down	648
22-Aug	10:06	70	yes	down	647
22-Aug	10:07	70	yes	up	648
22-Aug	10:08	70	yes	down	647
22-Aug	10:11	70	yes	up	648
22-Aug	10:12	70	yes	down	647
22-Aug	10:13	70	yes	up	648
22-Aug	10:15	70	yes	down	647

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
22-Aug	10:16	70	yes	up	648
22-Aug	10:27	70	yes	down	647
22-Aug	10:56	75	yes	down	646
22-Aug	11:01	75	yes	up	647
22-Aug	11:02	75	yes	down	646
22-Aug	12:49	60	yes	up	647
22-Aug	12:53	60	yes	down	646
22-Aug	13:22	85	yes	down	645
22-Aug	13:36	85	yes	up	646
22-Aug	13:37	85	yes	down	645
22-Aug	14:00	80	yes	down	644
22-Aug	14:01	80	yes	up	645
22-Aug	14:01	80	yes	up	646
22-Aug	14:02	80	yes	down	645
22-Aug	14:08	80	yes	up	646
22-Aug	14:10	80	yes	down	645
22-Aug	14:19	80	yes	up	646
22-Aug	14:19	75	yes	up	647
22-Aug	14:24	80	yes	down	646
22-Aug	14:26	55	yes	up	647
22-Aug	14:26	80	yes	up	648
22-Aug	14:27	55	yes	down	647
22-Aug	14:27	80	yes	down	646
22-Aug	14:29	82	yes	up	467
22-Aug	14:38	73	yes	up	648
22-Aug	15:32	71	yes	down	647
22-Aug	15:33	65	yes	up	648
22-Aug	15:34	80	yes	up	649
22-Aug	15:57	80	yes	down	648
22-Aug	15:58	83	yes	up	649
22-Aug	15:58	83	yes	down	648
22-Aug	15:59	70	yes	down	647
22-Aug	16:00	75	yes	up	648
22-Aug	16:01	66	yes	down	647
22-Aug	16:01	70	yes	up	648
22-Aug	16:10	78	yes	up	649
22-Aug	16:57	75	yes	up	650
22-Aug	17:05	67	yes	up	651

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
22-Aug	17:12	80	yes	down	650
22-Aug	18:18	75	yes	down	649
22-Aug	19:46	87	yes	down	648
22-Aug	19:49	74	yes	up	649
22-Aug	20:46	48	yes	up	650
22-Aug	20:53	55	yes	down	649
22-Aug	23:11	75	yes	up	650
23-Aug	0:14	65	yes	up	651
23-Aug	1:13	70	yes	down	650
23-Aug	1:13	80	yes	down	649
23-Aug	2:12	75	yes	up	650
23-Aug	5:19	60	yes	up	651
23-Aug	5:19	60	yes	down	650
23-Aug	5:21	65	yes	up	651
23-Aug	6:50	76	yes	up	652
23-Aug	7:01	57	yes	up	653
23-Aug	7:30	60	yes	down	652
23-Aug	7:44	82	yes	up	653
23-Aug	9:35	80	yes	down	652
23-Aug	10:43	75	yes	up	653
23-Aug	10:46	70	yes	down	652
23-Aug	11:02	75	yes	up	653
23-Aug	11:21	75	yes	down	652
23-Aug	12:02	75	yes	up	653
23-Aug	13:11	75	yes	up	654
23-Aug	13:47	78	yes	down	653
23-Aug	16:16	71	yes	up	654
23-Aug	16:49	71	yes	down	653
23-Aug	17:27	71	yes	up	654
23-Aug	17:36	77	yes	down	653
23-Aug	17:53	83	yes	down	652
23-Aug	17:59	92	yes	up	653
23-Aug	19:26	77	yes	up	654
23-Aug	20:22	70	yes	up	655
23-Aug	20:23	75	yes	down	654
23-Aug	20:25	75	yes	up	655
23-Aug	22:14	75	yes	down	654
23-Aug	22:26	70	yes	up	655

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
23-Aug	23:32	70	No	up	656
23-Aug	23:34	70	yes	up	657
24-Aug	2:34	75	No	up	658
24-Aug	2:50	75	yes	up	659
24-Aug	6:23	65	yes	down	658
24-Aug	7:01	75	yes	up	659
24-Aug	7:17	65	yes	up	660
24-Aug	8:11	75	yes	up	661
24-Aug	8:56	80	yes	up	662
24-Aug	9:00	85	yes	down	661
24-Aug	9:05	85	yes	up	662
24-Aug	11:48	75	yes	up	663
Correction for outage 8/24, 12:00 to 8/24, 12:30 (0)					663
24-Aug	14:05	80	yes	down	662
24-Aug	14:38	80	yes	up	663
24-Aug	14:38	80	yes	down	662
24-Aug	14:40	80	yes	up	663
24-Aug	14:41	80	yes	down	662
24-Aug	14:44	80	yes	up	663
24-Aug	14:50	80	yes	down	662
24-Aug	14:57	80	yes	up	663
24-Aug	14:59	80	yes	down	662
24-Aug	15:28	85	yes	down	661
24-Aug	17:56	80	yes	down	660
24-Aug	18:36	80	yes	up	661
24-Aug	20:17	75	yes	up	662
24-Aug	20:49	75	yes	down	661
24-Aug	21:09	75	yes	up	662
25-Aug	1:27	70	yes	up	663
25-Aug	2:53	65	yes	up	664
25-Aug	3:04	60	yes	up	665
25-Aug	4:41	75	yes	up	666
25-Aug	6:33	65	yes	up	667
Correction for outage 8/25, 6:00 to 8/25, 13:00 (+2)					669
25-Aug	13:37	70	yes	down	668
25-Aug	13:49	70	yes	up	669
25-Aug	13:57	65	yes	down	668
25-Aug	14:16	75	yes	down	667

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
25-Aug	14:25	80	yes	up	668
25-Aug	14:55	75	yes	up	669
25-Aug	18:11	75	yes	up	670
25-Aug	18:13	70	yes	up	671
25-Aug	18:37	80	yes	up	672
25-Aug	18:38	80	yes	down	671
25-Aug	18:39	80	yes	up	672
25-Aug	18:41	80	yes	down	671
25-Aug	21:43	70	yes	up	672
25-Aug	21:43	75	yes	up	673
25-Aug	21:50	75	yes	down	672
25-Aug	21:54	75	yes	up	673
25-Aug	21:55	75	yes	down	672
25-Aug	22:00	70	yes	up	673
26-Aug	0:07	80	yes	up	674
26-Aug	0:52	65	yes	down	673
26-Aug	2:15	?	yes	down	672
Correction for outage 8/26, 3:10 to 8/26, 8:10 (+1)					673
26-Aug	8:24	75	yes	up	674
26-Aug	8:33	75	yes	down	673
26-Aug	8:54	75	yes	up	674
26-Aug	12:45	70	yes	down	673
26-Aug	12:47	70	yes	up	674
26-Aug	13:53	50	no	down	673
26-Aug	14:03	70	yes	down	672
26-Aug	14:08	70	yes	up	673
26-Aug	14:36	70	yes	down	672
26-Aug	14:49	70	yes	down	671
26-Aug	15:33	75	yes	down	670
26-Aug	15:57	80	yes	up	671
26-Aug	16:24	80	yes	up	672
26-Aug	16:25	80	yes	down	671
26-Aug	17:19	75	yes	up	672
26-Aug	17:32	80	yes	up	673
26-Aug	19:24	75	yes	up	674
26-Aug	21:14	65	no	down	673
27-Aug	0:55	75	yes	up	674
27-Aug	0:58	80	yes	down	673

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
27-Aug	1:03	80	yes	up	674
27-Aug	1:06	80	yes	down	673
27-Aug	1:08	75	yes	up	674
27-Aug	1:09	75	yes	down	673
27-Aug	1:26	75	yes	up	674
27-Aug	1:33	70	yes	up	675
27-Aug	1:55	75	yes	down	674
27-Aug	1:56	75	yes	up	675
27-Aug	1:59	75	yes	down	674
27-Aug	2:04	70	yes	down	673
27-Aug	3:26	80	yes	up	674
27-Aug	3:33	?	yes	down	673
27-Aug	4:02	70	no	up	674
27-Aug	4:14	70	yes	up	675
27-Aug	4:17	80	yes	down	674
27-Aug	4:19	75	yes	up	675
27-Aug	4:28	80	yes	up	676
27-Aug	4:40	70	yes	down	675
27-Aug	5:00	70	yes	down	674
27-Aug	5:53	80	yes	down	673
27-Aug	5:57	80	yes	up	674
27-Aug	10:59	70	yes	up	675
27-Aug	11:30	70	yes	down	674
27-Aug	15:40	80	yes	down	673
27-Aug	15:48	80	yes	down	672
27-Aug	17:05	80	yes	up	673
27-Aug	18:59	75	yes	down	672
27-Aug	19:55	75	yes	down	671
27-Aug	20:02	75	yes	up	672
27-Aug	20:07	75	yes	up	673
27-Aug	20:49	70	yes	down	672
27-Aug	21:32	75	yes	down	671
27-Aug	21:49	70	yes	up	672
27-Aug	22:08	80	yes	up	673
27-Aug	22:35	75	yes	down	672
27-Aug	22:43	75	yes	up	673
27-Aug	23:40	80	yes	up	674
27-Aug	23:43	80	yes	down	673

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
28-Aug	0:01	75	yes	up	674
28-Aug	0:10	75	yes	up	675
28-Aug	0:29	80	yes	down	674
28-Aug	0:48	80	yes	down	673
28-Aug	0:52	80	yes	up	674
28-Aug	4:12	75	yes	down	673
28-Aug	4:15	75	yes	up	674
28-Aug	4:16	75	yes	down	673
28-Aug	4:22	75	yes	up	674
28-Aug	5:39	75	yes	up	675
28-Aug	5:48	80	yes	up	676
28-Aug	6:21	85	yes	down	675
28-Aug	14:05	80	yes	down	674
28-Aug	14:36	80	yes	up	675
28-Aug	15:44	50	no	up	676
28-Aug	15:57	80	yes	down	675
28-Aug	15:57	80	yes	up	676
28-Aug	15:58	80	yes	down	675
28-Aug	15:58	80	yes	down	674
28-Aug	16:07	80	yes	up	675
28-Aug	16:41	80	yes	down	674
28-Aug	20:19	80	yes	down	673
28-Aug	22:39	65	yes	up	674
28-Aug	22:56	70	yes	up	675
29-Aug	2:45	80	yes	down	674
29-Aug	4:17	70	yes	up	675
29-Aug	17:36	75	yes	down	674
29-Aug	17:42	75	yes	up	675
29-Aug	17:43	75	yes	down	674
29-Aug	22:44	70	yes	up	675
29-Aug	23:15	80	yes	up	676
29-Aug	23:19	70	yes	down	675
30-Aug	0:12	70	yes	up	676
30-Aug	1:01	75	yes	up	677
30-Aug	1:14	75	yes	up	678
30-Aug	1:40	80	yes	up	679
30-Aug	1:43	80	yes	down	678
30-Aug	1:55	75	yes	up	679

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
30-Aug	3:47	70	yes	down	678
30-Aug	4:28	80	yes	up	679
30-Aug	4:59	80	yes	up	680
30-Aug	5:01	75	yes	up	681
30-Aug	5:41	75	yes	up	682
30-Aug	5:53	75	yes	down	681
30-Aug	5:53	?	?	down	680
30-Aug	6:18	80	yes	up	681
30-Aug	6:34	75	yes	down	680
30-Aug	8:37	75	yes	up	681
30-Aug	14:38	70	no	up	682
30-Aug	14:45	70	no	down	681
30-Aug	15:17	70	no	up	682
30-Aug	17:18	75	yes	up	683
30-Aug	17:19	80	yes	down	682
30-Aug	17:21	80	yes	up	683
30-Aug	17:27	80	yes	down	682
30-Aug	17:47	80	yes	up	683
30-Aug	17:55	80	yes	down	682
30-Aug	18:37	80	yes	up	683
30-Aug	18:44	80	yes	down	682
30-Aug	21:44	70	yes	up	683
30-Aug	22:08	80	yes	up	684
30-Aug	22:18	75	yes	down	683
30-Aug	23:15	75	yes	down	682
30-Aug	23:42	80	yes	down	681
31-Aug	2:11	70	yes	up	682
31-Aug	2:28	80	yes	down	681
31-Aug	4:43	75	yes	up	682
31-Aug	4:48	75	yes	down	681
31-Aug	5:29	80	yes	up	682
31-Aug	5:30	75	yes	down	681
31-Aug	16:34	83	yes	up	682
31-Aug	16:52	78	yes	up	683
31-Aug	17:19	80	yes	down	682
31-Aug	23:45	70	yes	down	681
1-Sep	2:56	77	yes	up	682
1-Sep	3:12	?	yes	down	681

Table A-1 (continued)

Date (2001)	Time (hours)	Estimated Length (cm	Adipose Fin yes/no)	Direction (up/down)	Net Upstream Movement
1-Sep	3:45	80	yes	up	682
1-Sep	3:48	75	yes	down	681
1-Sep	6:50	80	yes	up	682
1-Sep	14:45	50	no	down	681
2-Sep	0:14	70	yes	down	680
2-Sep	20:06	60	no	down	679
3-Sep	6:53	70	yes	up	680
3-Sep	6:55	70	yes	down	679
3-Sep	16:33	75	yes	down	678
4-Sep	4:30	65	no	up	679
4-Sep	17:58	70	no	down	678
4-Sep	20:18	70	no	down	677
4-Sep	20:24	70	no	up	678
4-Sep	20:26	70	no	down	677
4-Sep	20:27	65	no	up	678
4-Sep	20:34	75	no	down	677
4-Sep	20:36	70	no	up	678
5-Sep	12:51	70	no	up	679
5-Sep	20:04	90	yes	up	680
5-Sep	20:36	90	yes	down	679
6-Sep	15:44	70	no	down	678
7-Sep	-	-	-	0	678
8-Sep	-	-	-	0	678
9-Sep	-	-	-	0	678
10-Sep	-	-	-	0	678
11-Sep	-	-	-	0	678
12-Sep	-	-	-	0	678
13-Sep	-	-	-	0	678
14-Sep	Cease operation			0	678

Table A-2. Diel movements of adult spring and summer chinook salmon passing through the Lake Creek fish counting station, by hour, in 2001.

Time (hours	Total Movements (Up and Down)	Percent (%) Total Movements	Net Upstream Movements	Percent (%) Net Upstream Movements
0:00	88	5	32	5
1:00	94	5	24	4
2:00	84	5	32	5
3:00	70	4	16	3
4:00	88	5	36	6
5:00	103	6	27	4
6:00	55	3	17	3
7:00	54	3	26	4
8:00	46	3	14	2
9:00	43	2	15	2
10:00	37	2	19	3
11:00	48	3	28	4
12:00	63	4	17	3
13:00	75	4	29	5
14:00	113	6	39	6
15:00	92	5	38	6
16:00	65	4	31	5
17:00	79	4	19	3
18:00	66	4	28	4
19:00	82	5	38	6
20:00	94	5	18	3
21:00	61	3	29	5
22:00	73	4	29	5
23:00	120	7	42	7

Time – Military time (hours)

Table A-3. Dates of net upstream migration and total movements of adult spring and summer chinook salmon through the Lake Creek fish counting station in 2001.

Date	Net Upstream	Total Movements
9-Jun	1	1
10-Jun	3	5
11-Jun	2	2
12-Jun	0	0
13-Jun	-1	1*
14-Jun	0	0*
15-Jun	4	6*
16-Jun	5	5*
17-Jun	10	16
18-Jun	22	26
19-Jun	10	24
20-Jun	23	29
21-Jun	34	42
22-Jun	54	64*
23-Jun	11	11
24-Jun	48	52
25-Jun	23	63
26-Jun	4	6
27-Jun	15	17*
28-Jun	48	50
29-Jun	45	57
30-Jun	7	33
1-Jul	22	32
2-Jul	22	50
3-Jul	45	73
4-Jul	11	15
5-Jul	18	26
6-Jul	3	7
7-Jul	9	11
8-Jul	6	6
9-Jul	2	4
10-Jul	3	3
11-Jul	4	10

Table A-3 (continued)

Date	Net Upstream	Total Movements
12-Jul	2	2*
13-Jul	3	3
14-Jul	2	2
15-Jul	5	7
16-Jul	4	4
17-Jul	-1	5
18-Jul	1	3
19-Jul	3	11
20-Jul	-1	1*
21-Jul	2	2
22-Jul	2	10
23-Jul	0	4
24-Jul	-1	3
25-Jul	4	4
26-Jul	0	4
27-Jul	0	10
28-Jul	0	2
29-Jul	0	10
30-Jul	5	5
31-Jul	4	14
1-Aug	3	17
2-Aug	2	14
3-Aug	3	47
4-Aug	5	23
5-Aug	7	39
6-Aug	8	32
7-Aug	4	24
8-Aug	9	37
9-Aug	7	45
10-Aug	6	38
11-Aug	7	31
12-Aug	-3	43
13-Aug	13	19
14-Aug	6	14

Table A-3 (continued)

Date	Net Upstream	Total Movements
15-Aug	0	22
16-Aug	5	41
17-Aug	5	39
18-Aug	-1	25
19-Aug	13	61
20-Aug	2	22*
21-Aug	2	44
24-Aug	5	25
25-Aug	11	25*
26-Aug	0	22*
27-Aug	0	40
28-Aug	2	24
29-Aug	0	8
30-Aug	6	32
31-Aug	0	10
1-Sep	0	6
2-Sep	-2	2
3-Sep	-1	3
4-Sep	0	8
5-Sep	1	3
6-Sep	-1	1
7-Sep	0	0
8-Sep	0	0
9-Sep	0	0
10-Sep	0	0
11-Sep	0	0
12-Sep	0	0
13-Sep	0	0
14-Sep	0	0

*Includes estimate during equipment outage

Table A-4. Corrections for turbidity and equipment downtime at the Lake Creek fish counting station, 2001.

Date/Time Outage	Downtime (Hours:Minutes)	Correction (No. of Fish)	95% Confidence Interval	Standard Deviation	Variance
6/13-13:24 to 6/13-15:53	2:29	+0.00	±0.00	0.00000	0.00000
6/14-5:33 to 6/14-12:41	7:08	+0.00	±0.00	0.00000	0.00000
6/15-9:20 to 6/15-12:00	2:40	+0.67	±0.44	0.66667	0.22222
6/16-12:07 to 6/16-16:58	4:51	+3.00	±1.80	0.91026	0.23503
6/22-9:41 to 6/22-12:05	2:24	+2.75	±1.16	2.02072	0.58333
6/22-21:00 to 6/23-12:58	15:58	+21.75	±0.55	2.22801	0.27850
6/27-22:24 to 6/28-7:54	9:42	+3.25	±0.29	0.94428	0.14930
7/12-1:33 to 7/12-9:00	7:27	+2.25	±0.20	0.58112	0.10273
7/20-7:10 to 7/20-9:14	2:04	+0.00	±0.00	0.00000	0.00000
8/20-0:49 to 8/20-12:43	11:54	+2.75	±0.23	0.84799	0.11759
8/25-6:00 to 8/25-13:00	7:00	+1.75	±0.28	0.75154	0.14203
8/26-3:10 to 8/26-8:10	5:00	+1.50	±0.41	0.92338	0.20647
Total	78:37	+39.67	±5.36		