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MEMORANDUM

TO: Fish Passage Advisory Committee

FROM: Michele DeHart

DATE: May 19, 2014

RE: 2014 Review of the Smolt Monitoring Program

Overview of the Smolt Monitoring Program

The purpose of this document is to describe the Smolt Monitoring Program (SMP), the data generated for this program, and impacts of potential modifications to sampling protocols at SMP bypass facilities. The SMP is a joint agency and tribal program with oversight by the Fish Passage Advisory Committee (FPAC). Sampling under the SMP is conducted by six different agencies and/or tribes throughout the basin. There are four primary goals of the SMP: (1) to provide real-time data on juvenile salmonid and lamprey migration to support in-season fisheries management decisions, (2) to provide a long-term time series of consistently collected data that allows for comparison of the impacts of changing river conditions among years, particularly with respect to juvenile fish survival, (3) implement the Gas Bubble Trauma Monitoring Program, a requirement of the State water quality waivers for biological monitoring, and (4) implement eleven Reasonable and Prudent Alternatives (RPAs) from the Biological Opinion. Specifically, these RPAs include:

- RPA 50.3 – Monitor juvenile fish migrations at mainstem hydro dams
- RPA 50.7 – Fund marking of hatchery releases from Action Agency funded facilities
- RPA 52.1 – Monitor/evaluate juvenile salmonid survival rates
- RPA 52.4 – Provide additional PIT-tag marking of UCR populations
- RPA 53.1 – Monitor/estimate abundance of smolts passing index dams
- RPA 53.2 – Monitor/describe migration timing of smolts at index dams
- RPA 53.3 – Monitor/document condition of smolts at dams with JBS systems
- RPA 54.5 – Evaluate overall dam passage for modifications at projects

- RPA 54.7 – Evaluate environmental condition impact on juvenile fish survival
- RPA 55.2 – Analyze post-BON mortality due to arrival timing/transport
- RPA 55.4 – Investigate key characteristics of SR fall Chinook early life history

To achieve these goals, there are three components of the SMP: (1) PIT-tag marking at hatcheries, (2) PIT-tag marking and monitoring at Snake River Basin traps and Rock Island Dam, and (3) fish sampling at bypass facilities at Lower Snake River, Upper Columbia, and Lower Columbia River dams. Below is an overview of the three components of the SMP that are used to achieve the primary goals of the SMP and to inform/contribute to the above listed RPAs.

PIT-Tag Marking

Throughout the basin, juvenile salmonids are PIT-tagged by various agencies and tribes for various reasons. These marking efforts are generally carried out at hatcheries, traps, and mainstem projects. In addition to the marking efforts of other projects, the SMP provides PIT-tagging where extra coverage is needed. Tag groups specific to the SMP include:

- Wells Hatchery subyearling Chinook (WDFW hatchery, marked by USFWS)
- Priest Rapids Hatchery subyearling Chinook (WDFW hatchery, marked by USFWS)
- Leavenworth NFH yearling Chinook (USFWS hatchery, marked by USFWS)
- Dworshak NFH steelhead (USFWS/NEZP hatchery, marked by USFWS).
- Imnaha River Trap (Nez Perce Tribe) – yearling Chinook and steelhead
- Grande Ronde River Trap (ODFW) – yearling Chinook and steelhead
- Salmon River Trap (IDFG) – yearling Chinook and steelhead
- Snake River Trap at Lewiston (IDFG) – yearling Chinook and steelhead
- Rock Island Dam (Chelan PUD) – yearling Chinook, steelhead, sockeye, subyearling Chinook

Upon the request of the Fisheries Managers or others, the Fish Passage Center (FPC) uses the PTAGIS database, an open database of PIT-tag records and observations, to conduct analyses relevant to the goals of the SMP and RPAs. These analyses require the use of PIT-tags from SMP and non-SMP tagging efforts. Examples of analyses conducted through the use of these PIT-tag data include: estimation of juvenile survivals, fish travel times, smolt-to-adult returns (SARs), etc.

Fish Sampling at Bypass Facilities – Data Collection and Data Uses

Currently, SMP sampling from bypass facilities occurs at six FCRPS projects and one Public Utility District (PUD) project. These bypass facilities include: Lower Granite Dam (WDFW/PSMFC), Little Goose Dam (ODFW), and Lower Monumental Dam (WDFW/PSMFC) in the Snake River, Rock Island Dam (Chelan PUD) in the Upper Columbia River, and McNary Dam (WDFW/PSMFC), John Day Dam (PSMFC), and Bonneville Dam (PSMFC) in the Lower Columbia River.

Although all bypass facilities collect the same data, sampling schedules, sampling frequency, etc., may differ between sites (see Appendix A for a site-by-site overview of the schedules and frequencies of each of the SMP bypass facilities). In general, data collected at

these bypass facilities include: (1) daily samples of target juvenile salmonids and lamprey, (2) descaling and mortality data collected on target species (no descaling for lamprey), (3) daily samples of incidental species, (4) weekly Gas Bubble Trauma (GBT) monitoring on Chinook and steelhead, and (5) daily condition monitoring on subsample (COE projects only).

Daily samples of target salmonids and juvenile lamprey are used by the Fisheries Managers to assess species composition and presence/absence to inform FCRPS in-season fisheries management decisions. In addition, descaling and mortality data are used by the COE, Chelan PUD, and the Fisheries Managers to assess impacts at the projects. GBT data are used by the Fisheries Managers and Action Agencies to assess the impacts of the voluntary spill program and are required as part of State water quality waivers for biological monitoring. Finally, the daily condition monitoring subsamples are used by the COE and Fisheries Managers to assess immediate impacts to fish health that may be attributed to the projects (e.g., injury rates). In addition, these condition data are used by the COE to estimate barge loading at transportation sites. The use of condition monitoring data to assess impacts from project operations is sensitive to both the duration and frequency of the condition sample. For more details on this, see the *Impacts of Limited Sampling* section of this memo.

The daily sample data are expanded to estimate the daily collection, which is an estimate of the number of fish that passed through the powerhouse bypass system. These collection estimates are used by COE for barge loading at transportation sites. Per the 2014 BiOp, estimates of daily collection will be used at LGR, LGS, and LMN to determine the termination date for summer spill and if/when summer spill is reinstated in August.

For salmonids, the daily collection estimates are also expanded to estimate the passage index, which is an estimate of the number of fish that passed the project, assuming a 1:1 ratio of proportion of fish passing through spill versus proportion of flow passing as spill. In season, the passage index is used by the Fisheries Managers to assess the magnitude of fish passage as well as how fish passage is trending and is often used when considering changes to FCRPS operations. The passage index is also used to estimate juvenile migration timing when the season has ended. Some SMP bypass facilities have been identified as "Index Sites." Historically, these Index Sites have included LGR, MCN, RIS, and BON. Being deemed an Index Site means that the Fisheries Managers have identified these sites to be of particular interest, particularly when it comes to historical passage index data that are often used to assess changes in operations over the years. Changes to the methods of data collection for these Index Sites may interfere with the use of historical data to assess operational changes and, therefore, may interfere with the ability of the SMP to aid in the accomplishment of RPAs 53.1 and 53.2.

The use of the passage index to assess daily operations is dependent on a full 24-hour sample, particularly since several species are passing at the same time. Furthermore, the use of the passage index to estimate passage timing is dependent on consistent and frequent sampling throughout the entire season. For more details on this, see the *Impacts of Limited Sampling* section of this memo.

At LGR, LGS, and LMN, the daily collection estimates are also expanded to estimate the population index, which is a real-time estimate of the daily population of juvenile salmonids passing the project. The daily population index is also used to assess juvenile passage timing.

Impacts of Limited Sampling

The ability of the SMP to accomplish its primary goals could be impacted by limited sampling at SMP sites. For this discussion, we divide limited sampling into two basic categories: (1) partial sampling (i.e., sampling that is limited to a few hours per day instead of a full 24-hour sample), and (2) infrequent sampling (i.e., sampling that occurs at a frequency less than every day). Currently, there are five sites where one (or both) of these categories of limited sampling routinely occur in a season. Below is an overview of how these categories of limited sampling may affect the ability of the SMP to meet its primary goals and inform/support associated RPAs.

Partial Sampling (Sampling Limited to a Few Hours per Day)

Partial sampling has the potential to impact the ability of Fisheries Managers to use SMP data for in-season management decisions, as the partial sample is representative only of what passed through the bypass during the limited period of the sample. For example, passage of salmonids through the bypass system is often diurnal, with larger proportions passing during early evening and nighttime hours than during daytime hours (see Figure 1 for an example). Therefore, condition data from a partial sample can be used only to assess what happened over the hours of the limited sample and not what may happen during the hours when sampling is not occurring.

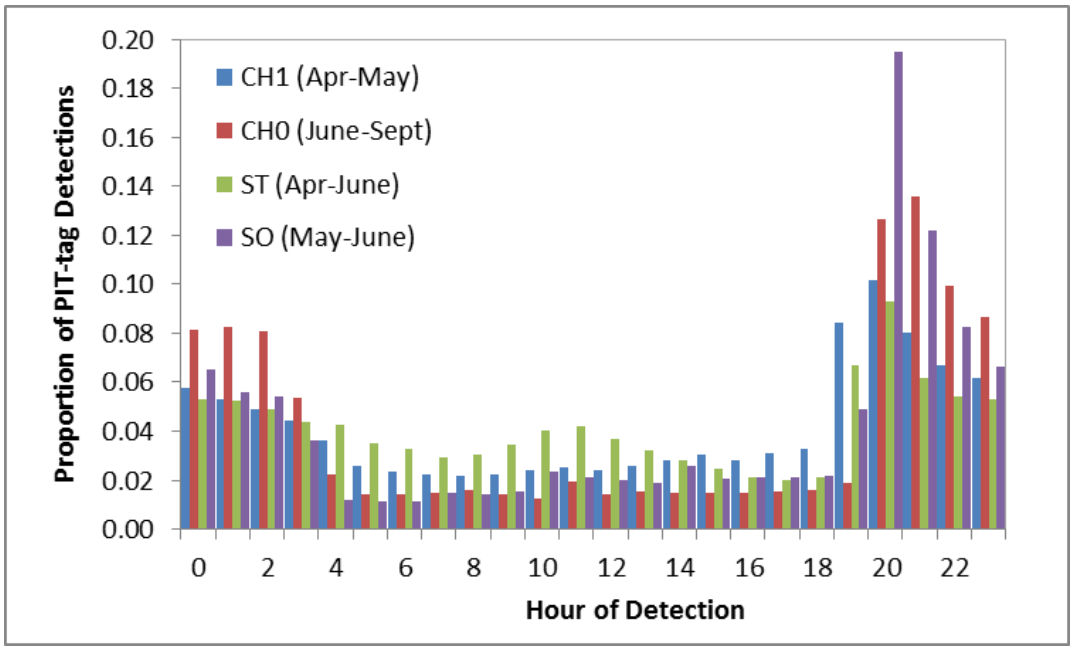

Figure 1. Hourly PIT-tag detections (expressed as a proportion) from the Lower Monumental Dam juvenile bypass system (2009–2013).

Issues with injuries, descaling, and/or mortality are often sudden and/or episodic and, therefore, when a sample is limited to only a few hours out of the day, episodes of injuries, descaling, and/or mortality may be missed altogether. It is also possible that a partial sample may lead to an overreaction to a perceived episode. For example, during the passage of the May 2014 release of subyearling fall Chinook tules from Spring Creek NFH, SMP personnel at BON provided updates on mortality and descaling as these juveniles passed the project. In their update on the afternoon of May 7th, SMP personnel provided an estimate of mortality for fish sampled during the period of 0700–1300, which was approximately 12.2%. However, mortality for the entire 24-hour period for this sample was 2.3%. If sampling at BON was limited to a partial sample from 0700–1300, Fisheries Managers may have been inclined to react to the perceived increase in mortality. Conversely, if sampling had occurred outside the 0700–1300 time frame (e.g., 1300–1900), the mortality event may have been underestimated or missed entirely.

Furthermore, some species seem to exhibit stronger diurnal passage than others. For example, over the past five years the vast majority (76%–84%) of PIT-tag detections for juvenile sockeye at the Snake River SMP bypass systems has occurred during the evening hours of 1900-0600 (Figure 2). As mentioned above, a partial sample is representative only of what passed through the bypass during the limited period of the sample. If the partial sample occurs during daytime hours, as is typical under current conditions, some species may be under-represented in the condition sample. This is particularly troublesome for sockeye because sockeye are known to be more sensitive to issues in the bypass systems and/or operational changes. For example, in recent years at BON, sockeye have exhibited high levels of descaling and/or mortality as a result of the turbines operating in the second powerhouse above the mid-range of the 1% operating range (SOR 2012-2, December 17, 2012, FPC memo). During much of this time, no other species showed signs of elevated descaling and/or mortality that otherwise would have alerted Fisheries Managers to this issue.

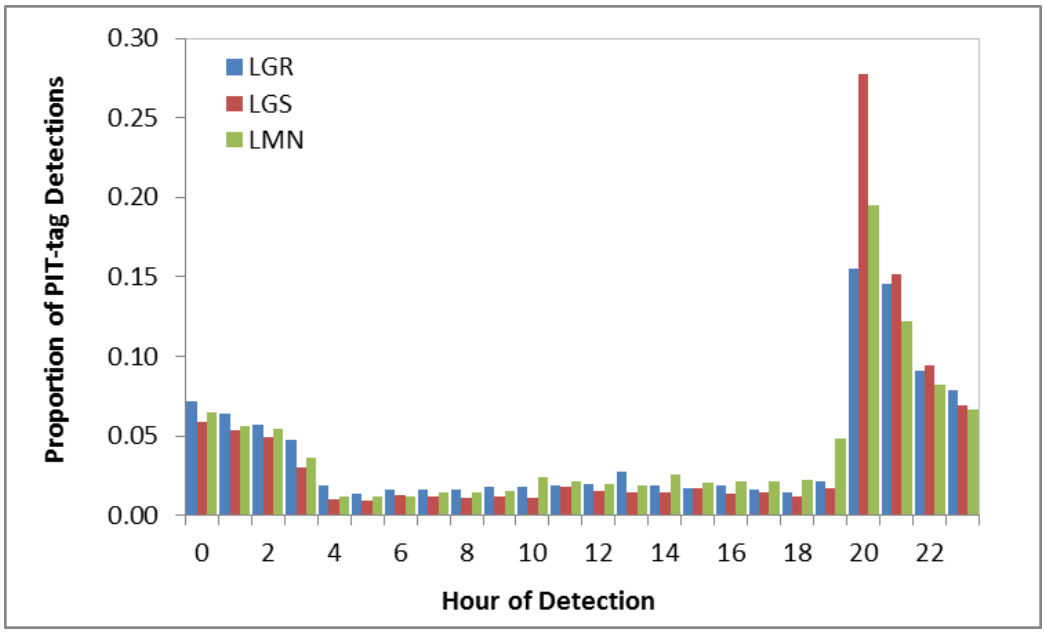

Figure 2. Hourly PIT-tag detections (expressed as a proportion) for juvenile sockeye in the juvenile bypass systems at Lower Granite Dam (LGR), Little Goose Dam (LGS), and Lower Monumental Dam (LMN) (2009–2013).

Finally, given that diurnal passage is present for most species at most sites, expansion of a partial sample to a passage index to assess magnitude of passage may be unreliable. For example, if the partial sample was conducted during the day, as is typically the case, the generally lower proportional passage will result in a passage index that will be biased low. Adjusting this passage index for the number of hours sampled would still result in a biased low estimate. Furthermore, given that some species exhibit higher degrees of diurnal passage than others, partial samples may not be reliable when assessing species composition as certain species may be underrepresented in the partial sample.

Infrequent Sampling (i.e., Sampling Less than Every Day)

Infrequent sampling also has the potential to impact the ability of Fisheries Managers to use SMP data for in-season management decisions and to adequately monitor the condition of juveniles passing through the juvenile bypass systems, as is mandated by RPA 53.3. As mentioned earlier, issues with injuries, descaling, and/or mortality are often sudden in their occurrence. Therefore, when sampling occurs less frequently than every day, episodes of injuries, descaling, and/or mortality may be missed until the next sample is taken. Under current sampling conditions, episodes of injury, descaling, and/or mortality may be missed for up to 5 days before another sample is conducted. In addition, infrequent samples leads to a loss of data that are needed in order to accurately assess trends in fish passage. An increase or decrease between two samples is difficult to interpret, particularly when several days may pass between samples.

Currently, five FCRPS projects undergo some level of limited sampling. These five sites are LGS, LMN, MCN, JDA, and BON. At LGS, sampling from April 1st until the start of transportation is limited to one 24-hour sample every 5 days. This infrequent sampling means that episodes of injuries, descaling, and/or mortality may be missed for up to 5 days. In addition, assessing trends in passage at LGS is not possible during this period of infrequent sampling. Finally, due to the infrequent sampling, estimating passage timing for spring migrants (primarily CH1 and ST) at LGS is not possible.

At LMN, sampling from April 1st until the start of transportation is both a partial sample (limited to 3–4 hours for condition and/or GBT fish only) and is infrequent (every 3–4 days). This means that, given diurnal passage, some species may be underrepresented in the condition sample. It is also possible that some episodes of injuries, descaling, and/or mortality may be missed for up to 4 days at LMN. Assessing trends in passage at LMN is not possible during this period of partial and infrequent sampling. Finally, due to the infrequent and partial sampling, estimating passage timing for spring migrants (primarily CH1 and ST) at LMN is not possible. An example of this limitation occurred prior to the 2014 out-migration season when the Fisheries Managers discussed proposed modifications to spill operations at LMN. The partial and infrequent sampling at LMN from recent years interfered with the Fisheries Managers abilities to use SMP data from this site to directly inform these discussions.

At MCN, sampling over the entire SMP season is limited to a 24-hour sample every-other-day. The every-other-day sampling means that episodes of injury, descaling, and/or mortality may be missed for up to one day. Currently, there are no limitations in using data from MCN to assess trends in passage or passage timing. However, if sampling becomes less frequent

the ability to use these data to assess trends in passage or passage timing for this Index Site may be limited.

At JDA, partial and infrequent sampling occurs in the summer as part of the high temperature sampling protocol developed by FPOM and outlined in the Fish Passage Plan (FPP). During this time, when/if temperatures in the sample tank exceed 70°F, sampling at JDA is modified to a 6-hour sample for condition only, typically on Tuesdays and Thursdays (2014 FPP, Appendix J). Underrepresentation of species during this period of partial sampling is unlikely, as passage in July–September is dominated by subyearling Chinook. However, the infrequent sampling during this period may cause some episodes of injuries, descaling, and/or mortality to be missed for up to 5 days. Assessing trends in passage at JDA during this time may not be possible during this period of partial and infrequent sampling. Finally, due to the infrequent and partial sampling, estimating passage timing for summer migrants (primarily CH0) at JDA is not possible.

At BON, infrequent sampling occurs in the summer as part of the high temperature sampling protocol developed by FPOM and outlined in the FPP. During periods of high temperatures (>70°F) sampling at BON is limited to a full 24-hour sample every-other-day. The every-other-day sampling means that episodes of injury, descaling, and/or mortality may be missed for up to one day. There are no limitations in using data from this period of infrequent sampling at BON to assess trends in passage or passage timing. However, if sampling were to become less frequent, the ability to use these data to assess trends in passage or passage timing for subyearling Chinook for this Index Site may be limited.

Conclusion and General Points for Discussion

RPA 53.3 calls for the monitoring and documentation of smolt condition at dams with JBS systems. SMP personnel at bypass facilities are the individuals on the project with the most immediate access to the data collected for the condition monitoring program as well as descaling and mortality data. In support of this RPA, SMP personnel provide real-time information to the COE biologists about any potential issues with fish passage at the projects, often before the data are ever sent to the FPC or made available to the Fisheries Managers. This enables COE biologists to remedy potential issues, sometimes before Fisheries Managers are even made aware of such issues. In order to realistically implement RPA 53.3 there needs to be adequate sampling to assure that an adverse fish passage event is not missed. Missed events would lead to an erroneous conclusion that there are no adverse effects of facility operations. Infrequent sampling could lead to such an error, as many days may pass between samples.

RPA 53.1 calls for the monitoring and estimation of abundance of smolts passing index dams. RPA 53.2 calls for the monitoring and description of migration timing of smolts at index dams. As described above, limited sampling at SMP bypass facilities may interfere with the accomplishment of these RPAs.

Below is a list of questions/points of discussion that the FPAC should consider when assessing whether the data provided by the SMP are adequate in fulfilling its primary goals and accomplishing its associated RPAs.

- Are the needs of the Fisheries Managers being met by the current levels of limited sampling at LMN, LGS, MCN, JDA, and BON?
- Is the present limited condition sampling schedule at some SMP sites adequate to accomplish the goals of RPA 53.3, given that there is some probability that adverse events may be missed. What is an acceptable number of days of potentially missed episodes of injury, descaling, and/or mortality?
- Are LGR, MCN, RIS, and BON still considered Index Sites by the Fisheries Managers? The Fisheries Managers may lose the ability to use MCN as an Index Site if the proposed changes for this site are implemented.

Appendix A

Site by site overview of Smolt Monitoring Program bypass facilities

Site	When	Data Collected	Other Considerations
Lower Granite Dam (LGR) Personnel: PSMFC Oversight: WDFW/PSMFC Separator Monitoring: COE	• 3/26-10/31 (24-hour sample, every day)	• Daily samples of target salmonids and lamprey • Daily descaling and mortality • Daily sample of incidentals • Daily condition monitoring subsample (salmonids only) • Once-per-week GBT sample (CH and ST)	• Collection estimates used for barge loading and determining summer spill termination date • LGR considered "Index Site" – passage index used by FPC to estimate migration timing as part of long-term dataset to evaluate changes in project operations • Passage index data used by CSS for SAR estimation • Daily collections used to generate population index • SMP personnel often asked to collect additional fish for research purposes
Little Goose Dam (LGS) Personnel: ODFW Oversight: ODFW Separator Monitoring: COE	• 4/1 to Transport (one 24-hour sample every 5 days) • Transport to10/31 (24-hour sample, every day)	• Daily samples of target salmonids and lamprey • Daily descaling and mortality • Daily sample of incidentals • Daily condition monitoring subsample (salmonids only) • Once-per-week GBT sample (CH and ST)	• Collection estimates used for barge loading and determining summer spill termination date • Daily collections used to generate population index • Currently no way of assessing magnitude of passage in April or overall timing of spring migrants, due to limited sampling from April 1 to start of transportation • Infrequent sampling from April 1to start of transportation may affect ability to assess impacts at project

Site	When	Data Collected	Other Considerations
Lower Monumental Dam (LMN) Personnel: PSMFC Oversight: WDFW/PSMFC Separator Monitoring: COE	• 4/1 to Transport (3 to 4-hour sample every 3-4 days) • Trans. to 10/1 (24-hour sample, every day)	• Daily samples of target salmonids and lamprey • Daily descaling and mortality • Daily sample of incidentals • Daily condition monitoring subsample (salmonids only) • Once-per-week GBT sample (CH and ST)	• Collection estimates used for barge loading and determining summer spill termination date • Daily collections used to generate population index • Currently no way of assessing magnitude of passage in April or overall timing of spring migrants, due to limited sampling from April 1 to start of transportation • Infrequent sampling and short duration from April 1to start of transportation may affect ability to assess impacts at project or to particular species • SMP personnel often asked to collect additional fish for research purposes (e.g., performance standards testing)
McNary Dam (MCN) Personnel: PSMFC Oversight: WDFW/PSMFC Separator Monitoring: COE	• 4/6-10/1 (24-hour sample, every-other-day)	• Every-other-day samples of target salmonids and lamprey • Every-other-day descaling and mortality • Every-other-day sample of incidentals • Every-other-day condition monitoring subsample (salmonids and lamprey) • Twice-per-week GBT sample (CH and ST)	• MCN considered “Index Site” – passage index used by FPC to estimate migration timing as part of long-term data set to evaluate changes in project operations • One of only three SMP sites that collects condition data on larval and juvenile lamprey
John Day Dam (JDA) Personnel: PSMFC Oversight: PSMFC Separator Monitoring: COE	• 4/1-9/15 (24-hour sample, every day) • High Temps – 6-hour sample, twice per week	• Daily samples of target salmonids and lamprey • Daily descaling and mortality • Daily sample of incidentals • Daily condition monitoring subsample (salmonids and lamprey)	• One of only three SMP sites that collects condition data on larval and juvenile lamprey • Ability to estimate migration timing of summer migrants may be limited due to high temperature sampling protocol (i.e., limited sampling) • SMP personnel often asked to collect additional fish for research purposes (e.g., performance standards testing)

Site	When	Data Collected	Other Considerations
Bonneville Dam (BON) Personnel: PSMFC Oversight: PSMFC Separator Monitoring: PSMFC	• 4/1-10/31 (24-hour sample, every day) • High Temps – 24-hour sample, every-other-day	• Daily samples of target salmonids and lamprey • Daily descaling and mortality • Daily sample of incidentals • Daily condition monitoring subsample (salmonids and lamprey) • Twice-per-week GBT sample (CH and ST)	• BON considered "Index Site" – passage index used by FPC to estimate migration timing as part of long-term data set to evaluate changes in project operations • One of only three SMP sites that collects condition data on larval and juvenile lamprey • Last location to observe fish before leaving FCRPS
Rock Island Dam (RIS) Personnel: Chelan PUD Oversight: Chelan PUD Separator Monitoring: N/A	• 4/1-8/31 (24-hour sample, every day)	• Daily samples of target salmonids and lamprey • Daily descaling and mortality • Daily sample of incidentals • Twice-per-week GBT sample (CH and ST)	• RIS considered "Index Site" – passage index used by FPC to estimate migration timing as part of long-term dataset to evaluate changes in project operations • Currently only site in Upper Columbia River where fish collected for monitoring program