BONNEVILLE POWER ADMINISTRATION

Pacific Ocean Shelf Tracking (POST) Project

Results from the Acoustic Tracking Study on Survival of Columbia River Salmon

Annual Report 2005 - 2006 | January 2007 | DOE/BP-00021107-1

This Document should be cited as follows:

Welch, David, "Pacific Ocean Shelf Tracking (POST) Project; Results from the Acoustic Tracking Study on Survival of Columbia River Salmon", 2005-2006 Annual Report, Project No. 200311400, 98 electronic pages, (BPA Report DOE/BP-00021107-1)

Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

Kintama Research Corporation

c/o Centre for Shellfish Research
Bldg 373
Malaspina University-College , 900-5th Street
Nanaimo, BC, Canada V9R 5S5

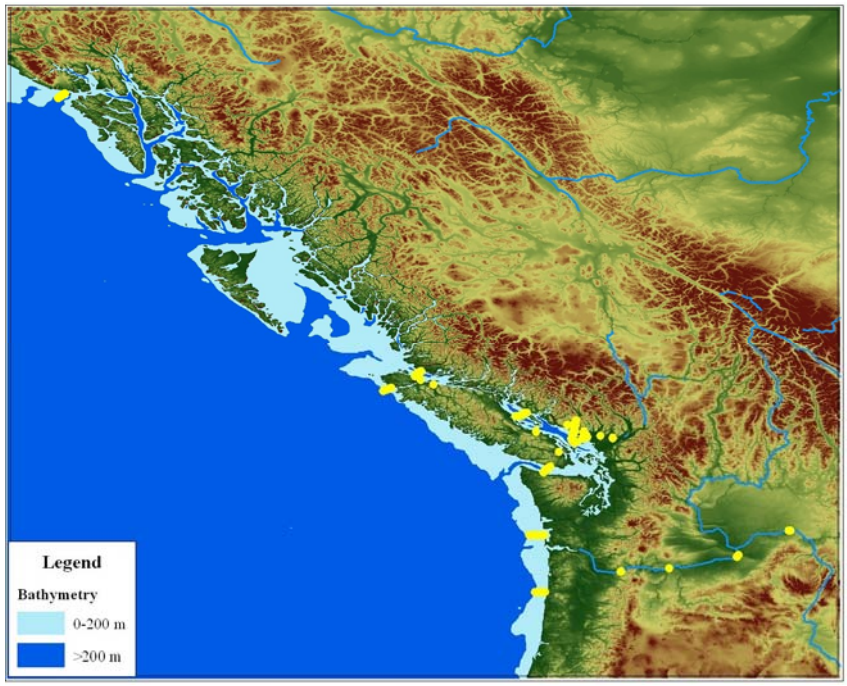
Phone (250) 714-0044
Fax (250) 714-0045

Pacific Ocean Shelf Tracking Project (POST): Results from the Acoustic Tracking Study on Survival of Columbia River Salmon, 2006

Report to the Bonneville Power Administration

Contract No. 2003-114-00, Grant No. 00021107

January 11, 2007



Location of the POST acoustic tracking array in 2006. Array locations are overlaid in yellow. Bathymetric and topographic data courtesy of the Government of Canada and NOAA

Introduction

The degree that hydropower development in the Columbia and Snake Rivers has affected the survival of juvenile salmon is a contentious issue. Snake River and upper Columbia River spring chinook salmon smolts must migrate through a series of 8 to 11 hydropower dams, respectively, in order to reach the Columbia estuary, and subsequently the Pacific Ocean. Much of the recent research on survival rate trends, differential mortality, and recovery actions for Columbia and Snake River spring chinook assumes that there is a common ocean effect on juvenile survival (Budy et al. 2002; Deriso et al. 2001) and that the varying conservation status of Columbia River salmon is largely attributed to the development of the hydrosystem (Schaller et al. 1999). Although there has been a growing recognition of the importance of ocean survival to Columbia River salmon stocks (Deriso et al. 2001; Kareiva et al. 2000; Scheuerell and Williams 2005) and therefore the need to incorporate ocean survival rates into survival models (Peters and Marmorek 2001), a technical means of addressing the key questions has been lacking.

In 2006, the POST Columbia River spring chinook survival study used acoustic telemetry to directly measure early marine survival from two populations of spring chinook in the Columbia River Basin, and to test two major hypotheses:

1. Is additional "latent" or "delayed" mortality experienced after Snake River smolts pass the eight dams they encounter as in-river migrants? If so, this would be evidence for the PATH hypothesis that cumulative stress from multiple dam passage is reducing the productivity of important Snake River chinook stocks.
2. Does transporting/barging of chinook smolts improve early marine survival rates over run of river smolts? If so, then transporting smolts down-river should provide a boost to adult return rates, reducing extinction risk.

To test the first hypothesis we compared survival of Snake River spring chinook (from Dworshak National Fish Hatchery), which migrate through eight dams, with that of Yakima River chinook (from the Cle Elum Supplementation and Research Facility). The Yakima population enters the Columbia River just upstream of the confluence of the Columbia and Snake Rivers, and only migrates through the four mainstem Columbia River dams. This stock was chosen for

comparison because historically it has had about a 5.2 times greater smolt to adult return rate (SAR) than the Snake River chinook (Cle Elum SAR's from Bosch and Fast 2006; Dworshak NFH SARs from CSS 2006). Our 2006 study thus allows us to contrast the survival of two stocks whose migration through the mainstem Columbia is similar, and where the major difference between stocks is in the extensive additional in-river migration that Snake River smolts must undertake past the four contentious Snake River dams.

The second hypothesis is confined to the Snake River stock alone, as collection for barging of spring salmon smolts occurs only in the lower Snake River. To test if barging improves the survival rates of these fish, we contrasted the lower river and early marine survival of two groups of transported smolts with the survival of the same two groups of run of river (ROR) Snake R spring chinook smolts used in the comparison with the Yakima R stock in Hypothesis #1.

Study Design

Stocks used in the Study

Spring chinook from Dworshak National Fish Hatchery (NFH) in Ahsahka, Idaho on the Clearwater River (a tributary of the Snake River) were chosen as the Snake River stock for three reasons: (1) Dworshak fish are of Snake River origin, (2) the location of the hatchery in the Snake River is above the four lower Snake River dams, and (3) the smolt to adult return rates are relatively low despite mitigation efforts (<1% in recent years). The present day Dworshak spring chinook stock was initiated with eggs transferred from the Rapid River NFH in 1985 and 1986; the Rapid River NFH stock in turn had been propagated from wild brood stock captured at Hell's Canyon Dam (on the Snake River). Since 1988 Dworshak NFH has sustained its population of Snake River spring chinook using this stock of known Snake R origin (Idaho Fishery Resource Office 2003). Prior to 1985, Dworshak had used spring chinook transferred from a Lower Columbia River Carson derivative stock. In 1985 and 1986 however, these eggs were relocated to Kooskia NFH (which is part of the Dworshak NFH Complex).

Approximately 1,400 juvenile spring chinook from the Dworshak hatchery were reserved for the POST study by the US Fish and Wildlife Service at Dworshak NFH. Dworshak fish released into

the Clearwater River must pass four dams in the Snake River and four dams in the lower Columbia River during their downstream migration to the ocean. All of these dams are equipped with juvenile bypass systems of varying sophistication; however, fish may also pass through turbines or during spill operations. Physical injury, high water temperature, and increased predation are possible dam-related sources of mortality that may contribute to low Snake River adult returns.

To reduce the detrimental effects of dam passage, a proportion of fish are collected at Lower Granite Dam, Little Goose and Lower Monumental Dams in the Snake River, and McNary Dam on the Columbia River, and are transported by barge to below Bonneville Dam. Since the remainder migrate through the dams, this stock is also useful for testing mortality due to barge related effects.

Spring chinook from the Cle Elum Supplementation and Research Facility (CESRF) on the Yakima River was chosen as the upper Columbia River stock for comparison. There is some uncertainty as to whether the Yakima River stock should be classified as an "upper" or "mid" Columbia River stock—it is thought that upper Columbia River chinook stocks have the most similar ocean distribution and behavior to the Snake River spring chinook, and it is in large part the disparity in abundance and survival to adult return that has motivated the suggestion that delayed mortality caused by additional stress from dam passage in the Snake River underlies the differences in survival.

The Yakima River enters the Columbia River 17 km upstream of the Snake River confluence. The Yakima/Klickitat Fisheries Program established the CESRF facility in 1997 to enhance production of spring chinook salmon in the Yakima River basin in order to increase harvest and augment the natural population (Fast 2002). The research facility (also referred to as Cle Elum hatchery) spawns returning wild spring chinook captured at Roza Dam (a barrier to migrating fish) on the Yakima River. Eggs are reared at the Cle Elum hatchery and fry are transferred to acclimation sites in winter, approximately one year after emergence. There are three acclimation sites which represent areas where historical spawning occurred; two are located on the Yakima River north and south of the hatchery (Easton and Clark Flats, respectively) and one is located on

a tributary of the Yakima (Jack Creek). Smolts are volitionally released from acclimation sites from March 15 to May 31. All fish are adipose fin clipped and a proportion of fish are coded wire tagged and/or PIT tagged. In the Yakima River, PIT tagged smolts are monitored in collection areas upon departure from acclimation sites and at the Chandler Juvenile Monitoring Facility on the lower Yakima River 76 km from the mouth. As no transport is allowed at McNary Dam during the spring outmigration, Yakima River spring chinook pass the dam without the possibility of being collected and inadvertently transported down the river to below Bonneville Dam.

With the help of the Yakima Klickitat Fisheries Program personnel, we temporarily retained non-PIT tagged migrating smolts captured at Chandler for the POST survival study. It was chosen for comparison with the Snake River stock because smolts migrate along almost the exact same length of the Columbia River as the Snake R stock, passing the four lower river hydro dams in the process, and has significantly higher adult return rates (~5% average in recent years). Thus, apart from inherent genetic differences, the major difference between the two stocks of spring chinook is the additional passage the Dworshak stock must undertake down the length of the Snake River and through the four Snake River dams.

Tagging

Snake and Yakima River spring chinook were surgically implanted with Vemco V9-6L acoustic transmitters (9 x 20 mm, 3.1 g in air). Each transmitter is uniquely coded so that individual fish may be identified when detected by acoustic receivers along their migration route. Fish were also implanted with a passive integrated transponder (PIT) tag in order to track movement through the hydropower system and ensure that tagged smolts were diverted back into the river and not collected for transport by barge. All PIT tag codes and release information were uploaded to the Pit Tag Information System (PTAGIS) website. PTAGIS listed David Welch as the coordinator ID (DWW), and Kintama Research Corp (KRC) as the organization.

The surgical procedure used to implant acoustic transmitters meets Canadian Council on Animal Care standards (Appendix 1). Portable self-contained surgical units were assembled on site, and fish surgery was carried out by veterinarian-trained staff. PIT tags were placed in the body cavity

through the incision. We set a minimum size limit for V9-6L acoustic tagging of spring chinook at 140mm FL, based on our previous surgical trials. This size threshold meant that approximately the upper half of the size distribution could be tagged (Average FL: 143 mm); above the 140mm minimum size, an effort was made to tag all available 5 mm size classes with an equal number of tags.

Snake River Stock

Spring chinook were relocated from Dworshak National Fish Hatchery (NFH) to Kooskia NFH in early March 2006. It was estimated that approximately 1,400 smolts >140 mm FL were transferred. A total of 800 spring chinook smolts were subsequently tagged at Kooskia NFH and placed into one of three treatments; run of river (ROR), transport, or retained for use in a long-term tag effect study (Table 1). Two separate groups of 200 acoustic and PIT tagged fish were released into Clear Creek (at Kooskia NFH) as the ROR groups, and two groups of 100 acoustic and PIT tagged fish were transported by truck to Lower Granite Dam and placed in a barge for transport and subsequent release below Bonneville Dam. The tag effect study group (100 smolts tagged with dummy V9-6L acoustic tags with an embedded PIT tag and 100 PIT tagged animals as controls) remained on site and was not released. Acoustic tagging of chinook smolts took place in mid and late April (for fish released directly into Clear Creek) and again in late May (for fish transported by barge). The release date of transported fish was intended to coincide with the arrival date of the ROR release groups at Bonneville Dam based on historical rates of movement.

Acoustic tagging mortality of run of river and transported groups was low (1%). There was no mortality reported for ROR acoustic tagged smolts pre-release. PIT tag loss was 5.5% during the 1-2 week recovery period prior to release into the creek or transport by truck/barge, probably because the PIT tag was placed into the body cavity through the incision (acoustic tags were retained during this period). In the future, PIT tags will either be embedded into the acoustic tag during potting, or bonded to the outside of the tag.

Yakima River Stock

Spring chinook released from Cle Elum Supplementation and Research Facility acclimation sites were recaptured at the Chandler Juvenile Monitoring Facility in Prosser, WA, and held for

tagging. Approximately 600 hatchery spring chinook were recaptured over several weeks of sampling. A total of 592 were tagged at Chandler and placed into one of two treatments; run of river (ROR) release or retained for the tag effect study (Table 1). Two groups of 200 fish marked with both acoustic and PIT tags were released back into the Yakima River as ROR groups; the remaining 192 fish were held for the tag effect study (100 acoustic tagged, 92 PIT tagged). Tagging of smolts took place in late May for both treatments. The release dates (May 30 and June 6 for ROR 1 and 2, respectively) of the ROR fish were selected so that the subsequent arrival dates at Bonneville Dam would coincide with the arrival time of the ROR release groups from Kooskia NFH.

There was no mortality reported for ROR acoustic tagged smolts pre-release, and PIT tag loss one to three days after tagging was 6%. There was no reported additional PIT tag loss prior to release.

Table 1. Summary of sample size, tag type, release date, and release site for groups of Yakima and Snake River chinook smolts.

Tag Group		# Tagged	Tag Type	Release Date	Release Site
Snake	**ROR 1**	198	Acoustic and PIT	May 1, 2006	Kooskia NFH (Clear Creek)
	ROR 2	198	Acoustic and PIT	May 8, 2006	Kooskia NFH (Clear Creek)
	Barge 1	102	Acoustic and PIT	June 7, 2006	RM 141 (below Bonneville)
	Barge 2	101	Acoustic and PIT	June 15, 2006	RM 141 (below Bonneville)
	Tag Effect	100	Acoustic	NA	NA
	Control	100	PIT	NA	NA
Yakima	**ROR 1**	199	Acoustic and PIT	May 30, 2006	Chandler Juvenile Monitoring Facility
	ROR 2	199	Acoustic and PIT	June 6, 2006	Chandler Juvenile Monitoring Facility
	Tag Effect	100	Acoustic	NA	NA
	Control	92	PIT	NA	NA

Location of the POST Array

The Pacific Ocean Shelf Tracking array is a large scale marine acoustic tracking network which currently extends from northern Oregon, throughout coastal British Columbia, and up to

southeast Alaska (see www.post.coml.org for more details; Figure 1). Of particular interest for this report are the three lines located (a) across the shelf at Willapa Bay, Washington, 40 kms north of the Columbia River mouth; (b) across the Strait of Juan de Fuca (entrance to the Strait of Georgia); and (c) across the shelf running offshore from Lippy Point, NW Vancouver Island. Equipment to deploy a cross-shelf line south of the Columbia River at Cascade Head, Oregon, was not delivered in time to be deployed prior to the ocean entry of the tagged smolts. Data from this line and a line across the Alaskan shelf at Graves Harbor, north of the Alaskan panhandle, had not yet been retrieved at the time of writing this report, owing to the winter storms that begin in October.

In spring of 2006, a total of 20 long-lived Vemco VR3 acoustic receivers were deployed in the main stem Columbia River and lower Snake River as an additional four sub-arrays forming a freshwater component of POST. In total, this unique and extensive array was used to measure the survival and movements of Columbia River Basin salmonids during their early life history in both freshwater and coastal marine environments. Figure 1 shows a close-up of the POST array centered around the Columbia R, and the cover figure to this report shows the extent of the entire array in 2006, including Alaska.

Figure 1. Region of interest for the tracking of acoustically tagged Snake and Yakima River Chinook during the summer of 2006. The Graves Harbour line, situated across the shelf north of the Alaska panhandle, is not shown in this figure, but lies over 1,700 kms north of the Cascade Head line. Bathymetric and topographic data courtesy of the Government of Canada and NOAA[i].

Columbia River Array

Twenty permanent moorings for VR3 receivers were installed in the Columbia River between April 25-28, 2006 (Figure 1). Four units were installed below the Bonneville Dam at

[i] Bathymetric data: ©2003, Government of Canada, with permission from Natural Resources Canada. Obtained through the GeogGratis web site (http://geogratis.cgdi.gc.ca).
Topographic data: GLOBE Task Team and others (Hastings, David A., Paula K. Dunbar, Gerald M. Elphingstone, Mark Bootz, Hiroshi Murakami, Hiroshi Maruyama, Hiroshi Masaharu, Peter Holland, John Payne, Nevin A. Bryant, Thomas L. Logan, J.-P. Muller, Gunter Schreier, and John S. MacDonald), eds., 1999. The Global Land One-kilometer Base Elevation (GLOBE) Digital Elevation Model, Version 1.0. National Oceanic and Atmospheric Administration, National Geophysical Data Center, 325 Broadway, Boulder, Colorado 80303, U.S.A. Digital data base on the World Wide Web (URL: http://www.ngdc.noaa.gov/mgg/topo/globe.html) and CD-ROMs.

McGowan's Channel; four in Lake Celilo, below the John Day Dam; eight in Lake Wallula, (21 km below the confluence of the Upper Columbia and Snake Rivers); and four in Lake Bryan below the Lower Granite Dam, with this furthest location providing survival and migration data more than 680 km upriver from the Columbia River mouth. At each of these locations, the receivers were deployed as paired lines, to ensure high detection probability and to provide coverage across the river below some of the major hydroelectric dams in order to provide a comparison of the survival of POST acoustic tagged smolts with conventional survival estimates using PIT tags. Data was successfully uploaded from all of these units on August 17-18 with the exception of one unit deployed below Bonneville Dam that failed to communicate. On September 4, a different unit from the same region of the river was removed from the array by a sport fisherman.

Cascade Head Line

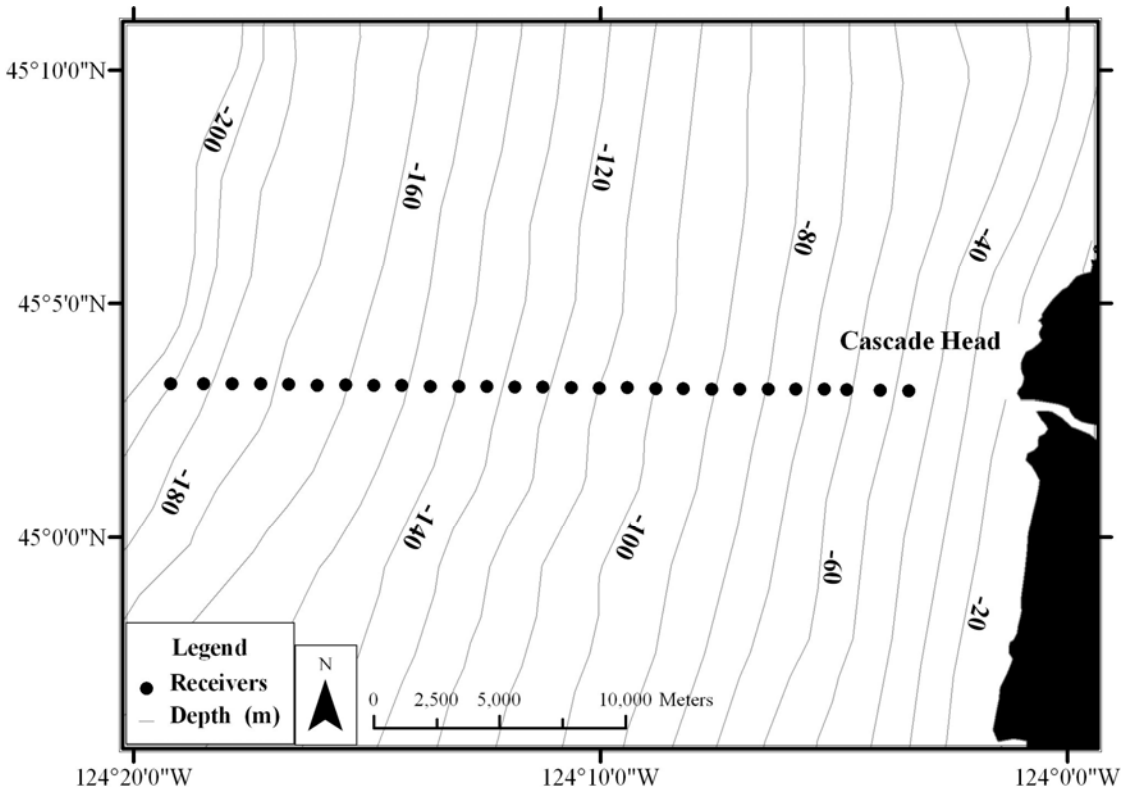


Figure 2. Detail of the placement of acoustic receivers on the Cascade Head line, off the coast of Oregon (see also Figure 1). These receivers are scheduled for recovery this winter. Bathymetric data courtesy of the USGS[ii].

[ii] Ann E. Gibbs, Maarten C. Buijsman, and Chris R. Sherwood, 2000. Non-Navigational Gridded Bathymetry Data for Washington-Oregon Coast: 1926-1998. Open-file report, obtained through the USGS Publications Warehouse (http://pubs.usgs.gov/of/2000/of00-448).

Twenty-seven VR2 acoustic receivers were deployed September 30th-Oct 1st 2006 near Cascade Head in Oregon State (Figure 2). The line was put out late in the season because of the extended timelines required for delivery and construction of all necessary equipment. The total length of this listening line is 20.7 km. Thirty units were planned, but the inside three receivers of this line were not deployed because of the shallowness of the water and the delay in timing resulted in undue risk to loss of gear in the inshore areas from exposure to fall and winter storms. As a result of poor weather and unfavorable sea conditions, these units have not yet been recovered.

Willapa Bay Line

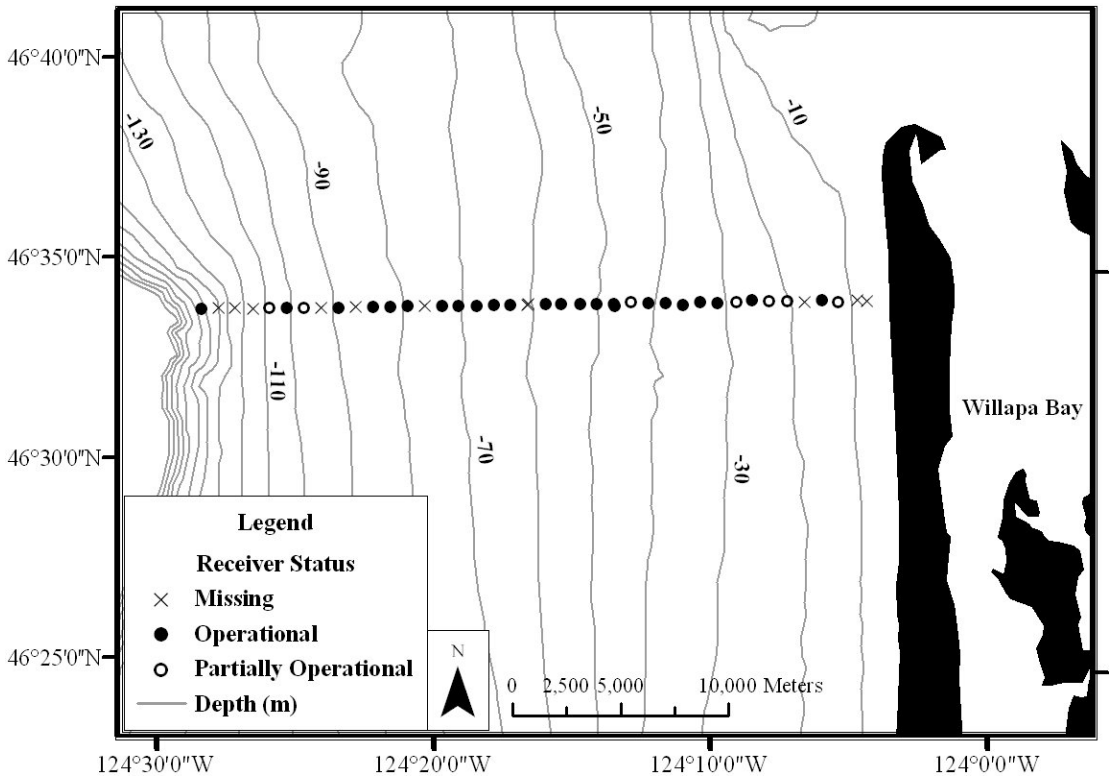


Figure 3. Detail of the placement of acoustic receivers on the Willapa line, off the coast of Washington (see also Figure 1). The total length of this line was 30.8 km for the original deployment. Bathymetric data courtesy of the USGS[ii].

Forty acoustic receivers were first deployed across the continental shelf west of Willapa Bay on April 23-24, 2006 (Figure 3). This line is located approximately 95 km south of the original 2005 Cape Elizabeth line where we had difficulty securing a permit for a permanent line. The 2006

deployment was composed of 13 VR2 receivers (that must be manually recovered to retrieve the data), and 27 VR3 receivers that are located permanently on the ocean bottom and transmit data via modem to surface vessels. The VR2 units were placed in the shallow inshore waters where marine conditions make it less likely that the units could survive in place in the long term because of winter storms. Within the first four days of the gear being submerged, four of the VR2 units were removed by crab fishing gear, and displaced from the array (three nearest shore, and one other further out at position nine). Units three and nine were redeployed on May 3rd, 2006; units one and two were not redeployed because it was anticipated that smolts would not migrate over that area of the shelf. Thus for the duration of the effective field season, the Willapa Bay listening line consisted of 38 receivers and was 29.4 km long.

Data was recovered/uploaded from this line on July 22nd, and again on Oct 20th. A number of units on the Willapa Bay line were impacted by fishing activities (bottom trawling offshore and crabbing inshore) during the time smolts were migrating over it. Locations marked by an x in Figure 3 were either removed from the array or were unresponsive during the July download. The units marked with an open circle were removed from the array for a period of time, but were replaced and operational for the majority of the field season. In most cases, data was recovered from displaced and subsequently returned units. A comparative analysis of the times that tagged smolts were detected on intact and displaced units indicates that most displaced units had remained in place during the critical time when smolts were traveling past the listening line (Figure 10). We are evaluating the design of our protective flotation collar and anchoring system with the aim of reducing equipment losses and with a view to modifying the design in time for the 2007 field season.

Lippy Point Line

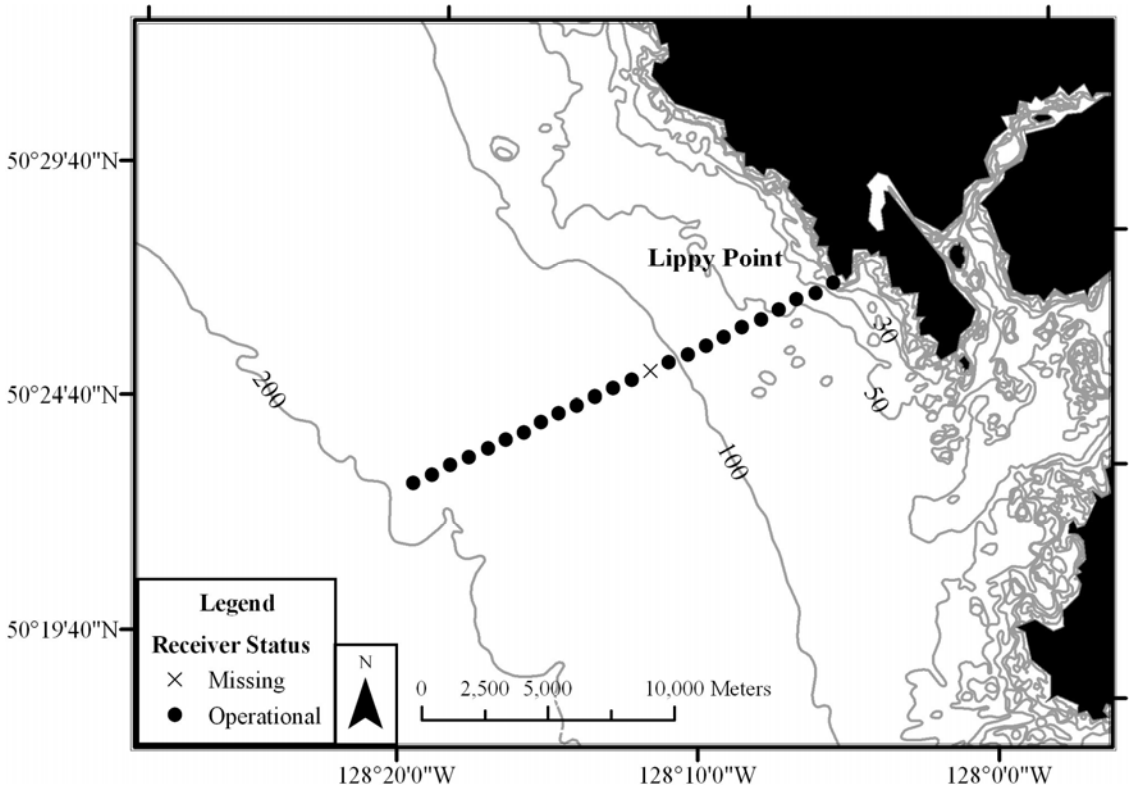


Figure 4. Detail of the placement of acoustic receivers on the Lippy Point line, off the coast of Vancouver Island, B.C. (see also Figure 1). The length of this line is 18.3 km. Bathymetric data courtesy of the Canadian Hydrographic Service.

Twenty-four acoustic receivers were deployed across the continental shelf west of Lippy Point British Columbia on June 29, 2006 (Figure 4). The overall length of this line is 18.3 km. It consists of two VR2 units that were deployed nearshore in shallow water, and twenty-two permanent VR3 units. This line was relocated 40 km north from the original Brooks Peninsula location because of the strong tidal currents (>4 knots) and remoteness of the site used in 2004 and 2005, and because tag detection rates should be higher in regions of weaker currents. Data was successfully uploaded/recovered in mid-September from all but one unit.

Graves Harbour Line (2005)

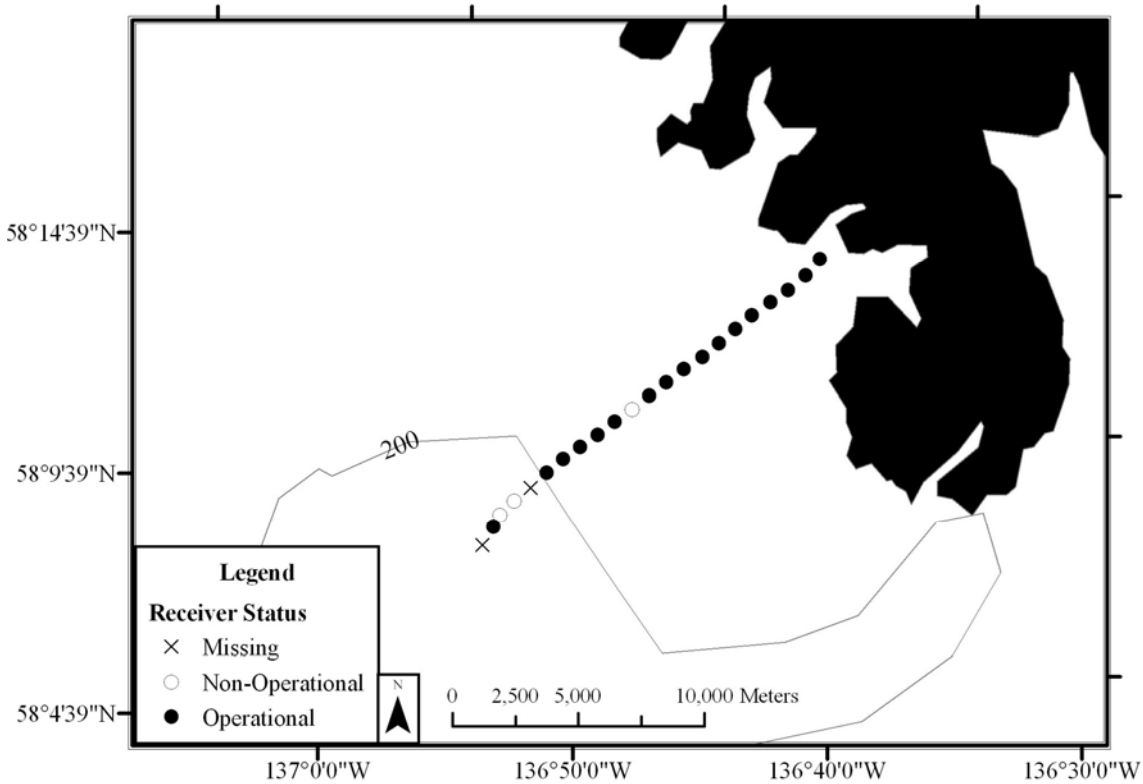


Figure 5. Detail of the placement of acoustic receivers on the 2005 Graves Harbor line off the South East Alaska coast, north of Icy Strait, AK (see also Figure 1). The length of this line is 17.4 km. Bathymetric data courtesy of the Government of Canada[iii].

A total of 22 units were deployed June 8, 2005, extending from Graves Harbour southwest out across the shelf (Figure 5). This line remained deployed over the entire winter because harsh weather conditions prevented its earlier recovery. All but two receivers were recovered one year later on June 14, 2006. However, three additional units failed to initialize and were non-functional during the deployment. Most equipment problems were located at the offshore end of the listening line.

[iii] Bathymetric data: ©2003, Government of Canada, with permission from Natural Resources Canada. Obtained through the GeogGratis web site (http://geogratis.cgdi.gc.ca).

Graves Harbour Line (2006)

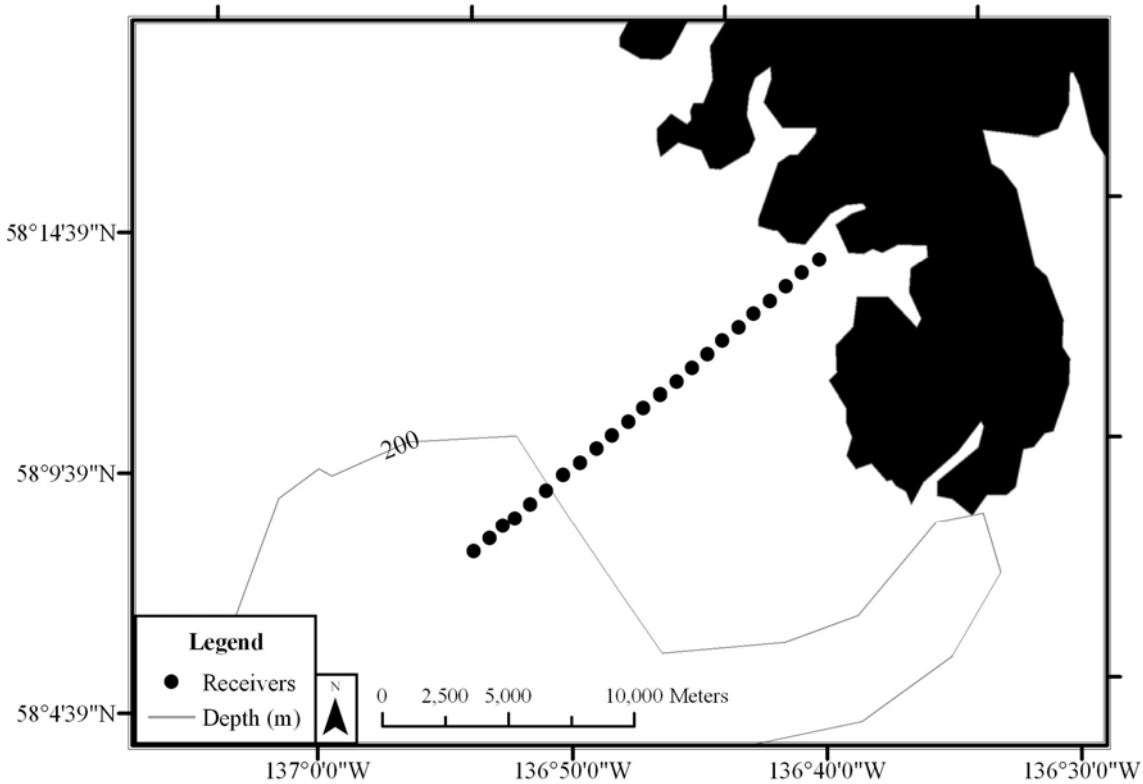


Figure 6. Detail of the placement of acoustic receivers on the 2006 Graves Harbour line, off the South East Alaska coast, north of Icy Strait, AK (see also Figure 1). The length of this line is 17.8 km. Bathymetric data courtesy of the Government of Canada[iii].

Twenty three VR2 units were deployed across the continental shelf southwest of Graves Harbor, Alaska on August 2-3, 2006 (Figure 6). Recovery is scheduled for 2007 when winter storms ease up.

Strait of Juan de Fuca Line

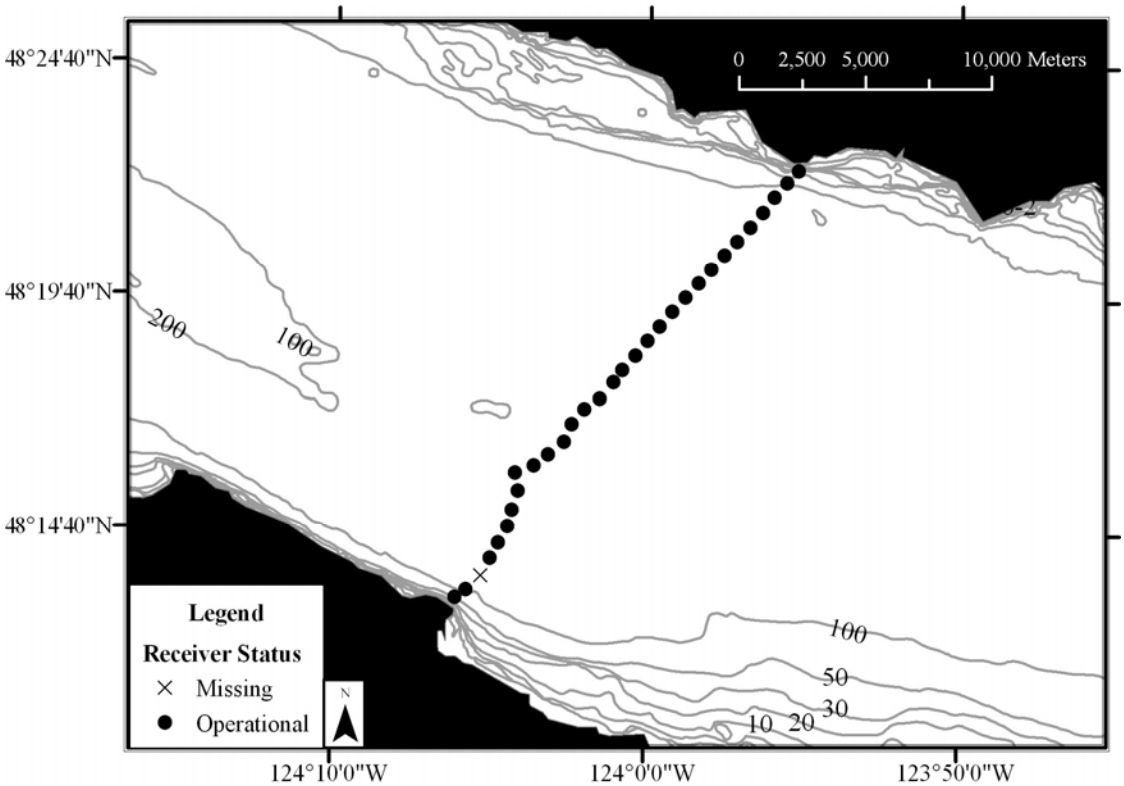


Figure 7. Detail of the placement of acoustic receivers on the Strait of Juan de Fuca line, between Vancouver Island, BC to the north and the central coast of Washington state on the southern shore (see also Figure 1). The total length of this line is approximately 22 km for the original deployment. Bathymetric data courtesy of the Canadian Hydrographic Service.

Fifteen VR2 acoustic receivers were deployed across the Canadian half of the Strait of Juan de Fuca on April 1st, 2007 (Figure 7). The line was completed on April 14th when a further 16 units were deployed from the American side of the Strait. These receivers were recovered, and replaced by 30 VR3 receivers on September 27 (Canadian side) and October 25 (American side). As in previous years, this line was impacted by fishing activity; however, the major effect was a uniform displacement of the line thus maintaining coverage across the vast majority of the Strait. All but one of the VR2 units was successfully recovered in September.

Northern Strait of Georgia

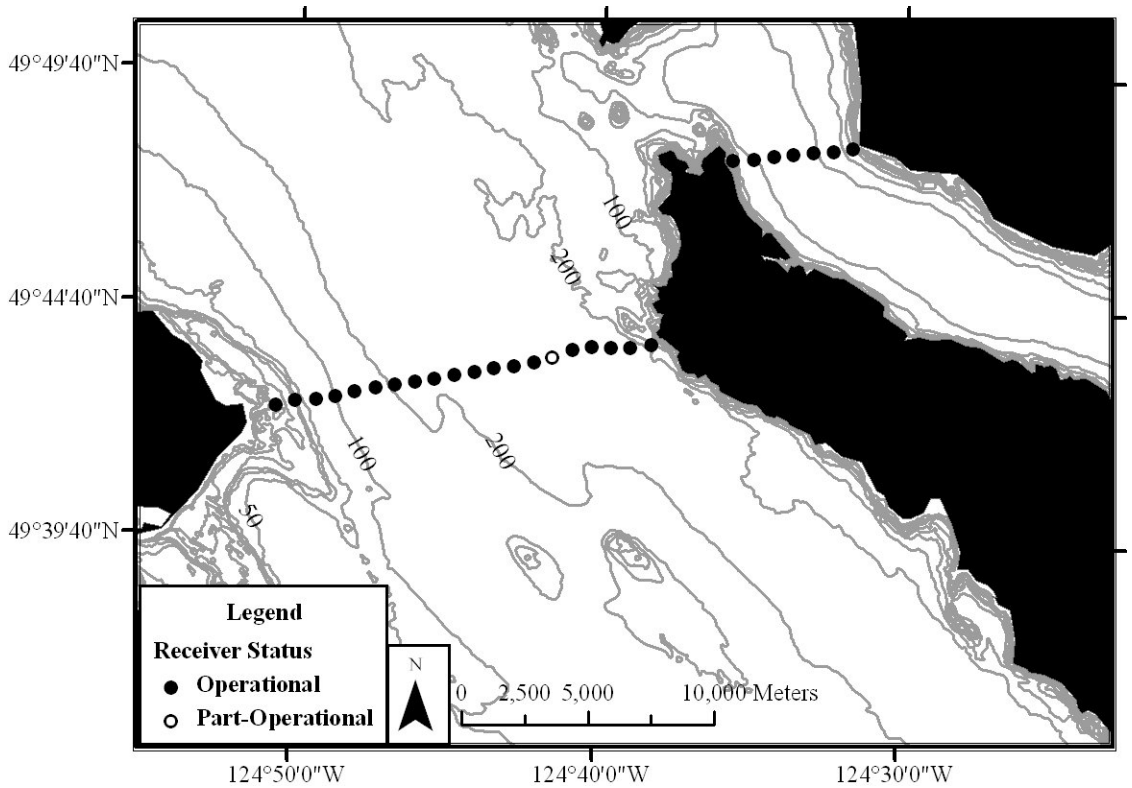


Figure 8. Detail of the placement of acoustic receivers on the Northern Strait of Georgia line, between Powell River on the B.C. mainland and Comox on Vancouver Island (see also Figure 1). Bathymetric data courtesy of the Canadian Hydrographic Service.

The Northern Strait of Georgia listening line extends from Powell River on the mainland to the northeast side of Texada Island, and then starts again on the west side of Texada and extends across the remainder of the Strait to Comox on Vancouver Island (Figure 8). In total, twenty-seven VR2 receivers were deployed between April 2-6, 2006. The VR2 line was replaced with a permanent VR3 line on July 19-20, sited slightly north of the existing VR2 line prior to its recovery. The intention was to eliminate gaps in coverage and reduce the possibility of failing to detect stocks migrating through the Strait while the VR2 units were being replaced with the permanent array platform. All of the VR2 receivers were successfully recovered on July 21-22, 2006. Unfortunately, six VR3 receivers were pulled out of position during this recovery; only three were moved a distance large enough to warrant replacements units to fill holes which could have otherwise compromise the detection coverage of the line. These three units were replaced immediately after they were displaced on July 22nd. All but one of the VR3 units downloaded data when polled at the end of October.

Queen Charlotte Strait Line

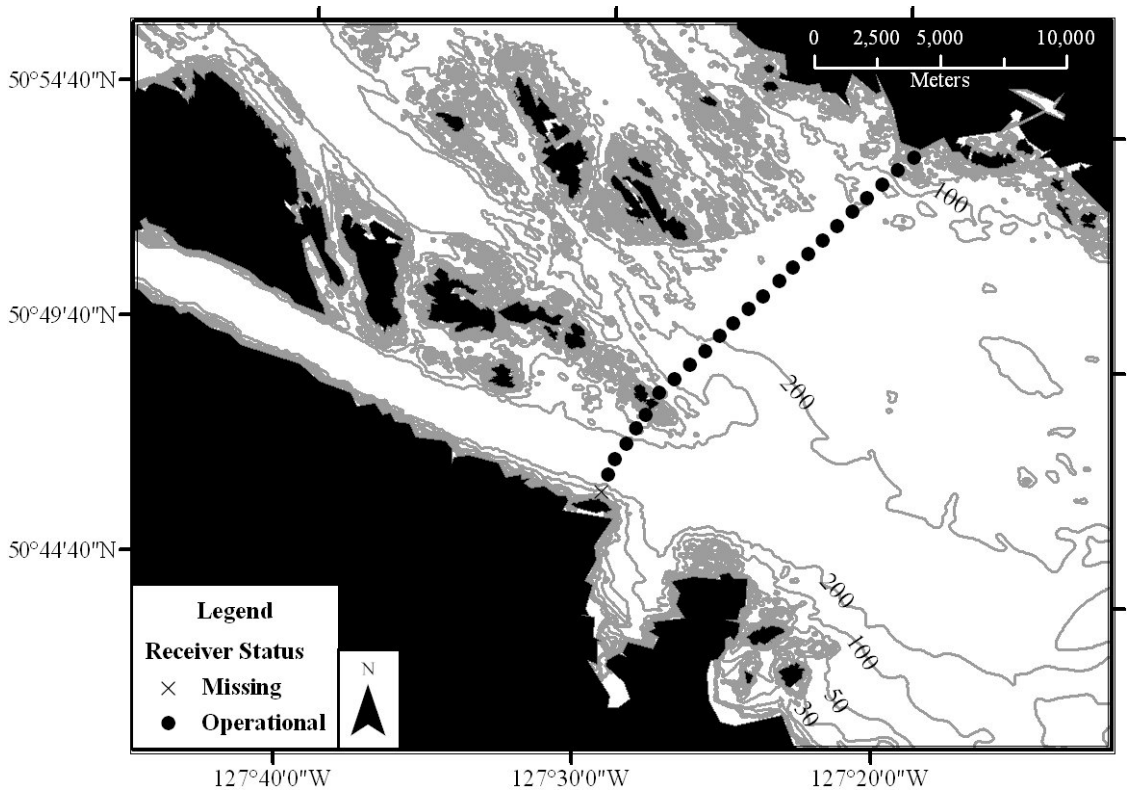


Figure 9. Detail of the placement of acoustic receivers on the Queen Charlotte Strait line, between Browning Island near the B.C. mainland and Port Hardy on Vancouver Island (see also Figure 1). Bathymetric data courtesy of the Canadian Hydrographic Service.

Twenty-four VR2 receivers were deployed March 28 and 30 across Queen Charlotte Strait from Browning Island near the mainland to Duval Island, close to Port Hardy on Vancouver Island (Figure 9). Twenty-three of the units were recovered September 6-10 and twenty-four permanent VR3 units were deployed in the same location September 6 and 10 without incident.

Keogh River Receivers

Two VR2 receivers were placed off the mouth of the Keogh River, approximately 15 km south of the Queen Charlotte Strait line (Figure 1). The receivers were put in place on March 29 and recovered on September 6, 2006, without incident. The main purpose of this line during the 2006 field season was to count the outmigrating smolts in order to partition the freshwater and marine survival of Keogh River coho and steelhead. As some smolts either died or remained continuously in the vicinity of the receivers, the potential for false detection of tag codes caused

by multiple tags transmitting simultaneously near the Keogh River receivers makes these units slightly less reliable for the purposes of tracking Snake and Yakima River smolts; this is discussed later in the report. Thus, any detections of Snake River tag codes on this line that are not also observed on at least one of the Queen Charlotte Strait, northern Strait of Georgia, or Juan de Fuca lines should be considered likely to be false positives.

The first season using the VR3 receivers has proven to be a considerable success despite a variety of both new challenges and old obstacles. Data transfer via the underwater modem technology generally worked well in both fresh and salt water situations, verifying the validity and feasibility of developing a permanent array for tracking movements and survival over great distances.

Survival Analysis

Minimum estimates of survival were calculated for in-river and ocean lines as the number of fish detected on each acoustic line divided by the number released (or by the number leaving the previous line along the migration route).

Minimum estimates of survival should be increased to account for the detection efficiency of the line, rates of tag retention and tagging related mortality, and gear loss on the listening lines. It is not feasible to directly estimate detection efficiency for the Willapa Bay or Lippy Point lines, but it is expected to be high based on the performance of other ocean lines with similar geometries (~95%). Tagging related mortality from the smolts retained at the hatcheries was generally low, but was somewhat compromised by outbreaks of freshwater diseases several months after the ROR and barged smolts were released. For these reasons, we restricted the adjustment of survival to account only for gear loss on the Willapa Bay line, where approximately 11 of 40 receivers were non-operational for a portion of the field season, as this was by far the major contributor to underestimating the number of smolts surviving to reach Willapa Bay.

Survival on the Willapa Bay line was adjusted to account for gear loss by initially calculating the number of unique fish heard on each receiver forming the listening line; for example, if a tagged

smolt was heard on two receivers, each receiver was credited with 0.5 smolts detected. When summed over all receivers, the total number of fish recorded will thus equal the number of unique fish detected. We then calculated an estimate of the number of additional unique smolts likely to have been detected on receivers lost from the Willapa Bay listening line in two ways. First we calculated the average number of unique smolts using all extant receivers and then applied this single value to estimate the number of smolts likely detected on the lost receivers. We refer to this as the "global average" approximation. Note that this upwards adjustment to the number of tagged fish likely present is conservative because receivers that were only partially operational were treated as fully operational in this assessment.

Second, because there is evidence (see later) that the distribution of Snake and Yakima River smolts are not uniformly distributed across the shelf, but have areas of higher relative abundance, we also calculated the likely number of smolts on a missing receiver by taking the average of the two nearest neighbors; this corrected count is thus a weighted local average that should better reflect parts of the listening line where smolts preferentially travel. If there was more than one lost receiver between two operational receivers, the missing receivers were allocated a number of unique fish proportional to the linear distance from the two neighboring receivers. If a lost receiver had one neighbor only (i.e. the end units on the line), each missing receiver was allocated the number of fish detected on the nearest neighboring receiver. We refer to this as the "nearest neighbor estimate". At Lippy Point, only one unit was non-operational and minimum survival estimates did not need to be adjusted because of the low number of smolts reaching northern Vancouver Island.

Results

Detections on Lines

The summary of where Snake and Yakima River chinook smolts were detected on the POST array is presented in Table 2 and Appendices 2 and 3. The following sections briefly highlights major features of this data.

Table 2. Summary of Snake and Yakima River chinook smolts detected on the POST ocean array. Note that only listening lines with detections of smolts are displayed. Detections on the Keogh and Southern Strait of Georgia listening lines are likely false (see False/Unusual Detections section below), as the tag codes for these fish were not detected on any of the listening lines they needed to pass over to reach these locations.

Stock	Study Group	Number Released	Willapa Bay	Lippy Point	Keogh River	Southern Strait of Georgia
Snake River	BARGE 1	102	48	8	0	0
	BARGE 2	101	30	3	0	0
	ROR 1	198	39	1	2	0
	ROR 2	198	42	3	1	0
Yakima River	ROR 1	199	19	2	0	1
	ROR 2	199	61	0	0	0

The peak of the Snake ROR smolts passed by the Willapa Bay line on May 25, 2006, and almost all fish had gone by before the arrival of the Snake River barged and the Yakima River ROR smolts (Figure 10). Despite being released one week later, the Snake ROR2 group overtook the ROR1 group and both groups were detected at Willapa Bay in the same time interval (See Travel Speeds). These two release groups were also the first to arrive at the Lippy Point line beginning on June 28th (Figure 11); smolts were first detected there within hours of the Lippy Point listening line being deployed, so it is plausible that some ROR Snake River smolts passed the Lippy Point line before it was deployed. The two barged Snake River groups peaked at the Willapa line on June 13th and June 20th. They arrived at the Lippy Point line over a distributed time period with ROR1 arriving first between July 1-27 and ROR2 arriving later between August 12-24. The Yakima ROR2 group also overtook the ROR1 group although far fewer smolts were detected on Willapa Bay line (14.3% survival versus 41.1 %; Table 5). Yakima River ROR1 detections on the Willapa line peaked about the same time as the Snake River barged fish on June 12-13th and ROR2 peaked two days later on June 15th. Only two Yakima smolts were detected on the Lippy Point line from Yakima ROR1 (July 10th and July 14th) and none were detected from ROR2.

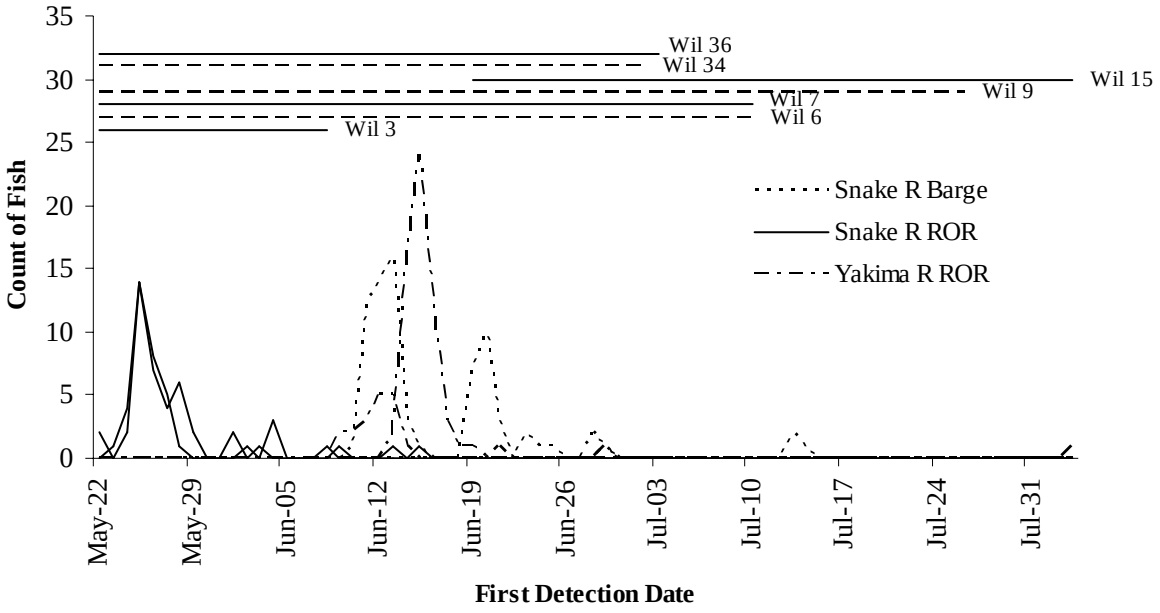


Figure 10. Number of Yakima and Snake River chinook smolts arriving on the Willapa Bay line by date from the arrival of the first fish until the arrival of the last fish (The listening line was deployed for a longer period of time). Horizontal bars indicate the date range during which displaced units were in place and operational. Note that there are 40 units on this line. Units 1 and 2 were displaced before fish arrived at the Willapa Bay line and were not replaced. All other units were in place for the entire duration of this study.

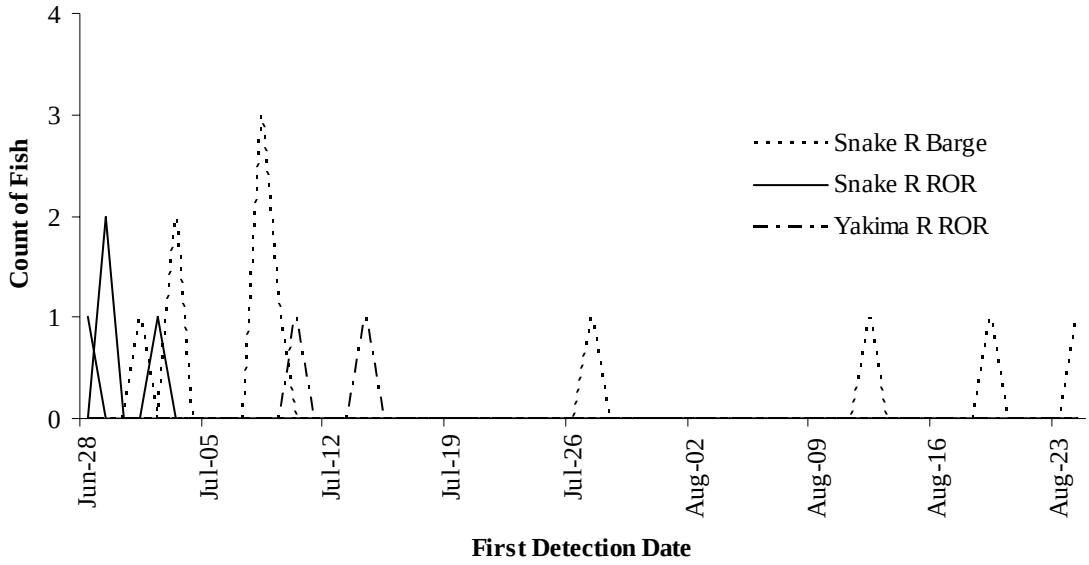


Figure 11. Number of Yakima and Snake River chinook smolts arriving on the Lippy Point line by date.

Cross-Shelf Distribution

Detections of Yakima River smolts were recorded along the entire length of the Willapa Bay line (Figure 12). Snake River smolts may migrate somewhat further offshore as they were not detected on the landward receivers and detections tended to increase towards the shelf break. Barged and ROR smolts from the Snake River appear to be distributed similarly along the line. The pattern of detections for all smolts suggests that some fish may have migrated beyond the outer edge of the Willapa Bay line; additional receivers will be placed to extend the line further offshore in 2007.

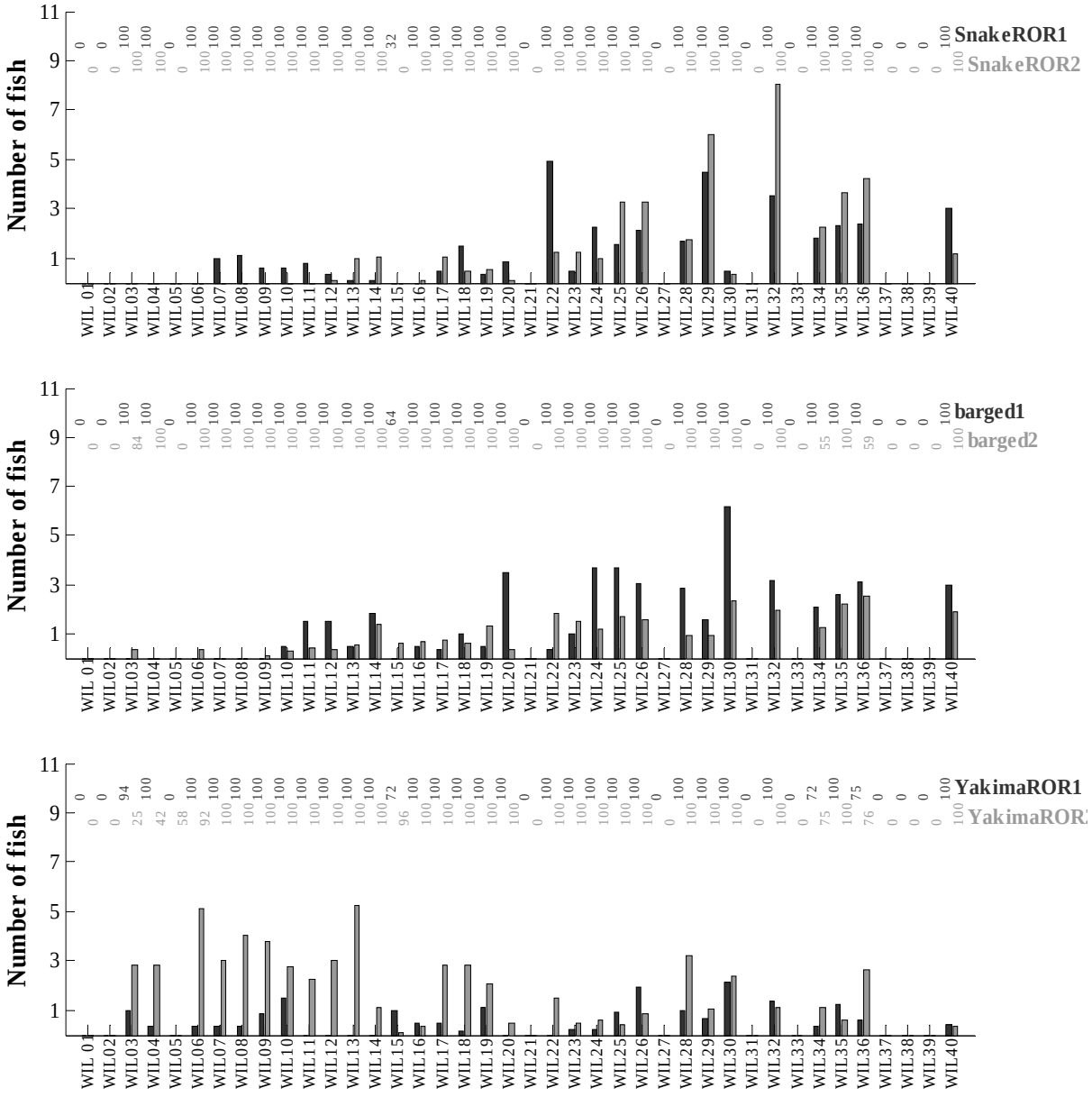


Figure 12. Distribution of unique detections of Snake and Yakima River spring chinook smolts from the ROR and barged study groups on the Willapa Bay listening line. The line extends from Wil 01 (inshore) to Wil 40 (offshore). Horizontal rows of numbers at the top of the plots indicate the percentage of time each receiver was operational between the dates of first and last detection for each study group.

The data from the Lippy Point line shows that the Columbia River smolts (a) are still distributed on the shelf, (b) are not found close to the offshore end of the line at the shelf break (200m), and (c) that detection rates of individual smolts are high (a large number of detections for each tag; Figure 13). These results indicate that the detection line is likely sited to cover the full migration path, and that the array geometry and tag programming is such that it makes the likelihood of a smolt passing by without being detected small.

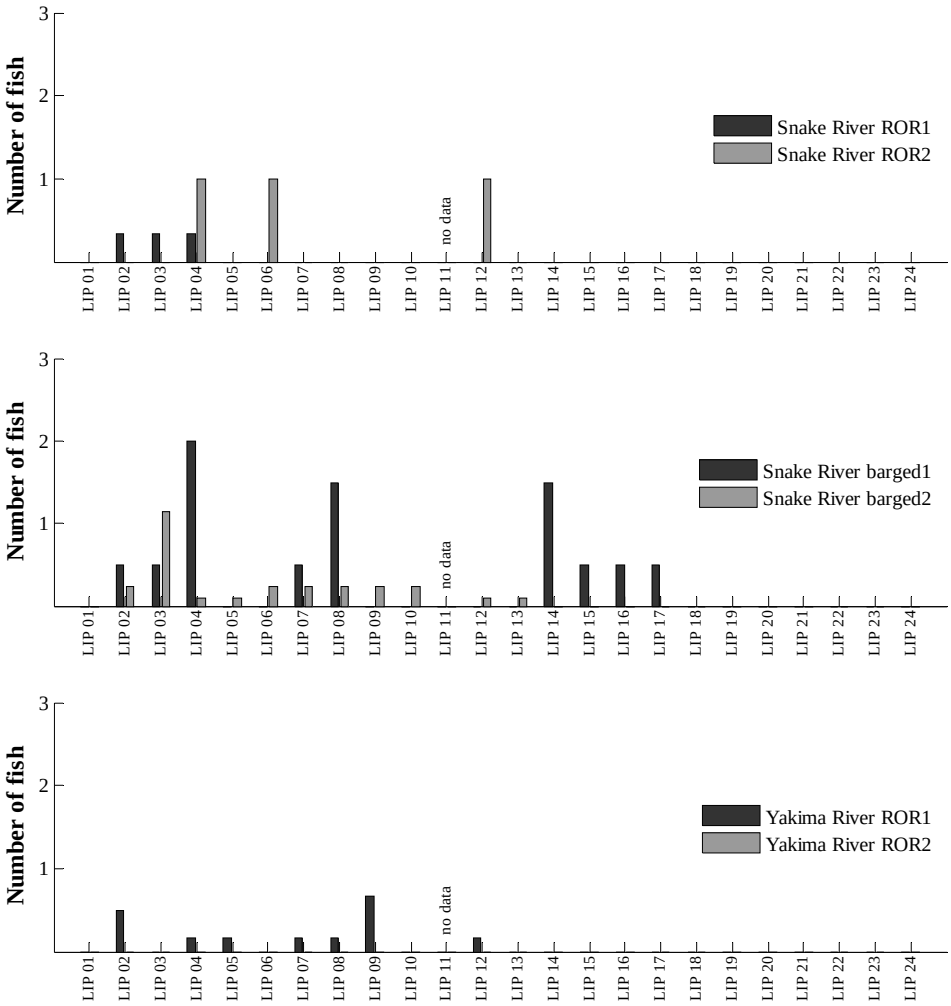


Figure 13. Distribution of Snake and Yakima River spring chinook smolts on the Lippy Point listening line. The line extends from Lip 01 inshore to Lip 24 offshore. Individual fish are allocated fractionally to each receiver based on the number of receivers detecting the individual, giving rise to non-integer numbers.

False/Unusual Detections

Although the array generally operated in a highly satisfactory manner, there are a few detections of Columbia River fish that are likely false positives (i.e. tags incorrectly detected and recorded). Detections of three Snake River ROR smolts on the Keogh River listening line and one Yakima River ROR smolt on the Southern Strait of Georgia listening line should be regarded with caution (Appendices 2 and 3). None of these fish were detected on the Bonneville, Willapa Bay, Lippy Point, or Juan de Fuca lines, which lie between the release site and the detection locations.

We believe that one of the tags recorded as a Snake River ROR smolt (Tag ID 936 with 9,588 detections), really came from a Keogh River steelhead tagged in 2004 with the same Tag ID code and which appeared to have died close to a Keogh receiver shortly after exiting the river mouth in 2004. That tag was recorded over a long period of time in 2004 as being present in the vicinity of the river mouth. The battery on this tag has likely lasted much longer than the guaranteed lifespan provided by Vemco, but is consistent with some of our own tests on maximum achieved tag lifespans using the POST programming with the Vemco tags. The two other Snake River ROR smolts were probably false detections caused by multiple tags transmitting simultaneously near the Keogh River receivers, which is a pathological condition known to occasionally generate spurious detections. One of these fish was first detected before it was released in the Columbia River, and the other was first detected too soon after release to have swum the distance between the Clear Creek release site in Idaho State and the Keogh River on Vancouver Island. We are currently undecided about the detection of the Yakima ROR fish on the Southern Strait of Georgia line because the pattern of detections does not conform to our usual criteria for identifying false detections caused by tag collisions. We have submitted an inquiry to the tag manufacturer.

Estimates of Survival

Minimum survival estimates were calculated for in-river and ocean lines as the number of fish detected on each acoustic line divided by the number released (or by the number leaving the previous line along the migration route; Table 3).

Table 3. Minimum estimates of survival for chinook smolts released at locations in the Yakima and Snake Rivers to lines of acoustic receivers. Data uploaded to mid-August 2006 for in-river receivers, mid-October for Willapa Bay, and mid-September for Lippy Point. Standard errors (SE) are reported using the normal approximation to the binomial proportion, and are calculated as $SE = \sqrt{S(1-S)/N}$ *.*

	Yakima R		Snake R		Snake R	
Tag Group	**ROR 1**	**ROR 2**	**ROR 1**	**ROR 2**	**Barged 1**	**Barged 2**
Release Date	30-May	06-Jun	01-May	08-May	07-Jun	15-Jun
Number Released	199	199	198	198	102	101
Lake Bryan (189 km from Snake R release site)						
Number Detected	NA	NA	149	154	NA	NA
Survival			75.3%	77.8%		
±SE(Survival)			±3.1%	±3.0%		
Stock Average			76.5%			
±SE(Survival)			±2.1%			
Lake Wallula (368 km from Snake R release site; 113 km from Yakima R release site)						
Number Detected	127	145	102	114	NA	NA
Survival	63.8%	72.9%	51.5%	57.6%		
±SE(Survival)	±3.4%	±3.2%	±3.6%	±3.5%		
Stock Average	68.3%		54.8%			
±SE(Survival)	±2.3%		±2.5%			
Lake Cecilo (530 km from Snake R release site; 275 km from Yakima R release site)						
Number Detected	74	79	55	46	NA	NA
Survival	37.2%	39.7%	27.8%	23.2%		
±SE(Survival)	±3.4%	±3.5%	±3.2%	±3.0%		
Stock Average	38.4%		25.5%			
±SE(Survival)	±2.4%		±2.2%			
McGowans Channel (645 km from from Snake R release site; 390 km from Yakima R release site)						
Number Detected	49	75	65	57	29	28
Survival	24.6%	37.7%	32.8%	28.8%	28.4%	27.7%
±SE(Survival)	±3.1%	±3.4%	±3.3%	±3.2%	±4.5%	±4.5%
Stock Average	31.2%		30.8%		28.1%	
±SE(Survival)	±2.3%		±2.3%		±3.2%	

Willapa Bay Ocean Line (908 km from Snake R release site; 653 km from Yakima R release site)						
Number Detected	19	61	39	42	48	30
Survival	9.5%	30.7%	19.7%	21.2%	47.1%	29.7%
±SE(Survival)	±2.1%	±3.3%	±2.8%	±2.9%	±4.9%	±4.5%
Stock Average	20.1%		20.5%		38.4%	
±SE(Survival)	±2.0%		±2.0%		±3.4%	
Lippy Point Line (1,433 km from Snake R release site; 1,178 km from Yakima R release site)						
Number Detected	2	0	1	3	8	3
Survival	1.0%	0.0%	0.5%	1.5%	7.8%	3.0%
±SE(Survival)	±0.7%		±0.5%	±0.9%	±2.7%	±1.7%
Stock Average	0.5%		1.0%		5.4%	
±SE(Survival)	±0.4%		±0.5%		±1.6%	

Survival estimates for the Willapa Bay line adjusted to compensate for gear loss using the global average approximation increased proportionally to the number of fish detected for all study groups (Figure 14; Table 4). In contrast, survival estimates adjusted using the nearest neighbor approximation increased more for the Snake River stocks than for the Yakima River stocks because the Yakima River smolts were distributed more evenly across the line while the Snake River stock had more detections towards the outer shelf where there was a greater percentage of equipment loss (Figure 14; Table 5).

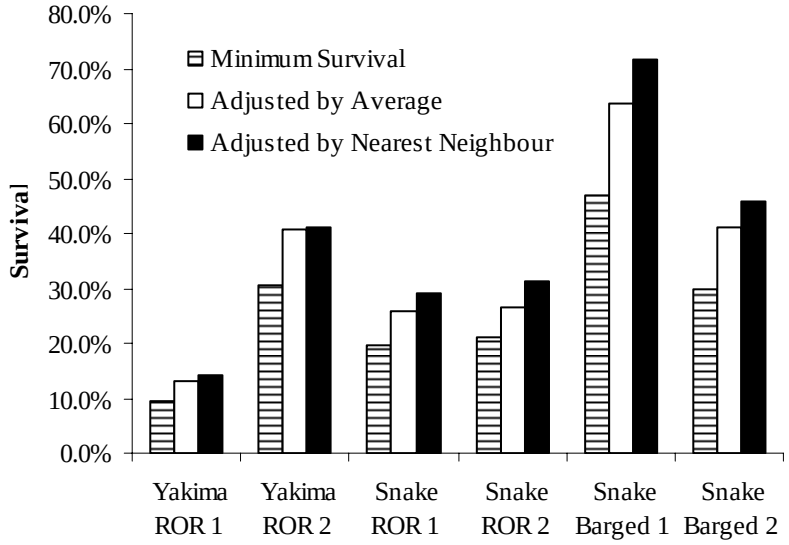


Figure 14. Estimates of minimum survival and minimum survival adjusted for gear loss of Yakima and Snake River chinook smolts to the Willapa Bay line

Survival estimates of the replicate groups to Willapa Bay were nearly identical for the two Snake ROR groups, but the estimated survival of Yakima ROR1 was substantially smaller than the survival of Yakima ROR2 (Figure 15; Table 5). Conversely, survival of the Snake R Barged1 group was substantially higher than the survival of the second replicate, although timing of ocean entry seems to have been similar for both the Yakima ROR and Snake Barged groups.

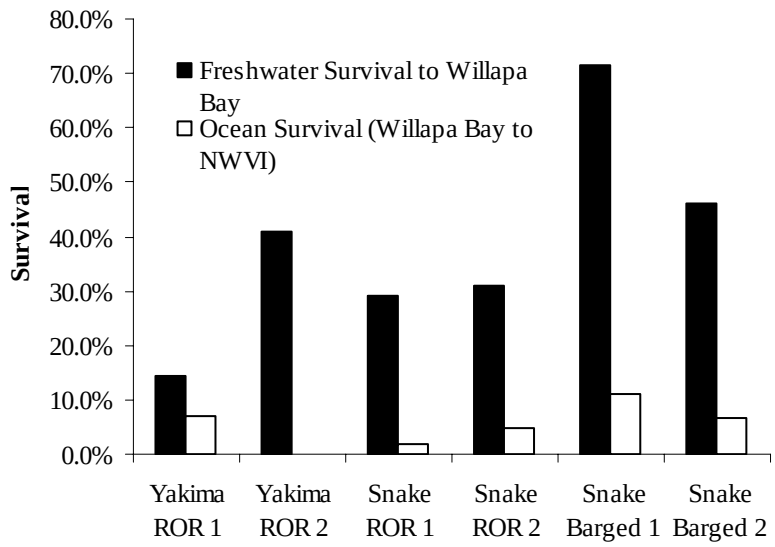


Figure 15. Estimated survival to the Willapa Bay and Lippy Point listening lines of Yakima and Snake River chinook smolts using the nearest-neighbour method of adjustment for gear loss.

Our estimates indicate that survival to the acoustic detection site below Bonneville Dam and survival to the ocean detection line adjacent to Willapa Bay is similar for Snake River and Yakima River ROR chinook (Figure 15; Tables 3 and 5). However, survival of the Snake River population to Lippy Point (NW coast of Vancouver Island, ~525 km N of the Willapa Bay line) was double that of the Yakima population. Survival of barged Snake River chinook to the southern Washington coast (Willapa Bay area) was approximately twice the survival of Yakima and Snake ROR groups, as expected, given the shelter the barges provide from the 50% in-river mortality. Furthermore, minimum survival to Lippy Point on Vancouver Island was at least five times greater than that of the ROR groups.

Table 4. Estimates of survival of Snake and Yakima River chinook smolts from release to arrival at ocean detection lines adjusted for lost gear using the global average method.

	Yakima R		Snake R		Snake R	
Tag Group	**ROR 1**	**ROR 2**	**ROR 1**	**ROR 2**	**Barged 1**	**Barged 2**
Release Date	30-May	31-May	02-Jun	03-Jun	05-Jun	06-Jun
Number Released	199	199	198	198	102	101
Willapa Bay Ocean Line (908 km from Snake R release site; 653 km from Yakima R release site)						
Number Detected	19	61	39	42	48	30
Adjusted Number Detected	25.4	81.4	52	56	64	40
Adjusted Survival to Willapa Bay	12.8%	40.9%	26.3%	28.3%	62.7%	39.6%
±SE(Adjusted Survival)	±2.4%	±3.5%	±3.1%	±3.2%	±4.8%	±4.9%
Adjusted Stock Average	26.8%		27.3%		51.2%	
±SE(Adjusted Survival)	±2.2%		±2.2%		±3.5%	

Table 5. Estimates of survival of Snake and Yakima River chinook smolts from release to arrival at ocean detection lines adjusted for lost gear using the nearest neighbour method.

	Yakima R		Snake R		Snake R	
Tag Group	**ROR 1**	**ROR 2**	**ROR 1**	**ROR 2**	**Barged 1**	**Barged 2**
Release Date	30-May	31-May	02-Jun	03-Jun	05-Jun	06-Jun
Number Released	199	199	198	198	102	101
Willapa Bay Ocean Line (908 km from Snake R release site; 653 km from Yakima R release site)						
Number Detected	19	61	39	42	48	30
Adjusted Number Detected	26.9	82.9	56.5	62.7	69.4	43.8
Adjusted Survival to Willapa Bay	13.5%	41.7%	28.5%	31.7%	68.0%	43.4%
±SE(Adjusted Survival)	±2.4%	±3.5%	±3.2%	±3.3%	±4.6%	±4.9%
Adjusted Stock Average	27.6%		30.1%		55.7%	
±SE(Adjusted Survival)	±2.2%		±2.3%		±3.5%	

Evidence for Delayed Mortality

We find no evidence for a difference in mortality between Snake and Yakima River spring chinook smolts migrating all the way to the northern tip of Vancouver Island (815 kms beyond Bonneville Dam, 1,470 kms from the Snake River release site; Figure 15, Tables 3 and 5). As

Yakima spring chinook SARs have historically been 5.2 times higher than that of the Snake River SARs (similar to a number of other Columbia River stocks), there has been speculation that delayed mortality due to the extra stress of migrating past the Snake River dams is the cause of the poor adult returns (Budy et al. 2002). We find no evidence of this. This suggests that the poor Snake River survival occurs somewhere later in the ocean life history and that differential effects of the ocean have been confounded with the operation of the hydrosystem. We do not find evidence that "delayed" or "latent" mortality has been expressed in the region that we conducted the 2006 pilot study—the upper reaches of the Columbia/Snake River system to the northern tip of Vancouver Island.

Assessment of Benefits of Transportation

Although barged Snake River fish initially do better after release than the ROR Snake River fish (the intended goal), it appears that the additional month of ocean mortality imposes greater mortality than if the fish were left to migrate to sea on their own. That is, the level of ocean mortality we are measuring is higher than the in-river mortality, so transport places the fish in a higher mortality environment for a longer time period. Additionally, growth incurred during the downstream migration may reduce predation and alter timing of ocean entry (Muir et al. 2006). Thus, the development of the transport program may have traded "the frying pan for the fire". As a result, there may not be as large a benefit as initially thought from operating the barging system once the role of the ocean is considered.

A more complete assessment of the relative merits of transportation would be possible if it was possible to census each group of smolts on the same day. For example, if on June 30th the ROR smolts had just arrived at the Willapa Bay listening line and the barged smolts had just arrived at the Lippy Point line at the north end of Vancouver Island, a direct comparison of survival *on the same day in the overall life history* would be possible. Even here, some question would still remain about possible changes in the subsequent differential survival of the two groups because of ocean conditions that might develop separately over time off the Washington and central B.C. to Alaska coasts, but the key principle is that the later in the life history that comparative survival

can be measured, the better the assessment will be of the merits of transport for Snake River salmon stocks.

Travel Speeds

As in the past two years, travel speeds for the Snake River chinook smolts are high, with average rates ranging between 37.2 and 82.5 km/day in-river and slowing to about 30% of this value in the ocean (16.4-22 km/day; Table 6). These speeds correspond to migration rates of slightly less than 2 body-lengths/sec in the ocean, indicating a sustained and highly directed migration along the shelf is taking place.

Yakima River smolts traveled more quickly than the Snake River smolts downriver as far as the Bonneville Dam although this pattern is less clear between Bonneville and the Willapa Bay line. The first release of both the Yakima and Snake River ROR groups traveled more quickly between release and the Bonneville Dam, and this difference continued for the Yakima stock as far as the Willapa Bay line.

Table 6. Rates of travel (km/day) of Snake and Yakima River Chinook smolts detected on the POST array in 2006. Speeds are calculated as the difference between the last detection time on one line and the first detection time on the next divided by the minimum path distance between each reach while remaining in-river and over the continental shelf. Travel speeds in the river are not corrected to remove the speed of river flow.

		Release to Bonneville		**Bonneville to Willapa Bay**		**Willapa Bay to Lippy Point**	
Stock	**Group**	**No. Fish**	**Average Rate (min-max)**	**No. Fish**	**Average Rate (min-max)**	**No. Fish**	**Average Rate (min-max)**
Snake River	Barged 1	0	No Data	18	53.3 (12.1-80.6)	7	22.0 (19.6-25)
Snake River	Barged 2	0	No Data	6	53.3 (9.6-72.3)	1	12.41
Snake River	ROR 1	65	37.2 (20.8-117)	28	60.9 (17.7-102.8)	0	No Data
Snake River	ROR 2	57	53.1 (31.7-99.9)	29	64.7 (15.3-105.8)	2	17.9 (16.2-19.5)
Yakima River	ROR 1	49	66.6 (39.9-88.1)	16	48.1 (31.8-79.5)	2	16.4 (15.8-16.9)
Yakima River	ROR 2	75	82.5 (51.5-100.6)	52	76.3 (5-105.5)	0	No Data

Although time of arrival at the ocean (Willapa Bay) listening line differs for the Yakima and Snake River stocks (Figure 10), the average travel time from Willapa Bay to Lippy Point is 32 days for both stocks, demonstrating a similar migration speed in the ocean (Table 6).

Duration on Line

Over 75% of the smolts migrated past the Willapa Bay line within 6 hours (Figure 16); however, a subset of all release groups were detected on the line 10 days or more after their first detection (Figure 17; Snake ROR1: 7.7%; ROR2: 4.8%; Yakima ROR1 & 2: 26%; Snake Barged 1: 14.6%, Barged 2: 23%)

The Yakima River ROR study groups had the longest duration on the line with 8-11% of total detections occurring more than a month after arrival, but the Snake River groups (except ROR2) were also detected over extended periods of time (>20 days for 4%-13% of smolts). The median residence time for the 12 individuals that were detected on both the Willapa Bay and the Lippy Point lines was 30 minutes; no smolts that were detected on the Willapa Bay line over a five day or greater period were subsequently detected at Lippy Point. Extended residence times were also apparent on the Lippy Point line for Snake River Barged2 and Yakima River ROR1 although patterns are difficult to describe because the sample size is small (Figures 18 and 19). These results raise the question of whether tags heard over prolonged periods may be present inside predators or whether the low survivals recorded at Lippy Point may be partially the result of smolts that do not migrate directly northward after they enter the ocean.

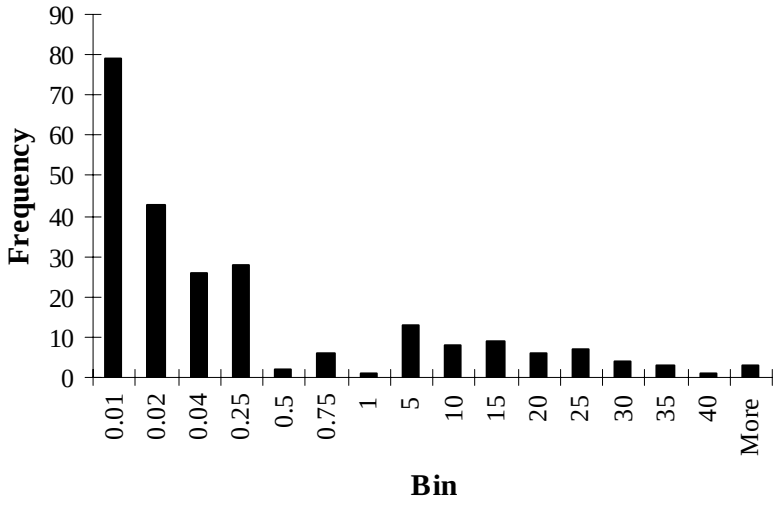


Figure 16. Duration of Yakima and Snake River chinook smolts on the Willapa Bay line from time of first detection to time of last detection. Note that fish were not detected continuously during this interval.

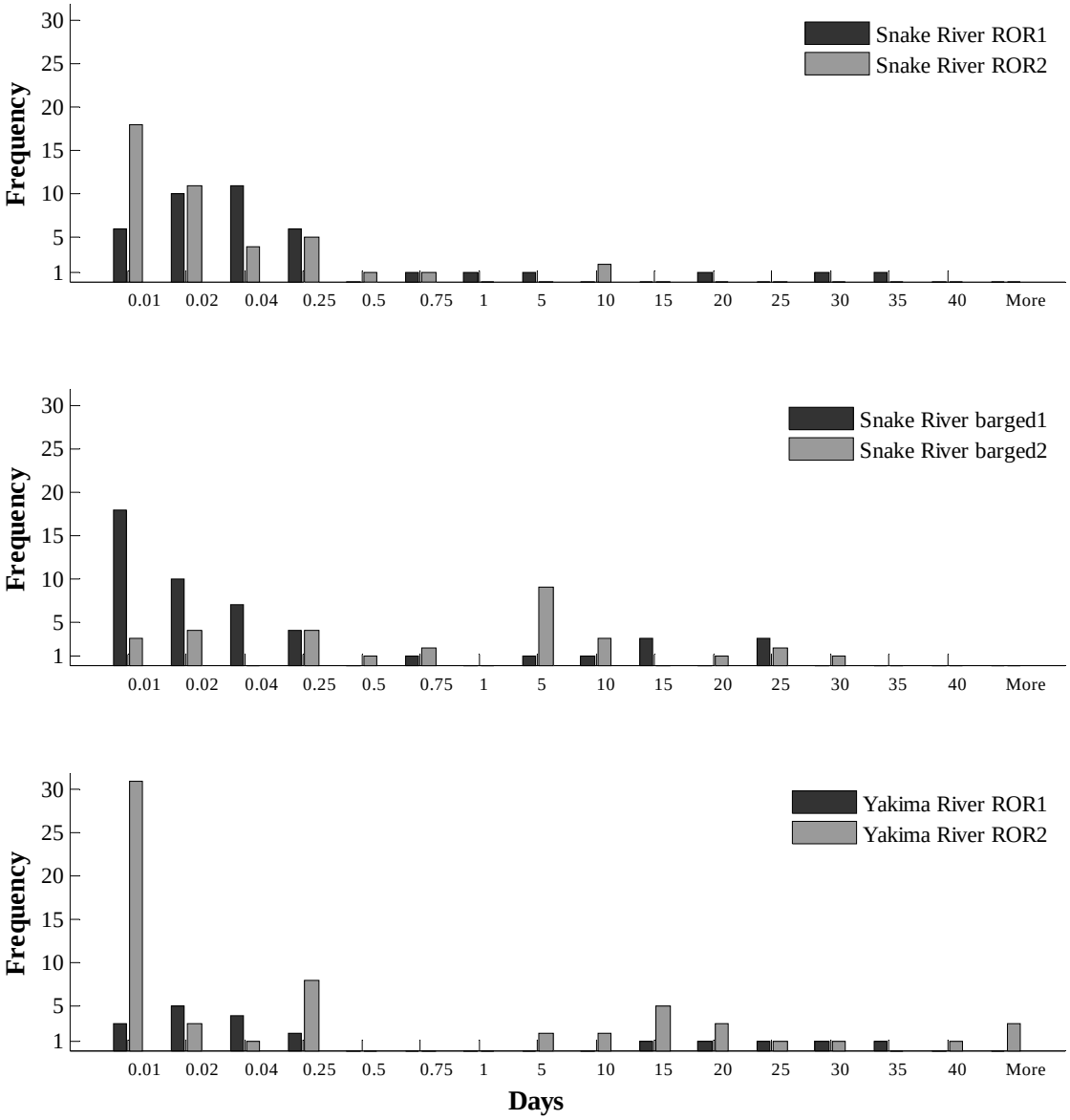


Figure 17. Duration of Yakima and Snake River chinook smolts by study group on the Willapa Bay line from time of first detection to time of last detection. Note that fish were not detected continuously during this interval.

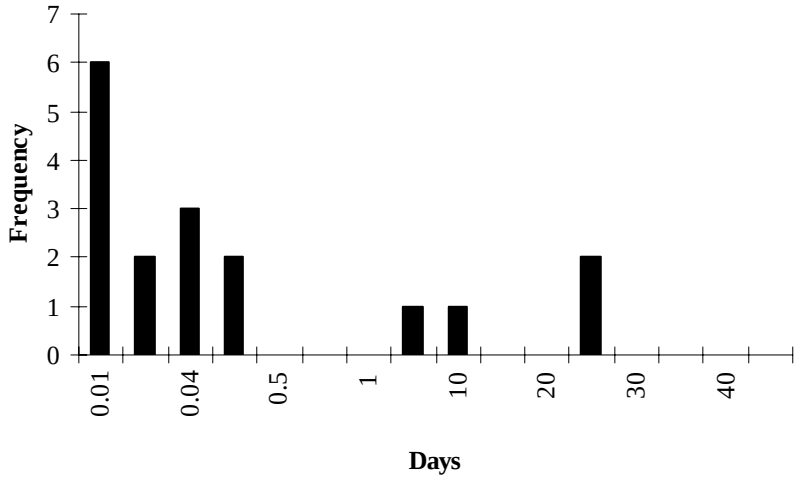


Figure 18. Duration of Yakima and Snake River chinook smolts on the Lippy Point line from time of first detection to time of last detection. Note that fish were not detected continuously during this interval.

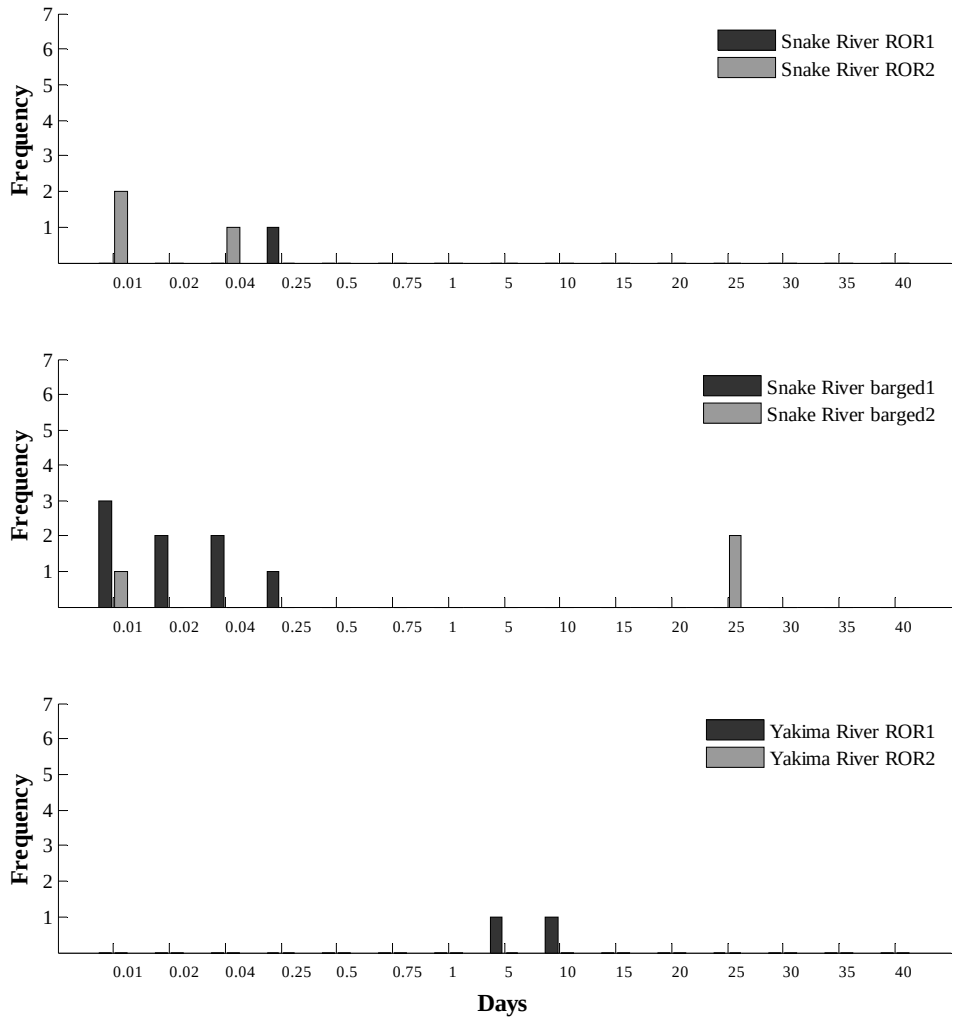


Figure 19. Duration of Yakima and Snake River chinook smolts on the Lippy Point line from time of first detection to time of last detection. Note that fish were not detected continuously during this interval.

Comparative Survival Down the Columbia River

There have been concerns that the relatively large acoustic tags used with the POST array will affect the subsequent movements and survival of the smolts after release, thereby distorting the study results. As this is a critical issue, we measured minimum survivals down the Snake and Columbia Rivers using the four acoustic listening lines placed in-river in the spring of 2006. We also calculated a corrected minimum estimate of the survival of acoustically tagged smolts by adding all tags detected downstream that were not detected at a given freshwater detection point.

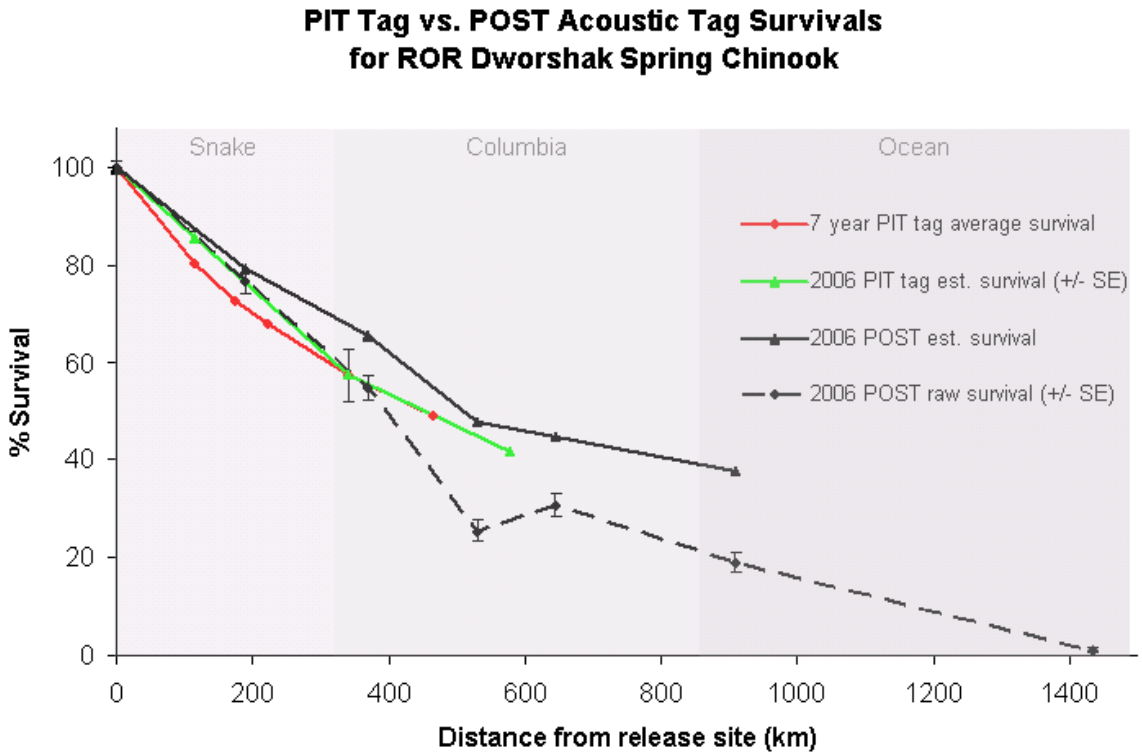


Figure 20. Comparison of survival estimates in 2006 for Snake River chinook implanted with acoustic tags, with both the seven year average of PIT tag based survival estimates for Snake R chinook (1999-2005; red line) and the 2006 PIT tag survival estimates for this same stock (green line). The survival estimates for the acoustically tagged fish are presented as minimum survival and minimum survival adjusted for the detection efficiency of the in-river lines. POST estimated survivals are slightly higher than either the historical average or the 2006 estimate using PIT tags.

Figure 20 compares our measured survivals for acoustically tagged Snake River spring chinook out to various distances post-release (as far as the ocean detection line at Lippy Point) with current and previous survivals for Snake River spring chinook estimated using the PIT tag system at the dams and reported by the Fish Passage Center (CSS 2006) (bold dotted line; 2006 PIT tag estimates of survival are preliminary; Bill Muir, NOAA, *personal communication*). The survival of PIT tagged smolts from the Snake River in 2006 was consistent with average survival results for the previous seven years and POST acoustic tagged smolts in 2006 had slightly higher survival than the measured survivals for the PIT tagged smolts. (Dworshak stock was used for the comparison). Note that at distances beyond where PIT tag data are available, the POST tagged fish show a fairly steady attrition in numbers, and do not show a sudden jump in mortality that would be consistent with delayed mortality being expressed. Our conclusion is thus that there is

no evidence that the acoustic tags used with the POST array seriously distort the measurement of survival within the hydrosystem and track the PIT tag survival results closely for those locations where PIT tag survival estimates can be made. Beyond the hydrosystem, the POST array provides the only means of measuring movement and survival of salmon smolts in the ocean.

Effect of Smolt Size on Survival Measurements

An additional assessment of the effect of the acoustic tag can be made by breaking out the survival measured to various listening lines relative to the initial size of the smolts (Figure 21). This was done separately for the ROR Yakima River smolts, and both the ROR and barged Snake River smolts. No consistent pattern is apparent that would suggest that larger smolts have better survival within the Columbia River (there is some very slight evidence for this at the northern end of Vancouver Island).

In conclusion, the size of the acoustic tag used with the POST array does not seem to have a significant influence on smolt survival over the size range tagged, and allows us to extend the research effort out into the ocean where much of the key mortality seems to be expressed.

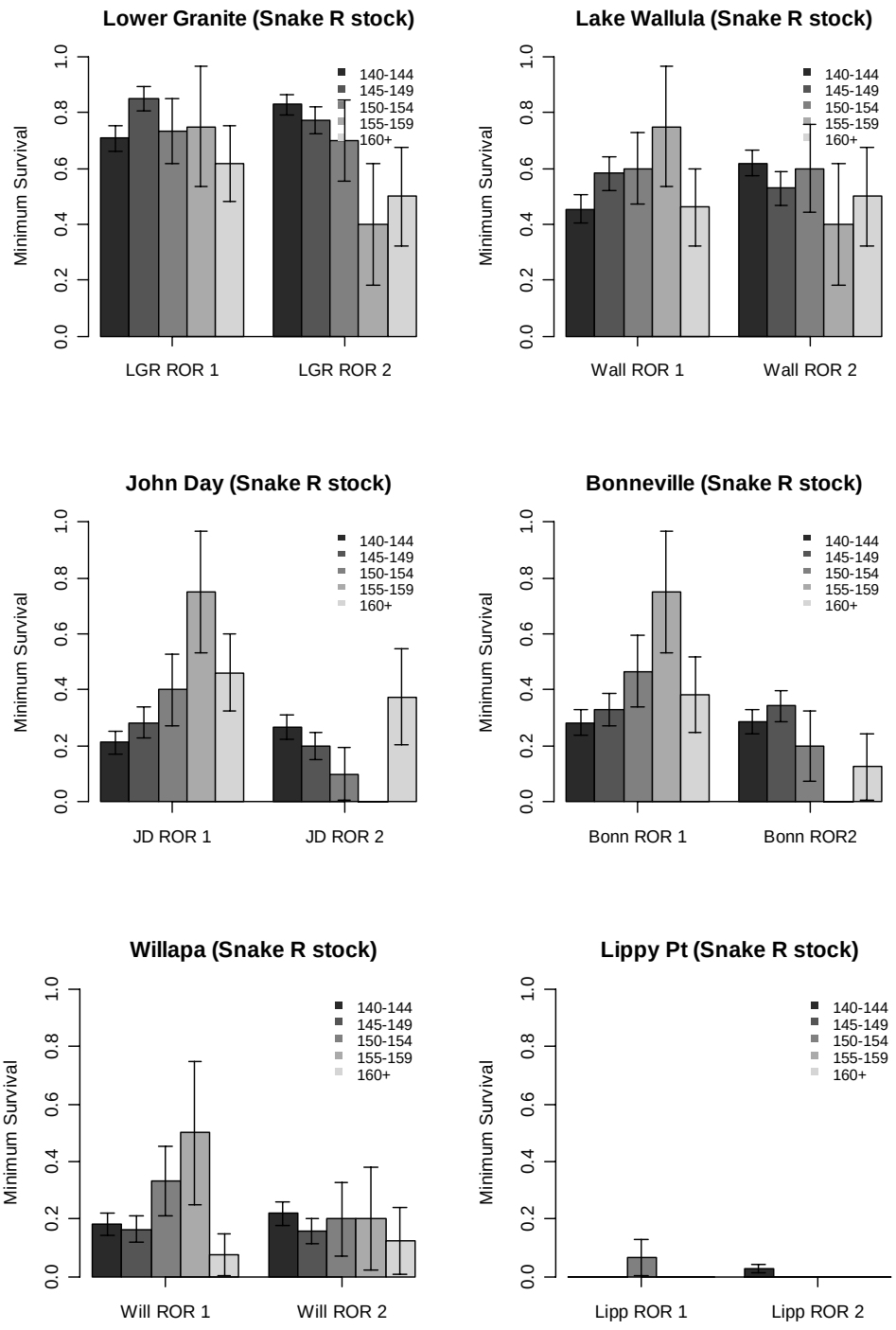


Figure 21(a). Comparison of raw survival estimates divided into 5 mm fork length intervals of ROR Snake R chinook smolts to each of the in-river and ocean listening lines.

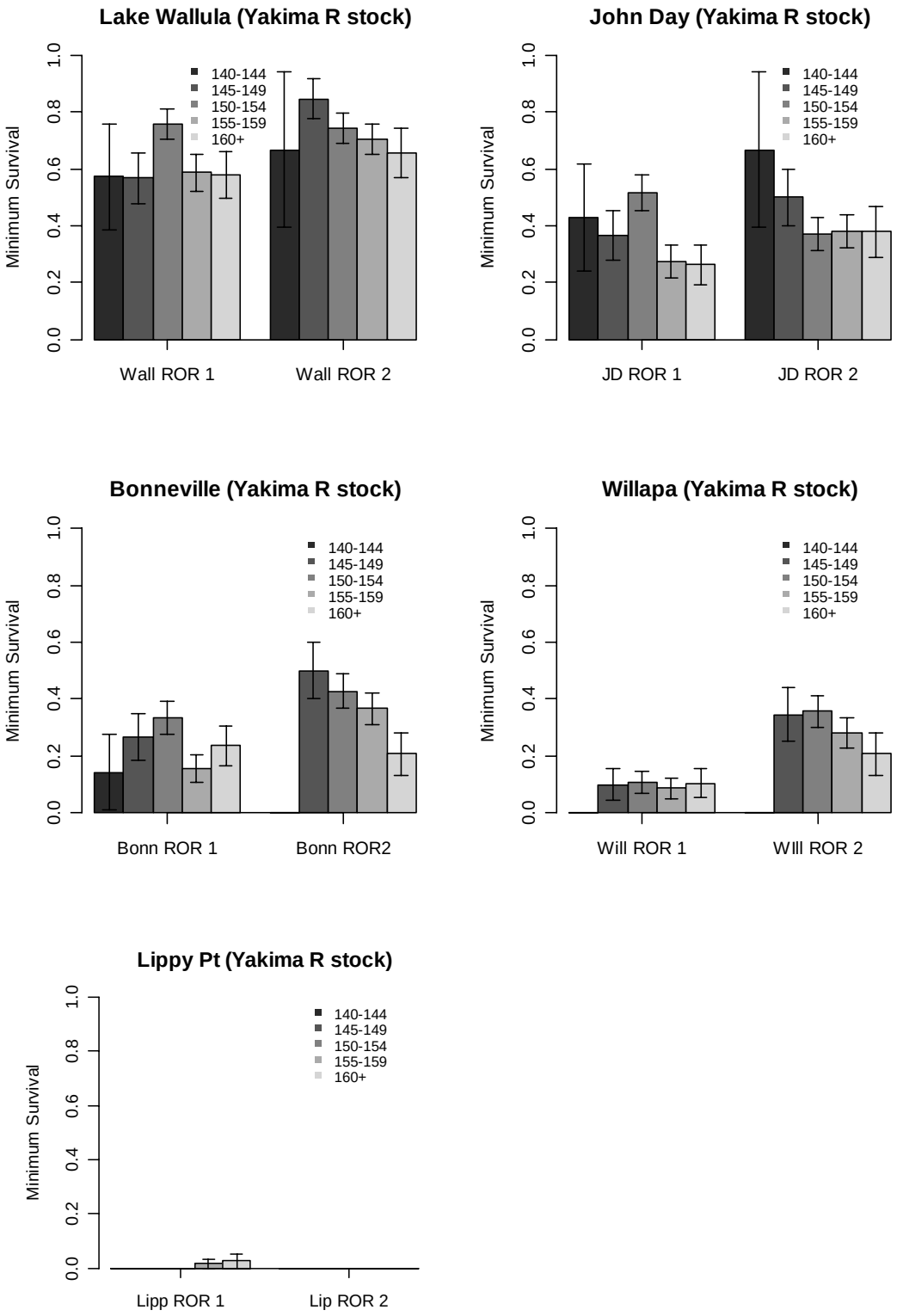


Figure 21(b). Comparison of raw survival estimates divided into 5 mm fork length intervals of Yakima R ROR chinook smolts to each of the in-river and ocean listening lines.

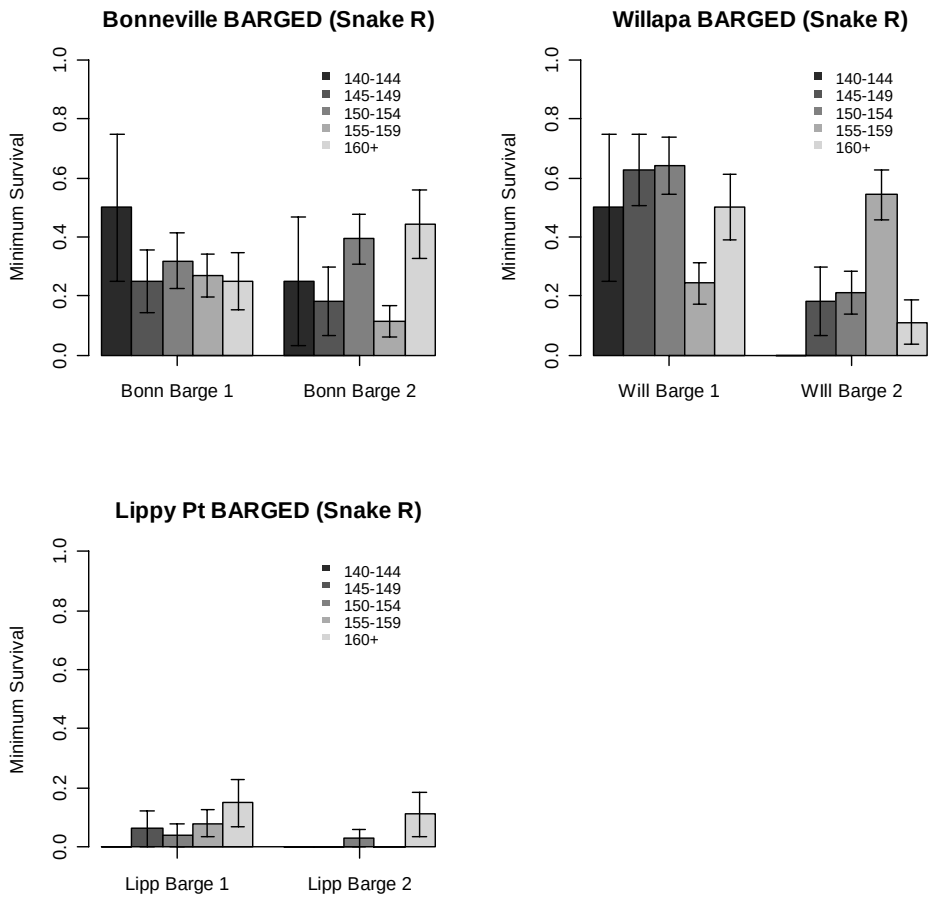


Figure 21(c). Comparison of raw survival estimates divided into 5 mm fork length intervals of barged Snake R chinook smolts to the ocean listening lines.

Conclusions

In recent years, the smolt-to-adult return rate of Yakima River Spring chinook has averaged 5.2 times greater than that of Snake River spring chinook (Bosch and Fast 2006; CSS 2006). This large disparity in survival has led to the hypothesis that Snake River smolts suffer much higher mortality below Bonneville Dam as a result of higher stress from migrating past more dams (Schaller et al 1999). Our direct test of this hypothesis finds no difference in migration speeds along the continental shelf north of the Columbia River mouth, and finds that freshwater and ocean survival of Snake River smolts is comparable to that of the Yakima stock. If subsequent adult return rates in 2008-09 again show that the Yakima River adults return at a SAR similar to historical levels, this would constitute strong evidence that the differential mortality is not expressed before the smolts reach NW Vancouver Island. This would reduce the likelihood that

the different levels of expressed mortality are attributable to cumulative stress from passage through the hydropower system, and increase the evidence for a differential effect of the ocean environment on different stocks of the same species—an important result.

In comparing the survival of barged and run-of-river (ROR) Snake River chinook smolts, we find that survival to Willapa Bay was precisely double that of the ROR smolts. This finding is consistent with expectation, as mortality of PIT tagged smolts to Bonneville Dam has historically been approximately 50% (Williams et al. 2005; See our Figure 20). Our data indicate that the survival of barged smolts to Lippy Point, NW Vancouver Island, remains greater than that of the ROR smolts. However, our results also indicate that early marine survival rates are lower than the survival rates experienced in-river which results in substantially lower *daily* survival rates in the ocean. Thus, while the goal of the transportation program is initially met by increasing the number of smolts that reach the ocean, transport could actually be counter-productive if the additional time spent in the ocean means that more mortality is experienced than if the smolts had migrated unaided in freshwater. Whether this final point is true cannot be clearly distinguished at this time.

While we caution that our first-year results should be viewed as tentative, they strongly suggest that the ocean plays the critical role in the management and conservation of these Columbia River salmon stocks, and that ignoring these issues leads to more blame being ascribed to the hydrosystem than is in fact appropriate. This has consequences both for the science and management—in terms of time and money lost on, in some cases, answering the wrong questions.

Acknowledgements

Project POST is one of 13 field programs under the International Census of Marine Life. We thank the Bonneville Power Administration, Alfred P. Sloan Foundation, and Gordon and Betty Moore Foundation for financial support. Fish Passage Solutions again ably assisted with logistical support and permitting during the 2006 field season.

References

Bosch, B., and D. Fast. 2006. "Yakima/Klickitat Fisheries Project; Monitoring and Evaluation", 2005-2006 Annual Report, Project No. 199506325, 222 electronic pages, (BPA Report DOE/BP-00022449-1).

Budy, P., G. P. Thiede, N. Bouwes, C. E. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management 22:35-51.

CSS. 2006. "Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and PIT-tagged Summer Steelhead", 2006 Annual Report (BPA Contract #19960200).

Deriso, R. B., D. R. Marmorek, and I. J. Parnell. 2001. Retrospective patterns of differential mortality and common year-effects experienced by spring and summer chinook salmon (*Oncorhynchus tshawytscha*) of the Columbia River. Canadian Journal of Fisheries and Aquatic Sciences 58:2419-2430.

Fast, D. 2002. Design, operations and monitoring of a production scale supplementation research facility. http://www-heb.pac.dfo-mpo.gc.ca/congress/2002/Hatchery/fast.pdf

Kareiva, P., M. Marvier, and M. Mcclure. 2000. Recovery and management options for spring/summer chinook salmon in the Columbia River Basin. Science 290:977-979.

Muir, W. D., D. M. Marsh, B. P. Sandford, S. G. Smith, and J. G. Williams. 2006. Post-Hydropower System Delayed Mortality of Transported Snake River Stream-Type Chinook Salmon: Unraveling the Mystery. Transactions of the American Fisheries Society 135:1523-1534.

Idaho Fisheries Resource Office. 2003. Annual Report for FY 2002, Appendix A: Adult spring Chinook salmon returns to Dworshak and Kooskia National Fish Hatcheries in 2002 and Prognosis for 2003. *in* I. F. R. Office and, eds. Dworshak Fishery Complex, U.S. Fish and Wildlife Service, Ahsahka, Idaho.

Peters, C. N., and D. R. Marmorek. 2001. Application of decision analysis to evaluate recovery actions for threatened Snake River spring and summer chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 58:2431-2446.

Schaller, H. A., C. E. Petrosky, and O. P. Langness. 1999. Contrasting patterns of productivity and survival rates for stream-type chinook salmon (*Oncorhynchus tshawytscha*) populations of the Snake and Columbia rivers. Canadian Journal of Fisheries and Aquatic Sciences 56:1031-1045.

Scheuerell, M. D., and J. G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Oceanography 14:448-457.

Williams, J. G., S. G. Smith, R. W. Zabel, W. D. Muir, M. D. Scheuerell, B. P. Sandford, D. M. Marsh, R. McNatt, and S. Achord. 2005. Effects of the Federal Columbia River power system on salmon populations. U.S. Dept. Commerce, NOAA Tech Memo. NMFS-NWFSC-63, 150 p.

Appendices

A1. Animal Care Protocol… …Page 46.

A2. Summary of detections of individual Snake and Yakima River spring chinook smolts on freshwater acoustic listening lines… …Page 60.

A3. Summary of detections of individual Snake and Yakima River spring chinook smolts on ocean acoustic listening lines… …Page 80.

Pacific Ocean Shelf Tracking: Surgical Protocols for Fish Tagging

Adrian Ladouceur, Melinda Jacobs, & David Welch

adrian.ladouceur@kintamaresearch.org

melinda.jacobs@kintamaresearch.org

david.welch@kintamaresearch.org

Overview of Surgical Tagging of Fish

Recent technological advances make it feasible to implant fish as small as salmon smolts with ultrasonic tags capable of individually identifying each tagged fish. Identification and tracking of such tagged fish has been demonstrated in river, lake, and ocean environments via the use of listening arrays formed of many acoustic receivers laid out to detect the ultrasonic transmissions of these tags throughout the water column. Such tracking arrays have the potential to be deployed in fresh and salt water bodies on a continental scale, and the recent (2004-2005) demonstration phase of the POST project has demonstrated that by a judicious optimization of tag programming and array geometry it is possible to directly measure movements and survival of salmon smolts in the ocean with a very high degree of accuracy. (The 2004 results demonstrated a 91% detection rate for individual salmon smolts migrating across 20 km long listening lines).

Before any tracking can occur, tags must be successfully implanted into fish, and both tag and fish have to function normally and long enough to be detected by the acoustic array. Implantation of the tag into the body cavity of a fish is

considered major surgery and involves significant training and preparation, and also due consideration for the animal's well being. Kintama Research Corporation (KRC) surgeons follow the Canadian Council for Animal Care (CCAC) guidelines and KRC's Standing Operating Procedures, which were developed from veterinary consultation and years of hands-on experience. Implantation of tags is done by surgical teams which consist of two or more members, including at least one senior surgeon. Surgical teams are fully equipped, both in skill and in required materials to handle nearly every scenario encountered in the field.

The surgical process for implantation of the acoustic tag into fish can be broken down into four main steps. These are sedation, induction (anaesthesia), surgery, and recovery. Sedation is a state of numbness or light anaesthesia, and is very important as it aids in preoperative handling of the fish and helps to reduce stress from handling, transport, and immersion into the anaesthetic bath. Minimizing stress is crucial because it can negatively impact immune function as well as behaviour, which in turn can result in the fish being more susceptible to infectious agents, thus potentially reducing survivorship. Handling of fish can also predispose them to infection by disrupting the natural protective exterior mucous layer. So as an extra measure of protection, a synthetic mucous solution is added to all water baths and contact surfaces to help preserve this mucous layer. While under sedation fish are assessed to determine if they are candidates for the surgery. Fish that are deemed acceptable for surgery are transferred to a tank containing a higher

concentration of anaesthetic for the purpose of inducing general anaesthesia. Once the fish is fully under it is transferred to a surgical cradle for implantation of the tag. When the surgery is completed the fish is transferred to a recovery tank for observation. Post surgery mortalities are uncommon in smolts in good condition, and in KRC'S experience can be less than 1%.

As with any invasive surgery it is very important to employ aseptic techniques in order to reduce the chance of infection. It is also important to maintain, as close as possible, the fish's normal physiological processes, and to keep ambient environmental conditions stable. To these ends, surgical instruments, tags, and gloves are disinfected prior to surgery and between each fish. The potential for oxygen deficiency (hypoxia) during surgery is eliminated by providing a constant flow of aerated water over the gills. This aerated water also contains a maintenance dose of anesthetic which ensures that the fish remains under general anaesthesia for the entire surgery. The aerated/anesthetic water is constantly recirculated using a pump and other specialized surgical equipment, and its temperature, dissolved oxygen (DO_2) levels, and general quality are continuously monitored using electronic sensors so that they do not fall outside CCAC guidelines. The entire fish is kept wet at all times and a moistened towel is draped over its head to protect it from UV light.

Implantation of the tag is achieved by making an incision through the body wall in the belly of the fish at the mid ventral line, allowing entry into the peritoneal cavity. The acoustic tag is gently inserted through this incision, seated properly, and the incision closed with absorbable monofilament suture material. The fish

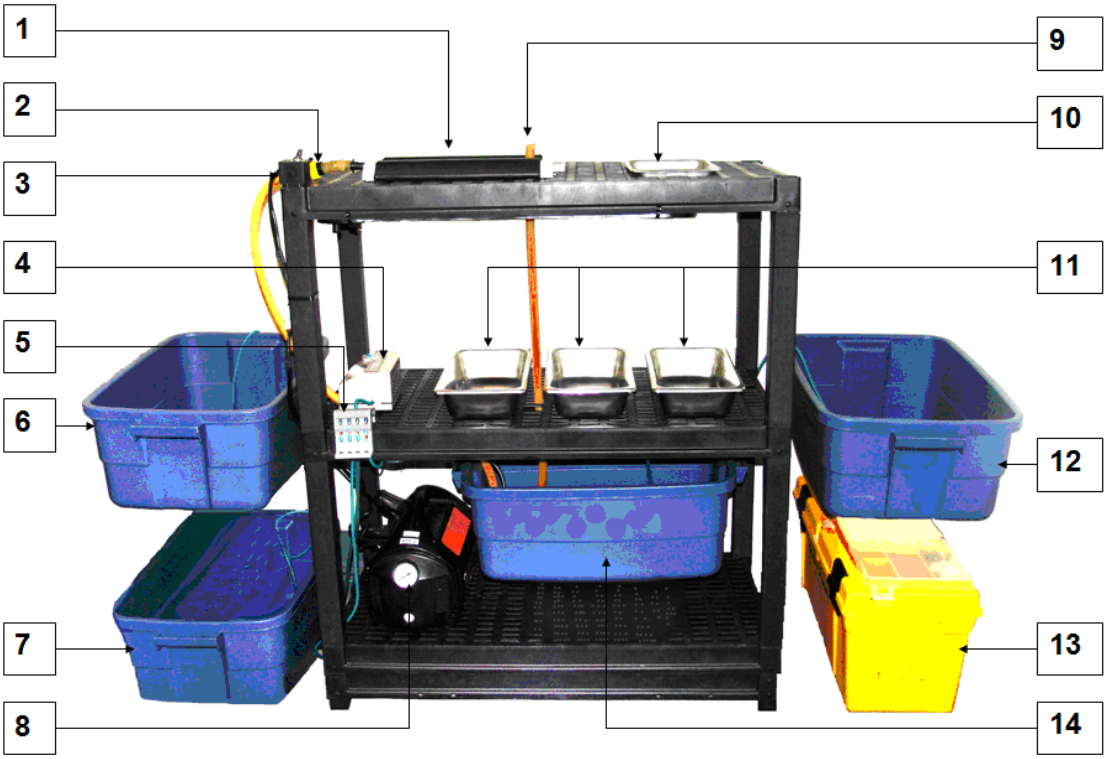
is then transferred to recovery and typically monitored for approximately twenty-four hours before release.

Portable Surgical Kits

KRC's portable surgical kits are comprehensive and provide the surgical teams with all the required materials necessary to complete the surgeries. Everything, from drugs (seadatives & anaesthetics), surgical tools and tables, to portable shelters and battery supplies is provided in each kit, allowing the surgical teams to work in remote locations and poor weather, while still maintaining high surgical standards.

The design of the surgical kits is kept simple and modular. Complete setup of a kit usually takes about thirty minutes but can be reduced to several minutes depending on the situation. For example, when only a few fish will be operated on and/or the surgeries are to be performed in a remote location, the surgeries can be performed without the need for battery operated pumps and aeration.

The core components of the surgical kit are the surgical cradle, collapsible/height adjustable table, stainless steel surgical trays, aeration system, battery pack, recirculation reservoir, sedation bath, anaesthesia bath, recovery bath, and surgical supply box containing all required surgical supplies (see below). Wherever possible, all components are made from synthetic materials or surgical-grade stainless steel to avoid problems with corrosion and to facilitate disinfection of the surgical set-up.



1) Surgical cradle
2) Recirculation pressure valve
3) On/Off switch for recirculation pump
4) Air compressor
5) Air line multi-valve
6) Induction bath
7) Sedation bath reservoir (to maintain anaesthesia during surgery)
8) Battery pack
9) Drain tube
10) Surgical instrument tray
11) Disinfection/rinse trays
12) Recovery bath
13) Surgical supply box
14) Recirculation

The surgical table includes cut-outs for routing the plumbing required for the recirculation system, a drip tray, and attachment points for the electrical wiring which delivers power to the recirculation pump and air compressor. The surgical cradle holds the fish during surgery and is designed to keep the gills

submerged throughout the procedure. Water from the recirculation reservoir, containing a maintenance dose of anaesthetic, is pumped into the head of the cradle where it then flows down past the head and gills and along the length of the fish. The water then exits via a drain tube at the opposite end of the cradle. Water flow is adjusted using a valve at the head of the cradle and the water level in the cradle is controlled via a stand-pipe at the exit drain tube. Water level is adjusted to allow the gills to remain bathed by flowing water while allowing the abdomen to protrude from the water, thus preventing water from entering into the abdominal cavity through the surgical incision.

The tools required for the surgeries are a pair of cutting needle drivers, scalpel, suture guide/shield, and surgical probe (Fig. 1). Two complete sets of these instruments are rotated during surgeries so that one set sits in one of three stainless steel trays containing Ovadine™ for disinfection, while the other set is being used for surgery. The other two stainless steel trays contain distilled water and are for rinsing the instruments free of Ovadine™ prior to use on the next fish.

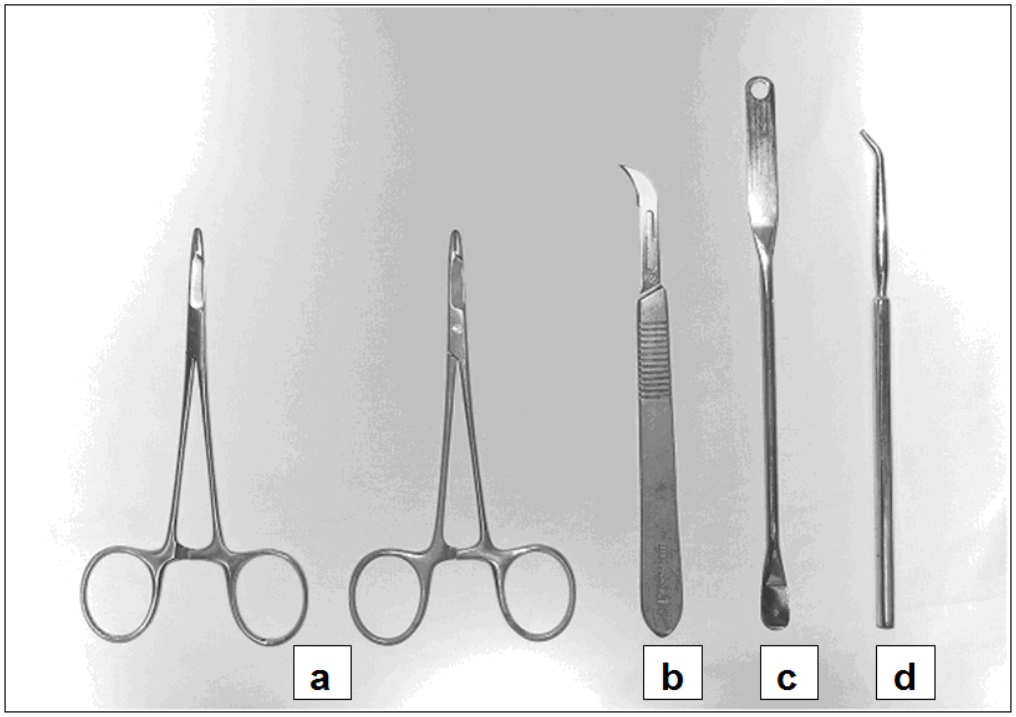


Fig. 1 - a) Needle drivers b) Scalpel c) Suture guide / shield and d) Probe

Anaesthesia

As per CCAC guidelines, only fish of appropriate size are considered for surgery. Fish deemed acceptable are typically first sedated with Metomidate (Aquacalm™); a sedative which helps to reduces stress, prior to handling or transport. In addition, a synthetic mucous (Vidalife™) is used to help preserve the natural protective mucous layer of the fish. General anaesthesia is achieved by using Tricaine Methane Sulphonate (MS-222™). Proper anaesthesia depends on water temperature, water hardness, salinity, oxygen concentration, the biomass and species of fish, and the length of time of immersion. Surgeons generally rely on their experience with the anesthetic and visual cues from the

fish, rather than relying on strictly set dosages. However, in general the dosages required fall around 70ppm for induction into general anaesthesia and 50ppm for maintenance during surgery. As surgeries progress for a group of fish 5ml quantities of MS-222 are periodically added to compensate for loss due to metabolization of the drug. The acidity of MS-222 is buffered using stock solutions of sodium bicarbonate dissolved in water.

Implantation of Tags

Pre-operative preparation is generally accomplished through isolating the animals in a tank of their own and allowing them to acclimate to the new environment. Though it is not always possible to isolate the fish, it is helpful to do so because it gives the surgical teams an opportunity to assess the general health of the selected fish, based on how well they tolerate the transfer and subsequent acclimate to the new tank. If further handling is involved, such as in the case of size grading fish, the surgical teams can more closely examine the fish for signs of stress and/or disease. As handling subjects the fish to some level of stress, sedatives should be used to help minimise stress. This is very important because stressed fish are potentially unhealthy fish, with decreased vitality and increased susceptibility to disease, especially when combined with the stress of surgery. Whenever possible, fish deemed acceptable for surgery should not be fed for approximately twenty-four hours prior to surgery. This ensures that the fish have eliminated most of their gastric content, which helps

because surgery on fish with full guts can be more difficult. (With wild-caught fish this is frequently more difficult, since the traps used to capture the smolts also capture and accumulate their prey).

Surgical tools and all surfaces should be disinfected with Ovadine™ prior to use, and surgical instruments are disinfected between each fish during surgeries. The surgical process is as follows:

1) Source water temperature and oxygen level are recorded on data sheets, along with general observations for that day;

2) Fish are transferred from source tank to the sedation bath and left covered and undisturbed for approximately ten minutes;

3) Individual fish are taken from the sedation bath and put into the anaesthesia (Induction) bath at about three minute intervals. This is about the time it takes for an experienced surgeon to complete the surgical implantation of the tag.

4) The fish remains in the induction bath until stage four or five anaesthesia is reached (Appendix A).

5) Once properly anesthetised, the fish can be measured (fork length and/or weight) and then transferred to the surgical cradle.

6) In preparation for surgery, the fish is placed ventral side up in the cradle with its mouth around the recirculation water output nozzle. The output nozzle and tubing is made from supple latex tubing so that the fish's mouth and teeth can grab on to it, thus helping to maintain

position of the fish and proper water flow during surgery. Further support of especially small fish is accomplished, if necessary, using folded pieces of paper towels that are soaked in water and Vidalife™ and placed along the flanks of the fish to ensure proper positioning of the abdomen.

7) Water flow is adjusted and monitored throughout the surgery to provide a gentle flow through the mouth and over the gills. A properly positioned fish has its head nearly completely submerged with none of the gill lamellae exposed to air. The ventral body wall is above the water line in the cradle only enough to avoid spilling water into the body cavity and a squirt bottle is kept handy to ensure that all exposed parts of the fish remain wet during the procedure.

Extreme care is taken when making the incision in order not to damage any internal organs. The surgeon applies gentle pressure at the incision site by squeezing the belly of the fish with his gloved fingers. This helps to push internal organs down and out of the way of the scalpel blade and facilitates a safer and cleaner cut by helping to better maintain control of the scalpel when the blade cuts or pierces through scales. For smolt-sized Pacific salmon, the incision is made on the mid ventral line and is started several millimeters proximal to the pelvic girdle. The incision is extended cranially just long enough to allow insertion of the tag. Once the incision is completed, a quick visual inspection of the abdominal cavity is made to further assess the fish's condition. For example, the surgeon can see if the internal organs look normal (particularly the spleen), and he/she can see the amount of fatty tissue, and

also if the fish is infected with some types of parasites. After inspection, the tag is gently inserted through the opening into the abdominal cavity and is seated lengthwise so that it sits parallel to the mid ventral and lateral lines. Proper positioning of the tag is very important because it helps to reduce pressure points inside the abdominal cavity. Pressure points are sources of chronic trauma and can result in internal damage, frequently in the form of contact necrosis of compressed tissues. If this occurs on the inside body wall or surface of the intestine, either an abscess may form or the tag may be encapsulated, either event possibly resulting in eventual expulsion of the tag. Once the tag is seated properly, the incision is closed with sterile monofilament absorbable suture material using simple interrupted sutures. In smolt-sized fish there is frequently little to no visible bleeding throughout the entire surgical procedure.

Recovery and Holding

After surgery, fish are gently transferred to a recovery tank where they are generally held for approximately twenty-four hours before release. This holding period allows the surgical team, or other persons attending the fish, to visually assess whether or not the fish have returned to normal behaviour patterns before release. Additionally, most mortalities that are the direct result of the surgical procedure occur within this timeframe (probably more as a result of stress, or the effect of the anaesthetic, rather than the actual surgery). Thus, holding the fish ensures that costly tags are not wasted on fish that would have

died soon after release, and improves estimates of survival gained by monitoring the animal's movements over the acoustic array. Finally, the holding period is especially valuable to the surgical teams as it provides feedback that can be used to compare against records taken during surgery, thus allowing them to critically assess their work. The fish are released at an appropriate time after consultation with biologists, technicians or hatchery personnel who are most familiar with the release site and the purpose of the biological study, so as to give the fish the greatest chance of initial survival after release. (For example, releasing tagged smolts at dusk reduces mortality from visual predators such as birds). In addition, the surgically implanted fish are preferably released with a large number of similar non-implanted fish. This is done with the hope that initial predation will occur on the group as a whole rather than just on the tagged fish.

Appendix A

0	Normal	Reactive to external stimuli; opercular rate and muscle tone normal
1	Light sedation	Slight loss of reactivity to external visual and tactile stimuli; opercular rate slightly decreased; equilibrium normal
2	Deep sedation	Total loss of reactivity to external stimuli except strong pressure; slight decrease in opercular rate; equilibrium normal
3	Partial loss of equilibrium	Partial loss of muscle tone; swimming erratic; increased opercular rate; reactive only to strong tactile and vibrational stimuli
4	Total loss of equilibrium	Total loss of muscle tone and equilibrium; slow but

		regular opercular rate; loss of spinal reflexes
5	Loss of reflex reactivity	Total loss of reactivity; opercular movements slow and irregular; heart rate very slow; loss of all reflexes
6	Medullary collapse (stage of asphyxia)	Opercular movements cease; cardiac arrest usually follows quickly

Stages of anaesthesia (modified from McFarland 1959 and Jolly et al. 1972) – Schreck C. B. and Moyle P. B., 1990. Methods for Fish Biology, p. 217 pp. American Fisheries Society, Bethesda Maryland. 665pp

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
900	154	88	12/05 6:25	12/05 11:51	47	18/05 8:24	18/05 11:32				1	23/05 14:24	23/05 14:24
901	144	126	09/05 13:14	09/05 19:32							5	15/05 5:24	15/05 5:50
902	145	98	05/05 0:54	05/05 4:34	55	12/05 6:53	12/05 11:17						
903	151	378	06/05 7:17	06/05 14:44	429	16/05 13:27	16/05 20:50				4	22/05 8:49	22/05 8:55
904	153	73	07/05 6:44	07/05 9:59									
905	149	133	05/05 11:53	05/05 14:59									
906	165	139	07/05 22:01	08/05 3:50	107	13/05 9:19	13/05 12:36	27	16/05 15:44	16/05 16:07	12	18/05 5:49	18/05 6:12
907	153	49	07/05 3:37	07/05 6:35									
908	142	111	05/05 5:25	05/05 8:51									
909	140	97	08/05 16:08	08/05 20:28	44	15/05 12:41	15/05 15:30	2	18/05 16:52	18/05 17:01	1	19/05 21:22	19/05 21:22
910	140	165	10/05 6:11	10/05 10:46									
911	157	200	15/05 0:09	15/05 23:53	20	20/05 8:49	20/05 11:28	1	22/05 21:19	22/05 21:19	1	24/05 1:54	24/05 1:54
912	151	72	07/05 6:21	07/05 9:34	64	13/05 14:44	13/05 17:07	3	17/05 12:56	17/05 13:03	1	18/05 22:13	18/05 22:13
913	140	204	12/05 9:09	12/05 15:10	19	20/05 20:23	21/05 2:46	2	23/05 20:36	23/05 20:43	9	26/05 6:14	26/05 6:39
917	141	383	11/05 9:48	12/05 6:41	48	18/05 9:42	18/05 12:39	2	20/05 17:23	20/05 17:30	3	22/05 1:11	22/05 1:42
918	141										7	15/05 4:57	15/05 5:32
919	145	181	14/05 13:42	15/05 4:29	28	21/05 10:00	21/05 13:16	1	24/05 14:19	24/05 14:19			
920	143	113	05/05 5:11	05/05 8:24	188	13/05 9:10	13/05 13:13	4	18/05 16:17	18/05 16:23			
921	142	1	08/05 2:55	08/05 2:55									
922	149	1454	08/05 8:16	10/05 7:20	25	19/05 8:48	19/05 13:10						
924	149										3	19/05 4:36	19/05 4:41
927	143	308	05/05 14:41	06/05 9:26									
930	143	169	15/05 10:29	15/05 16:57									
931	144	124	09/05 1:41	09/05 7:24	81	17/05 9:23	17/05 13:58	3	19/05 20:58	19/05 21:07			
932	167	100	08/05 7:12	08/05 11:06	97	15/05 12:49	15/05 15:35	3	18/05 20:37	18/05 20:45	1	20/05 3:03	20/05 3:03
933	147	55	09/05 2:00	09/05 4:50	153	14/05 1:48	14/05 5:06	1	17/05 7:41	17/05 7:41	1	19/05 3:35	19/05 3:35
934	157	523	06/05 11:12	07/05 9:07	86	15/05 15:02	15/05 18:44	1	18/05 14:56	18/05 14:56	1	19/05 19:12	19/05 19:12
935	151	78	08/05 8:33	08/05 13:16	40	14/05 13:17	14/05 15:47	1	18/05 9:57	18/05 9:57			
936	146	177	05/05 15:04	06/05 8:42	64	16/05 15:27	16/05 19:39						
937	152	292	08/05 5:10	09/05 15:26	108	17/05 16:40	17/05 20:20	3	20/05 19:01	20/05 19:10			
938	153	226	15/05 9:37	16/05 4:43	90	21/05 8:44	21/05 12:10	1	24/05 9:51	24/05 9:51	1	25/05 16:12	25/05 16:12
939	146	81	09/05 3:55	09/05 8:03	35	18/05 11:30	18/05 14:05	1	28/05 12:31	28/05 12:31			
943	145	78	04/05 17:29	04/05 20:50									
944	146	74	06/05 6:16	06/05 8:48							1	14/05 1:30	14/05 1:30

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
945	150	42	18/05 10:30	18/05 14:12	71	22/05 10:16	22/05 13:16	1	25/05 8:21	25/05 8:21	1	26/05 17:06	26/05 17:06
947	141	314	05/05 19:17	06/05 5:20	115	13/05 12:00	13/05 15:05	20	16/05 13:58	16/05 14:14	11	18/05 11:22	18/05 11:43
948	143	219	11/05 9:13	12/05 9:39	58	20/05 6:53	20/05 9:44	3	22/05 17:30	22/05 17:32			
949	141	78	13/05 9:53	13/05 14:47	13	20/05 8:11	20/05 11:54	1	22/05 22:11	22/05 22:11	1	24/05 7:26	24/05 7:26
950	142	936	05/05 11:59	06/05 6:17	886	14/05 7:21	16/05 2:26	3	21/05 6:52	21/05 7:00			
951	143	425	10/05 13:57	11/05 2:40									
953	143	221	05/05 14:54	05/05 20:49	193	14/05 16:03	14/05 20:39	2	19/05 14:19	19/05 14:20			
954	144	321	11/05 5:07	11/05 13:39									
956	146	92	07/05 5:22	07/05 8:54									
958	143	91	17/05 7:52	17/05 11:17	114	24/05 13:47	24/05 17:14				1	28/05 12:18	28/05 12:18
959	142	239	12/05 15:26	13/05 22:05									
960	145	89	10/05 2:15	10/05 6:06	97	17/05 8:49	17/05 12:34	2	20/05 7:12	20/05 7:17	6	21/05 11:54	21/05 12:02
961	142	121	11/05 6:14	11/05 11:02									
962	141	145	12/05 6:31	12/05 16:44	45	18/05 11:33	18/05 13:56						
964	140	73	10/05 5:48	10/05 10:05									
965	144	52	15/05 23:38	16/05 4:15	4	20/05 9:23	20/05 9:38						
966	140	61	12/05 6:29	12/05 9:32	127	18/05 4:48	18/05 8:51						
967	143										3	11/05 6:00	11/05 6:06
968	147	105	14/05 7:46	14/05 12:12	15	20/05 14:26	20/05 15:13						
969	140	351	06/05 8:00	07/05 14:58									
970	143	78	06/05 6:16	06/05 10:24	154	13/05 18:27	13/05 22:24						
971	142	167	12/05 4:23	12/05 9:54	90	19/05 7:44	19/05 11:37	1	22/05 5:48	22/05 5:48	2	23/05 15:03	23/05 15:03
972	147	99	06/05 5:57	06/05 8:49	84	13/05 8:41	13/05 11:20	3	17/05 9:05	17/05 9:07	11	19/05 2:59	19/05 5:41
973	142	182	15/05 12:43	15/05 21:59							7	19/05 4:38	19/05 6:03
974	146	130	05/05 14:41	06/05 5:24	275	12/05 9:00	12/05 22:00	2	18/05 21:11	18/05 21:18	2	20/05 12:59	20/05 14:09
976	141	419	10/05 14:47	11/05 9:26							19	19/05 4:38	19/05 5:53
977	141	113	09/05 9:42	09/05 15:23							6	15/05 4:51	15/05 5:21
978	149	345	13/05 11:53	14/05 2:49	130	22/05 4:31	22/05 10:37						
979	142	85	14/05 6:56	14/05 11:25	87	19/05 12:01	19/05 16:18						
980	146	253	11/05 9:05	12/05 5:38	40	18/05 14:18	18/05 16:20	4	20/05 19:36	20/05 19:43	18	22/05 4:39	22/05 5:31
981	142	134	08/05 5:40	08/05 9:38	121	16/05 4:27	16/05 8:29				5	21/05 13:47	21/05 14:07
982	142	128	04/05 14:55	04/05 19:59	360	13/05 21:00	14/05 8:16	2	18/05 6:40	18/05 6:45	1	19/05 16:52	19/05 16:52
984	145	36	08/05 5:04	08/05 7:28									
986	145	103	04/05 11:42	04/05 15:03									
988	145	89	17/05 9:00	17/05 12:03	130	21/05 13:35	21/05 20:58						
989	146	310	10/05 7:11	10/05 17:23	47	19/05 12:24	19/05 14:53						

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
990	149	68	07/05 5:19	07/05 7:52									
991	145	163	12/05 10:54	12/05 17:06	82	19/05 10:27	19/05 13:44	2	24/05 0:41	24/05 0:46	3	25/05 6:58	25/05 7:00
993	148	104	13/05 9:27	13/05 15:06	37	20/05 12:11	20/05 14:17	1	23/05 0:33	23/05 0:33	6	24/05 6:16	24/05 6:22
994	147	526	09/05 12:01	09/05 22:42	109	18/05 0:47	18/05 4:03	1	20/05 22:46	20/05 22:46	2	22/05 6:54	22/05 7:07
995	147	57	16/05 9:37	16/05 12:06	12	20/05 19:15	20/05 22:04				1	25/05 3:07	25/05 3:07
996	146	62	13/05 15:19	14/05 5:24	35	21/05 11:03	21/05 14:24						
998	148	572	05/05 8:55	06/05 4:47	84	14/05 13:53	14/05 16:47						
1000	142	145	13/05 10:52	13/05 19:59	48	19/05 10:26	19/05 13:37	1	22/05 1:14	22/05 1:14	3	23/05 8:26	23/05 8:29
1002	151	133	14/05 7:40	14/05 12:59	129	20/05 15:55	20/05 20:29						
1003	158	59	13/05 7:50	13/05 11:39	5	20/05 17:45	20/05 18:02						
1004	145	72	14/05 6:07	14/05 10:13	29	20/05 2:28	20/05 7:48	1	22/05 23:16	22/05 23:16			
1005	175	44	15/05 10:37	15/05 12:29	13	20/05 10:37	20/05 12:48						
1008	143	126	12/05 18:37	13/05 3:50	38	20/05 20:58	20/05 23:02	1	23/05 0:13	23/05 0:13	5	24/05 10:25	24/05 10:33
1009	143	95	11/05 11:46	11/05 14:48	76	19/05 7:43	19/05 12:03						
1011	144	121	12/05 16:03	13/05 4:28	41	18/05 21:24	18/05 23:31				1	22/05 18:49	22/05 18:49
1012	142	103	12/05 16:08	13/05 4:16									
1013	149	268	16/05 6:11	16/05 15:57									
1014	145	89	12/05 6:21	12/05 10:35	130	18/05 12:56	18/05 17:00	6	20/05 21:14	20/05 21:23	3	22/05 8:07	22/05 8:24
1015	164	79	14/05 8:38	14/05 12:22	35	19/05 9:37	19/05 14:11	1	22/05 22:48	22/05 22:48			
1016	143	72	11/05 2:30	11/05 4:32	67	14/05 19:31	14/05 22:15	5	17/05 21:16	17/05 21:30	2	19/05 8:29	19/05 8:30
1017	154	46	13/05 4:55	13/05 7:44	6	18/05 15:29	18/05 19:36				1	23/05 18:09	23/05 18:09
1018	143	185	15/05 14:01	16/05 0:15	19	19/05 15:41	19/05 17:30						
1019	147	161	16/05 19:37	17/05 5:11	137	21/05 10:14	21/05 14:56						
1020	140	58	11/05 23:25	12/05 2:19	160	17/05 6:04	17/05 10:48						
1021	144	112	12/05 0:47	12/05 5:15	50	16/05 17:37	16/05 19:35						
1023	147	53	11/05 19:22	11/05 21:24									
1025	148	45	16/05 9:50	17/05 5:17									
1026	146	65	10/05 23:12	11/05 1:08	49	14/05 15:22	14/05 17:56	1	17/05 3:35	17/05 3:35			
1027	145	81	11/05 0:33	11/05 2:36							13	15/05 4:56	15/05 5:54
1028	142	253	13/05 0:36	13/05 10:32									
1029	142	501	14/05 9:03	14/05 21:03	35	20/05 12:33	20/05 15:48	2	23/05 2:49	23/05 2:55			
1030	145	70	11/05 16:21	11/05 19:00	35	17/05 6:35	17/05 9:53				5	21/05 10:38	21/05 11:51
1031	151	100	12/05 10:33	12/05 14:58	54	18/05 6:23	18/05 10:09						
1032	143	87	12/05 5:09	12/05 7:47	52	19/05 5:32	19/05 7:49						
1035	140	770	14/05 8:57	15/05 10:05	55	21/05 12:10	21/05 15:04				2	25/05 20:07	25/05 20:09
1037	141	125	16/05 6:42	16/05 10:35	176	21/05 5:30	21/05 12:41	2	25/05 7:54	25/05 8:01			

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1039	147	211	11/05 22:20	12/05 4:30	105	16/05 11:53	16/05 14:27	1	19/05 6:29	19/05 6:29	1	20/05 14:38	20/05 14:38
1040	143	98	12/05 7:14	12/05 10:42	62	17/05 12:44	17/05 15:37	5	20/05 16:31	20/05 16:39	2	22/05 1:07	22/05 1:09
1041	146	105	13/05 5:13	13/05 9:44	89	19/05 4:04	19/05 7:56						
1042	147	137	13/05 5:42	13/05 11:04	140	19/05 3:43	19/05 8:28	4	21/05 19:24	21/05 19:34	1	23/05 4:22	23/05 4:22
1044	143	110	12/05 3:27	12/05 7:10	254	17/05 20:34	18/05 4:07						
1045	146	103	13/05 9:22	13/05 14:18									
1046	145	143	12/05 15:37	13/05 8:33							9	19/05 4:31	19/05 4:43
1048	146	54	10/05 18:24	10/05 20:17	8	19/05 17:51	19/05 19:44						
1049	148	81	12/05 7:04	12/05 9:57									
1050	144	211	11/05 19:32	12/05 3:43	226	18/05 3:01	18/05 6:18						
1051	142	112	13/05 4:22	13/05 7:59	63	17/05 14:30	17/05 17:03	3	20/05 22:18	20/05 22:28			
1053	146	127	11/05 21:13	12/05 1:07									
1054	145	287	14/05 23:34	15/05 10:13	104	25/05 13:08	25/05 17:44						
1055	143	225	12/05 14:56	12/05 22:28	83	17/05 6:18	17/05 11:39	4	19/05 21:45	19/05 21:51	2	21/05 10:40	21/05 17:12
1056	141	173	13/05 10:40	13/05 16:47	138	20/05 6:27	20/05 11:25	3	23/05 8:16	23/05 8:25			
1058	143	170	14/05 5:21	14/05 10:01	61	18/05 13:11	18/05 15:09	8	20/05 21:22	20/05 21:32	23	22/05 4:43	22/05 5:56
1059	144	159	12/05 4:29	12/05 9:31									
1060	144	51	12/05 5:56	12/05 8:45	127	17/05 10:08	17/05 13:53				1	21/05 1:00	21/05 1:00
1061	140	268	12/05 13:24	12/05 20:39	41	20/05 13:18	20/05 16:51	2	24/05 2:19	24/05 2:20			
1063	144	175	13/05 12:18	13/05 18:14									
1064	143	51	15/05 19:57	15/05 21:27	36	19/05 6:40	19/05 8:42						
1065	144	103	11/05 4:01	11/05 6:58	154	16/05 9:13	16/05 12:50				2	20/05 9:31	20/05 9:32
1066	141	76	15/05 10:30	15/05 13:46									
1067	143	49	12/05 15:46	12/05 18:43									
1068	143	92	16/05 5:29	16/05 11:19									
1069	144	58	11/05 18:53	11/05 21:17							28	15/05 4:59	15/05 6:17
1070	144	62	12/05 4:31	12/05 7:19							3	18/05 3:56	18/05 3:59
1073	146	118	15/05 2:21	15/05 6:26	45	19/05 18:40	20/05 0:21	1	23/05 2:06	23/05 2:06	2	24/05 16:28	24/05 16:29
1074	142	76	12/05 9:40	12/05 13:55	27	20/05 13:02	20/05 17:03	2	22/05 21:45	22/05 21:55	1	24/05 5:25	24/05 5:25
1075	140	77	14/05 6:41	14/05 9:43									
1076	142	66	13/05 5:05	13/05 8:21	21	19/05 6:19	19/05 11:30						
1077	142	132	14/05 11:13	14/05 16:12	38	21/05 1:26	21/05 6:43						
1078	142	155	15/05 1:15	15/05 9:01									
1079	141	93	11/05 13:43	11/05 18:00	33	17/05 19:48	17/05 22:06						
1081	141	220	12/05 18:24	13/05 7:44									
1082	145	771	13/05 12:10	14/05 4:06							5	19/05 4:21	19/05 4:29

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1083	147	42	15/05 14:55	15/05 16:40	91	23/05 10:44	23/05 13:41						
1084	146	86	17/05 6:31	17/05 11:00	158	23/05 4:19	23/05 11:22				1	15/05 5:14	15/05 5:14
1085	140	55	13/05 10:59	13/05 14:33	43	19/05 8:29	19/05 11:54						
1086	142	70	17/05 7:38	17/05 11:39	62	21/05 10:48	21/05 13:49	1	25/05 13:03	25/05 13:03	2	27/05 7:50	27/05 7:52
1087	147	72	12/05 5:33	12/05 8:29	86	18/05 10:04	18/05 16:31	1	21/05 21:09	21/05 21:09			
1088	143	69	14/05 8:23	14/05 11:56	144	23/05 1:20	23/05 9:07						
1089	144	190	13/05 7:34	14/05 2:31	52	19/05 11:38	19/05 14:18				1	23/05 10:35	23/05 10:35
1090	140	76	13/05 7:15	13/05 11:54	37	21/05 11:44	21/05 13:46						
1091	148	63	12/05 1:50	12/05 6:33	8	18/05 15:30	18/05 17:19						
1092	142	150	12/05 10:42	12/05 16:49	68	19/05 8:44	19/05 11:47						
1093	147	91	13/05 7:23	13/05 12:20	14	20/05 11:42	20/05 15:03						
1094	146	109	11/05 8:02	11/05 11:32							13	15/05 4:57	15/05 5:40
1095	144	173	13/05 11:32	13/05 19:40									
1096	143	91	14/05 6:27	14/05 10:49									
1097	146	114	13/05 3:00	13/05 6:32	127	17/05 1:52	17/05 8:47						
1098	140	142	15/05 2:39	15/05 7:29	183	23/05 4:13	23/05 10:57						
1099	145	68	15/05 7:16	15/05 9:38	24	20/05 10:01	20/05 12:45				2	24/05 17:43	24/05 17:45
1104	154												
1105	146												
1106	146												
1107	155										5	08/06 5:46	08/06 6:17
1108	146										6	08/06 6:31	08/06 6:36
1110	156												
1114	152												
1116	152										1	08/06 5:51	08/06 5:51
1121	141										3	08/06 6:05	08/06 6:12
1123	152												
1124	154										1	08/06 6:04	08/06 6:04
1125	145										1	08/06 5:58	08/06 5:58
1127	147												
1128	161												
1130	156												
1131	167												
1132	154												
1135	149										1	08/06 5:46	08/06 5:46
1136	160										1	08/06 6:03	08/06 6:03

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1137	161												
1138	155										1	08/06 5:45	08/06 5:45
1141	150										13	08/06 6:36	08/06 6:55
1142	154												
1144	146												
1145	151										1	08/06 5:43	08/06 5:43
1148	158										7	08/06 5:55	08/06 7:23
1149	152										4	08/06 6:10	08/06 6:17
1152	155												
1154	157										2	16/06 4:09	16/06 4:10
1155	151												
1156	150												
1159	161												
1160	150												
1161	154										6	16/06 4:10	16/06 4:23
1162	160										1	16/06 3:54	16/06 3:54
1164	153										5	16/06 4:00	16/06 5:17
1165	157										4	16/06 4:12	16/06 4:46
1166	154										21	16/06 4:09	16/06 6:00
1170	154										3	16/06 5:00	16/06 5:04
1173	149										5	16/06 4:17	16/06 4:23
1174	157												
1177	155												
1178	158												
1179	155												
1180	153										5	16/06 4:53	16/06 5:36
1183	155												
1184	150												
1185	152										6	16/06 5:27	16/06 5:37
1187	150										7	16/06 4:08	16/06 6:07
1188	155												
1191	157										4	16/06 4:15	16/06 4:18
1193	168										1	16/06 4:03	16/06 4:03
1194	150										7	16/06 3:57	16/06 4:58
1195	149										2	16/06 4:22	16/06 4:24
1197	168										6	16/06 4:45	16/06 5:21

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1198	153												
1199	157												
1200	152				81	01/06 9:47	01/06 13:45						
1202	156				12	01/06 9:16	01/06 11:41						
1204	147				53	01/06 9:17	01/06 13:14						
1205	153				119	02/06 4:55	02/06 16:27	2	07/06 9:11	07/06 9:19			
1206	143				33	01/06 7:33	01/06 9:55						
1207	158				54	01/06 5:24	01/06 8:12						
1208	163				16	01/06 8:32	01/06 12:06	6	05/06 0:53	05/06 1:02	12	06/06 9:35	06/06 10:49
1209	149				37	01/06 10:33	01/06 13:35	7	05/06 15:09	05/06 15:21	11	07/06 8:08	07/06 9:28
1210	151				59	01/06 4:58	01/06 7:48	4	03/06 21:35	03/06 21:43			
1211	159				15	01/06 9:12	01/06 12:28	2	04/06 2:07	04/06 2:16			
1213	146				68	01/06 8:34	01/06 13:12	2	05/06 6:17	05/06 6:23	5	06/06 14:26	06/06 14:32
1215	156				33	01/06 4:57	01/06 7:09	5	03/06 14:35	03/06 14:46			
1216	153				36	01/06 12:51	01/06 15:23	4	03/06 16:46	03/06 16:51			
1218	155				40	01/06 5:38	01/06 8:00	7	03/06 6:34	03/06 6:45	10	04/06 16:46	04/06 18:02
1219	160				36	01/06 8:58	01/06 13:57						
1220	150				57	01/06 12:03	01/06 16:17						
1222	150				49	01/06 3:34	01/06 6:51				12	05/06 16:25	05/06 17:05
1223	149				55	01/06 7:58	01/06 11:38				14	05/06 12:32	05/06 13:55
1224	155				37	01/06 6:43	01/06 9:20						
1227	152				76	01/06 20:20	01/06 23:23						
1228	155				65	01/06 13:28	01/06 17:31	6	05/06 23:27	05/06 23:32	3	07/06 4:52	07/06 4:54
1229	158				47	01/06 8:19	01/06 11:35	3	06/06 9:21	06/06 9:29	6	07/06 14:07	07/06 14:14
1230	149				26	01/06 18:06	01/06 21:35						
1231	151				89	01/06 14:19	01/06 20:03	2	08/06 15:50	08/06 15:52	4	09/06 23:25	09/06 23:27
1232	151				33	01/06 5:20	01/06 7:37						
1234	146				10	01/06 9:40	01/06 11:46	7	04/06 10:29	04/06 10:38	2	05/06 23:24	05/06 23:26
1236	155				31	01/06 11:37	01/06 15:18	4	06/06 16:42	06/06 16:52			
1237	152				37	01/06 7:20	01/06 9:43	1	03/06 23:19	03/06 23:19	4	05/06 13:17	05/06 13:40
1238	153				157	01/06 18:54	01/06 23:52	3	05/06 3:39	05/06 3:44	2	06/06 6:17	06/06 6:19
1239	154				130	01/06 16:09	01/06 19:08	7	04/06 22:51	04/06 23:01	6	06/06 7:07	06/06 7:50
1243	152				384	01/06 16:57	02/06 5:25	2	07/06 3:55	07/06 4:00			
1248	155				79	01/06 13:32	01/06 17:50						
1249	158				32	01/06 7:04	01/06 11:13	4	04/06 3:38	04/06 3:47			
1250	150				59	01/06 12:37	01/06 15:23						

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1251	153				143	01/06 11:11	01/06 21:45	2	06/06 4:26	06/06 4:30	11	07/06 10:57	07/06 11:23
1255	161				110	01/06 17:02	01/06 21:15	2	05/06 5:57	05/06 6:02	3	06/06 11:19	06/06 11:25
1256	161				38	01/06 8:14	01/06 10:32	2	03/06 12:32	03/06 12:37	4	04/06 15:07	04/06 15:10
1257	151				38	01/06 7:03	01/06 10:33						
1258	162				59	01/06 5:09	01/06 8:45	3	04/06 10:19	04/06 10:21	2	05/06 18:03	05/06 18:04
1260	152				28	01/06 4:19	01/06 7:25	1	03/06 21:42	03/06 21:42	11	05/06 10:09	05/06 10:31
1262	155				84	01/06 11:34	01/06 17:35						
1263	144				53	01/06 6:44	01/06 10:13	1	07/06 10:41	07/06 10:41			
1264	151				40	01/06 9:55	01/06 13:35				7	05/06 13:16	05/06 13:28
1266	152				39	01/06 12:26	01/06 14:51	2	03/06 16:12	03/06 16:17			
1267	154				83	01/06 11:24	01/06 17:05	6	05/06 22:38	05/06 22:48	7	07/06 7:56	07/06 8:07
1270	165				41	01/06 6:41	01/06 9:56						
1271	150				37	01/06 15:42	01/06 17:44	1	08/06 3:01	08/06 3:01			
1272	148				45	01/06 9:30	01/06 13:16						
1273	151				430	01/06 13:27	05/06 19:35	6	07/06 18:12	07/06 18:19	5	09/06 0:33	09/06 0:37
1274	153				43	01/06 5:09	01/06 7:46						
1275	154				32	01/06 8:16	01/06 11:00				3	05/06 19:16	05/06 19:49
1276	148				15	01/06 13:15	01/06 15:32						
1277	150				37	01/06 12:25	01/06 14:28	3	04/06 18:01	04/06 18:09	5	06/06 2:44	06/06 3:01
1278	157				34	11/06 17:28	11/06 19:44	2	14/06 18:30	14/06 18:31			
1281	150				45	01/06 9:18	01/06 12:58	3	07/06 15:58	07/06 16:02			
1284	157				84	01/06 9:19	01/06 14:25						
1285	155				42	01/06 8:40	01/06 13:45	3	05/06 8:04	05/06 8:10	18	06/06 16:40	06/06 17:21
1287	158				50	01/06 10:32	01/06 13:40	1	08/06 9:48	08/06 9:48			
1288	152				80	01/06 5:31	01/06 9:15	1	03/06 21:35	03/06 21:35	10	05/06 5:30	05/06 5:54
1289	157				85	01/06 8:30	01/06 12:38				3	05/06 0:36	05/06 0:55
1290	167				48	01/06 10:11	01/06 13:18						
1294	153				29	01/06 7:42	01/06 11:04	1	03/06 16:55	03/06 16:55			
1298	159				42	01/06 8:19	01/06 11:22						
1299	166				40	01/06 10:22	01/06 14:19						
1301	160				12	08/06 8:57	08/06 11:18	2	10/06 19:05	10/06 19:06			
1303	151				9	08/06 3:12	08/06 5:15						
1304	157				30	08/06 15:03	08/06 17:31				3	12/06 20:57	12/06 21:00
1305	155				15	08/06 3:31	08/06 5:58	2	11/06 20:38	11/06 20:43	6	13/06 8:01	13/06 8:07
1306	153				34	08/06 3:16	08/06 5:18						
1307	158				26	08/06 4:05	08/06 5:58	2	10/06 2:42	10/06 2:47	5	11/06 3:01	11/06 3:11

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1308	155				42	08/06 3:46	08/06 6:25	2	09/06 23:05	09/06 23:08	1	11/06 1:25	11/06 1:25
1310	160				12	08/06 4:46	08/06 6:51	2	10/06 16:35	10/06 16:38			
1312	145				54	08/06 5:05	08/06 7:55	2	10/06 6:35	10/06 6:41	4	11/06 9:43	11/06 9:46
1313	153				113	08/06 22:59	09/06 6:06						
1315	146				11	08/06 5:45	08/06 6:06				3	11/06 5:43	11/06 5:46
1317	151				45	08/06 9:16	08/06 12:47	5	10/06 10:39	10/06 10:46	1	11/06 17:32	11/06 17:32
1318	157				21	08/06 8:33	08/06 10:55	2	10/06 8:24	10/06 8:29	10	11/06 8:25	11/06 8:40
1320	152				17	08/06 22:12	09/06 6:11						
1321	165				17	08/06 5:25	08/06 7:30						
1322	151				28	08/06 17:44	08/06 23:38						
1323	163				1	17/07 5:10	17/07 5:10						
1325	149				10	08/06 15:22	08/06 17:42	1	11/06 11:50	11/06 11:50	5	12/06 21:11	12/06 21:25
1328	157				18	08/06 8:31	08/06 10:47						
1330	159				16	08/06 4:03	08/06 6:34	1	10/06 3:06	10/06 3:06	2	11/06 9:02	11/06 9:03
1331	153				20	08/06 4:11	08/06 6:39	2	10/06 10:12	10/06 10:13	1	11/06 20:16	11/06 20:16
1332	157				22	08/06 8:35	08/06 16:51	3	11/06 14:58	11/06 15:03	4	12/06 19:00	12/06 19:04
1333	157				5	08/06 10:10	08/06 10:19				1	12/06 6:40	12/06 6:40
1334	152				121	08/06 10:44	09/06 3:28	1	12/06 7:12	12/06 7:12			
1336	149				31	08/06 5:16	08/06 7:52				5	11/06 8:31	11/06 8:46
1337	149				49	08/06 12:15	08/06 15:01	2	13/06 15:09	13/06 15:15			
1338	151				16	08/06 7:55	08/06 11:02	2	10/06 14:14	10/06 14:15			
1339	151				23	08/06 10:29	08/06 10:37				3	11/06 22:10	11/06 22:36
1340	154				32	08/06 4:40	08/06 7:17				4	11/06 14:19	11/06 15:19
1341	167				29	08/06 2:41	08/06 4:38						
1342	153				21	08/06 3:55	08/06 6:17	1	10/06 4:53	10/06 4:53	1	11/06 6:20	11/06 6:20
1344	154				53	08/06 7:16	08/06 9:38						
1346	150				68	08/06 10:45	08/06 18:06	1	11/06 4:12	11/06 4:12	13	12/06 12:37	12/06 13:54
1348	158				14	08/06 3:27	08/06 5:19	4	10/06 17:10	10/06 17:17	8	12/06 1:03	12/06 1:27
1350	147				10	08/06 6:07	08/06 6:53	4	10/06 17:54	10/06 18:01	5	12/06 0:18	12/06 0:30
1352	162				18	08/06 12:46	08/06 15:07						
1353	161				12	09/06 6:19	09/06 8:47	2	11/06 5:24	11/06 5:28	15	12/06 8:55	12/06 9:20
1355	157				20	09/06 7:45	09/06 9:08						
1357	151				16	08/06 9:40	08/06 11:54						
1358	150				17	08/06 5:28	08/06 8:01	3	10/06 6:29	10/06 6:33	3	11/06 15:08	11/06 15:15
1359	153				15	08/06 11:19	08/06 13:49						
1360	153				32	08/06 11:27	08/06 21:00	4	11/06 20:38	11/06 20:44			

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
1362	149				13	08/06 7:24	08/06 9:55	1	10/06 13:48	10/06 13:48	1	11/06 16:48	11/06 16:48
1365	158				29	08/06 1:43	08/06 3:37						
1366	157				46	08/06 9:16	08/06 12:29	3	10/06 7:49	10/06 7:54	17	11/06 9:25	11/06 10:36
1367	156				61	08/06 10:10	08/06 13:07						
1368	157				19	08/06 5:13	08/06 8:45	2	10/06 17:02	10/06 17:03			
1421	155				33	08/06 5:38	08/06 8:50						
1422	157				7	08/06 8:23	08/06 10:53	3	10/06 9:23	10/06 9:27			
1424	158				47	08/06 7:55	08/06 13:15	2	10/06 14:15	10/06 14:19	9	11/06 14:17	11/06 15:04
1425	153				25	08/06 6:03	08/06 8:59	1	11/06 12:14	11/06 12:14	11	12/06 19:15	12/06 20:23
1427	146				43	08/06 7:10	08/06 10:41						
1428	158				35	08/06 8:05	08/06 10:25	1	10/06 9:24	10/06 9:24	3	11/06 11:23	11/06 11:35
1429	152				26	08/06 5:45	08/06 8:28				1	13/06 2:06	13/06 2:06
1430	148				20	08/06 4:04	08/06 6:12	1	10/06 18:05	10/06 18:05	1	11/06 19:55	11/06 19:55
1431	151				22	08/06 11:29	08/06 13:27	1	10/06 12:59	10/06 12:59	4	11/06 16:42	11/06 16:51
1432	151				20	08/06 5:23	08/06 8:09				1	11/06 13:19	11/06 13:19
1433	152				15	08/06 8:49	08/06 11:40	1	10/06 19:51	10/06 19:51	13	11/06 22:49	12/06 6:54
1434	156				20	08/06 7:34	08/06 10:04						
1435	152				7	08/06 4:52	08/06 4:58				5	14/06 10:21	14/06 10:24
1436	156				8	08/06 6:21	08/06 8:55	1	10/06 9:13	10/06 9:13	6	11/06 13:30	11/06 17:14
1438	155				23	08/06 11:12	08/06 13:52						
1439	148				26	08/06 2:35	08/06 5:20						
1440	155				54	08/06 17:15	08/06 21:40						
1441	154				34	08/06 5:10	08/06 7:45	4	10/06 13:43	10/06 13:48	3	12/06 0:13	12/06 0:17
1442	156				29	08/06 5:48	08/06 8:15	3	10/06 7:49	10/06 7:54	6	11/06 7:15	11/06 7:27
1443	145				66	08/06 9:55	08/06 18:33	2	12/06 12:37	12/06 12:41			
1444	151				12	08/06 10:12	08/06 11:05				3	13/06 5:58	13/06 6:01
1445	152				21	08/06 11:37	08/06 13:35						
1446	147				4	08/06 12:14	08/06 12:27	5	11/06 17:54	11/06 18:02	2	13/06 14:06	13/06 14:09
1448	157				4	08/06 4:57	08/06 7:28	1	10/06 10:44	10/06 10:44	2	11/06 16:35	11/06 16:47
16455	144	108	10/05 16:02	10/05 20:43							1	23/05 1:05	23/05 1:05
16456	140	69	07/05 6:34	07/05 9:53									
16457	142	146	13/05 4:47	13/05 12:34									
16460	155	172	05/05 12:40	05/05 19:32	143	10/05 15:14	10/05 21:09	3	14/05 3:41	14/05 3:48	7	15/05 18:06	15/05 18:16
16463	160	98	04/05 17:22	04/05 20:09									
16464	140	82	11/05 8:15	11/05 10:50									
16465	184	173	14/05 3:01	14/05 7:57									

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16466	143	99	04/05 17:40	04/05 21:05	123	09/05 9:09	09/05 13:29						
16467	143	53	07/05 5:51	07/05 10:03	58	16/05 16:33	16/05 18:52				1	20/05 10:59	20/05 10:59
16468	188	246	12/05 7:04	12/05 20:26	115	18/05 1:00	18/05 6:20	3	20/05 18:32	20/05 18:39	5	22/05 5:22	22/05 5:29
16469	179	196	10/05 14:57	11/05 0:03	37	19/05 12:18	19/05 14:29	1	23/05 2:23	23/05 2:23	6	24/05 10:59	24/05 11:41
16470	142	98	07/05 11:18	13/05 8:29									
16472	147	76	04/05 0:46	04/05 3:43									
16473	153	200	09/05 9:00	09/05 18:30	100	17/05 8:50	17/05 13:40						
16474	141	246	10/05 13:17	10/05 20:32	72	18/05 9:53	18/05 13:31	3	20/05 21:35	20/05 21:45	3	22/05 11:01	22/05 11:13
16475	143	231	06/05 8:09	07/05 3:16	174	19/05 10:56	19/05 16:00						
16476	143	102	09/05 5:41	09/05 11:04	310	15/05 14:32	15/05 23:17	4	18/05 22:41	18/05 22:48	2	20/05 4:05	20/05 4:07
16477	147	261	05/05 10:26	05/05 15:57	135	13/05 17:01	13/05 21:33	2	18/05 4:36	18/05 4:36	4	19/05 7:35	19/05 7:57
16478	141	145	11/05 13:11	11/05 19:10	95	17/05 9:08	17/05 13:26	2	20/05 5:53	20/05 5:57	13	21/05 9:12	21/05 10:25
16479	145	107	04/05 6:44	04/05 9:31	327	09/05 15:57	09/05 21:49	4	14/05 3:16	14/05 3:23			
16480	168	125	04/05 6:47	04/05 11:09	92	09/05 6:32	09/05 10:16	5	13/05 7:43	13/05 7:53	7	14/05 18:48	14/05 19:12
16482	142	105	04/05 1:02	04/05 4:19	78	08/05 8:55	08/05 11:37						
16483	143	96	15/05 5:32	15/05 9:19	38	21/05 13:23	21/05 16:02				2	25/05 21:07	25/05 21:08
16484	147	141	05/05 5:33	05/05 9:50									
16485	148	337	05/05 10:40	05/05 20:58	193	14/05 14:47	14/05 18:35						
16487	142	159	05/05 15:37	05/05 19:56	662	10/05 16:30	11/05 2:21	10	17/05 1:05	17/05 1:17			
16488	151	47	09/05 4:55	09/05 9:49	90	16/05 16:24	16/05 21:33	7	19/05 23:47	20/05 0:04	6	21/05 6:19	21/05 6:35
16489	148	142	13/05 7:39	13/05 13:34	69	19/05 8:23	19/05 11:33						
16490	142	28	04/05 16:14	04/05 18:22	52	11/05 14:35	11/05 17:21	4	15/05 10:54	15/05 11:05	2	17/05 2:19	17/05 2:30
16491	147	44	13/05 6:48	13/05 12:27	44	19/05 10:19	19/05 13:01						
16492	142	811	13/05 9:03	14/05 5:16	42	19/05 22:14	20/05 1:47	2	22/05 15:32	22/05 15:39	1	23/05 22:52	23/05 22:52
16493	146	49	03/05 21:00	03/05 22:40	130	11/05 16:03	11/05 20:15	7	15/05 13:16	15/05 13:27			
16494	142	566	14/05 12:59	15/05 4:12	46	19/05 22:49	20/05 2:14						
16495	185	71	13/05 8:14	13/05 13:59	22	17/05 14:54	17/05 17:33	1	20/05 2:01	20/05 2:01			
16496	153										11	07/05 5:42	07/05 6:06
16497	145	51	09/05 7:22	09/05 10:16							1	14/05 2:11	14/05 2:11
16499	149	118	04/05 22:07	05/05 4:05	116	12/05 8:50	12/05 12:14	6	15/05 17:17	15/05 17:28	3	17/05 12:13	17/05 12:16
16500	147	541	12/05 8:13	13/05 11:39	45	20/05 7:50	20/05 12:13	1	23/05 0:59	23/05 0:59			
16501	142	46	07/05 6:09	07/05 9:11									
16502	148	25	19/05 0:40	19/05 1:58	39	21/05 6:06	21/05 8:15	1	23/05 21:07	23/05 21:07	3	24/05 23:15	24/05 23:31
16508	140										47	10/05 2:51	10/05 4:48
16509	145	55	08/05 6:00	08/05 9:30									
16510	143	26	13/05 7:58	13/05 12:28	7	19/05 12:21	19/05 13:51						

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16512	140	58	13/05 10:18	13/05 16:07	12	19/05 21:11	19/05 23:34						
16515	146	67	04/05 22:32	05/05 1:16	26	21/05 5:45	21/05 8:39				2	25/05 8:42	25/05 8:56
16516	147	63	07/05 6:16	07/05 9:36	56	15/05 13:59	15/05 16:15						
16517	146	54	03/05 22:35	04/05 0:50	46	07/05 16:59	07/05 18:54	1	10/05 4:47	10/05 4:47	4	11/05 11:40	11/05 11:48
16518	145	57	06/05 7:21	06/05 11:03	66	15/05 13:23	15/05 16:31						
16519	147	71	15/05 5:30	15/05 9:50	24	20/05 21:28	21/05 2:04	1	23/05 21:13	23/05 21:13			
16520	140	31	07/05 6:39	07/05 9:26	32	15/05 13:03	15/05 15:26						
16522	146	79	07/05 5:03	07/05 8:41	26	17/05 14:25	17/05 16:44				1	23/05 11:06	23/05 11:06
16523	145	67	06/05 0:35	06/05 3:02	65	12/05 6:58	12/05 10:24	4	16/05 5:37	16/05 5:43	1	17/05 17:17	17/05 17:17
16524	142	25	09/05 6:31	09/05 9:02	15	21/05 13:23	21/05 15:00						
16527	142	122	15/05 12:03	15/05 22:21									
16528	148	45	06/05 8:17	06/05 11:12									
16529	140	109	05/05 19:18	06/05 7:09	107	13/05 7:30	13/05 12:49						
16530	143	313	10/05 12:55	11/05 5:47							26	16/05 5:25	16/05 6:42
16531	144	44	17/05 5:30	17/05 8:57	13	22/05 12:49	22/05 14:27						
16532	145	12	12/05 5:36	12/05 8:15	3	19/05 8:15	19/05 11:29						
16533	146	61	06/05 5:56	06/05 8:51									
16534	142	33	16/05 6:15	16/05 10:14	28	21/05 5:46	21/05 10:21						
16535	142	73	05/05 7:24	05/05 11:29									
16536	142	51	09/05 6:25	09/05 10:14	82	17/05 2:56	17/05 6:37	1	22/05 9:37	22/05 9:37			
16537	144	133	13/05 5:57	13/05 13:54	9	21/05 14:39	21/05 16:07						
16538	143	99	18/05 15:21	19/05 5:34	77	25/05 5:17	25/05 13:48				3	01/06 16:59	01/06 17:20
16539	145	41	13/05 7:16	13/05 11:09									
16540	147	19	17/05 6:22	17/05 9:24							1	24/05 2:32	24/05 2:32
16541	143	74	11/05 19:37	12/05 1:55	14	19/05 13:25	19/05 15:10				1	25/05 11:49	25/05 11:49
16542	141	84	06/05 10:49	07/05 5:10									
16546	142	43	04/05 19:11	04/05 22:36	67	13/05 13:21	13/05 17:52						
16547	142	49	06/05 4:41	06/05 6:46	29	11/05 4:27	11/05 6:25	2	13/05 22:16	13/05 22:16			
16548	148	56	10/05 19:24	10/05 23:19							68	15/05 4:54	16/05 11:30
16549	146	44	13/05 7:32	13/05 13:09	11	21/05 2:07	21/05 4:34				1	26/05 11:10	26/05 11:10
16550	147	37	10/05 7:33	10/05 10:02									
16551	145	11	16/05 7:45	16/05 8:02									
16553	145	29	08/05 10:07	13/05 9:23	21	18/05 6:30	18/05 9:57						
16554	141	33	13/05 8:06	13/05 11:02	35	21/05 12:49	21/05 15:32	1	24/05 17:16	24/05 17:16	2	26/05 8:49	26/05 8:50
16555	151	119	13/05 23:56	14/05 6:46									
16556	143	73	12/05 6:12	12/05 9:25	87	17/05 19:14	18/05 0:38	3	20/05 16:48	20/05 16:55	4	21/05 22:51	21/05 23:26

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16557	140	91	13/05 5:28	13/05 8:41	290	18/05 19:27	19/05 11:39	1	23/05 9:42	23/05 9:42	6	24/05 11:06	24/05 11:13
16558	141	81	13/05 6:20	13/05 9:51									
16559	141	765	14/05 11:35	15/05 4:32	44	21/05 2:08	21/05 5:51	2	23/05 23:50	23/05 23:51	3	25/05 5:49	25/05 5:52
16560	146	60	12/05 4:17	12/05 6:53	45	17/05 3:57	17/05 6:41						
16561	147	87	14/05 6:48	14/05 11:51	18	19/05 10:50	19/05 13:38				15	23/05 7:45	23/05 8:31
16562	148	40	12/05 8:15	12/05 11:41	17	18/05 8:53	18/05 11:06						
16563	143	96	12/05 9:52	12/05 14:32									
16564	192	68	11/05 14:19	11/05 16:28	53	14/05 7:17	14/05 9:47	3	17/05 14:42	17/05 14:44	3	18/05 20:27	18/05 20:41
16566	148	48	15/05 6:27	15/05 8:56	18	19/05 8:17	19/05 11:20						
16569	142	92	16/05 7:17	16/05 10:37	58	22/05 0:47	22/05 4:12						
16572	153	87	14/05 9:36	14/05 13:22	22	22/05 22:25	23/05 0:27						
16578	160	56	12/05 7:53	12/05 10:36	49	17/05 15:07	17/05 18:09	1	20/05 18:58	20/05 18:58			
16580	147	71	13/05 10:31	13/05 15:19									
16581	146	119	14/05 7:32	14/05 19:49							68	19/05 5:11	19/05 7:20
16582	142	46	13/05 7:58	13/05 11:14	57	22/05 8:51	22/05 11:39						
16583	141	76	14/05 6:11	14/05 9:25									
16584	155	151	11/05 18:46	13/05 11:53	52	16/05 12:48	16/05 14:57						
16585	144	58	16/05 13:27	16/05 20:31	98	26/05 18:49	27/05 3:29						
16586	145	75	15/05 7:01	15/05 10:46	36	20/05 6:49	20/05 11:00	2	23/05 1:31	23/05 1:38			
16587	150	55	13/05 11:37	13/05 14:55	19	18/05 15:40	18/05 18:12	1	21/05 8:07	21/05 8:07			
16588	144	125	16/05 7:05	16/05 12:38	21	21/05 1:00	21/05 2:56	2	23/05 23:32	23/05 23:37	10	25/05 11:29	25/05 11:38
16590	145	81	11/05 4:54	11/05 7:01	75	16/05 5:26	16/05 11:38	2	18/05 17:33	18/05 17:34			
16591	145	66	17/05 3:54	17/05 6:53	40	20/05 20:07	20/05 22:45	1	23/05 4:03	23/05 4:03	18	24/05 8:49	24/05 9:21
16592	142	69	13/05 5:22	13/05 9:06	13	18/05 12:27	18/05 14:02						
16593	154	42	17/05 1:27	17/05 4:22	141	24/05 3:34	24/05 9:31				1	29/05 1:20	29/05 1:20
16594	145	58	14/05 6:04	14/05 8:32	15	19/05 23:39	20/05 3:18	1	22/05 22:10	22/05 22:10	1	24/05 6:25	24/05 6:25
16597	140	31	17/05 9:14	17/05 12:11	59	26/05 7:26	26/05 9:13						
16598	142	262	11/05 13:45	12/05 0:39	28	18/05 13:45	18/05 17:02	4	20/05 18:38	20/05 18:51	2	22/05 4:46	22/05 4:47
16600	142	114	14/05 11:13	14/05 16:11	31	20/05 13:49	27/05 3:13						
16601	142	69	13/05 9:22	13/05 13:02									
16602	140	68	14/05 8:18	14/05 11:52	27	21/05 0:23	21/05 4:31						
16603	145	136	14/05 5:25	14/05 10:17	74	21/05 14:33	21/05 20:28						
16605	143	44	13/05 9:13	13/05 12:09	34	18/05 16:33	18/05 18:54	1	21/05 6:00	21/05 6:00	1	23/05 2:30	23/05 2:30
16606	146	226	11/05 20:28	12/05 6:37									
16608	149	128	14/05 11:13	14/05 21:47	104	25/05 17:06	25/05 22:26	1	29/05 4:09	29/05 4:09			
16609	140	174	14/05 12:45	14/05 19:40	50	20/05 7:50	20/05 11:42	1	23/05 2:04	23/05 2:04	2	24/05 12:57	24/05 12:58

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16610	145	82	11/05 1:42	11/05 4:07							11	15/05 4:52	15/05 5:42
16611	141	84	12/05 3:07	12/05 6:25	124	18/05 1:10	18/05 5:23				2	22/05 17:43	22/05 17:45
16613	142	165	12/05 22:55	13/05 8:01									
16614	145	60	13/05 9:59	13/05 14:10	58	18/05 23:26	19/05 1:35				7	23/05 7:52	23/05 7:58
16615	142	154	14/05 6:15	14/05 12:33	252	22/05 4:01	22/05 10:28	3	26/05 19:28	26/05 19:36			
16616	142	507	12/05 13:26	13/05 6:58									
16619	143	97	16/05 4:56	16/05 8:18									
16620	140	44	18/05 11:55	18/05 14:13	142	23/05 10:22	23/05 14:35				1	28/05 1:25	28/05 1:25
16621	140	222	13/05 9:00	13/05 17:50	58	20/05 4:57	20/05 8:37	11	22/05 20:10	22/05 20:38	2	24/05 6:08	24/05 6:09
16622	140	130	12/05 12:19	12/05 19:50	107	18/05 20:57	19/05 0:24						
16623	142	84	13/05 2:25	13/05 6:41	20	20/05 11:10	20/05 14:53						
16625	140	143	15/05 11:11	15/05 14:48	61	20/05 11:57	20/05 14:43	1	24/05 15:07	24/05 15:07	1	26/05 1:49	26/05 1:49
16626	143	271	14/05 15:50	15/05 6:04	83	20/05 6:27	20/05 10:06	2	22/05 23:09	22/05 23:15	6	24/05 4:25	24/05 4:48
16627	148	64	12/05 8:23	12/05 11:26	52	20/05 9:29	20/05 12:26	2	23/05 1:29	23/05 1:35	1	27/05 4:42	27/05 4:42
16628	143	37	12/05 5:44	12/05 7:26									
16629	146	144	16/05 5:09	16/05 12:27	56	21/05 10:32	21/05 13:14						
16630	145	103	14/05 5:13	14/05 11:32	47	21/05 0:30	21/05 3:56	3	23/05 23:59	24/05 0:07	1	25/05 8:22	25/05 8:22
16631	140	88	11/05 13:37	11/05 17:16	222	16/05 16:32	17/05 0:15	1	20/05 6:45	20/05 6:45			
16632	141	113	12/05 12:46	12/05 17:13	55	17/05 11:02	17/05 14:20	6	19/05 23:46	19/05 23:56	1	21/05 4:03	21/05 4:03
16633	144	81	15/05 5:54	15/05 9:33	47	20/05 0:57	20/05 4:49						
16635	147	103	13/05 6:49	14/05 5:49	43	19/05 13:00	19/05 15:08				4	23/05 7:57	23/05 8:01
16636	143										6	15/05 4:58	15/05 5:44
16640	146										11	15/05 4:59	15/05 5:43
16641	144	509	12/05 14:36	13/05 4:41	72	21/05 13:42	21/05 15:55						
16642	144	72	11/05 3:21	11/05 5:36	102	17/05 13:48	17/05 16:36	3	20/05 15:15	20/05 15:22			
16643	147	177	13/05 2:54	16/05 1:28							7	19/05 5:20	19/05 5:45
16644	142	89	11/05 2:15	11/05 5:15	248	15/05 12:25	15/05 18:23						
16645	147	151	13/05 7:22	13/05 14:55	62	19/05 15:05	19/05 17:39						
16646	145	98	13/05 7:25	13/05 11:53									
16647	147	95	13/05 7:42	13/05 13:51	32	19/05 20:41	19/05 22:24						
16648	147	102	12/05 4:46	12/05 8:53	72	19/05 7:10	19/05 11:45						
16649	148	459	15/05 14:18	16/05 4:31	23	22/05 0:09	22/05 3:57				1	25/05 22:26	25/05 22:26
16650	141	166	12/05 18:20	13/05 4:05	72	18/05 15:44	18/05 18:51						
16651	145	51	12/05 8:01	12/05 11:39							8	19/05 4:21	19/05 4:29
16653	141	64	13/05 4:36	13/05 8:37	17	17/05 12:20	17/05 14:46				1	22/05 0:03	22/05 0:03
16654	141	175	15/05 17:46	16/05 3:20	160	20/05 18:56	21/05 2:05	1	23/05 13:17	23/05 13:17			

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16656	151												
16658	142										1	08/06 5:50	08/06 5:50
16659	155										1	08/06 6:05	08/06 6:05
16661	160										1	08/06 5:58	08/06 5:58
16662	148												
16665	164												
16666	147												
16668	156										3	08/06 6:19	08/06 6:38
16669	150										1	08/06 6:11	08/06 6:11
16670	155										6	08/06 6:17	08/06 6:30
16672	145												
16673	155										1	08/06 5:46	08/06 5:46
16674	156										2	08/06 5:49	08/06 6:02
16675	154												
16677	152										6	08/06 6:33	08/06 8:26
16679	155												
16680	157												
16683	152												
16684	158												
16686	142												
16689	158												
16690	149										1	08/06 6:03	08/06 6:03
16691	161										1	08/06 5:39	08/06 5:39
16692	157												
16695	157										2	08/06 5:43	08/06 6:08
16696	164										6	08/06 6:12	08/06 6:20
16698	162												
16699	153												
16700	154										1	08/06 5:45	08/06 5:45
16701	152												
16702	155										2	08/06 5:43	08/06 6:17
16703	165												
16704	160										1	08/06 6:12	08/06 6:12
16705	155												
16706	154										2	16/06 4:21	16/06 4:22
16707	155												

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16708	155												
16709	165										3	16/06 4:00	16/06 4:37
16713	166										2	16/06 3:57	16/06 5:10
16714	164										9	16/06 3:58	16/06 4:41
16715	155												
16718	162												
16719	166										4	16/06 4:44	16/06 5:02
16727	157												
16729	150										1	16/06 4:08	16/06 4:08
16731	150										2	16/06 4:29	16/06 5:00
16732	152										7	16/06 4:28	16/06 4:39
16733	150										1	16/06 4:14	16/06 4:14
16738	157												
16740	157												
16741	160										2	16/06 5:27	16/06 5:47
16745	141										4	16/06 4:57	16/06 5:29
16746	160												
16751	158												
16753	158										4	16/06 4:40	16/06 5:02
16754	148												
16755	152				38	01/06 4:41	01/06 7:41	2	03/06 10:21	03/06 10:27	1	04/06 19:18	04/06 19:18
16756	148				158	01/06 17:45	02/06 0:17	2	05/06 15:33	05/06 15:40	1	06/06 23:19	06/06 23:19
16757	149				20	01/06 8:39	01/06 12:13	2	04/06 1:45	04/06 1:49	1	05/06 4:44	05/06 4:44
16758	160				100	01/06 17:55	02/06 1:28	1	09/06 6:07	09/06 6:07			
16759	155				42	01/06 12:32	01/06 15:27				14	05/06 7:53	05/06 9:50
16760	156				65	01/06 12:07	01/06 15:36						
16763	147				82	01/06 9:05	01/06 15:29	3	04/06 21:59	04/06 22:07			
16765	152				45	01/06 12:59	01/06 16:46	1	04/06 20:22	04/06 20:22	20	06/06 7:45	06/06 8:16
16766	152				78	01/06 20:44	01/06 22:57				1	05/06 6:16	05/06 6:16
16767	158				63	01/06 12:56	01/06 16:29	3	05/06 21:12	05/06 21:21	2	07/06 2:50	07/06 2:52
16768	152				180	01/06 11:39	01/06 22:59	35	07/06 18:34	09/06 22:41			
16769	150				36	01/06 12:52	01/06 15:46						
16770	156				70	01/06 12:27	01/06 16:24	3	03/06 18:08	03/06 18:14			
16775	148				67	01/06 5:55	01/06 9:31	1	03/06 22:26	03/06 22:26			
16776	155				30	01/06 9:14	01/06 12:36						
16781	156				54	01/06 10:47	01/06 14:51						

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16782	149				27	01/06 8:33	01/06 12:02	2	03/06 22:40	03/06 22:48	9	05/06 8:41	05/06 9:06
16783	170				27	01/06 14:21	01/06 17:20	3	04/06 22:05	04/06 22:14	10	06/06 3:11	06/06 4:05
16784	159				23	01/06 9:36	01/06 12:26	2	03/06 12:18	03/06 12:27			
16786	154				48	01/06 3:43	01/06 6:27	40	03/06 11:29	07/06 5:56			
16787	158				99	03/06 19:19	03/06 23:31						
16789	154				23	01/06 5:35	01/06 7:30	7	03/06 15:29	03/06 15:38			
16794	173				26	01/06 6:28	01/06 9:42						
16796	145				141	01/06 11:20	01/06 19:49	2	06/06 13:54	06/06 13:58			
16797	149				38	01/06 6:02	01/06 8:26						
16798	143				26	01/06 12:09	01/06 15:22	13	04/06 18:00	04/06 18:09	6	06/06 2:50	06/06 2:55
16800	155				71	01/06 11:12	01/06 16:24						
16801	164				35	01/06 7:01	01/06 9:55	4	03/06 18:23	03/06 18:30	29	05/06 6:26	05/06 9:37
16802	151				66	01/06 11:47	01/06 15:11						
16803	150				42	01/06 8:21	01/06 13:01	1	04/06 14:42	04/06 14:42	6	06/06 0:36	06/06 0:55
16805	159				32	01/06 7:14	01/06 9:50	12	04/06 19:18	04/06 20:06	13	06/06 6:37	06/06 6:56
16806	154				97	01/06 5:53	01/06 9:02						
16808	156				53	01/06 8:08	01/06 13:42	2	04/06 3:45	04/06 3:51	20	05/06 13:48	05/06 18:27
16810	152				136	01/06 17:51	01/06 21:48	2	06/06 18:54	06/06 19:02			
16811	156				272	03/06 5:30	12/06 4:14						
16812	156				45	01/06 11:29	01/06 13:45						
16813	164				46	01/06 6:44	01/06 10:11	3	03/06 21:02	03/06 21:08	2	05/06 1:29	05/06 1:30
16815	166				118	02/06 16:01	03/06 1:44						
16816	146				57	01/06 7:32	01/06 10:50	1	04/06 3:10	04/06 3:10	3	05/06 19:45	05/06 20:31
16817	152				79	01/06 7:23	01/06 14:22	3	06/06 4:30	06/06 4:38	4	07/06 15:05	07/06 15:10
16818	167				23	01/06 9:05	01/06 12:04						
16821	154				55	01/06 3:43	01/06 6:47	1	04/06 0:32	04/06 0:32	9	05/06 14:57	05/06 15:16
16822	153				99	01/06 6:34	01/06 10:38	3	04/06 2:58	04/06 3:08			
16823	151				41	01/06 9:47	01/06 12:56				5	06/06 13:47	06/06 13:58
16824	153				41	01/06 14:43	01/06 17:02	3	04/06 19:24	04/06 19:30			
16826	173				46	01/06 9:02	01/06 12:37	3	03/06 19:54	03/06 20:00			
16827	146				39	01/06 4:09	01/06 6:37	1	03/06 18:39	03/06 18:39			
16829	154				41	01/06 8:03	01/06 11:39	3	04/06 14:51	04/06 14:59			
16831	157				42	01/06 8:14	01/06 12:22	2	04/06 2:43	04/06 2:48			
16832	151				101	01/06 13:48	01/06 17:23	1	05/06 12:17	05/06 12:17			
16834	151				24	01/06 9:17	01/06 12:10	7	04/06 18:50	04/06 19:02			
16837	155				48	01/06 9:01	01/06 13:52						

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16839	164				39	01/06 7:47	01/06 11:00						
16840	162				98	01/06 17:08	01/06 20:06				2	07/06 9:41	07/06 9:46
16843	143				93	04/06 4:22	04/06 7:59	1	06/06 22:24	06/06 22:24			
16845	150				82	02/06 6:24	02/06 10:15						
16846	161				26	01/06 9:34	01/06 12:38						
16847	154				34	01/06 8:40	01/06 11:36	2	04/06 2:46	04/06 2:51	7	05/06 7:27	05/06 7:47
16848	170				25	01/06 9:50	01/06 12:31	1	04/06 13:53	04/06 13:53	2	06/06 2:53	06/06 2:55
16849	161	1	14/05 12:54	14/05 12:54	70	01/06 12:01	01/06 19:36						
16850	162				36	01/06 7:38	01/06 10:31						
16851	152				271	01/06 14:34	02/06 18:32	5	06/06 19:52	06/06 20:00	2	08/06 10:31	08/06 10:34
16854	158				33	01/06 9:05	01/06 13:05						
16855	156				6	08/06 6:52	08/06 9:39						
16856	152	1	12/05 17:59	12/05 17:59	37	09/06 2:47	09/06 10:09						
16859	157				31	08/06 3:59	08/06 6:40	1	10/06 2:22	10/06 2:22	8	11/06 3:56	11/06 4:32
16861	157				22	08/06 3:54	08/06 5:40	1	10/06 3:56	10/06 3:56	12	11/06 8:02	11/06 9:22
16862	156				4	08/06 9:06	08/06 9:26	1	10/06 5:39	10/06 5:39	1	11/06 7:21	11/06 7:21
16863	158				8	08/06 8:19	08/06 11:00						
16865	153				19	08/06 3:01	08/06 7:04						
16867	159				3	08/06 6:06	08/06 9:01	2	11/06 6:36	11/06 6:40	4	12/06 11:05	12/06 11:37
16869	150				40	10/06 2:48	10/06 5:41	1	12/06 14:10	12/06 14:10	1	13/06 17:57	13/06 17:57
16870	152				53	08/06 14:42	08/06 17:15	2	12/06 6:12	12/06 6:13	9	13/06 9:53	13/06 10:13
16871	144				2	08/06 7:52	08/06 7:54	1	11/06 5:47	11/06 5:47			
16872	149				37	08/06 2:34	08/06 6:03						
16874	150				12	08/06 19:13	08/06 21:15	3	10/06 19:23	10/06 19:29	10	11/06 22:29	12/06 0:43
16875	160				6	08/06 9:14	08/06 11:18	1	10/06 7:10	10/06 7:10	2	11/06 6:49	11/06 7:05
16877	155				22	08/06 7:40	08/06 9:57						
16878	147				20	08/06 11:08	08/06 11:59				13	12/06 3:32	12/06 4:50
16879	154				51	08/06 6:00	08/06 9:50	2	10/06 16:32	10/06 16:33	6	11/06 19:19	11/06 19:44
16880	157				52	08/06 9:51	08/06 17:42						
16881	150				35	08/06 2:31	08/06 5:41	2	10/06 14:22	10/06 14:23	2	11/06 22:22	11/06 22:23
16883	147				50	08/06 4:29	08/06 7:02	1	10/06 5:32	10/06 5:32	3	11/06 6:49	11/06 7:02
16884	152				19	08/06 9:52	08/06 12:46	1	10/06 15:48	10/06 15:48			
16885	152				12	08/06 9:08	08/06 9:54						
16886	153				144	08/06 10:49	09/06 1:03	1	13/06 7:56	13/06 7:56	6	14/06 18:05	14/06 18:10
16887	153				24	08/06 10:46	08/06 13:00	3	10/06 15:12	10/06 15:16	13	11/06 21:52	12/06 0:46
16889	151				33	08/06 2:23	08/06 4:47						

Tag ID code	Fork Length	Granite Dam No. Detects	Granite Dam Date Detected First	Granite Dam Date Detected Last	Wallula Dam No. Detects	Wallula Dam Date Detected First	Wallula Dam Date Detected Last	John Day Dam No. Detects	John Day Dam Date Detected First	John Day Dam Date Detected Last	Bonneville Dam No. Detects	Bonneville Dam Date Detected First	Bonneville Dam Date Detected Last
16890	147				2	08/06 9:04	08/06 9:05				4	12/06 9:26	12/06 9:30
16892	162				5	08/06 9:55	08/06 12:01	1	10/06 17:03	10/06 17:03			
16893	154				19	08/06 13:29	08/06 15:33	3	10/06 13:36	10/06 13:43	1	11/06 17:21	11/06 17:21
16895	151				51	08/06 7:23	08/06 10:45	3	11/06 14:23	11/06 14:29	1	12/06 18:36	12/06 18:36
16898	153				36	08/06 8:10	08/06 11:28	1	10/06 11:41	10/06 11:41	1	11/06 13:35	11/06 13:35
16899	159				34	08/06 6:18	08/06 8:27						
16900	161				6	08/06 8:31	08/06 11:08	1	10/06 12:06	10/06 12:06	1	11/06 14:32	11/06 14:32
16901	160				12	08/06 8:53	08/06 9:23	1	10/06 15:42	10/06 15:42			
16902	166				27	08/06 3:02	08/06 5:00	2	09/06 21:42	09/06 21:43			
16903	157				43	08/06 4:56	08/06 8:38						
16904	152				9	08/06 6:57	08/06 10:29				9	12/06 5:42	12/06 6:07
16905	164				39	08/06 3:54	08/06 6:54	5	10/06 1:08	10/06 1:13	4	11/06 3:01	11/06 3:05
16906	159				9	08/06 4:14	08/06 6:35						
16907	155				47	08/06 6:50	08/06 10:04						
16908	160				66	10/06 3:21	10/06 6:27						
16909	156				27	08/06 5:53	08/06 8:00				2	11/06 9:46	11/06 9:47
16911	158				36	08/06 23:28	09/06 5:39	2	12/06 7:34	12/06 7:39	9	13/06 10:54	13/06 11:51
16912	155				13	08/06 6:54	08/06 9:56	1	11/06 4:23	11/06 4:23			
16916	156				10	08/06 2:27	08/06 4:04						
16918	148				20	08/06 5:01	08/06 7:17	7	10/06 5:12	10/06 5:18	3	11/06 7:04	11/06 7:12
16919	159				16	08/06 3:08	08/06 4:59	1	09/06 18:35	09/06 18:35			
16920	150				12	08/06 2:26	08/06 4:01	2	10/06 3:21	10/06 3:24	4	11/06 5:24	11/06 5:49
16921	155				25	08/06 7:48	08/06 13:04				5	12/06 7:00	12/06 7:05
16923	144				64	08/06 8:33	08/06 13:08	1	11/06 17:50	11/06 17:50			
16924	153				38	08/06 8:18	08/06 10:43	8	10/06 5:21	10/06 5:26	4	11/06 7:38	11/06 7:45
16925	152				26	08/06 1:48	08/06 3:47						
16926	154				4	08/06 7:16	08/06 10:08				12	12/06 6:09	12/06 6:47
16927	153				19	08/06 6:54	08/06 10:02						
16928	149				6	08/06 7:44	08/06 10:37	1	10/06 15:07	10/06 15:07	2	11/06 17:09	11/06 17:10
16929	147				48	08/06 7:19	08/06 11:31						
16931	154				38	08/06 6:48	08/06 8:55	5	10/06 6:20	10/06 6:26	3	11/06 13:07	11/06 13:08
16932	168				41	08/06 8:51	08/06 11:05	2	10/06 14:32	10/06 14:32	15	11/06 18:59	11/06 19:54
16933	156				39	08/06 11:10	08/06 13:38	2	10/06 13:20	10/06 13:23	1	11/06 20:54	11/06 20:54
16934	153				4	08/06 10:30	08/06 10:35						
16935	157				40	08/06 11:10	08/06 14:10	3	10/06 11:55	10/06 11:59			
16936	161				18	08/06 11:30	08/06 13:47						

		Granite Dam			Wallula Dam			John Day Dam			Bonneville Dam		
			Date Detected			Date Detected			Date Detected			Date Detected	
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last
16938	149				78	08/06 11:47	08/06 23:07						
16939	156				26	08/06 8:59	08/06 10:33	2	10/06 22:59	10/06 23:03	9	12/06 1:40	12/06 2:00
16940	156				3	08/06 11:51	08/06 12:09	2	10/06 17:28	10/06 17:33			
16941	155				5	08/06 9:58	08/06 10:20				1	11/06 19:55	11/06 19:55
16944	160				16	08/06 8:58	08/06 11:15						
16945	150				11	08/06 3:49	08/06 6:04						
16946	155				21	08/06 7:01	08/06 9:21	1	10/06 14:39	10/06 14:39	5	11/06 16:03	11/06 16:08
16947	162				25	08/06 5:43	08/06 8:04	1	10/06 23:36	10/06 23:36	5	12/06 10:58	12/06 11:30
16949	158				21	08/06 6:58	08/06 10:04						
16950	162				17	08/06 12:09	08/06 15:45						
16951	151				10	08/06 2:38	08/06 4:47						
16953	148				166	24/06 5:35	24/06 20:30	4	28/06 8:18	28/06 8:28			
16954	147				41	08/06 1:46	08/06 3:49	1	12/06 16:47	12/06 16:47			

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
900	154	1	23/05 14:24	23/05 14:24	23	26/05 22:26	26/05 23:01							
901	144	5	15/05 5:24	15/05 5:50										
902	145													
903	151	4	22/05 8:49	22/05 8:55	21	25/05 8:58	25/05 9:21							
904	153				6	25/05 5:04	25/05 5:11							
905	149													
906	165	12	18/05 5:49	18/05 6:12										
907	153													
908	142													
909	140	1	19/05 21:22	19/05 21:22										
910	140													
911	157	1	24/05 1:54	24/05 1:54										
912	151	1	18/05 22:13	18/05 22:13										
913	140	9	26/05 6:14	26/05 6:39										
917	141	3	22/05 1:11	22/05 1:42	13	24/05 23:06	24/05 23:25							
918	141	7	15/05 4:57	15/05 5:32	15	26/05 2:47	26/05 3:29							
919	145				11	15/06 19:52	15/06 20:05							
920	143				2	23/05 9:12	23/05 9:12							
921	142										6	30/03 1:28	12/06 10:06	Keogh
922	149													
924	149	3	19/05 4:36	19/05 4:41										
927	143													
930	143													
931	144				26	25/05 16:14	25/05 19:05							
932	167	1	20/05 3:03	20/05 3:03										
933	147	1	19/05 3:35	19/05 3:35	26	25/05 20:16	25/05 20:46							
934	157	1	19/05 19:12	19/05 19:12	17	26/05 2:57	26/05 3:28							
935	151													
936	146										9588	29/03 18:15	12/08 20:05	Keogh
937	152				267	26/05 9:08	27/05 2:00							
938	153	1	25/05 16:12	25/05 16:12				30	28/06 16:08	28/06 19:36				
939	146													
943	145													
944	146	1	14/05 1:30	14/05 1:30										
945	150	1	26/05 17:06	26/05 17:06										
947	141	11	18/05 11:22	18/05 11:43										
948	143													
949	141	1	24/05 7:26	24/05 7:26										

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
950	142													
951	143													
953	143													
954	144													
956	146													
958	143	1	28/05 12:18	28/05 12:18	10	02/06 17:57	02/06 18:30							
959	142													
960	145	6	21/05 11:54	21/05 12:02										
961	142													
962	141													
964	140													
965	144													
966	140													
967	143	3	11/05 6:00	11/05 6:06	22	26/05 3:54	26/05 4:16							
968	147													
969	140													
970	143													
971	142	2	23/05 15:03	23/05 15:03	2	27/05 10:18	27/05 10:30							
972	147	11	19/05 2:59	19/05 5:41										
973	142	7	19/05 4:38	19/05 6:03										
974	146	2	20/05 12:59	20/05 14:09	9	24/05 8:51	24/05 9:04							
976	141	19	19/05 4:38	19/05 5:53	56	24/05 23:15	25/05 1:43							
977	141	6	15/05 4:51	15/05 5:21	68	25/05 1:20	25/05 3:24							
978	149													
979	142													
980	146	18	22/05 4:39	22/05 5:31	11	25/05 5:29	25/05 5:48							
981	142	5	21/05 13:47	21/05 14:07	34	25/05 18:10	25/05 19:25							
982	142	1	19/05 16:52	19/05 16:52										
984	145													
986	145													
988	145													
989	146													
990	149													
991	145	3	25/05 6:58	25/05 7:00										
993	148	6	24/05 6:16	24/05 6:22	115	27/05 18:43	28/05 14:33							
994	147	2	22/05 6:54	22/05 7:07	23	25/05 18:39	25/05 19:14							
995	147	1	25/05 3:07	25/05 3:07										
996	146													
998	148				78	25/05 10:09	25/05 12:30							
1000	142	3	23/05 8:26	23/05 8:29										

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1002	151													
1003	158				14	28/05 1:18	28/05 1:34							
1004	145				53	01/06 16:04	07/06 0:53							
1005	175													
1008	143	5	24/05 10:25	24/05 10:33	8	28/05 12:20	28/05 12:28							
1009	143													
1011	144	1	22/05 18:49	22/05 18:49	20	25/05 20:20	25/05 20:42							
1012	142													
1013	149													
1014	145	3	22/05 8:07	22/05 8:24	38	26/05 3:15	26/05 4:02							
1015	164													
1016	143	2	19/05 8:29	19/05 8:30										
1017	154	1	23/05 18:09	23/05 18:09	2	28/05 15:04	28/05 15:05							
1018	143													
1019	147													
1020	140													
1021	144													
1023	147													
1025	148													
1026	146													
1027	145	13	15/05 4:56	15/05 5:54	1	25/05 4:12	25/05 4:12							
1028	142													
1029	142													
1030	145	5	21/05 10:38	21/05 11:51	12	24/05 20:31	24/05 20:55							
1031	151													
1032	143													
1035	140	2	25/05 20:07	25/05 20:09	24	01/06 22:16	02/06 16:04	11	29/06 12:53	29/06 13:06				
1037	141				7	29/05 17:10	29/05 17:19							
1039	147	1	20/05 14:38	20/05 14:38	3	25/05 6:33	25/05 6:38							
1040	143	2	22/05 1:07	22/05 1:09	1	25/05 4:12	25/05 4:12							
1041	146													
1042	147	1	23/05 4:22	23/05 4:22	16	26/05 9:02	26/05 9:20							
1044	143													
1045	146													
1046	145	9	19/05 4:31	19/05 4:43										
1048	146													
1049	148													
1050	144													
1051	142													
1053	146													

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1054	145													
1055	143	2	21/05 10:40	21/05 17:12	57	27/05 23:05	28/05 2:39							
1056	141													
1058	143	23	22/05 4:43	22/05 5:56	8	25/05 4:44	25/05 4:51							
1059	144													
1060	144	1	21/05 1:00	21/05 1:00	46	24/05 22:06	24/05 23:08							
1061	140													
1063	144													
1064	143													
1065	144	2	20/05 9:31	20/05 9:32	21	25/05 13:18	25/05 13:42							
1066	141													
1067	143													
1068	143													
1069	144	28	15/05 4:59	15/05 6:17										
1070	144	3	18/05 3:56	18/05 3:59	6	25/05 8:42	25/05 8:58							
1073	146	2	24/05 16:28	24/05 16:29										
1074	142	1	24/05 5:25	24/05 5:25	2	28/05 8:49	28/05 8:50	4	29/06 19:09	29/06 19:15				
1075	140													
1076	142													
1077	142													
1078	142													
1079	141													
1081	141													
1082	145	5	19/05 4:21	19/05 4:29										
1083	147													
1084	146	1	15/05 5:14	15/05 5:14										
1085	140													
1086	142	2	27/05 7:50	27/05 7:52	23	13/06 14:02	13/06 14:35							
1087	147													
1088	143													
1089	144	1	23/05 10:35	23/05 10:35	20	26/05 11:47	26/05 12:11							
1090	140				17	29/05 14:02	29/05 15:32							
1091	148													
1092	142				5	27/05 7:49	27/05 7:58				1	11/05 17:49	11/05 17:49	Keogh
1093	147													
1094	146	13	15/05 4:57	15/05 5:40										
1095	144													
1096	143													
1097	146													
1098	140													

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1099	145	2	24/05 17:43	24/05 17:45										
1104	154				24	12/06 17:24	12/06 17:50							
1105	146				27	12/06 22:31	25/06 1:56							
1106	146				28	13/06 5:52	27/06 7:57							
1107	155	5	08/06 5:46	08/06 6:17										
1108	146	6	08/06 6:31	08/06 6:36	30	12/06 4:55	12/06 7:54							
1110	156				4	11/06 10:46	11/06 10:52	20	03/07 21:12	03/07 21:44				
1114	152				9	11/06 10:37	11/06 10:47							
1116	152	1	08/06 5:51	08/06 5:51	2	13/06 15:54	13/06 15:57							
1121	141	3	08/06 6:05	08/06 6:12										
1123	152				23	11/06 11:41	11/06 12:03							
1124	154	1	08/06 6:04	08/06 6:04	16	12/06 1:44	12/06 2:03	72	03/07 9:52	03/07 11:31				
1125	145	1	08/06 5:58	08/06 5:58										
1127	147				10	15/06 5:23	15/06 5:33							
1128	161				29	11/06 21:25	11/06 23:42	22	08/07 3:14	08/07 3:37				
1130	156				4	13/06 2:47	13/06 2:53	4	08/07 7:35	08/07 7:41				
1131	167				70	12/06 4:45	05/07 12:23							
1132	154				57	12/06 6:48	03/07 20:28							
1135	149	1	08/06 5:46	08/06 5:46	177	29/06 22:18	01/07 17:50							
1136	160	1	08/06 6:03	08/06 6:03	176	12/06 2:17	02/07 12:08							
1137	161				20	10/06 22:04	10/06 22:55	7	01/07 22:38	01/07 22:44				
1138	155	1	08/06 5:45	08/06 5:45										
1141	150	13	08/06 6:36	08/06 6:55	25	12/06 10:42	12/06 11:12							
1142	154				21	12/06 7:25	12/06 7:46							
1144	146				33	12/06 14:20	12/06 14:54							
1145	151	1	08/06 5:43	08/06 5:43	13	13/06 8:15	13/06 8:33							
1148	158	7	08/06 5:55	08/06 7:23										
1149	152	4	08/06 6:10	08/06 6:17										
1152	155				71	20/06 7:21	20/06 12:26							
1154	157	2	16/06 4:09	16/06 4:10	294	19/06 21:53	24/06 23:37							
1155	151				234	25/06 20:31	01/07 13:17	11	12/08 20:53	12/08 21:05				
1156	150				253	28/06 17:06	02/07 16:29							
1159	161							260	19/08 16:34	12/09 14:39				
1160	150				63	20/06 16:43	20/06 18:27							
1161	154	6	16/06 4:10	16/06 4:23										
1162	160	1	16/06 3:54	16/06 3:54										
1164	153	5	16/06 4:00	16/06 5:17										
1165	157	4	16/06 4:12	16/06 4:46	14	13/07 17:32	13/07 17:47							
1166	154	21	16/06 4:09	16/06 6:00										
1170	154	3	16/06 5:00	16/06 5:04										

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1173	149	5	16/06 4:17	16/06 4:23										
1174	157				353	20/06 1:22	21/06 15:12							
1177	155				148	20/06 1:06	09/07 5:40							
1178	158				1	19/06 21:36	19/06 21:36							
1179	155				102	23/06 4:51	14/07 14:10							
1180	153	5	16/06 4:53	16/06 5:36										
1183	155				3	14/07 14:12	14/07 14:15							
1184	150				260	28/06 12:18	29/06 3:30							
1185	152	6	16/06 5:27	16/06 5:37										
1187	150	7	16/06 4:08	16/06 6:07	201	20/06 21:15	23/06 14:35							
1188	155				114	24/06 4:06	27/06 12:58							
1191	157	4	16/06 4:15	16/06 4:18										
1193	168	1	16/06 4:03	16/06 4:03										
1194	150	7	16/06 3:57	16/06 4:58										
1195	149	2	16/06 4:22	16/06 4:24	88	20/06 23:09	22/06 15:41							
1197	168	6	16/06 4:45	16/06 5:21				422	24/08 22:16	15/09 17:53				
1198	153				27	20/06 20:31	20/06 23:11							
1199	157				251	19/06 21:15	22/06 12:31							
1200	152													
1202	156				1	21/06 17:09	21/06 17:09							
1204	147													
1205	153													
1206	143													
1207	158													
1208	163	12	06/06 9:35	06/06 10:49										
1209	149	11	07/06 8:08	07/06 9:28										
1210	151													
1211	159													
1213	146	5	06/06 14:26	06/06 14:32	167	12/06 13:00	12/07 21:12							
1215	156				36	09/06 21:43	09/06 22:31	18	10/07 22:12	12/07 13:26				
1216	153													
1218	155	10	04/06 16:46	04/06 18:02										
1219	160													
1220	150													
1222	150	12	05/06 16:25	05/06 17:05										
1223	149	14	05/06 12:32	05/06 13:55										
1224	155													
1227	152													
1228	155	3	07/06 4:52	07/06 4:54										
1229	158	6	07/06 14:07	07/06 14:14	17	11/06 23:25	12/06 0:11							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1230	149													
1231	151	4	09/06 23:25	09/06 23:27										
1232	151													
1234	146	2	05/06 23:24	05/06 23:26	1	10/06 3:40	10/06 3:40							
1236	155													
1237	152	4	05/06 13:17	05/06 13:40	64	12/06 11:41	12/06 12:52							
1238	153	2	06/06 6:17	06/06 6:19										
1239	154	6	06/06 7:07	06/06 7:50										
1243	152				15	12/06 23:38	13/06 0:02							
1248	155													
1249	158													
1250	150													
1251	153	11	07/06 10:57	07/06 11:23	63	11/06 4:18	06/07 18:35							
1255	161	3	06/06 11:19	06/06 11:25	41	09/06 18:59	04/07 16:35							
1256	161	4	04/06 15:07	04/06 15:10										
1257	151													
1258	162	2	05/06 18:03	05/06 18:04	18	14/06 0:48	14/06 1:12							
1260	152	11	05/06 10:09	05/06 10:31										
1262	155													
1263	144													
1264	151	7	05/06 13:16	05/06 13:28										
1266	152													
1267	154	7	07/06 7:56	07/06 8:07										
1270	165													
1271	150													
1272	148													
1273	151	5	09/06 0:33	09/06 0:37										
1274	153													
1275	154	3	05/06 19:16	05/06 19:49	9	13/06 16:53	13/06 17:09							
1276	148													
1277	150	5	06/06 2:44	06/06 3:01	97	13/06 16:55	10/07 15:54							
1278	157													
1281	150													
1284	157													
1285	155	18	06/06 16:40	06/06 17:21	124	13/06 17:25	27/06 22:52							
1287	158													
1288	152	10	05/06 5:30	05/06 5:54										
1289	157	3	05/06 0:36	05/06 0:55										
1290	167													
1294	153													

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1298	159													
1299	166													
1301	160													
1303	151													
1304	157	3	12/06 20:57	12/06 21:00										
1305	155	6	13/06 8:01	13/06 8:07	31	16/06 19:28	16/06 19:56							
1306	153													
1307	158	5	11/06 3:01	11/06 3:11										
1308	155	1	11/06 1:25	11/06 1:25	39	14/06 7:47	28/06 2:13							
1310	160				1	14/06 21:08	14/06 21:08							
1312	145	4	11/06 9:43	11/06 9:46	4	14/06 7:26	14/06 7:30							
1313	153													
1315	146	3	11/06 5:43	11/06 5:46	19	15/06 1:55	15/06 3:21							
1317	151	1	11/06 17:32	11/06 17:32	32	15/06 10:08	15/06 10:38							
1318	157	10	11/06 8:25	11/06 8:40										
1320	152													
1321	165													
1322	151													
1323	163													
1325	149	5	12/06 21:11	12/06 21:25	16	16/06 1:27	16/06 1:40							
1328	157													
1330	159	2	11/06 9:02	11/06 9:03										
1331	153	1	11/06 20:16	11/06 20:16	120	15/06 1:52	18/07 19:31							
1332	157	4	12/06 19:00	12/06 19:04	10	15/06 22:00	15/06 22:11							
1333	157	1	12/06 6:40	12/06 6:40										
1334	152													
1336	149	5	11/06 8:31	11/06 8:46	8	15/06 0:55	15/06 1:02							
1337	149													
1338	151													
1339	151	3	11/06 22:10	11/06 22:36	2	15/06 1:48	15/06 1:49							
1340	154	4	11/06 14:19	11/06 15:19										
1341	167													
1342	153	1	11/06 6:20	11/06 6:20	6	14/06 8:52	14/06 8:56							
1344	154													
1346	150	13	12/06 12:37	12/06 13:54	185	16/06 12:34	01/07 8:14							
1348	158	8	12/06 1:03	12/06 1:27										
1350	147	5	12/06 0:18	12/06 0:30	11	15/06 11:09	15/06 11:20							
1352	162													
1353	161	15	12/06 8:55	12/06 9:20	17	15/06 7:31	15/06 7:50							
1355	157													

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
1357	151													
1358	150	3	11/06 15:08	11/06 15:15	3	15/06 4:57	15/06 5:00							
1359	153													
1360	153													
1362	149	1	11/06 16:48	11/06 16:48										
1365	158													
1366	157	17	11/06 9:25	11/06 10:36	2	14/06 4:36	14/06 4:38							
1367	156													
1368	157													
1421	155													
1422	157				419	15/06 5:03	02/07 14:58							
1424	158	9	11/06 14:17	11/06 15:04	7	14/06 5:32	14/06 5:38							
1425	153	11	12/06 19:15	12/06 20:23	357	15/06 22:59	30/06 12:33							
1427	146													
1428	158	3	11/06 11:23	11/06 11:35	308	14/06 10:51	02/07 20:51							
1429	152	1	13/06 2:06	13/06 2:06	3	16/06 1:08	16/06 1:14							
1430	148	1	11/06 19:55	11/06 19:55	16	14/06 18:17	27/06 0:14							
1431	151	4	11/06 16:42	11/06 16:51	1	15/06 1:17	15/06 1:17							
1432	151	1	11/06 13:19	11/06 13:19	145	15/06 2:59	02/08 13:33							
1433	152	13	11/06 22:49	12/06 6:54	30	15/06 9:39	22/06 2:20							
1434	156													
1435	152	5	14/06 10:21	14/06 10:24										
1436	156	6	11/06 13:30	11/06 17:14										
1438	155													
1439	148													
1440	155													
1441	154	3	12/06 0:13	12/06 0:17										
1442	156	6	11/06 7:15	11/06 7:27	2	14/06 7:31	14/06 7:33							
1443	145													
1444	151	3	13/06 5:58	13/06 6:01	5	16/06 5:06	16/06 5:13							
1445	152													
1446	147	2	13/06 14:06	13/06 14:09										
1448	157	2	11/06 16:35	11/06 16:47	78	03/08 7:07	16/08 14:14							
16455	144	1	23/05 1:05	23/05 1:05										
16456	140													
16457	142													
16460	155	7	15/05 18:06	15/05 18:16	24	25/05 14:43	22/06 14:28							
16463	160													
16464	140													
16465	184													

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16466	143													
16467	143	1	20/05 10:59	20/05 10:59	19	24/05 23:46	25/05 0:17							
16468	188	5	22/05 5:22	22/05 5:29	8	25/05 5:24	25/05 5:46							
16469	179	6	24/05 10:59	24/05 11:41										
16470	142													
16472	147													
16473	153													
16474	141	3	22/05 11:01	22/05 11:13	75	25/05 20:15	26/05 1:59							
16475	143													
16476	143	2	20/05 4:05	20/05 4:07	12	25/05 3:11	25/05 3:28							
16477	147	4	19/05 7:35	19/05 7:57										
16478	141	13	21/05 9:12	21/05 10:25										
16479	145													
16480	168	7	14/05 18:48	14/05 19:12										
16482	142													
16483	143	2	25/05 21:07	25/05 21:08										
16484	147													
16485	148													
16487	142													
16488	151	6	21/05 6:19	21/05 6:35	5	25/05 17:52	25/05 18:12							
16489	148													
16490	142	2	17/05 2:19	17/05 2:30										
16491	147				2	26/05 7:10	26/05 7:11							
16492	142	1	23/05 22:52	23/05 22:52	11	26/05 12:24	26/05 12:39							
16493	146													
16494	142													
16495	185													
16496	153	11	07/05 5:42	07/05 6:06										
16497	145	1	14/05 2:11	14/05 2:11										
16499	149	3	17/05 12:13	17/05 12:16										
16500	147				25	28/05 1:08	28/05 1:37							
16501	142													
16502	148	3	24/05 23:15	24/05 23:31	6	27/05 13:36	01/07 12:18							
16508	140	47	10/05 2:51	10/05 4:48										
16509	145													
16510	143				138	04/06 2:01	20/06 20:04							
16512	140													
16515	146	2	25/05 8:42	25/05 8:56										
16516	147													
16517	146	4	11/05 11:40	11/05 11:48										

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16518	145													
16519	147													
16520	140													
16522	146	1	23/05 11:06	23/05 11:06	11	27/05 18:10	27/05 18:28							
16523	145	1	17/05 17:17	17/05 17:17										
16524	142													
16527	142													
16528	148													
16529	140													
16530	143	26	16/05 5:25	16/05 6:42										
16531	144													
16532	145													
16533	146													
16534	142													
16535	142													
16536	142				25	26/05 13:25	26/05 14:12							
16537	144				29	08/06 19:38	08/06 20:24							
16538	143	3	01/06 16:59	01/06 17:20										
16539	145													
16540	147	1	24/05 2:32	24/05 2:32	12	27/05 13:35	27/05 14:13							
16541	143	1	25/05 11:49	25/05 11:49	6	04/06 14:12	08/06 9:40							
16542	141													
16546	142													
16547	142													
16548	148	68	15/05 4:54	16/05 11:30										
16549	146	1	26/05 11:10	26/05 11:10	9	04/06 3:10	04/06 3:33							
16550	147													
16551	145													
16553	145													
16554	141	2	26/05 8:49	26/05 8:50										
16555	151													
16556	143	4	21/05 22:51	21/05 23:26										
16557	140	6	24/05 11:06	24/05 11:13	433	26/05 22:59	03/06 15:49							
16558	141													
16559	141	3	25/05 5:49	25/05 5:52	1	28/05 7:06	28/05 7:06							
16560	146				6	25/05 7:33	25/05 8:01							
16561	147	15	23/05 7:45	23/05 8:31										
16562	148				2	25/05 5:11	25/05 5:12							
16563	143													
16564	192	3	18/05 20:27	18/05 20:41	26	22/05 14:27	22/05 14:59							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16566	148				11	27/05 2:41	27/05 2:59							
16569	142													
16572	153													
16578	160													
16580	147													
16581	146	68	19/05 5:11	19/05 7:20	19	25/05 10:25	25/05 10:52							
16582	142													
16583	141													
16584	155													
16585	144													
16586	145													
16587	150													
16588	144	10	25/05 11:29	25/05 11:38										
16590	145													
16591	145	18	24/05 8:49	24/05 9:21										
16592	142													
16593	154	1	29/05 1:20	29/05 1:20	17	09/06 1:23	09/06 1:42							
16594	145	1	24/05 6:25	24/05 6:25										
16597	140													
16598	142	2	22/05 4:46	22/05 4:47	11	25/05 8:13	25/05 8:27							
16600	142													
16601	142													
16602	140				14	03/06 6:30	03/06 8:31							
16603	145													
16605	143	1	23/05 2:30	23/05 2:30	10	26/05 5:16	26/05 5:26							
16606	146													
16608	149													
16609	140	2	24/05 12:57	24/05 12:58										
16610	145	11	15/05 4:52	15/05 5:42										
16611	141	2	22/05 17:43	22/05 17:45	7	25/05 18:21	25/05 18:29							
16613	142													
16614	145	7	23/05 7:52	23/05 7:58										
16615	142							19	02/07 17:35	02/07 18:12				
16616	142													
16619	143													
16620	140	1	28/05 1:25	28/05 1:25										
16621	140	2	24/05 6:08	24/05 6:09										
16622	140													
16623	142													
16625	140	1	26/05 1:49	26/05 1:49										

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16626	143	6	24/05 4:25	24/05 4:48	29	27/05 13:32	27/05 14:07							
16627	148	1	27/05 4:42	27/05 4:42										
16628	143													
16629	146													
16630	145	1	25/05 8:22	25/05 8:22										
16631	140				3	25/05 6:41	25/05 6:45							
16632	141	1	21/05 4:03	21/05 4:03										
16633	144													
16635	147	4	23/05 7:57	23/05 8:01	8	26/05 8:24	26/05 8:34							
16636	143	6	15/05 4:58	15/05 5:44	37	22/05 21:33	22/05 22:56							
16640	146	11	15/05 4:59	15/05 5:43										
16641	144													
16642	144				37	25/05 19:00	26/05 1:16							
16643	147	7	19/05 5:20	19/05 5:45										
16644	142													
16645	147													
16646	145													
16647	147				10	26/05 4:13	26/05 4:25							
16648	147													
16649	148	1	25/05 22:26	25/05 22:26										
16650	141													
16651	145	8	19/05 4:21	19/05 4:29										
16653	141	1	22/05 0:03	22/05 0:03										
16654	141				1	28/05 1:27	28/05 1:27							
16656	151				16	12/06 9:06	12/06 9:24							
16658	142	1	08/06 5:50	08/06 5:50	55	13/06 19:06	21/06 23:11							
16659	155	1	08/06 6:05	08/06 6:05										
16661	160	1	08/06 5:58	08/06 5:58	5	11/06 12:23	11/06 12:30							
16662	148				9	13/06 4:42	13/06 4:50	9	08/07 22:58	08/07 23:28				
16665	164				3	13/06 8:51	13/06 9:03							
16666	147				2	12/06 14:28	12/06 14:35							
16668	156	3	08/06 6:19	08/06 6:38										
16669	150	1	08/06 6:11	08/06 6:11	17	13/06 14:52	14/06 8:15							
16670	155	6	08/06 6:17	08/06 6:30	8	13/06 5:28	13/06 5:50							
16672	145				7	14/06 3:59	14/06 4:07							
16673	155	1	08/06 5:46	08/06 5:46	14	13/06 20:11	13/06 20:25							
16674	156	2	08/06 5:49	08/06 6:02										
16675	154				2	11/06 14:10	11/06 14:25							
16677	152	6	08/06 6:33	08/06 8:26	6	13/06 9:25	13/06 9:34							
16679	155				5	11/06 14:32	11/06 14:37							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16680	157				25	11/06 14:35	11/06 15:09							
16683	152				43	11/06 11:26	25/06 9:41							
16684	158				51	11/06 17:14	11/06 20:44							
16686	142				8	14/06 8:16	14/06 8:23							
16689	158							8	27/07 4:01	27/07 4:11				
16690	149	1	08/06 6:03	08/06 6:03	58	14/06 1:13	14/06 3:07							
16691	161	1	08/06 5:39	08/06 5:39										
16692	157				5	11/06 8:49	11/06 8:53							
16695	157	2	08/06 5:43	08/06 6:08	9	13/06 11:22	13/06 11:34							
16696	164	6	08/06 6:12	08/06 6:20	16	13/06 9:27	13/06 9:44							
16698	162				7	12/06 17:36	12/06 17:45							
16699	153				28	12/06 4:18	12/06 4:49							
16700	154	1	08/06 5:45	08/06 5:45	11	13/06 0:39	13/06 1:20							
16701	152				18	11/06 13:55	11/06 14:14							
16702	155	2	08/06 5:43	08/06 6:17										
16703	165				6	13/06 0:25	13/06 0:38	23	09/07 19:46	09/07 20:12				
16704	160	1	08/06 6:12	08/06 6:12	23	13/06 19:07	13/06 19:38							
16705	155				26	21/06 22:12	21/06 23:19							
16706	154	2	16/06 4:21	16/06 4:22										
16707	155				209	21/06 0:04	24/06 20:14							
16708	155				6	13/07 17:09	13/07 17:17							
16709	165	3	16/06 4:00	16/06 4:37										
16713	166	2	16/06 3:57	16/06 5:10										
16714	164	9	16/06 3:58	16/06 4:41										
16715	155				106	19/06 18:57	14/07 3:43							
16718	162				140	20/06 13:19	15/07 16:20							
16719	166	4	16/06 4:44	16/06 5:02										
16727	157				221	19/06 21:10	29/06 3:09							
16729	150	1	16/06 4:08	16/06 4:08										
16731	150	2	16/06 4:29	16/06 5:00	16	20/06 22:58	20/06 23:20							
16732	152	7	16/06 4:28	16/06 4:39										
16733	150	1	16/06 4:14	16/06 4:14										
16738	157				42	21/06 4:33	21/06 11:27							
16740	157				307	23/06 2:42	24/06 18:53							
16741	160	2	16/06 5:27	16/06 5:47										
16745	141	4	16/06 4:57	16/06 5:29										
16746	160				10	29/06 7:06	29/06 7:21							
16751	158				168	20/06 0:15	21/06 14:41							
16753	158	4	16/06 4:40	16/06 5:02	35	19/06 20:32	20/06 9:58							
16754	148				18	19/06 20:45	19/06 21:06							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16755	152	1	04/06 19:18	04/06 19:18										
16756	148	1	06/06 23:19	06/06 23:19										
16757	149	1	05/06 4:44	05/06 4:44										
16758	160													
16759	155	14	05/06 7:53	05/06 9:50										
16760	156													
16763	147													
16765	152	20	06/06 7:45	06/06 8:16										
16766	152	1	05/06 6:16	05/06 6:16										
16767	158	2	07/06 2:50	07/06 2:52										
16768	152													
16769	150													
16770	156													
16775	148													
16776	155													
16781	156													
16782	149	9	05/06 8:41	05/06 9:06										
16783	170	10	06/06 3:11	06/06 4:05										
16784	159													
16786	154													
16787	158													
16789	154													
16794	173													
16796	145													
16797	149													
16798	143	6	06/06 2:50	06/06 2:55										
16800	155													
16801	164	29	05/06 6:26	05/06 9:37	20	13/06 12:43	13/06 13:09							
16802	151													
16803	150	6	06/06 0:36	06/06 0:55										
16805	159	13	06/06 6:37	06/06 6:56										
16806	154													
16808	156	20	05/06 13:48	05/06 18:27	14	13/06 12:20	13/06 12:37							
16810	152													
16811	156													
16812	156													
16813	164	2	05/06 1:29	05/06 1:30	36	11/06 15:50	11/06 16:45	129	14/07 23:48	21/07 1:53				
16815	166													
16816	146	3	05/06 19:45	05/06 20:31	1	10/06 21:05	10/06 21:05							
16817	152	4	07/06 15:05	07/06 15:10	61	12/06 12:11	12/06 13:28							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16818	167													
16821	154	9	05/06 14:57	05/06 15:16										
16822	153										7	09/09 21:50	21/09 14:43	SSOG
16823	151	5	06/06 13:47	06/06 13:58										
16824	153													
16826	173													
16827	146													
16829	154													
16831	157													
16832	151													
16834	151													
16837	155													
16839	164													
16840	162	2	07/06 9:41	07/06 9:46										
16843	143													
16845	150													
16846	161													
16847	154	7	05/06 7:27	05/06 7:47										
16848	170	2	06/06 2:53	06/06 2:55										
16849	161													
16850	162													
16851	152	2	08/06 10:31	08/06 10:34	85	12/06 16:18	02/07 11:35							
16854	158													
16855	156				4	15/06 2:37	15/06 2:47							
16856	152				191	17/06 15:40	24/06 1:57							
16859	157	8	11/06 3:56	11/06 4:32	8	13/06 23:14	13/06 23:22							
16861	157	12	11/06 8:02	11/06 9:22	8	15/06 4:47	15/06 4:56							
16862	156	1	11/06 7:21	11/06 7:21										
16863	158													
16865	153													
16867	159	4	12/06 11:05	12/06 11:37	1	16/06 1:18	16/06 1:18							
16869	150	1	13/06 17:57	13/06 17:57										
16870	152	9	13/06 9:53	13/06 10:13	176	17/06 23:07	21/06 10:21							
16871	144													
16872	149													
16874	150	10	11/06 22:29	12/06 0:43	10	15/06 21:58	15/06 22:07							
16875	160	2	11/06 6:49	11/06 7:05	53	14/06 13:20	14/06 14:32							
16877	155													
16878	147	13	12/06 3:32	12/06 4:50										
16879	154	6	11/06 19:19	11/06 19:44	9	15/06 18:11	15/06 18:21							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16880	157				43	19/06 7:06	20/06 0:58							
16881	150	2	11/06 22:22	11/06 22:23	224	16/06 2:42	28/09 10:08							
16883	147	3	11/06 6:49	11/06 7:02										
16884	152													
16885	152													
16886	153	6	14/06 18:05	14/06 18:10	7	18/06 21:32	18/06 21:39							
16887	153	13	11/06 21:52	12/06 0:46										
16889	151													
16890	147	4	12/06 9:26	12/06 9:30	1	16/06 1:57	16/06 1:57							
16892	162													
16893	154	1	11/06 17:21	11/06 17:21	9	14/06 12:10	14/06 12:18							
16895	151	1	12/06 18:36	12/06 18:36	5	16/06 2:29	16/06 2:34							
16898	153	1	11/06 13:35	11/06 13:35	37	14/06 22:07	08/07 2:56							
16899	159													
16900	161	1	11/06 14:32	11/06 14:32										
16901	160													
16902	166				2	14/06 13:05	14/06 13:06							
16903	157													
16904	152	9	12/06 5:42	12/06 6:07	33	15/06 20:54	15/06 21:54							
16905	164	4	11/06 3:01	11/06 3:05										
16906	159													
16907	155													
16908	160													
16909	156	2	11/06 9:46	11/06 9:47										
16911	158	9	13/06 10:54	13/06 11:51										
16912	155				111	16/06 11:24	17/08 13:26							
16916	156													
16918	148	3	11/06 7:04	11/06 7:12	1	29/06 9:15	29/06 9:15							
16919	159				72	13/06 21:23	14/06 0:08							
16920	150	4	11/06 5:24	11/06 5:49										
16921	155	5	12/06 7:00	12/06 7:05	3	15/06 8:26	15/06 8:30							
16923	144													
16924	153	4	11/06 7:38	11/06 7:45	1	14/06 21:10	14/06 21:10							
16925	152													
16926	154	12	12/06 6:09	12/06 6:47	10	16/06 16:37	16/06 16:50							
16927	153													
16928	149	2	11/06 17:09	11/06 17:10										
16929	147													
16931	154	3	11/06 13:07	11/06 13:08	81	15/06 2:49	15/06 4:14							
16932	168	15	11/06 18:59	11/06 19:54	199	16/06 15:26	02/07 14:13							

		Bonneville Dam			Willapa			Lippy			Keogh_River/Southern Stait of Georgia			
			Date Detected			Date Detected			Date Detected			Date Detected		
Tag ID code	Fork Length	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	No. Detects	First	Last	Line
16933	156	1	11/06 20:54	11/06 20:54	14	14/06 20:07	14/06 20:33							
16934	153													
16935	157													
16936	161													
16938	149													
16939	156	9	12/06 1:40	12/06 2:00	2	14/06 13:56	23/07 10:55							
16940	156													
16941	155	1	11/06 19:55	11/06 19:55	8	15/06 7:53	15/06 8:01							
16944	160													
16945	150													
16946	155	5	11/06 16:03	11/06 16:08	18	15/06 16:39	15/06 19:41							
16947	162	5	12/06 10:58	12/06 11:30	63	15/06 18:57	15/06 20:36							
16949	158													
16950	162													
16951	151													
16953	148													
16954	147				31	17/06 20:08	21/06 14:18							