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# Comparison of DIDSON Versus Video Estimates of 2013 Spring Chinook and Steelhead Escapement to the Upper Basin of the Klickitat River

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**August 15, 2014**

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# EXECUTIVE SUMMARY

A Dual-Frequency Identification Sonar (DIDSON) sonar was deployed during the summer of 2013 to obtain an escapement estimate of spring Chinook salmon *Oncorhynchus tshawytscha* and steelhead *O. mykiss* through the Castile Falls fishway and into the upper basin of the Klickitat River. The DIDSON was set up immediately outside a portion of fishway through which the fish could exit, and was programmed to continuously record sequential 1-hour files. During review of the recorded files, date and time of fish passage events were noted, and the events summed to provide an estimate of total escapement. These data were compared to those obtained with a video recording system installed before a viewing window within the recently constructed monitoring facility at the fishway, which in addition provided identification of the fish to species.

Between June 29 and September 28, 2013, a total of 11 medium to large-sized fish were observed in the DIDSON files. The 2013 video recordings showed a total of 34 upstream passage events during the same time period. In 2012, DIDSON provided a similarly reduced escapement estimate relative to that obtained with video recordings. Low resolution of the DIDSON images is no doubt the cause for underestimation of escapement. However, the video estimates are not without some level of uncertainty as well. Of the 11 DIDSON counts, only 3 appeared to involve passage events for which there was a corresponding video observation. It is likely that the video recordings also missed some passage events, and a combined escapement estimate for 2013 would be 42 fish.

The 2013 video observations consisted of 21 (62%) steelhead and 13 (38%) spring Chinook. The 2012 video recordings also showed a majority of steelhead (76%) relative to spring Chinook (24).

Trends in timing of the fish passage events was similar for the DIDSON and the video data sets. The greatest number of events occurred in early to mid-July, then progressively diminished. Time of day observed for passage events was also similar in the DIDSON and video recordings, occurring predominantly from early afternoon through early evening.

## INTRODUCTION

The Yakama Nation (YN) is actively involved in efforts to rebuild spring Chinook *Oncorhynchus tshawytscha* and and steelhead *O. mykiss* populations in the Klickitat River (YN 2008, and see www.ykfp.org/klickitat/). These efforts included a project to renovate the Castile Falls fishway complex to facilitate recolonization of the upper basin. Castile Falls (rkm 103) is a series of 11 natural falls with a total vertical drop of 33 m over 1.0 km, located in the Klickitat River Gorge immediately upstream of the confluence with the West Fork of the Klickitat River – all within the boundaries of the YN reservation. Upstream of Castile Falls, the Klickitat River and its tributary streams comprise 72 rkm, much of which would be prime spawning and juvenile rearing habitat for spring Chinook and steelhead (YN 2008). The falls, however, created a near-total barrier to upstream migration of fish to the upper basin (Figure 1).

In the early 1950s, the Washington Department of Fish and Wildlife (WDFW) signed a Memorandum of Agreement with the Yakama Nation (YN), the Bureau of Indian Affairs, and the US Fish and Wildlife Service to use Mitchell Act funds to finance a project to improve access for anadromous fish to the upper Klickitat basin (YN 2008). The project involved construction between 1960 and 1962, of a fishway complex consisting of two tunnels - one 61 m in length which by-passes Falls #4 and #5, and a second 260 m in length which by-passes Falls #10 and #11 (the uppermost barrier). Additionally, dynamite blasting of Falls #1, #8 and #9 was performed to facilitate fish passage at these locations. The smaller Falls #2, #3 and #6 were not modified as they were not considered to be barriers. At the upstream end of the upper fishway tunnel, a 3-4 m high concrete dam was constructed to divert flow into the fishway (Figure 2A and 2B). Unfortunately, the design of the tunnels did not sufficiently preclude entry of rock and debris which is mobilized by heavy flows that the river experiences each spring, and maintenance of the tunnels was inadequate. As a result, the tunnels became completely blocked within a few years of operation; and with the upstream dam creating an additional blockage for migration via the natural river channel, the upper basin became virtually inaccessible to spring Chinook and steelhead (YN 2008).

YN projects to renovate the fishway complex began in 2002. Flow into the two tunnels was blocked, and the accumulated debris removed. The concrete stair-step fish ladder structure within each tunnel was demolished and replaced with a vertical slot design that would accumulate debris less readily, and maintain suitable entrance velocities and depth, head differences between pools, and maximum velocities at the weir slots. Trash racks were modified and a fore bay sluice gate installed in both tunnels to better preclude entry of debris and to facilitate its removal (YN 2008). In summer of 2005, renovation was complete and water flow through the fishway was reestablished. Later that same year, spring Chinook redds were observed during walking surveys of the river in the upper basin, presumably the result of fish successfully accessing the upper basin via the renovated fishway.

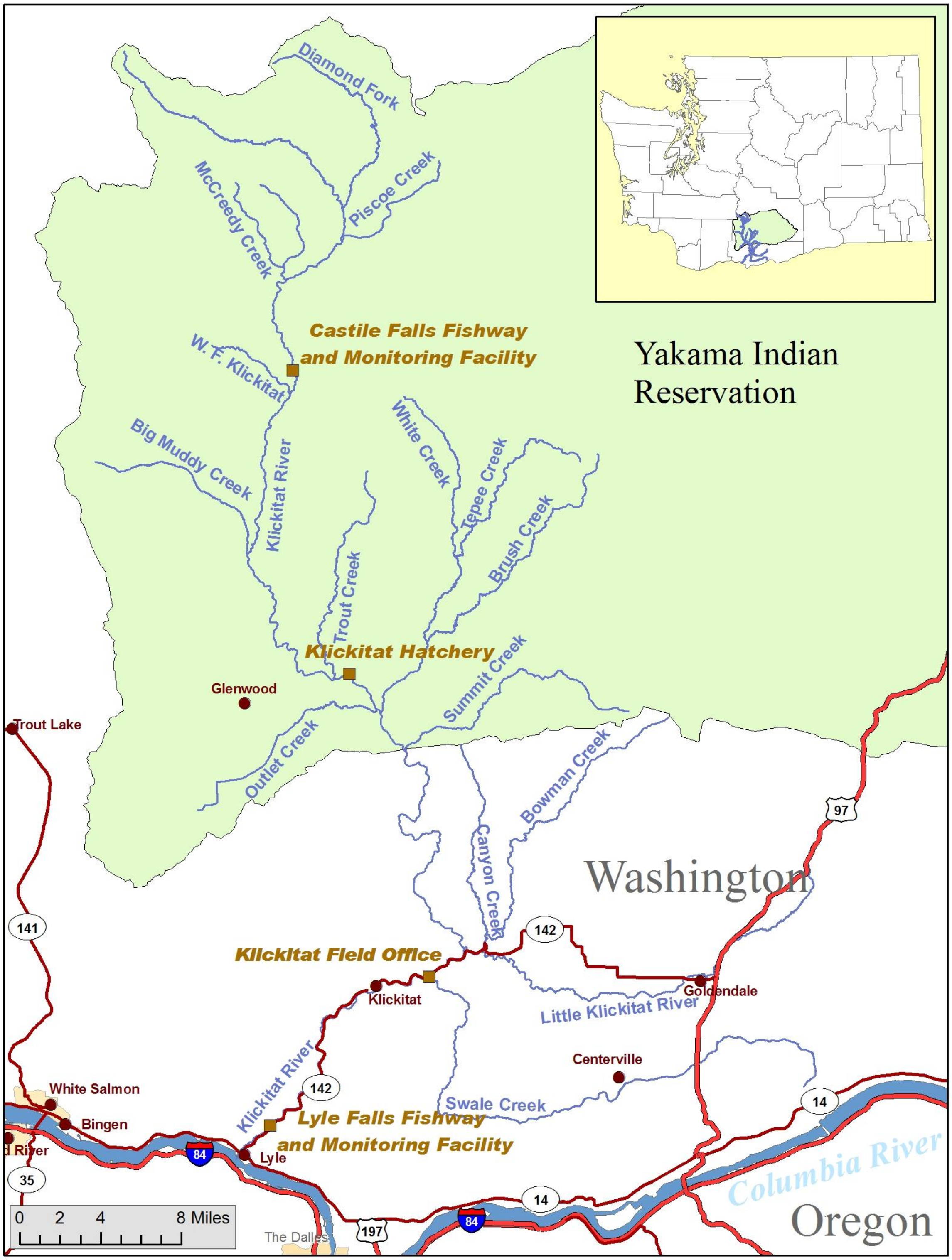



Figure 1. Location of Yakama Nation facilities for the Klickitat River Anadromous Fisheries Project (Figure 1-2, YN 2008).

For many years, WDFW operated a segregated spring Chinook program at the Klickitat Hatchery (rkm 68; Figure 1). Returns of fish from this program to the lower basin supported sport and tribal harvest, but the naturally spawning population has remained depressed. In December 2005, management of the hatchery was transferred to the YN, and operations are transitioning from a segregated to an integrated program, with the objective to supplement and rebuild the natural population (YN 2008). At present, the juvenile acclimation and release locations for the supplementation program will remain at locations in the river below Castile Falls. Prior to implementing any releases of spring Chinook in the upper basin, the YN first wished to monitor the rate at which the fish might naturally (re)colonize the upper basin via volitional upstream passage through the fishway.

Since reopening the fishway in 2005, spawning escapement of spring Chinook to the upper basin has been estimated indirectly by expansion of an annual redd count. The YN performs three to four successive redd surveys during the spawning season each year (mid-August through late-September), spaced approximately 10 to 15 days apart. The surveys are presumed to cover essentially the totality of the known spawning area within the basin above Castile Falls. The total number of redds observed during these surveys are then multiplied by an expansion factor of 3 fish per redd (Zendt and Bosch 2009) to obtain an estimate of total escapement. While the method of estimating spawning abundance by expansion of annual redd counts is recognized to have substantial uncertainty (e.g., Mosey and Truscott 1999, Murdoch and Miller 1999, Dunham et al. 2001, Faurot and Kucera 2005, Gallagher et al. 2007), it was the only method available for use in the upper basin.

A natural population of steelhead also exists in the Klickitat basin. However, because of its low abundance, a harvest mitigation program involving annual stocking (downstream of Castile Falls) with out-of-basin hatchery smolts (Skamania Fish Hatchery, Washougal WA) is ongoing. As for spring Chinook, the management decision was made to refrain from expansion of stocking activities in the upper basin following completion of the Castile Falls fishway renovation, and instead to wait and see to what extent the fish would (re)colonize naturally (YN 2008). Unlike spring Chinook, however, steelhead spawn in the springtime when high flows preclude being able to estimate abundance of the spawning population through redd surveys. As such, the tribe had no realistic means to monitor colonization rates of steelhead in the upper basin.

In 2008, the YN completed the Klickitat River Anadromous Fisheries Master Plan (YN 2008) which included a proposal to construct a fish monitoring facility at the upstream end of the Castile Falls fishway, that would include a counting window and a motion-detection triggered optical video recording system. The resulting video clips would permit species-specific escapement information on a year-round basis. The facility would also have radio and PIT tag antennae and associated recording instruments, and satellite data transmission equipment. While awaiting completion of this facility, in 2009 the Columbia River Inter-Tribal Fish Commission (CRITFC) proposed to the YN, a collaborative project to use a Dual-Frequency Identification Sonar (DIDSON™; Sound Metrics Corporation, Seattle, Washington, www.soundmetrics.com) positioned at the upstream outlet of the fishway to obtain passage

counts. Since that time, the DIDSON has been operated over the summer months each year to obtain estimates of the combined escapement of spring Chinook salmon and steelhead. Note, while image resolution level of the DIDSON images permits qualitative assessment of fish size, it is not sufficient to enable identification to species.

A DIDSON is a multi-beam underwater acoustic video camera. It repetitively emits sets of sound beams and uses its unique patented lens to resolve the reflections of objects passing within its field of view into two-dimensional images. The standard model of the DIDSON emits an array of 96 beams at high frequency (HF; 1.8 MHz), or 48 beams at low frequency (LF; 1.1 MHz). The DIDSON has a functional range of 10-12 m when operated at HF, and a range of 24+ m when operated at LF - though the images are of reduced resolution relative to those obtained using the HF transducer. Placed in a body of water and oriented to transmit horizontally through the water column, it produces a top-down ("bird's-eye") view of the conically-shaped ensonified field. Unlike optical cameras, the camera is able to "see" objects irrespective of light intensity, and in water with up to moderate levels of turbidity. Field testing for fisheries applications, including salmon escapement estimation, has shown the DIDSON to have some significant advantages relative to other sonar systems (Moursund et al. 2003, Johnson et al. 2004, Maxwell and Gove 2004, Faurot and Kucera 2005, Galbreath and Barber 2005, Xie et al. 2005, Kucera and Orme 2006, Burwen et al. 2007, Maxwell 2007, Faulkner and Maxwell 2008, Melegari and Osborne 2008).

Construction of the Castile Falls monitoring facility was completed in late 2011, after which continuous operation of the video recording system began. In the summer of 2012 and again in 2013, the DIDSON was nonetheless redeployed, in order to obtain concurrent sets of fish passage data by the two systems. These data sets were compared for concordance relative to number and time of the fish passage events, with the videos additionally providing species identification.

## METHODS

A standard model DIDSON was installed at the upstream outlet of the Castile Falls fishway (Figure 2A) and began operation on June 29, 2013. As in previous years (Galbreath et al. 2011, 2012 and 2013), weir frames were attached to the trash rack in five of the six 3.2 m long openings in the fishway outlet, such that passage of salmon would only occur in the sixth unblocked opening (Figure 2B and 2F). Each section of weir consisted of a 3.1 m x 0.8 m aluminum frame, with holes drilled along the lengths at 7 cm intervals, through which the pickets were passed. The pickets consisted of lengths (1.8 m for the downstream frames, and 1.2 m for the upstream frames) of 1.6 cm diameter aluminum conduit.

The DIDSON was attached to an H-frame stand (Figure 2C), and placed in the water immediately outside of the fishway, 4.0 m upstream of the unblocked section (Figures 2B and 2F). Sandbags were placed on the legs of the stand to stabilize the sonar against the force of the flowing water (Figure 2D). The DIDSON was oriented in a downstream direction parallel to

the fishway, and was readjusted over the course of the study to keep the lens at approximately 20 cm below the water surface. Two heavy duty job site storage boxes were installed on top of the fishway outlet adjacent to the location of the sonar – one to house the electronic equipment (field computer, external hard drive, universal power supply, etc.) and the other for storage of tools and miscellaneous equipment (Figures 2B, 2E and 2F). The DIDSON and associated field computer were plugged into a nearby 120 v AC outlet, powered by the diesel generator installed as part of the new monitoring facility.

The DIDSON was programmed with a 3.3 m Start Length and a 5 m Window Length (Sound Metrics Corporation 2010). These settings permitted visualization of the entire water column just outside the unblocked section, through which upstream migrating salmon were obliged to pass (Figure 2E). The DIDSON was likewise programmed to record sequential 1-hour files, at high frequency (1.8 MHz) and 10 frames per second. Operation of the DIDSON continued until October 18, 2013 (Figure 3). The site was visited regularly (approximately weekly) over the summer to confirm proper operation of the sonar, and to “swap out” the 500 GB external portable hard drive to which the preceding week’s files had been stored. The recorded files were later copied to a pair of larger (2 TB) office-based hard drives – one drive used for processing and file reading, and the other as a back-up.

Following downloading of the raw DIDSON “ddf” files to the storage hard drives, echogram (“ech”) files were processed for each. Processing parameters for the echograms included: Minimum Track Size = 12, Minimum cluster Area = 200 $cm^2$, and Maximum Cluster Area = 10,000 $cm^2$, and Minimum Threshold = 4.9 dB (Sound Metrics Corporation 2010). During review of the echograms, when a “track” was observed (indicative of a possible fish passage event), a rectangle was drawn around the track to create a “tape loop” of the raw video. Images deemed to represent upstream passage of a fish of medium to large size (suspected to be a spring Chinook salmon or a steelhead - as opposed to movement of a smaller sized fish, of floating debris, or of a cloud of air bubbles, etc.), a note was made of the date and time.

An interruption in operation of the DIDSON occurred on July 23 (10:52 am; an electronic “glitch” of unknown cause), and the sonar was not restarted until the following morning, creating a 24 hour gap in the files. Also, two major rain events occurred, one in early September and the other in late September (see Figures 2G and 2H, and Figure 3). The sudden increased water flows were accompanied with high sediment loads, and each time the sediment accumulated within the sonar lens, blocking emission and recapture of the sound waves. As a result, files were unreadable for the periods Sept 6 (5 am) to Sept 10 (12 noon), and from Sept 28 (11 pm) to October 3. Although the DIDSON recording was restarted on October 3 and continued until October 18, files were processed and read only through Sept 28, by which time spring Chinook migration should already have ceased.

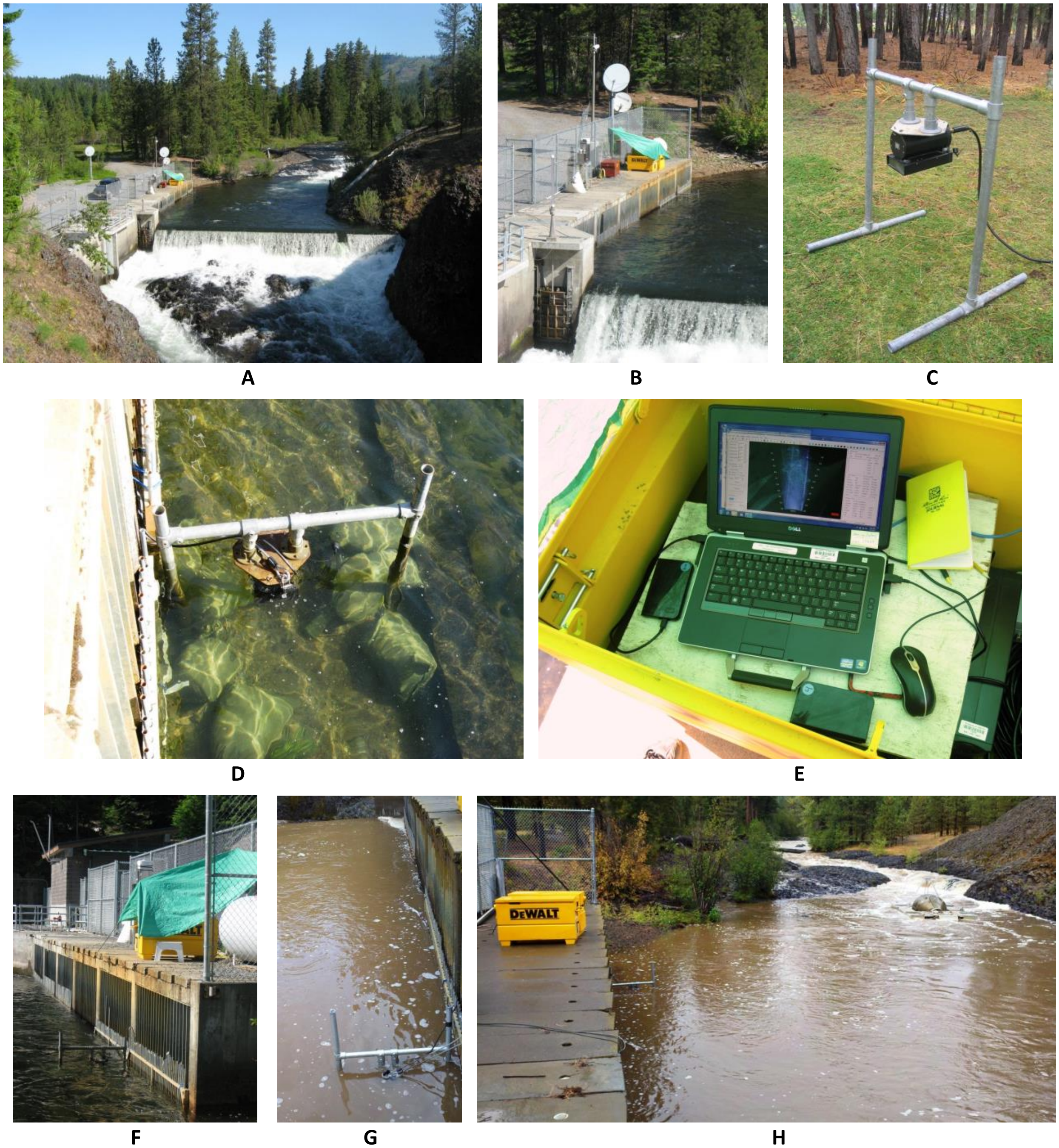



Figure 2. A) Dam and upstream outlet of Castile Falls upper fishway, B) View from downstream of fishway outlet, C) DIDSON on H-frame stand, D) DIDSON deployed underwater adjacent to trash rack, E) Field computer and external hard drive in job site storage box, F) View from upstream of fishway outlet showing the trash racks with weir frames attached, G) View from upstream of fishway outlet on Sept 6 during rainstorm, and H) View upstream of Castile Falls fishway on Sept 6 during rainstorm.

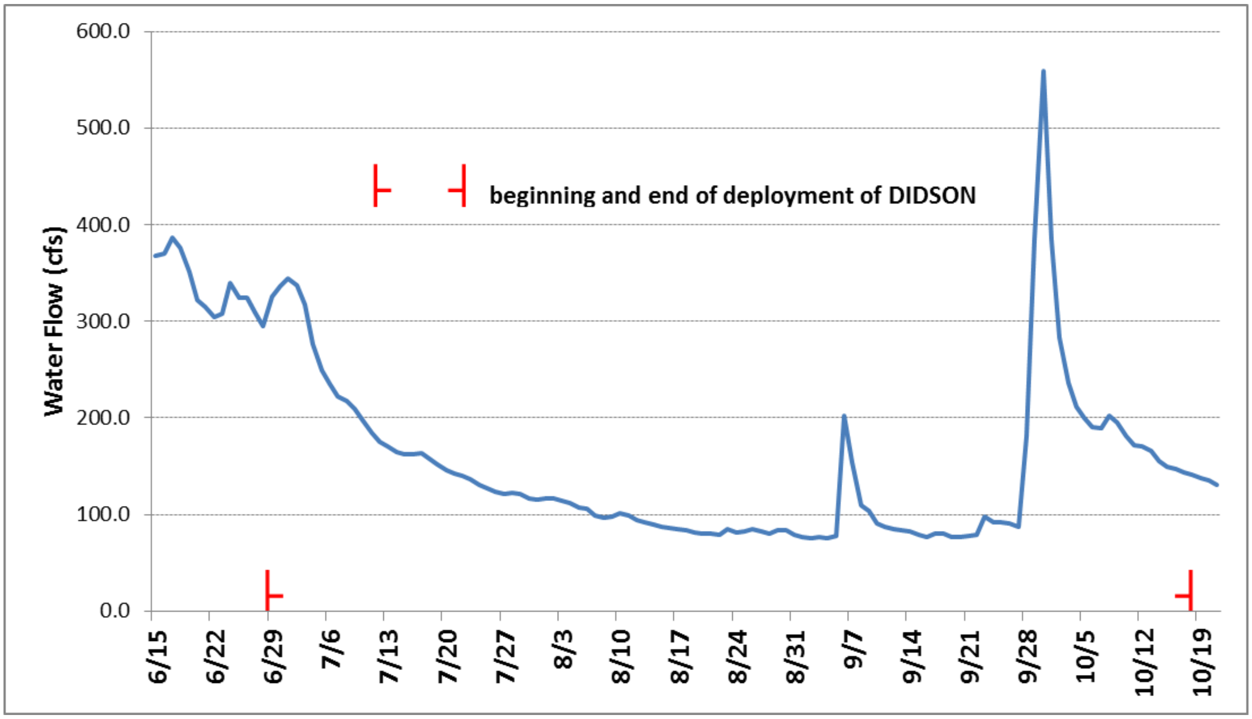



Figure 3. Water flow (cfs) recorded at the USGS stream flow gauge number 14107000 (Klickitat River above West Fork near Glenwood, WA), located 1 km upstream of the Castile Falls fishway Complex (rkm 103). (http://nwis.waterdata.usgs.gov/wa/nwis/uv?cb_00060=on&cb_00065=on&format=rdb&period=&begin_date=2013-06-15&end_date=2013-10-20&site_no=14107000)

As indicated previously, in late 2011 construction of a fish monitoring facility at Castile Falls was completed. This facility includes a viewing window and a video system with motion detection software to record images of fish swimming past the window. Video recordings obtained during the summer of 2013 were reviewed by the YN, and the date, time, species and migration direction of each fish passage event was noted. In several instances, the same fish repeatedly swam upstream then back downstream in front of the window. In these cases, time of the final upstream movement was recorded as the migration time. The date and time for each fish passage event observed in the video recordings for the period June 29 to September 28 (data provided by Jeff Trammell, Yakama Klickitat Fisheries Project, Nelson Springs WA) was then evaluated for concordance to data obtained with the DIDSON.

## *RESULTS and DISCUSSION*

### *DIDSON versus Video Escapement Estimation*

Upstream passage of a total of 11 medium to large-sized fish was observed in the DIDSON files recorded between June 29 and September 28, 2013. This estimate is well below the 34 upstream passage events observed in the video recordings over the same period (Table 1). In 2012 a similarly lower escapement estimate was obtained with the DIDSON (n=30) relative to the video system (n=45) (Galbreath et al. 2013). Missed observation of many of the fish

passage events, and thus consistent underestimation of total escapement based on the DIDSON sonar recordings, was no doubt due to the relatively low resolution of the DIDSON images. The sonar images are based on a limited number of sound beams (n=96), and additionally, configuration of the concrete cleaning canal just outside the fishway caused many of the fish to turn from the desired perpendicular orientation relative to the sonar beams as they exited the fishway, to a “head-on” orientation as they swam upstream, thus reducing their reflective silhouette.

Nonetheless, there also appears to be some uncertainty in the video escapement estimate. Of the 11 passage events noted in the DIDSON files, only 3 appeared to concord with a video image (see shaded rows in Table 1). Concordance was presumed when a fish passage event noted in the video recordings was followed within a 0 to 4 hour period by an observation made with the DIDSON. A delay between the two observations is reasonable. After passing through the dark tunnel, past the viewing window, and arriving within the fishway outlet, fish apparently choose to hold within the fishway for some period before exiting, especially if doing so would avoid sudden exposure to bright daylight. If indeed the 8 non-concordant DIDSON observations represent migration of fish that were not observed in the video files, then a combined 2013 escapement estimate would be 42 fish.

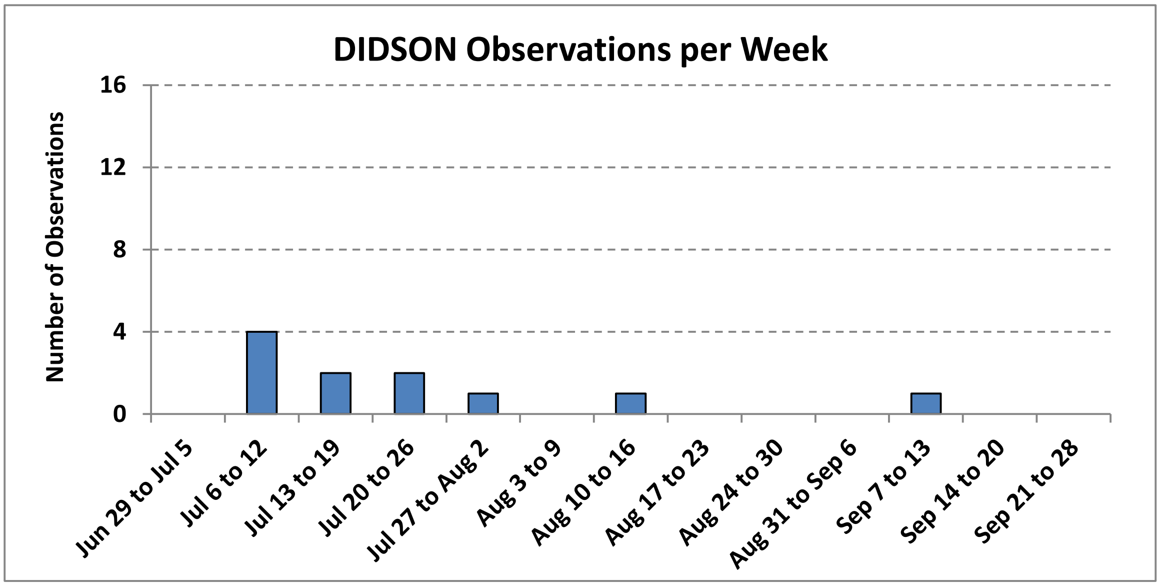
Of note, the 2013 video counts consisted of 13 (38%) spring Chinook and 21 (62%) steelhead. As indicated in previous reports, the DIDSON images permit only a relative assessment of fish size; they do not enable identification of fish to species. The proportions of the two species in 2013 video recordings are relatively close to those observed in 2012 - 24% spring Chinook and 76% steelhead.

*Fish Passage Timing*

Trends in timing of the fish passage events during the summer of 2013 was similar for the DIDSON and the video data sets. Frequency of upstream fish passage was greatest in early to mid-July, then progressively diminished. Passage events observed in both the DIDSON and the video recordings occurred predominantly from early afternoon through early evening. These trends in frequency of passage relative to date and to time of day are similar to those observed with the DIDSON and video recordings in 2012.

Table 1. Observations of upstream fish passage at the Castile Falls fish recorded with the DIDSON sonar and with the fish monitoring facility video camera from June 29 to September 28, 2013.

| Date | Species | Passage Time | | Time Delay |
|---|---|---|---|---|
| | | Video | DIDSON | |
| 30-Jun | Sthd | 15:07 | | |
| 30-Jun | Sthd | 15:30 | | |
| 30-Jun | Sthd | 15:42 | | |
| 30-Jun | Sthd | 17:01 | | |
| 2-Jul | Sthd | 11:23 | | |
| 3-Jul | Sthd | 13:37 | | |
| 3-Jul | CK | 16:23 | | |
| 3-Jul | Sthd | 19:16 | | |
| 4-Jul | Sthd | 14:07 | | |
| 5-Jul | Sthd | 11:27 | | |
| 5-Jul | Sthd | 14:15 | | |
| 5-Jul | Sthd | 14:15 | | |
| 5-Jul | Sthd | 14:34 | | |
| 6-Jul | CK | 20:02 | | |
| 7-Jul | | | 5:39 | |
| 7-Jul | Sthd | 13:59 | | |
| 8-Jul | Sthd | 14:35 | | |
| 10-Jul | Sthd | 16:49 | | |
| 11-Jul | Sthd | 18:43 | 19:55 | 1:12 |
| 11-Jul | | | 21:53 | |
| 12-Jul | Sthd | 17:35 | 21:33 | 3:58 |
| 15-Jul | | | 21:54 | |
| 16-Jul | Sthd | 11:04 | | |
| 16-Jul | Sthd | 14:18 | | |
| 17-Jul | | | 18:12 | |
| 18-Jul | CK | 9:37 | | |
| 19-Jul | CK | 12:13 | | |
| 19-Jul | CK | 12:35 | | |
| 20-Jul | CK | 3:15 | 6:15 | 3:00 |
| 20-Jul | CK | 8:11 | | |
| 20-Jul | CK | 8:44 | | |
| 21-Jul | CK | 15:03 | | |
| 21-Jul | CK | 15:03 | | |
| 25-Jul | | | 21:35 | |
| 28-Jul | | | 10:56 | |
| 1-Aug | Sthd | 18:40 | | |
| 1-Aug | Sthd | 18:43 | | |
| 8-Aug | CK | 6:21 | | |
| 8-Aug | CK | 6:21 | | |
| 14-Aug | | | 5:24 | |
| 31-Aug | CK | 19:41 | | |
| 10-Sep | | | 17:33 | |
| | No. Observations | 34 | 11 | |
| | Sthd | 21 | | |
| | CK | 13 | | |
| | Unique Observations | 42 | | |



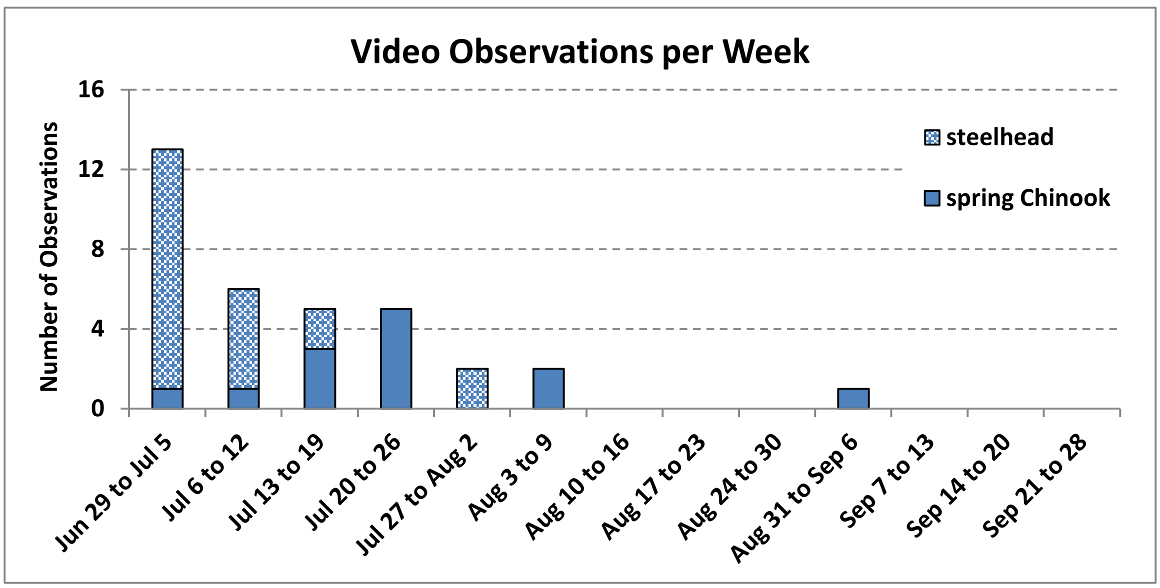
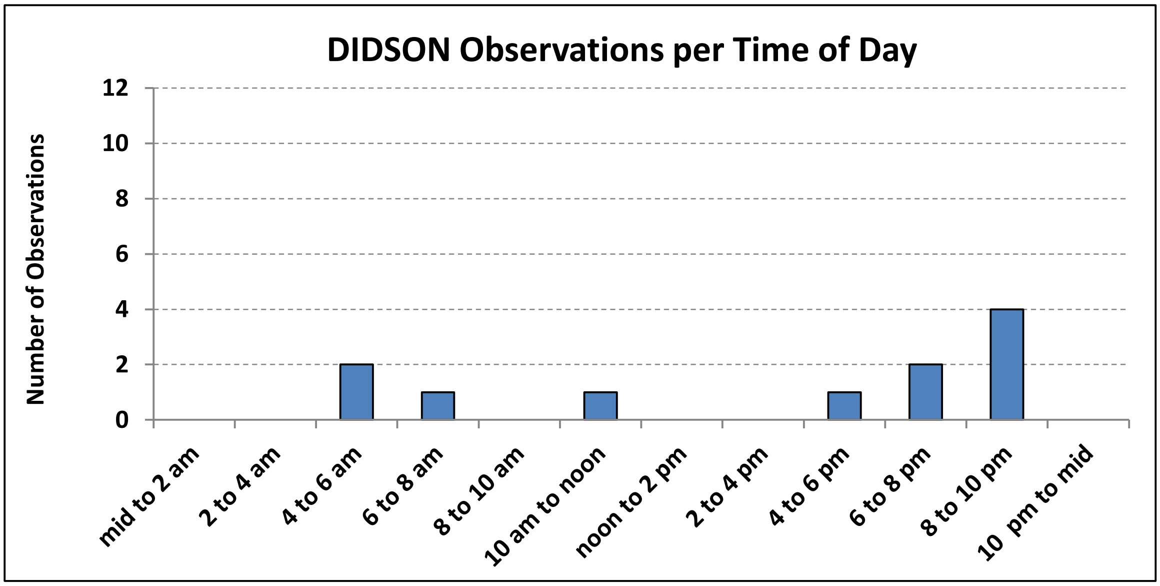




Figure 4. Frequency of fish passage observations per week recorded with the DIDSON and video camera, with video observations for spring Chinook and steelhead indicated separately.



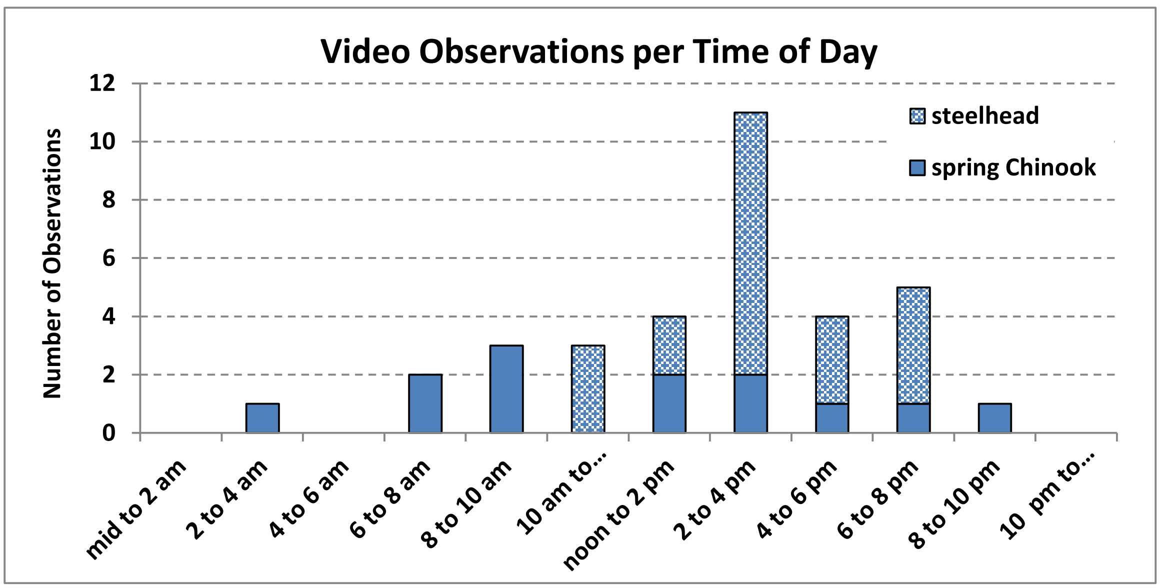




Figure 5. Frequency of fish passage observations per time of day recorded with the DIDSON and video camera, with video observations for spring Chinook and steelhead indicated separately.

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## APPENDICES

A. Fish passage events recorded with a DIDSON sonar.

| | June | | July | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | August | | | | | | | | |
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B. Fish passage events recorded with a video system, with data for spring Chinook and steelhead indicated separately.

spring Chinook

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steelhead

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spring Chinook + steelhead

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spring Chinook

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| 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
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| 17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 19 | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| Σ per day | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **13** |
| Σ per week | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | 1 | | | | | | | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | | 13 |

steelhead

| | August | | | | | | | | | | | | | | | | | | | | | | September | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | 7 | | | | | | | 8 | | | | | | | 9 | | | | | | | 10 | | | | | | | 11 | | | | | | | 12 | | | | | | | 13 | | | | | | | | Σ |
| Hour | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | |
| 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6 |
| 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 |
| 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 |
| 19 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 21 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| Σ per day | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **21** |
| Σ per week | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | | 21 |

spring Chinook + steelhead

| | 7 | | | | | | | 8 | | | | | | | 9 | | | | | | | 10 | | | | | | | 11 | | | | | | | 12 | | | | | | | 13 | | | | | | | | Σ |
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| Σ per week | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | 1 | | | | | | | 0 | | | | | | | 0 | | | | | | | 0 | | | | | | | | 34 |