Fast Track FCRPS BiOp Project Review

Section 10. Narrative

This last section of your project form is for text responses, explanations, and justifications that support the previous nine sections of the online form.

To complete and return the Narrative Form (Section 10):

1. See the Narrative Instructions document (bullet #3 of online form Section 10)
2. Provide as much detail as you need in the spaces marked "(Replace this text with your response in paragraph form)." Although there is no limit to the number of pages for the narrative section, most projects can provide sufficient detail to adequately cover items A-G in 10 pages, complex projects in no more than 25 pages.
3. You can insert tables, graphics, or maps into this document.
4. This document will be viewed on the Internet. If you refer to online documents, include web addresses and use Word's hyperlink tool to make those addresses active links in the document.
5. Use Word's spell-check tool before submitting this document.
6. Upload your completed narrative using Section 10 of the online form.

PROJECT TITLE:
Chinook Salmon Adult Abundance Monitoring (Includes Fast Track Joseph Creek Steelhead Escapement Monitoring project)

A. Abstract

This project proposes to continue natural origin (wild) adult chinook salmon abundance and productivity monitoring in the Secesh River to provide an accurate long-term data set for examination of trends and for recovery metric monitoring. The Secesh River is an unsupplemented stream, in the South Fork Salmon River drainage in Idaho, which acts as a reference stream for supplementation program comparison. It is the only stream in the Snake River basin where monitoring of natural origin salmon escapement occurs absent a hatchery supplementation. Salmon escapement monitoring will be accomplished using dual frequency identification sonar (DIDSON). This project implements the Salmon River Subbasin Plan (Ecovista 2004) by providing abundance and productivity data on natural origin salmon populations. The project also implements reasonable and prudent alternative (RPA) 50.6, 51.1, 62.5, 63.1, and 64.2 in the 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (NOAA Fisheries 2008) for research, monitoring and evaluation activities.

This project also includes the fast track Joseph Creek steelhead escapement monitoring project. The proposed project seeks to provide status monitoring of natural origin adult steelhead in Joseph Creek in the lower Grande Ronde River in Washington. This project may use a floating weir to collect escapement data, determine hatchery:natural composition, age structure, progeny-to-parent productivity data, and validate/correlate index redd survey data to actual escapement via regression analysis. Implementation of this project meets the Grande Ronde Subbasin Plan (Cat Tracks Wildlife Consulting 2004) objectives of describing status and trends in adult abundance and productivity for all focal populations. Further, project implementation meets the reasonable and prudent alternative (RPA) 50.6 of the 2008 FCRPS Biological Opinion.

Both projects will provide population status and trend monitoring of natural origin fish which will be used for effective population management, assessing effectiveness of conservation actions, viability, and recovery metric monitoring. Projects would be conducted by the Nez Perce Tribe Department of Fisheries Resources Management.

B. Problem statement: technical and/or scientific background

To place the following sections into context, the decline in Chinook salmon and steelhead populations in the Snake River basin necessitated listing of chinook salmon as threatened under the Endangered Species Act in 1992 (NMFS 1992) and steelhead in 1997. This project proposal addresses collection of natural origin adult salmon escapement and productivity data in a reference stream, the Secesh River. It also includes a proposal to collect natural origin adult steelhead escapement information in Joseph Creek. Information in this section will address the identified problems/limiting factors related to fish in the subbasin, the need to address the problem, and the associated technical background.

Identified Problems:

The Salmon Subbasin Management Plan (Ecovista 2004) identified three biological problem statements that is relevant to this project. The first problem statement was that out-of-basin factors limit adult returns (as measured by SAR) in the Salmon River subbasin. The limiting factor was out-of-subbasin effects which included ocean and estuarine conditions, hydropower impacts on fish passage and water quality, mainstem hydroelectric corridor water quality and quantity conditions, and downriver and ocean fisheries which limited recruitment of anadromous salmonid spawners to the Salmon River subbasin. The second biological problem statement was that small population size of anadromous and resident species leads to an increased risk of extinction. The identified limiting factor was increased extinction risk at low population. The third biological problem statement states that integral to the above statements, the lack of information (data gaps) precludes effective management of aquatic focal species.

The Grande Ronde Subbasin Plan (Cat Tracks Wildlife Consulting 2004) identified anadromous focal species are limited primarily by out-of-subbasin factors such as hydropower development, ocean productivity, predation and harvest. Effects manifested themselves in terms of lowered adult escapement and smolt-to-adult return rates to subbasin streams. Ecosystem Diagnosis and Treatment (EDT) modeling was used to identify that stream temperature and sediment were thought to be limiting factors within the Joseph Creek drainage.

Need and Technical Background:

Given the problem statements and limiting factors listed in the Salmon Subbasin Management Plan (Ecovista 2004) and the Grande Ronde Subbasin Plan, a list of objectives, strategies, and research, monitoring and evaluation (RM&E) activities were developed and linked to these approaches. The objectives and strategies identified the need to conduct various RM&E activities. The Viable Salmonid Populations (VSP) criteria recommended by McElhaney et al. (2000) were suggested to provide a means of analyzing population response to implementing objectives and strategies (Ecovista 2004). Population level performance standards were to be evaluated in terms of abundance, population growth rate, life history diversity, spatial distribution, and genetic diversity. The need to collect population specific adult abundance and productivity key performance data were identified as data gaps necessary to collect as a direct measure of delisting metrics (Ecovista 2004). This information along with other key performance measures were identified to be necessary for effective management, addressing Biological Opinion Tier 1, 2, and 3 questions, understanding mechanisms that affect freshwater survival, relating fish population data to current habitat conditions and proposed rehabilitation measures, and providing unbiased and precise estimators of interim abundance and productivity delisting targets.

The need to assess biological performance of natural origin salmon and steelhead populations in tributary streams and for measurement of recovery status of listed species has been recognized by multiple Biological Opinion related documents (NMFS 2000, NOAA Fisheries 2004, U.S. Army Corps of Engineers et al. 2004, 2005, NOAA Fisheries 2008, ICTRT 2007). The Northwest Power and Conservation Council's Fish and Wildlife program (NPCC 2000, 2005) lists biological objectives which contains abundance as one of the biological performance measures. A number of authors have identified the need for population monitoring, viability assessment, and species conservation (Allendorf and Ryman 1987, Botkin et al. 2000, Foose et al. 1995, Franklin 1980, Goodman 1987, ICTRT 2005, Kapuscinski and Miller 1995, Kincaid 1997, Kucera and Blenden 1999, Mace and Lande 1991, McElhaney et al. 2000, Mundy 1999, Reed and Blaustein 1997, Shaffer 1987, Soule 1980, Soule 1987, Starfield et al. 1995).

The Nez Perce Tribe Department of Fisheries Resources Management (Department) identified the Secesh River for long-term monitoring of natural origin adult chinook salmon escapement and productivity. Population status monitoring in the Secesh River implements the Salmon Subbasin Management Plan (Ecovista 2004) objectives of quantifying population specific adult abundance and productivity, wild stock monitoring objective for focal species, and measuring progress toward delisting criteria. This population is the only remaining natural origin (unsupplemented) population remaining in the South Fork Salmon River and also acts as a reference stream for supplementation program comparison (Vogel et al. 2005, Hesse et al. 2006). It is recognized by the Department and ICTRT (2005) as a population for recovery planning. The Secesh River was designated as an intermediate population size category, with a 750 fish viability level. The major population group (MPG) viability guidelines developed by the ICTRT (2005) would require that two of the four populations in the South Fork Salmon River MPG exceed VSP criteria.

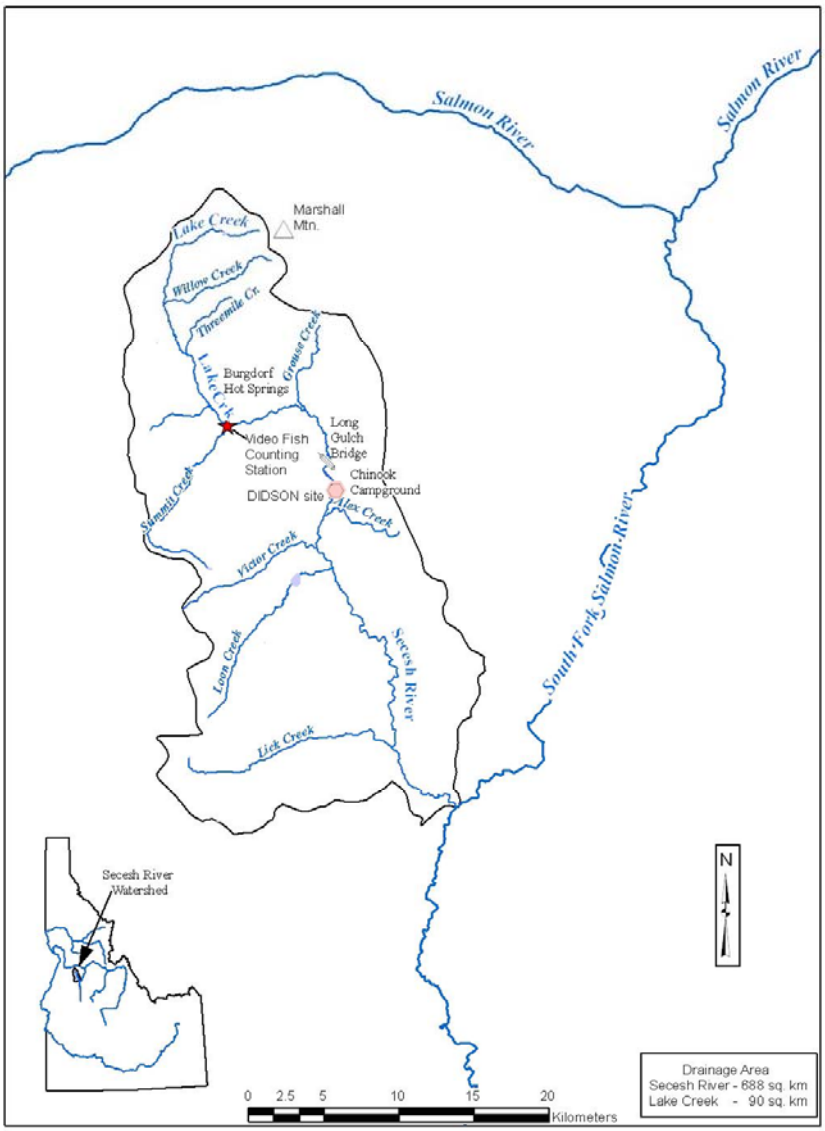

Figure 1. Location of the DIDSON monitoring site in the Secesh River.

The Secesh River is located in west central Idaho (Figure 1) in the South Fork Salmon River drainage and encompasses an area of 688 square kilometers. Salmon redd count surveys have been conducted on the Secesh River since 1957. These one-time peak index area counts provided an index of relative abundance (Pollard 1984), but were not designed to provide escapement estimates (Kiefer et al. 1996). The redd count data contained unknown accuracy and precision. Redd count data has been used in the past for viability analysis and to estimate spawner abundance (ICTRT 2007) since the time series extends back to 1957.

The original intent of this project was to determine escapement of the Secesh River adult chinoook salmon population. Underwater video fish counting station methodology was initially tested in Lake Creek (a headwater tributary) and the Secesh River for this purpose. Underwater video technology provided accurate and precise salmon escapement estimates in the smaller Lake Creek (Faurot et al. 2000, Kucera and Orme 2006, Kucera and Orme 2007), but was unsuccessful in the larger Secesh River environment due to higher stream discharge and debris load (Faurot and Kucera 2001). Underwater video salmon escapement monitoring was discontinued in the Secesh River in 2001 due to this constraint. Video escapement monitoring continued in Lake Creek until a newer technology, dual frequency identification sonar (DIDSON), was identified as a potential method for monitoring the entire Secesh River population. DIDSON monitoring was initially tested in the Secesh River in 2003 (Johnson et al. 2004) and has been used successfully since 2004 for salmon escapement monitoring at the population level. The DIDSON monitoring site (rkm 30) (Figure 1) is located downstream of the majority of salmon spawning habitat; 97.4% to 99% of all salmon redds in the Secesh River drainage are located upstream of the DIDSON monitoring site. DIDSON target counts have been validated for species identification by underwater video, have evaluated the precision of counts between two sonar units, and have investigated and adjusted for known sources or error in determining daily salmon passages and escapement estimates over a six year period (see expanded discussion in Section E). The technology has provided salmon escapement estimates with known accuracy and precision (CV's - 3.7%-10.8%) (Kucera and Orme 2007, Kucera 2009). DIDSON escapement information has also allowed an analysis of redd count data as an index of abundance. From the initial six years of DIDSON escapement monitoring (2004-2009), it appears that this technology has been useful to meet subbasin plan objectives and strategies to provide unbiased and precise estimators of abundance and recovery metric monitoring. As parent-per-progeny ratio (productivity) information is developed it should also provide data relative to replacement rate questions, and supplementation program performance to separate environmental effects from supplementation effects.

For the sake of clarity, operation of the Lake Creek underwater video salmon escapement monitoring was discontinued by this project in 2006 and was transferred to the Tribal Idaho Supplementation Study (ISS) (BPA Project No. 198909800). The ISS project has continued to operate the Lake Creek underwater video monitoring through 2009.

Joseph Creek is a tributary to the lower Grande Ronde River (Figure 2) and contains a native run of anadromous steelhead (Cat Tracks Wildlife Consulting 2004). The Joseph Creek system is managed as a wild fish management area by the Oregon Department of Fish and Wildlife (ODFW). A resident rainbow trout form is also present in the drainage. No chinook salmon or bull trout are known to inhabit the stream. Index area and supplemental area steelhead redd count surveys have been conducted by the ODFW since the 1960's in Joseph Creek (Jeff Yanke – personal communication). Redd counts, that were collected consistently from 10 streams in the Joseph Creek drainage, averaged from 0 to 26 redds per mile of stream annually. Apparently, both resident rainbow and steelhead are observed spawning during redd count surveys, in some areas, and only

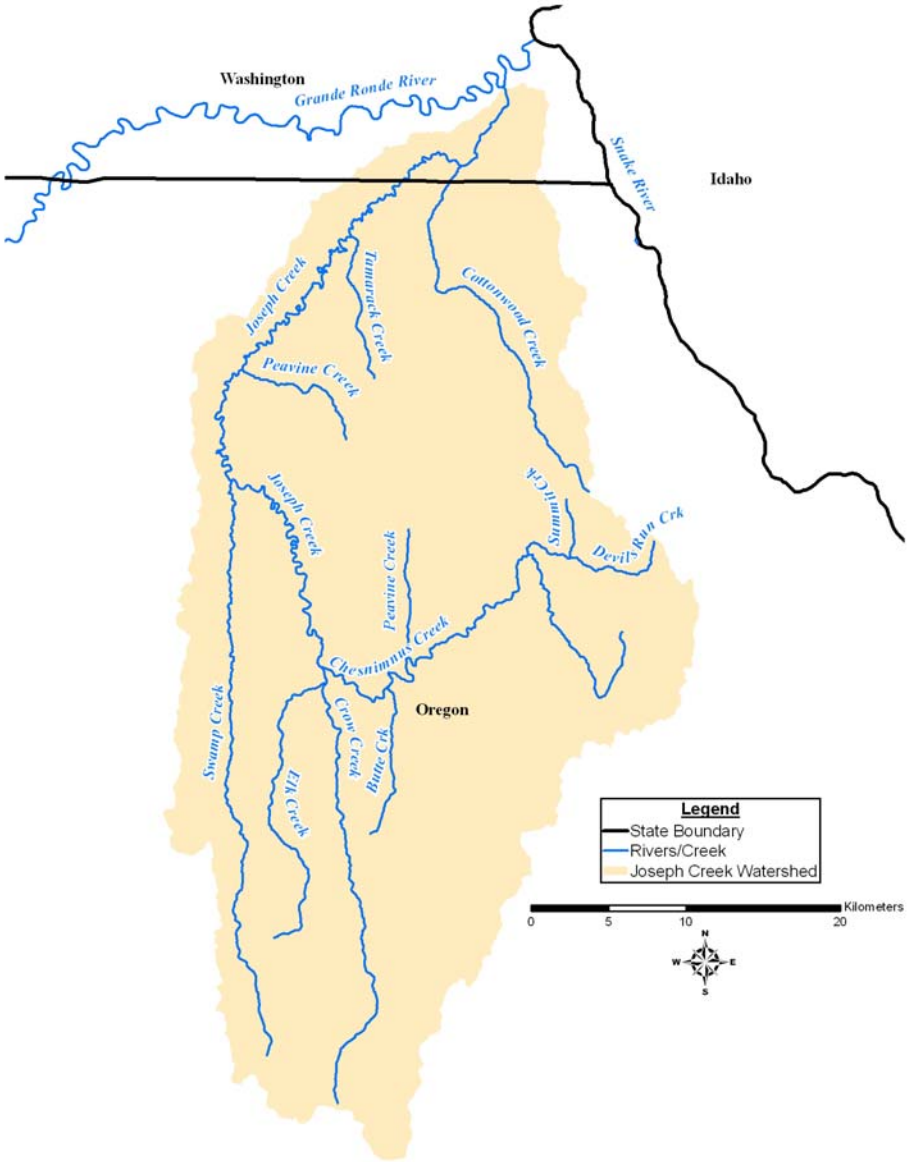

Figure 2. Location of Joseph Creek.

larger redds are recorded as steelhead redds (Jay Hesse – personal communication). In addition, hatchery steelhead supplementation occurs in the Grande Ronde River (Schuck 1998, Whitesel et al. 1998) and the amount of hatchery straying into the Joseph Creek system is unknown. Both Snake River basin, Columbia River basin, and Wallowa River steelhead broodstock has been used as the supplementation broodstock source. Concern exists over whether or not expanded steelhead redd counts provide a valid and robust estimate of spawner abundance (Personal communication – Jay Hesse - RM&E Collaboration Workshop participant). It has been recommended that steelhead redd counts need to be validated/correlated to escapement due to the challenges associated

with consistently and accurately counting redds in index areas during turbid water conditions. Grande Ronde Subbasin Plan EDT modeling estimated the steelhead spawner abundance in Joseph Creek had declined by 80% compared to historic levels, but contained a model-estimated 621 fish. The Subbasin Plan also provided another steelhead population estimate of 945 fish conducted by the ODFW. Although steelhead in the Snake River basin are listed as a threatened species, the subbasin plan indicated that Joseph Creek exceeds interim recovery target levels. NOAA Fisheries (2008) estimated that Joseph Creek had a 10 year geometric mean abundance of 2,132 fish, between 1996 and 2005, based on redd count expansion. Steelhead in Joseph Creek were estimated to meet ICTRT (2007) abundance and intrinsic productivity viability criteria. The recommended viability threshold was 500 fish. For a population located upstream of eight FCRPS mainstem Columbia River and Snake River dams, Joseph Creek appears to contain a resilient and productive steelhead population when other populations are below viable population levels. Mayer et al. (2006, 2007, 2008) reported that Asotin Creek, a mainstem tributary of the Snake River, had adult steelhead escapement levels that ranged between 342 and 653 fish from 2005 to 2007. The current project proposal seeks to collect natural origin adult steelhead escapement information and to validate/correlate index area redd counts with actual escapement. Further, the proposal seeks to provide high precision escapement, age structure and hatchery composition information for status monitoring.

C. Rationale and significance to regional programs

It is important that objectives from regional plans be quantifiable in biological terms as standardized performance measures (CSMEP 2005, Ecovista 2004). When the common tender across regional plans, policies, and goals is performance measures, this provides the necessary linkage for research, monitoring, and evaluation studies. This project provides the standardized performance measure of accurate and precise population specific adult salmon abundance and productivity information. The Joseph Creek steelhead project proposes to provide high accuracy and precision adult steelhead abundance data. This information provides a direct measure and feedback to regional objectives and supports derived life stage specific and population growth rate performance measures (SAR, parent:progeny ratios, and lambda). The following section will present the requested information for the ongoing Chinook Salmon Adult Abundance monitoring in the Secesh River first, then the proposed Joseph Creek steelhead escapement monitoring project next.

The 2008 FCRPS Biological Opinion (NOAA Fisheries 2008) lists Reasonable and Prudent Alternatives (RPA's) for research, monitoring and evaluation (RM&E) actions. The overall RM&E objective was to provide information needed to support planning and adaptive management and demonstrate accountability related to the implementation of FCRPS ESA hydropower and offsite actions for all Evolutionary Significant Units (ESU's). The Action Agencies were directed to undertake RM&E through project implementation and compliance monitoring, status monitoring, action effectiveness

research, and critical uncertainties research in nine RM&E strategy areas. RM&E strategy 1 identified the need for monitoring the status of selected fish populations related to FCRPS actions (RPA 50). The RPA 50 action description calls for status and trend monitoring to occur: 1) in the South Fork Salmon River to advance methods to assess status and evaluate effectiveness actions, 2) to improve Action Agency compliance with regional standards and protocols and prioritized by critical performance measures and populations, and 3) for assessment of wild populations. RPA 50 further references the USACE (2007) FCRPS Biological Assessment which specifically identifies the Listed Stock Adult Escapement project (BPA Project No. 199703000 - this project) for the 2007 to 2009 implementation plan to meet the RPA strategy. The implementation plan for the 2008 FCRPS Biological Opinion (Action Agency 2009 draft) identifies status and trend monitoring of Chinook salmon to occur in the Secesh River under RPA 50.6. DIDSON salmon escapement estimates (this project) will be compared to PIT tag array salmon escapement data in the Secesh River over a period of years to evaluate accuracy and precision. The Action Agency (2009) draft implementation plan also identifies expanding BPA project 199703000 (this project) to quantify adult steelhead escapement in Joseph Creek under RPA 50.6. This project is also related to RPA 51.1 to support data management of fish population metrics (Chinook and steelhead), RPA 62.5 to investigate genetic stock identification monitoring techniques (steelhead), RPA 63.1 effect of safety-net and conservation hatchery programs (Chinook), and RPA 64.2 to determine if artificial production makes a net positive contribution to recovery of listed populations (Chinook).

NEED RM&E COLLABORATION WORKSHOP – JAY TO PROVIDE!!!

The Northwest Power and Conservation Council Fish and Wildlife Program (NPPC 2009) states that biological objectives have two components, biological performance and environmental characteristics. Biological performance which describes population responses to habitat conditions in terms of capacity, abundance, productivity, and life history diversity. The biological objective component, abundance, is intended to be empirically measurable based on explicit scientific rationale to meet Power Council objectives and vision of the Fish and Wildlife program. Objectives should be expressed in quantitative and measurable terms at the province and subbasin level. Strategies identified in the adult passage subsection (NPPC 2009) include evaluation of escapement numbers to spawning grounds. Strategies identified under the Research, Monitoring and Evaluation subsection identifies the primary RM&E strategies as: 1) identify priority fish and wildlife and ecosystem elements of the Program that can be monitored in a cost-effective manner, evaluate the monitoring data and manage the Program based on results, 2) research and report on key uncertainties, 3) make information from this program accessible to the public, and 4) to the extent practicable ensure consistency with other processes. The purpose of the monitoring and evaluation strategies is to assure that the effects of actions taken under this program are measured, that these measurements are analyzed so that we have better knowledge of the effects of the action, and that this improved knowledge is used to choose future actions. Monitoring and evaluation of tributary specific adult salmon abundance and productivity in the Secesh River as a key biological performance measure is closely linked to biological objectives. Salmon

abundance information from this project is quantified, has high accuracy and precision, is available to the public, is compared to supplementation program performance, and directly measures the effect of FCRPS (2008) conservation measures in the aggregate. Finally, the NPPC (2009) has adopted the subbasin plans. The Salmon Subbasin Management Plan biological objectives and strategies are discussed below, and contain direct linkages to the population level salmon adult abundance and productivity information that this project collects. The proposed Joseph Creek natural origin adult steelhead escapement monitoring project would collect similar data as described above for salmon, at the population level. Steelhead information would relate in the same manner for the described NPPC Fish and Wildlife Program objectives and strategies. This project is consistent with the NPPC (2009) Fish and Wildlife Program direction. The Salmon Subbasin Management Plan (Ecovista 2004) identified three biological problem statements, related objectives, and strategies that this project relates to. The strategies developed to address biological problem statement number 1 (Objective 1A and 1B; Strategy 1A2, and 1B4, p. 20-21) are standardized performance measures which are: 1) determine population specific smolt-to-adult return rates (SAR) on a representative set of index streams, and 2) to monitor and evaluate program effectiveness in meeting adult return objectives for the Salmon subbasin. Natural origin adult salmon escapement information from this project is a key performance measure that can be used in conjunction with juvenile emigrant abundance data collected by the Nez Perce Tribe ISS study to derive a SAR rate for chinook salmon in the Secesh River. Secesh River salmon escapement information can be aggregated along with other Salmon River subbasin streams to address meeting adult return objectives identified in the Ecovista (2004). Two strategies were listed (Strategy 2A1 and 2A4, p. 23-24) that were related to information needed to address biological problem statement two. The strategies were: 1) to protect and monitor abundance and productivity of wild stocks in the subbasin that have not been influenced by hatchery intervention., and 2) identify where there is a lack of knowledge pertaining to the population size of anadromous and resident focal species. This project directly relates to strategy one above, by monitoring wild stock adult chinook salmon abundance in an unsupplemented stream. This stream is identified as a control stream by the Idaho Supplementation Studies (Project No. 198909802, Bowles and Leitzinger 1991), and is identified as a reference stream by both the draft Monitoring and Evaluation Plan for Northeast Oregon Hatchery (Project No. 1998007092, Hesse et al. 2004), and the Johnson Creek summer chinook salmon monitoring and evaluation plan (Project No. 199604302, Vogel et al. 2005). It is acknowledged that a small proportion of adult hatchery fish, presumably from McCall Hatchery releases in the South Fork Salmon River, have strayed into the Secesh River. The number and proportion of hatchery strays are usually small and can be accounted for in subsequent analyses. This project has identified where there is a lack of knowledge pertaining to the population size of adult spring and summer chinook salmon. The Secesh River lacks a time series of natural origin abundance data to assess both short-term trends and longer-term trends in abundance and productivity. This information is essential for population level status monitoring, for comparison with supplementation projects to rule out environmental effects from supplementation effects, and to assess delisting abundance thresholds. Five strategies were listed under Objectives 3A and 3C that related to information needed to address biological problem statement three, that relate to information collected by this

project. The five strategies (Strategy 3A2, 3C1, 3C2,3C3, and 3C5, p. 25) again identified performance measures which were to: 1 Determine juvenile or smolt per female measurement to further knowledge of freshwater productivity, 2) Quantify population specific adult and juvenile abundance information on a representative set of index streams, 3) Determine population specific smolt-to-adult (SAR) rates for chinook salmon and steelhead on a representative set of index streams, 4) Determine population productivity (e.g., spawner to spawner ratios and/or lambda) on a representative set of index streams, and 5) Use information obtained from strategies 3C1 through 3C4 to assess delisting criteria when it becomes available. This project relates indirectly to strategy 1 by providing an accurate estimate of adult salmon abundance in the Secesh River, which when combined with the estimated proportion of females in the run through carcass recoveries, can be used to derive a accurate number of females on the spawning grounds. The abundance of juvenile or smolt emigrants is estimated by the ongoing Tribal ISS study. When this data is combined a derived measure of freshwater productivity (juvenile/female) can be obtained. Information from this project is directly related to strategy two above, because it quantifies population specific adult chinook salmon abundance. Data from this project is related to strategy three above for chinook SAR information which is essentially the same as described under biological problem statement one above. The fourth strategy above is to determine population productivity such as spawner to spawner ratios or lambda on a representative set of streams. Most of these derived performance measures rely on adult spawner abundance data. More correctly, this project would provide data to estimate adult to adult ratios based on abundance rather than spawner to spawner ratios. The fifth strategy (above) is directly related to information provided by this project. It is acknowledged that the list of index streams has yet to be determined in the context of a regional research, monitoring, and evaluation plan. The Secesh River is a logical candidate because it supports an ICTRT recognized chinook population, is not supplemented, has ongoing studies whose stated objectives are to quantify adult and juvenile abundance and associated productivity key performance measures, and which serves as a control or reference stream for supplementation studies. Information from the Secesh River project is necessary to understand with certainty the effects of management and conservation actions, such as supplementation, and that FCRPS actions are effective in achieving viability thresholds, delisting of ESA listed species and in meeting ICTRT (2007) criteria.

The Grande Ronde Subbasin Plan (Cat Tracks Wildlife Consulting 2004) identified limiting factors and management objectives for monitoring and evaluation that this project relates to. The subbasin plan stated that anadromous focal species in the Grande Ronde subbasin were limted by out-of-subbasin factors involving hydropower development, ocean productivity, predation and harvest. An EDT model was used to identify and prioritize within-subbasin limiting factors. Four factors were identified to be the most limiting in the subbasin with respect to focal species and they were sediment, temperature, flows and channel condition (key habitat quantity and diversity). Within the Joseph Creek drainage sediment and temperature were identified by the model as limiting factors. Monitoring and evaluation objective 1b (p. 276) identified the need to describe status and trends in adult abundance and productivity for all focal populations in the Grande Ronde subbasin. Subbasin plan monitoring and evaluation objective 2a (p. 277)

was to determine and compare the productivity of hatchery origin fish and natural origin fish. Monitoring and evaluation objective 3b (p. 282) was necessary to determine and compare adult life history characteristics between hatchery and natural fish. The Joseph Creek adult steelhead escapement proposal would implement these monitoring evaluation objectives by collecting escapement, productivity, hatchery composition, and age structure information.

The NPPC (2006) Columbia River Basin Research Plan identified the need for monitoring and evaluation, including status and trend monitoring of fish, wildlife, habitats, and ecosystems, and action effectiveness research, to provide information to evaluate project outcomes, project objectives, and programmatic standards within an adaptive management framework. This plan acknowledged that monitoring contributes needed information to address whether biological and programmatic performance objectives in the Fish and Wildlife Program, subbasin plans, FCRPS Biological Opinion and ESA recovery plans were being met. Use of monitoring data to recommend management changes, identify factors that limit achieving performance standards, and identifying which mitigation actions are most effective at addressing limiting factors was emphasized. Collection of natural origin salmon and steelhead escapement and productivity data on this project, for status and trend monitoring, supplementation program comparison, Biological Opinion and recovery plan metrics seem to agree with intent of the NPPC (2006) research plan.

The Independent Scientific Review Panel (ISRP 2005) provided retrospective recommendations on monitoring in subbasin plans. The ISRP identified the need to develop a coordinated system-wide monitoring and evaluation progam. Recommendation 1 was to develop a sound census monitoring procedure to examine fish population and habitat trends over time. Census monitoring of fish populations might include data from all stream reaches in a watershed……. and adult counts at weirs. This project provides census monitoring of natural origin adult spring and summer chinook salmon abundance and productivity in the Secesh River at the population level. The ISRP also recommends that as data are obtained on status and trends of fish populations that regression models be developed to predict abundance or presence/absence of focal species. One of the tasks of this project is to compare empirical redd count and abundance information to evaluate whether redd counts provide an accurate estimate of adult salmon abundance.

In addition, the ISRP has consistently recommended the need for storage of primary data and metadata collected in research studies in the Columbia River basin. The Department takes seriously the need to make primary data and metadata available within the region (ISRP 2005). This project will result in the collection of extremely valuable data given society's monetary investment and the important management questions to be answered. Hence, the volume and complexity of information gathered through the monitoring and evaluation activities will need to be compiled and organized in a systematic manner. It will involve archiving monitoring data, integrating data from different co-manager monitoring and evaluation activities, and making the data accessible in local and regional

databases. For these reasons it is imperative that data management receive careful attention.

In addition to annual progress reports posted to the BPA website, we will utilize project specific and region-wide databases that have been developed to centralize data associated with widely used data collection activities and standardized performance measures. The Nez Perce Tribe website (www.nezperce.org/~dfrm/research) will house a standardized database for primary data, description of meta-data, and summary/annual reports related to this project. Appropriate components of program data and results will be provided to the following websites: Pacific States Marine Fisheries Commission (PSMFC), including: PIT Tag Information System (PTAGIS), and the Regional Mark Information System (RMIS); StreamNet, and Northwest Environmental Data Network (NED; when functional). The Tribe currently is coordinating with the Columbia River InterTribal Fish Commission to seek additional Streamnet funds which would be dedicated for the Nez Perce Tribe to make project data more readily available.

Viability criteria for application to interior Columbia Basin salmonid ESU's have been recommended by the ICTRT (2005). The ICTRT recognizes the Secesh River chinook salmon population for recovery planning purposes. The ICTRT recommended MPG viability guidelines require that two of the populations in the South Fork Salmon River should exceed VSP guidelines. The Secesh River is the only remaining natural origin salmon population in the South Fork Salmon River, and as such may be a candidate for measurement of delisting criteria under the ESA to roll up to the larger ESU level. Once regional monitoring and evaluation plans are completed they may shed light on use of the Secesh River in recovery metric monitoring. Information from this project may be used by NOAA Fisheries to assess effectiveness of conservation actions and delisting decisions for spring and summer chinook salmon in the Snake River basin.

The Wy-Kan-Ush-Me-Wa-Kush-Wit, Spirit of the salmon, (1995) provides guidance to establish and monitor escapement checkpoints at mainstem dams and in index subbasins. Methods to be used include video counting at hydropower dams and at key locations in tributaries using the least intrusive method to collect the necessary information. It further recommends establishing additional monitoring programs for each of the subbasin tributary systems to monitor adult escapement and resulting smolt production, and to evaluate (by measuring the number of adults returning) the ability of managers to meet goals set by the Columbia River Fish Management Plan (CRFMP).

D. Relationships to other projects

The Chinook Salmon Adult Abundance Monitoring project is related to several other BPA funded projects within the Snake River basin. It is also related to several regional projects that deal with system-wide planning and monitoring activities.

The Idaho Salmon Supplementation project (BPA Project No. 198909802) identifies the Secesh River as a control stream. The Chinook Salmon Adult Abundance Monitoring

project provides a salmon escapement and spawner abundance data for the ISS project. ISS uses the adult abundance measure for spatial and temporal comparison of population trends between supplementation treatment streams to rule out environmental effects from supplementation effects. Information from this project is combined with juvenile emigrant abundance data from the ISS project to develop stock recruit relationships and smolt-to-adult return estimates. Project staff coordinate and assist with daily operations on an as needed basis because they work in such close proximity with one another. Project technicians are also cost shared between the two projects to improve efficiency and save on costs.

The Secesh River acts as a reference stream for the Johnson Creek Artificial Propagation and Enhancement project (BPA Project No. 199604300) (Vogel et al. 2005). The Secesh River project provides adult salmon escapement and spawner abundance information from an unsupplemented stream for trend comparison, and productivity (progeny-per-parent ratios) data over time between reference and treatment streams. The Johnson Creek monitoring and evaluation project (BPA Project No. 19964300) relies on this project to supply this information.

The monitoring and evaluation plan for the northeast Oregon hatchery Imnaha and Grande Ronde subbasin spring chinook salmon (BPA Project No. 1998007092) recognizes the Secesh River as a reference stream. The monitoring and evaluation plan will employ reference streams in a pair-wise fashion to provide inference on the gross level of impact/effectiveness absent supplementation. Longer term productivity data sets (progeny-per-parent ratios) in the Secesh River are identified to compare reference streams to treatment streams. A direct measurement of adult abundance in the Secesh River will also be used to test accuracy and precision of redd count expansion adult abundance estimates in Oregon streams. The monitoring and evaluation plan (Hesse et al. 2004) relies on this project to provide these performance measures.

This project is related to the Integrated Status and Effectiveness Monitoring Program (ISEMP) Salmon River project (BPA Project No. 200301700) whose primary purpose is to determine whether innovative methods can be employed to increase the accuracy and precision of adult abundance estimates for summer chinook salmon at the subpopulation, population, and major population group scale. The ISEMP study has installed PIT tag arrays in the lower Secesh River to quantify both natural rorigin adult salmon and steelhead escapement. The plan recommends comparison of PIT tag array escapement data with DIDSON salmon escapement information over a period of years. Results from ISEMP investigations have both regional and subbasin level application.

The Idaho Habitat and Natural Production Monitoring project (BPA Project No. 199107300) monitors juvenile and adult salmon natural production indices. This project is being modified in scope to implement probabilistic sampling for chinook salmon redd counting to estimate abundance of redds (Tim Copeland, IDFG – personal communication). The Chinook Salmon Adult Abundance Monitoring project provides a comparison between adult salmon abundance data and redd count expansion abundance estimates that describe variation between methods.

The Nez Perce Tribe Department of Fisheries Resource Management research division is not directly or formally involved in the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). PNAMP relies on volunteer participation; as such NPT participation has not been possible due to reliance/existence solely on task specific contracts (primarily BPA). We have suggested making funding available to primary comanagers conducting research, monitoring and evaluation in the Columbia River basin to participate in PNAMP to NPCC staff. We are indirectly linked to PNAMP via CSMEP; as CSMEP is functionally serving as the technical work group of PNAMP for developing standardized fish metric monitoring protocols/standards.

The Nez Perce Harvest Monitoring Project (BPA Project No. 200206000) monitors anadromous fisheries conducted by the Nez Perce Tribe. Primary focal species are Snake River spring, summer, and fall chinook salmon, and steelhead to implement on the ground harvest monitoring in the Clearwater River, Salmon River, Imnaha River, Grande Ronde River, Tucannon River, and in the Columbia River in Zone 6. Quantification of harvest is essential for tributary run reconstruction and evaluation of the effectiveness of supplementation.

The Secesh River chinook salmon represent a population that is recognized for recovery planning purposes (ICTRT 2005). Escapement and productivity information from this project may be used by NOAA Fisheries assessment of conservation actions, viability analysis, and delisting decisions for spring and summer chinook salmon in the Snake River basin.

The proposed Joseph Creek steelhead escapement monitoring project is related to several other BPA funded projects in the Snake River basin and is related to several regionally funded monitoring and evaluation projects.

This project is related to the Assess Salmonids in Asotin Creek Watershed (BPA Project No. 200205300) in that they both seek to conduct population status monitoring on natural origin steelhead in the Snake River basin. Both projects provide complimentary information on steelhead escapement, hatchery composition, migration timing, and adult age structure.

The Potlatch River Steelhead Monitoring and Evaluation project is related to this project proposal in that they also collect population status monitoring on adult steelhead in the Clearwater River system. This project is funded by the Pacific Coast Salmon Recovery Funds. Steelhead monitoring in the Potlatch River collects escapement, hatchery composition, migration timing, and age structure data.

The Idaho Steelhead Monitoring and Evaluation Studies project (BPA Project No. 19905500) collects adult steelhead escapement data in Fish Creek in the upper Clearwater River. This project also collects migration timing, hatchery composition, and age structure information on a natural origin steelhead population. Information on steelhead

escapement at hatchery weirs at Rapid River Hatchery, Pahsimeroi Hatchery, and Sawtooth Hatchery are also compiled.

This project is related to the Integrated Status and Effectiveness Monitoring Program (ISEMP) Salmon River project (BPA Project No. 200301700). The ISEMP project has a fast track proposal to install two PIT tag arrays in both lower Joseph Creek and the lower Grande Ronde River. If both this project's and the ISEMP fast track proposal are funded, it will validate the PIT tag array generated adult steelhead escapement with a weir or resistivity method.

The Imnaha River Steelhead Status Monitoring fast track project (BPA Project No. 201003200) has proposed steelhead population status monitoring in a hatchery supplemented system. This project will collect steelhead escapement, hatchery composition, migration timing and age structure information.

E. Project history

The Department was extremely concerned over the significant trends in salmon population decline in the early 1990's (Kucera et al. 1994). Decline in salmon populations throughout the Snake River basin led to listing of the salmon as a threatened species under the Endangered Species Act in 1992 (NMFS 1992). Concern also existed over the general lack of escapement and spawner abundance data with known accuracy and precision to describe population status and trends of threatened chinook salmon. The original intent and goal of the Chinook Salmon Adult Abundance Monitoring project (formerly the Listed Stock Adult Escapement Monitoring project) was to provide long term monitoring of adult salmon escapement and migration timing at the population level in the Secesh River and in Lake Creek (Faurot et al. 2000). The Secesh River is a tributary stream in the South Salmon River in Idaho (Figure 1).

<u>Lake Creek and Secesh River Underwater Video</u>

This project began in 1991 with planning and conceptual engineering design (Fish Management Consultants 1991) and preliminary engineering design (River Masters Engineering 1994). These were both non-BPA funded efforts. In 1997 BPA funding of this project (BPA Project No. 199703000) began and preliminary testing of an underwater video fish counting station was initiated in Lake Creek (a headwater tributary of the Secesh River). Equipment and methods were field-tested and problems rectified. Underwater video fish counting stations were operated on the Secesh River and Lake Creek from 1998 to 2000. The fish counting station performed adequately on Lake Creek which is a smaller headwater tributary chinook spawning stream. The project demonstrated successful application of using underwater video to determine adult salmon escapement in a remote stream environment (Lake Creek) (Table 1). However, application of temporary picket fences and underwater video technology in the larger Secesh River site proved unsuccessful. Because of larger stream size, stream discharge, and debris loads we were not able to install the fish counting station and observe the first

adult salmon passage during the first three years of operation (1998-2000). With this knowledge the project was adaptively managed and monitoring in the Secesh River site was discontinued in 2001. Results from monitoring in the Secesh River are reported in Faurot et al. (2000), Faurot and Kucera (2001a), and Faurot and Kucera (2001b). Monitoring at the Lake Creek site, at the mouth of Lake Creek, continued from 1998 through 2006, when escapement monitoring in Lake Creek was transferred to the Nez Perce Tribe Idaho Salmon Supplementation Study (ISS) (BPA Project No. 198909800). The ISS project has continued Lake Creek salmon escapement monitoring through 2009. A monitoring and evaluation plan was implemented for the first three years of project operation to determine if the fish counting station impeded spawner migration or displaced spawning activity in the Secesh River (Faurot and Kucera 2001a). We did not detect any spawner displacement downstream of the fish count station or observe adults kegging up downstream of the structure. It was felt that the design of the counting chamber allowed unimpeded upstream and downstream passage of adult salmon (Faurot et al. 2000, Faurot and Kucera 2001a, Faurot and Kucera 2001b).

Table 1. Adult salmon escapement estimate, 95% confidence intervals, standard error, percentage of jacks in the run, adult hatchery composition and fish per redd numbers in Lake Creek from 1998 to 2006.

Year	Adult Escapement Estimate	Confidence Interval Range (95 % CI)	Standard Error (s.e.)	Percen-tage of Jacks (%)	Hatchery Composi-tion (%)	Fish Per Redd
1998	45	45-46	0.26	2.2[1]	4.3[2]	0.90
1999	65	63-66	0.86	26.9	6.2[2]	2.71
2000	299	295-304	2.26	9.2	1.1[2]	1.68
2001	697	680-714	8.77	10.0	7.8	2.07
2002	409	404-414	2.45	6.9	6.7	2.06
2003	481	0	0	16.1	1.4	1.99
2004	408	396-420	6.19	4.7	3.0	2.15
2005	140	138-142	0.95	5.3	1.5	1.77
2006	86	0	0	5.8	7.0	2.20

A major goal of the project was to provide accurate and precise adult salmon escapement data for status and trend monitoring. Underwater video salmon escapement estimates varied dramatically from 45 fish to 697 fish between 1998 and 2001; a 15 fold range in escapement (Faurot and Kucera 1999, Faurot et al. 2000, Faurot and Kucera 2001a, Faurot and Kucera 2001b, Faurot and Kucera 2002, Faurot and Kucera 2003, Faurot and Kucera 2004, Kucera et al. 2005, Kucera and Orme 2006, Kucera and Orme 2007) (http://www.efw.bpa.gov./searchpublications/). Standard error of the estimates ranged from 0 to 8.77. All potential known sources of error were examined and accounted for in

salmon escapement estimates. Videotape file reader error, by direction of passage, and count station downtime was quantified and used to adjust daily salmon passage information and escapement estimates. Videotape reader error was generally small with experienced observers, ranging from 1% to 2%. Species mis-identification was not a source of error in this study. This project has demonstrated the successful application of underwater video techniques to estimate salmon escapement in a remote stream environment. We believe that accurate and precise adult salmon escapement data has been collected in Lake Creek from 1998 to 2006 (Table 1). Lake Creek salmon escapement data was used, with redd count data in the Secesh River excluding Lake Creek, with prespawning mortality, and hatchery fraction data to calculate a total Secesh River natural origin salmon spawner abundance (Kucera and Orme 2007) and compared to ICTRT (2007) abundance viability and potential delisting thresholds (Figure 3). Redd counts, prespawning mortality, and hatchery fraction data were provided by the Tribe's ISS study (BPA Project No. 198909802). This data set provided nine years of salmon spawner abundance information to compare to ICTRT recommended 10 year geometric mean spawner abundance criteria. This data was shared with the ICTRT for salmon population viability analysis.

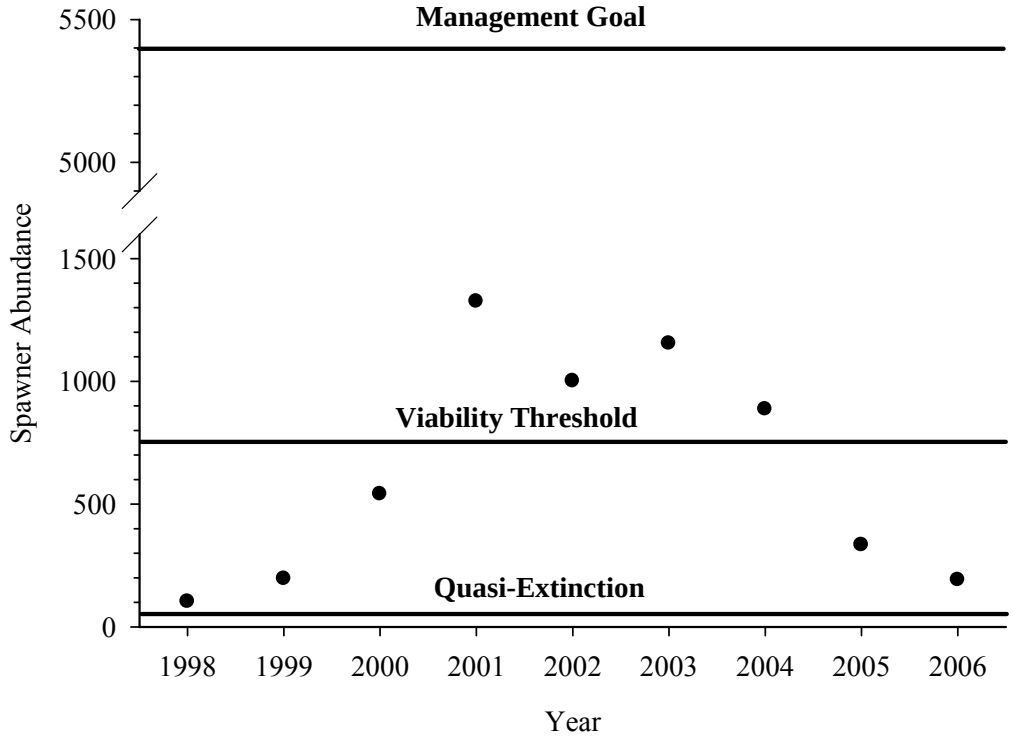

Figure 3. Estimated natural origin salmon spawner abundance in the Secesh River from 1998 to 2006 compared to quasi-extinction threshold, population viability threshold (ICTRT 2005), and management goals.

Underwater video was also able to collect data to provide an index of the percentage of jacks in the run, estimated hatchery composition on adipose fin clipped adults, and fish

per redd data (Table 1). The percentage of jack salmon in the run, estimated from video length estimates, has ranged from 2.2% to 26.9% during the study period. An unbalanced age structure at low population size was observed in 1999 when jacks comprised 26.9% of the run. Estimated hatchery composition during the study period has ranged from 1.1 to 7.8%. Both of the estimated jack composition and hatchery fraction estimates appear to be more accurate than the carcass recovery derived estimates from the Tribe's ISS study. Representative recovery of jacks from carcass surveys has been problematic and information from the project has been shared with the ISS study for run reconstruction purposes. Annual fish per redd values in Lake Creek have ranged from 0.90 to 2.71 over the study period. Unbalanced age structure at low population sizes in 1998 and 1999 contributed to the low and high ranges in fish per redd values observed (Kucera and Faurot 2005). Fish per redd estimates at population sizes of approximately 400 adults or more, were less variable ranging from 2.01 to 2.17 fish per redd. The regression fish per redd value was 2.08 from escapement versus multiple ground count extensive area redd surveys (1998 to 2006). Lake Creek fish per redd values were compared to three other streams by regressive techniques to examine variation in the data. All of the escapement versus redd regression analyses were significant ($P < 0.003$) (Kucera and Orme 2007). Comparison of the mean fish per redd values (slopes) via a two-tailed t-test indicated significant differences between streams. Lake Creek, a natural origin subpopulation, was different than the three remaining supplemented populations. These data indicated large annual variability in fish per redd values within and between streams. These data have important implications. Application of an average fish per redd value or a value derived from different stream may lead to erroneous results in redd count expansion techniques. Including variation in fish per redd data is encouraged in subsequent redd count expansion abundance estimates if these techniques are utilized in recovery planning.

Regressions were performed to describe the relationship between salmon escapement and peak index area, multiple pass index area, and extensive area multiple pass salmon redd counts in Lake Creek from 1998-2006 (Kucera and Orme 2007). This analysis occurred between escapement and redd counts at the subpopulation scale. All of the linear regressions were significant at the $p < 0.001$ level. Linear regression results were as follows: 1) Peak index area counts – $R^2 = 0.895$, $P < 0.001$, SE of slope = 0.29, 2) Multiple index area counts - $R^2 = 0.968$, $P < 0.001$, SE of slope = 0.162, and 3) Multiple extensive area ground counts - $R^2 = 0.978$, $P < 0.001$, SE of slope = 0.12. The results indicated increasing precision with increasing redd count effort. Increased precision was demonstrated by the increasing R^2 value and the decreasing standard error of the slope from the lower effort peak index area count to the higher effort extensive area multiple counts.

Spawner migration timing has been described on an annual basis. Salmon arrival timing has ranged from June 9 to September 6. A general bimodal distribution in arrival timing has been observed at Lake Creek over the study period and is more pronounced during some years. Migrating salmon appear to exhibit two behaviorally distinct segments of fish movement. Rapid upstream only passage of both sexes generally characterize the first segment during the early season. The second segment of the run consists of a larger total number of both upstream and downstream passages, usually by males, with less net

upstream movement. Variation in arrival timing of the first adult salmon in Lake Creek (between years) has ranged more than one month, from June 9 in 2001 to July 11 in 1999. The earliest arriving salmon observed occurred on June 9 in 2001, and was observed during a drought year (38% of normal snowpack). The latest arrival of the first salmon passage occurred in 2001 on July 11, when the highest observed snowpack occurred; 148% of normal.

Adult salmon escapement data in Lake Creek was compared to expanded redd count abundance point estimates (index area and extensive area surveys) to examine the difference from the actual Lake Creek video obtained escapement. The average fish per redd values used by PATH (2.31) (Beamesderfer et al. 1998) and ISS (3.2) (Walters et al. 2000) were used for redd count expansion abundance estimates in Lake Creek. These values represented a range in fish per redd numbers used for redd count expansions. Variation was expressed as the percent difference of redd count expansion point estimates from the actual abundance estimate. Redd count expansion techniques estimated from 61% fewer salmon to 172% more salmon compared to video determined salmon escapement during the study period. At low population size redd count expansion methods appeared highly variable and are not consistently biased. At larger population sizes redd count expansion techniques appeared more accurate and were generally positively biased.

Relative numbers of bull trout were also recorded as a secondary objective at the Lake Creek site from 2004 to 2006. This data was collected because almost no information exists on the abundance of threatened bull trout in Lake Creek. Bull trout actively migrated upstream into and out of Lake Creek from early June through mid September when the fish counting station was removed. Bull trout migrated upstream before fish count station installation so the numbers represent relative numbers of bull trout. Net upstream bull trout passages by year were: 2004 (126 fish), 2005 (112 fish) and in 2006 (141 fish). Small numbers on the bull trout passages were fish ≥ 55 cm in size; 5 fish in 2004, 3 fish in 2005, and 7 fish in 2006. Estimated bull trout lengths were obtained for a gross analysis of length frequency. The potential exists to use underwater video as a technique to determine bull trout abundance in some stream systems given the life history types for this species (Rieman and McIntyre 1996).

Beside project annual progress reports that are on the Bonneville Power Administration web site the following professional presentations were made:
2000 – Idaho Chapter AFS meeting – Coeurd'Alene, ID
2000 – Western Division AFS – Telluride, CO
2003 – Idaho Chapter AFS – Boise, ID
Collaborative System Wide Monitoring and Evaluation Program (CSMEP) Workshop on data strengths and weaknesses and data standards

A peer reviewed journal manuscript is in preparation for the Lake Creek salmon escapement monitoring data.

Secesh River DIDSON Salmon Escapement Monitoring

Monitoring of natural origin adult salmon abundance in the Secesh River was still the goal of this project even after underwater video monitoring in the Secesh was discontinued after 2000. The project proposal for the 2002 provincial review process proposed the use of a quad-multiplexed split beam hydroacoustic array at the Secesh River site for adult salmon abundance determination. The 2002 review and funding process was delayed and the full project was not implemented in 2002. In the meantime, dual frequency identification sonar (DIDSON) technology became available (Belcher et al. 2001) and the technology was field tested in Alaska for adult salmon escapement monitoring with positive results. DIDSON is a new class of identification sonar that allows near video quality images for identification of objects under water (http://www.nezperce.org/~dfrm/research). By using up to 96 different sonar beams high frequency sound waves are sent through water to register vibrations reflected from an object. DIDSON collects sufficient information to show the size, shape, and direction of movement (upstream or downstream) of an object. The observer views a two dimensional silhouette of a fish swimming not a sonar blip that requires positive identification in the laboratory. The acoustic imaging camera operates at ultra high frequencies, at 1.8 MHz and 1.1 MHz, and uses acoustic lenses which allow high quality images up to 60m. The literature was examined to determine the potential for salmon and steelhead avoidance to these frequencies. Gregory et al. (2001) summarized the relevant published literature on fish sensitivity to sound. The frequencies the DIDSON unit operates at appears to be well above the audible range of chinook salmon (Kucera et al. 2005). A decision was made to experimentally test DIDSON technology for adult salmon escapement monitoring in the Secesh River (rkm 30)(Figure 1). Initial results of the DIDSON unit in 2003 indicated that it detected 94 to 100% of all salmon targets that were acquired by underwater optical cameras. These positive results led to full scale experimental testing of DIDSON technology in the Secesh River in 2004. Since this is a new technology the reader is directed to Kucera and Faurot (2005) for a complete discussion of methods.

A major goal of the project was to provide long term adult salmon escapement and productivity data for status and trend monitoring. High precision and accuracy data sets were desired for this purpose. DIDSON salmon escapement estimates (Table 2) have ranged from 209 fish to 914 fish over the five year study period (Kucera et al. 2005, Kucera and Orme 2006, Kucera and Orme 2007, Kucera 2008, Kucera 2009) ((http://www.efw.bpa.gov./searchpublications/). Coefficient of variation around the escapement estimates ranged from 3.7% to 10.8% indicating high precision. Substantial effort was made to assess all potential sources of error in DIDSON escapement estimates. An outside-of-agency consulting statistician, Quantitative Consultants, was contracted to assist with modeling, escapement, and variance estimator analysis. DIDSON sonar file reader error by direction of passage, convoluted samples over threshold (CSOT) file processing error, and downtime error were determined and used to adjust daily salmon passages and escapement estimates. Daily salmon passages were stratified and adjusted

by individual observer error and CSOT processing error, by direction of passage, and early or late season migration period (Kucera 2009). The statistical approach was analysis intensive and is provided in Section F on work elements, methods, and metrics.

Table 2. DIDSON adult salmon escapement estimate with 95% confidence intervals, coefficient of variation, down time adjustments, file reader/CSOT error adjustment, and percent of redds upstream of the DIDSON site in the Secesh River from 2004 to 2008.

Year	Escapement Estimate (±95% CI)	Coefficient of Variation (CV)	Down Time Adjustments	File Reader/CSOT Error Adjustment	Percent of Redds Upstream Of DIDSON
2004	914 (± 194)	10.8	+ 86	- 105	99.0
2005	336 (± 59)	8.9	+ 5	- 179	98.0
2006	209 (± 24)	5.8	+ 6	- 43	98.7
2007	301 (± 23)	5.6	+ 48	- 31	98.8
2008	888 (± 65)	3.7	+ 20	- 109	97.4

Adjustments for sources of error (Table 2) were important and affected accuracy of the escapement estimate (Figure 3). If sources of error had not been accounted for escapement would have been positively biased by 10.3% to 53.3% over the five year study period. The 95% confidence intervals around the adjusted escapement estimates did not overlap the unadjusted escapement estimates from 2005 to 2008, suggesting that the estimates may be significantly different.

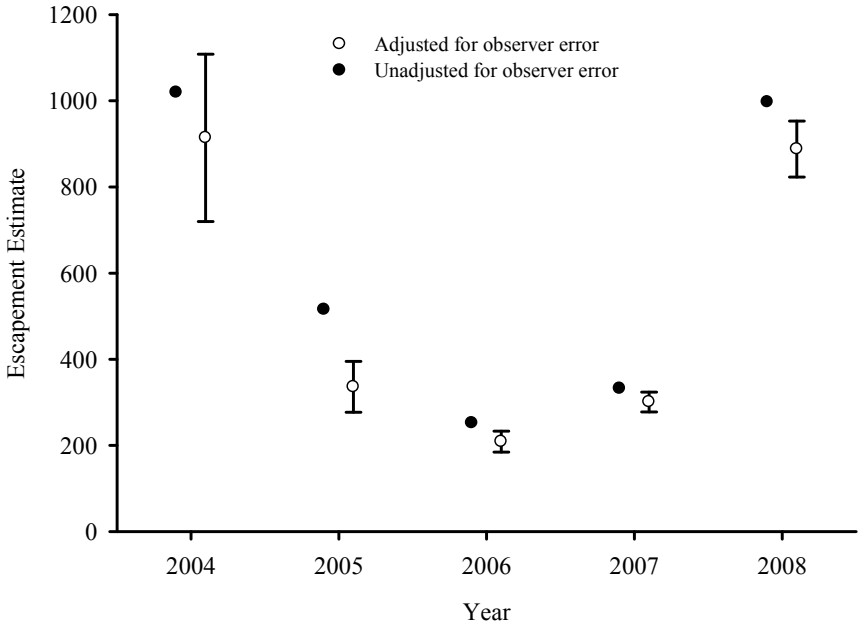

Figure 4. Comparison of DIDSON adult salmon escapement estimates adjusted for observer error, CSOT error and downtime (± 95% confidence intervals) and unadjusted escapement estimates in the Secesh River from 2004 to 2008.

Secesh River escapement monitoring has provided status and trend monitoring of natural origin salmon (Figure 4) at the population level that meets regional and subbasin plan biological objectives and strategies. The data was also used to calculate natural origin spawner abundance to compare with ICTRT (2007) population viability abundance criteria (Figure 5). Spawner abundance data from this project was provided to the ICTRT in 2007 for their viability analysis.

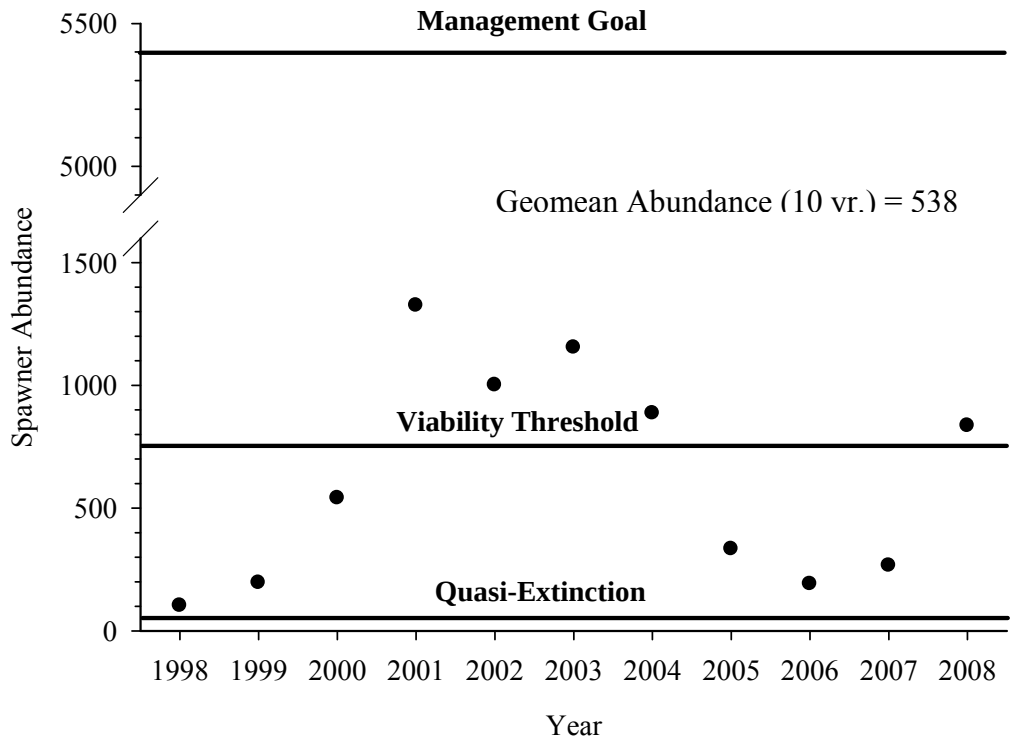

Figure 5. Estimated natural origin salmon spawner abundance (wild fish) in the Secesh River from 1998 to 2008 compared to quasi-extinction threshold, population viability threshold (ICTRT 2007), and management goals.

Validation of DIDSON target counts was conducted with an independent method, underwater optical cameras, to validate species identification. Optical cameras are the standard validation approach used for hydroacoustics (Gregory et al. 2001, Gough and Gregory 1997), resistivity counters (Smith et al.1996, McCubbing et al. 2000), and electronic counters (Shardlow 1998). Validation occurred via a stratified random sample from 13-15 days throughout the season, in a five foot validation zone located in the main channel during daytime and nighttime periods (except for 2004). In 2004, optical cameras observed 914 salmon during daytime only periods in August, with no missed species identification of DIDSON counts. Daytime and nighttime optical camera validation occurred in 2005 through 2008 with the following years and sample size in parenthesis: 2005 (435), 2006 (133), 2007 (281), and 2008 (860). No missed species identification occurred in 2005, 2006, and 2008 (i.e. – counts were identical). Six large migratory bull trout ≥ 55 cm were misidentified in 2007 (1 upstream and 5 downstream). A paired t-test indicated no significant difference ($p > 0.05$) between mean DIDSON count and optical camera count in 2007. Kucera (2009) noted that there is a relatively small migratory run of bull trout in Lake Creek (upstream of the DIDSON site) with few individuals ≥ 55 cm in the run. This was determined by bull trout observation at the Lake Creek fish count station. The

potential magnitude of bias of counting large bull trout as salmon was considered small. However, we remain concerned over the potential bias of counting larger bull trout as salmon. In 2009 underwater optical cameras were installed at the DIDSON monitoring site after ice-out to determine early season movement of bull trout compared to DIDSON target counts. Analysis of this data in currently under way. We propose to continue early season validation monitoring to determine the extent (if any) of large bull trout migration relative to the DIDSON counts.

Precision of the DIDSON technology to record salmon targets was evaluated in two ways: 1) by comparing daily net upstream passages between DIDSON and underwater video fish count station over a 51 day period, and 2) by operating two DIDSON sonar units and comparing escapement estimates and associated confidence intervals over a short block of days. A linear regression indicated that DIDSON daily net upstream counts and fish count station daily net upstream counts were nearly identical (slope = 1.01) and were highly correlated ($R^2 = 0.998$) (Figure 6). Precision comparisons between DIDSON 1 and DIDSON 2 sonar units conducted from 2005 through 2008 have been consistent. Escapement estimates and associated 95% confidence intervals have overlapped each other in 2005, 2007, and 2008 indicating the escapement estimates are not significantly different between the two sonar units. In 2006, the lack of overlap in the 95% confidence intervals suggested a significant difference between the escapement estimates. However, the difference observed in escapement estimates between DIDSON 1 and DIDSON 2 monitoring sites in 2006 (14.3%) was due to observer error (Kucera and Orme 2007).

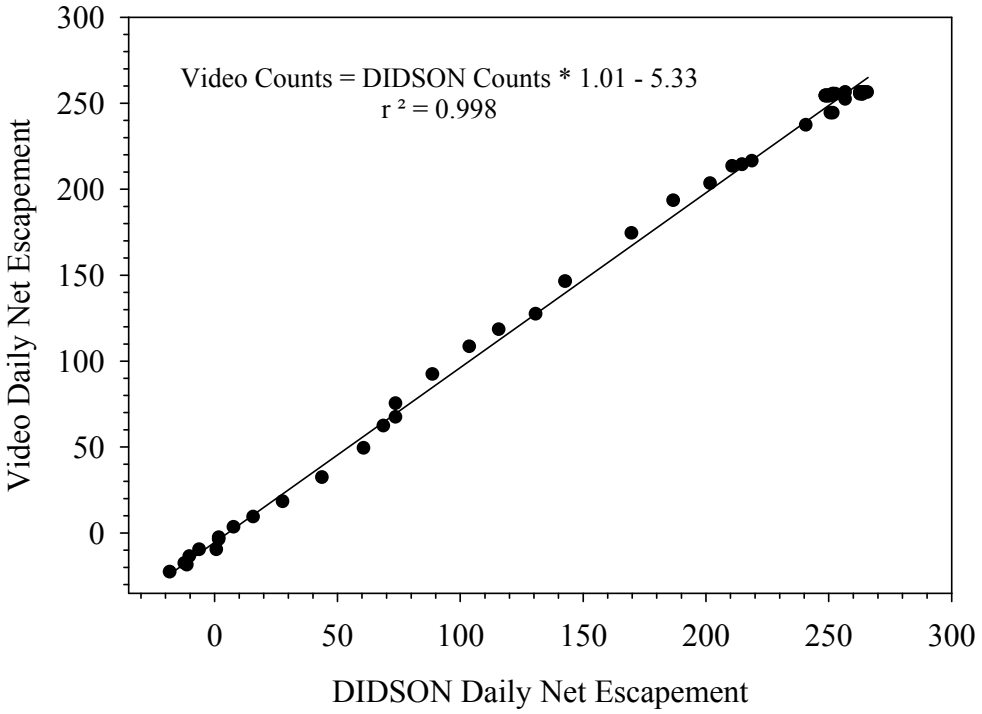

Figure 6. Linear regression of daily net upstream DIDSON escapement versus daily net upstream underwater video fish count station escapement over a 51 day period in the Secesh River in 2004.

Migration timing of adult Chinook salmon has been collected and analyzed along with water temperature and staff gage data since 2004. The percent of the salmon migration observed at the DIDSON monitoring site by date on average is: 10% - July 1, 50% - July 13, and 90% - August 13. Diel movement and within season salmon movement was also investigated. Because salmon

migration occurs in an open channel with passive DIDSON data collection, data is available on actual dates and times that salmon migrate. This information is available for potential behavioral studies on salmon migration in the Secesh River.

DIDSON sonar operation has also proven to be reliable. The sonar unit was operational from 84% to 98.1% of the salmon migration period over the five year study period. Small periods of downtime have been associated with power outages and laptop software problems. Forest fire related problems in 2007 caused the DIDSON unit to be operational only 84% of the time. Results from this project indicate that DIDSON technology is reliable and can be used to generate accurate and precise estimates of salmon escapement if appropriate methods are used.

Calculation of productivity (progeny-per-parent ratios) data relies on annual run reconstructions and will use two variants of parents; estimated escapement and spawner abundance (Hesse et al. 2006). Productivity data has lagged behind determination of population size (escapement and spawner abundance). DIDSON salmon escapement monitoring in the Secesh River began in 2004. The 2004 parent brood year would return adult progeny in 2007 (jacks), 2008 (four year olds), 2009 (five year olds), and 2010 (six year olds if any). Age assignment of adult returns from carcass recoveries in 2008 and 2009 is currently pending laboratory analysis (Jerry Lockhart – personal communication).

This project acknowledges the need to share updated information on adult natural origin salmon escapement, spawner abundance, and productivity as soon as it is available. The project in the past has used the annual report submissions to the BPA web site (http://www.efw.bpa.gov/searchpublications/) to make project information available. Annual reports are now also available on the Tribe's web site (http://www.nezperce.org/~dfrm/research) The project also maintains an annual distribution list of managers, researchers, ICTRT members, and other recovery planners who receive hard copies of annual reports.

Beside project annual progress reports that are on the Bonneville Power Administration web site the following DIDSON salmon escapement monitoring professional presentations were made:
2005 – Idaho Chapter AFS meeting – Boise, ID
2006 – Western Division AFS meeting – Missoula, MT
2008 – National Chapter AFS meeting – Invited speaker - San Francisco, CA
2008 – Adult Salmon and Steelhead Sonar Monitoring Workshop – Invited speaker - Vancouver, WA
2009 - Idaho Chapter AFS meeting – Boise, ID

This project has been funded since 1997. There are 12 annual reports available on the BPA web site summarizing major project findings from 1997 through 2008. The estimated annual project funding levels from 2001 to 2009 are: 2001 - $169,053; 2002 - $220,924; 2003 - $456,380; 2004 - $424,459; 2005 - $401,789; 2006 - $401,789; 2007 - $ 305,071; 2008 - $305,071; 2009 - $305,071. Total estimated expenditure on the project since 1997 is $??????????? (Alicia Mendenhall, BPA – personal communication).

Adaptive Management Implications

The project has been adaptively managed for successful project operation in the following manner. As mentioned previously in the Lake Creek section, underwater video operations on the

Secesh River were discontinued after 2000 because of the inability to utilize temporary weir structures in the river and to observe the first salmon passage during any year (1998-2000). The 2002 provincial review process was used to request the necessary funds to implement new or innovative technology to determine natural origin adult salmon abundance at the population level in the Secesh River. We collaborated with the Pacific Northwest National Laboratory (PNNL) and conducted a review of available techniques to determine salmon abundance in large river systems. PNNL recommended the use of DIDSON technology for adult salmon escapement monitoring. We have implemented and adapted this technology for use in a remote stream environment with successful results through the first six years of application. Implication from the adult spawner abundance estimate information (Figure 5) is that the Scesh River population, 10 year geometric mean abundance (538), is below a proposed viable population level (ICTRT 2007). A time series of adult spawner and productivity data on the Secesh River is underway to allow analysis using a geometric mean abundance in concert with productivity and spatial distribution information. Coordination with regional monitoring and evaluation plans still needs to occur to identify the list of index streams where population status and trend monitoring will occur. The Secesh River is a logical candidate because it supports a natural origin chinook salmon population recognized by the ICTRT for recovery planning, is unsupplemented, has ongoing studies whose stated objectives are to quantify adult and juvenile abundance and associated productivity key performance measures, and which serves as a control or reference stream for supplementation studies.

F. Proposal biological/physical objectives, work elements, methods, and metrics

The major goal of the project is to collect natural origin adult spring and summer chinook salmon escapement and productivity information for population status and trend monitoring in the Secesh River. This data will be used for reference stream comparison to supplementation programs, for effective resource management, and for long term monitoring of listed species recovery metrics. This project also proposes to collect adult steelhead escapement data in Joseph Creek for population status and trend monitoring.

The project biological objectives listed below are clearly linked to the Salmon Subbasin Management Plan (Ecovista 2004), to the FCRPS Biological Opinion RPA 50.6 (NOAA Fisheries 2008), and the NPPC (2009) Fish and Wildlife Program. The reviewer is directed to section C. - Rationale and significance to regional programs for specific listing of the respective plan biological problem statement, limiting factors, objectives, and strategies. In this manner, all of the objectives and strategies will not be duplicated and make this proposal even longer.

Objective 1. Coordinate the Chinook Salmon Adult Abundance Monitoring project with appropriate Tribal, National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries), and other federal and state management agencies and independent scientists in the Snake River basin. This is equivalent to **Work Element 189.** Regional Coordination and **Work Element A. 165.** Produce Environmental Compliance Documentation

Methods (Work Elements):

Task 1.1 Coordinate the escapement monitoring project with regional monitoring and evaluation efforts by NOAA Fisheries, federal, Tribal, and state management agencies, researchers and independent scientists.

Task 1.2 Attend research, management, and coordination meetings as required.

Task 1.3 Coordinate, modify, and maintain Section 10 research permits as necessary.
Task 1.4 Coordinate, provide information, and obtain NEPA clearance from the Bonneville Power Administration.
Task 1.5 Attend all relevant Inter- and Intra-agency meetings as required to coordinate activities and share project information.

DIDSON technology is a relatively new application of hydroacoustics to be used in salmon escapement investigations. There are very few in use in the field of fisheries and even fewer applied to the task of adult abundance monitoring in riverine environments. Reports from users, Alaska Department of Fish and Game, Washington Department of Fish and Wildlife, and our 2004-2009 work have been very positive. It is important that the results of this work be coordinated with other agencies as it occurs. NOAA Fisheries and the salmon managers are interested in the accuracy and precision of this technology and its application to status and trend monitoring, population viability, and recovery metric monitoring. Meetings, conferences and workshops will be attended to share information and to learn the latest developments in the use of the technology for escapement enumeration. There will be extensive net-working with colleagues to exchange the information. Research, management, and policy level project coordination meetings will be attended with multiple state and regional agencies as required for successful project operation. Department research and administrative staff will meet with the Bonneville Power Administration (BPA) and Northwest Power and Conservation Council (NPPC) staff as needed to coordinate BPA funded projects in the three state area. Project coordination meetings with various agencies usually occur in Portland given that that is where both the BPA and NPPC project headquarters are located. We will attend the annual coordination meeting with the Payette National Forest to share project direction and information.

The Nez Perce Tribe does not recognize that the Endangered Species Act takes precedence over or precludes Tribal sovereignty or rights in any manner. However, the Tribe does recognize that salmon and steelhead are listed as a threatened species, and strongly believes in coordination efforts to monitor, conserve, protect and recover populations at low levels of abundance and high risk of extirpation. In that regard the Columbia River Inter-Tribal Fish Commission maintains a Section 10 research permit, by and through the Bureau of Indian Affairs, coordinating Tribal activities relative to listed salmon populations. The NMFS has issued a Biological Opinion (NOAA Fisheries 2009) on the operation of the Federal Columbia River Power System. This project collects information on threatened species under RPA's for research, monitoring, and evaluation actions. The proposed activities are thus undertaken to coordinate with the National Marine Fisheries Service under the Endangered Species Act (NMFS 1992) and to monitor recovery actions.

Pisces statement of work and Section 10 research permits will be submitted to the BPA's Environmental Compliance Group. All environmental compliance requirements will be coordinated and completed prior to 2011 research activities being undertaken.

Objective 2. Administer the Chinook Salmon Adult Abundance Monitoring project. This is equivalent to **Work Element I:119**. Manage and Administer Projects.

Methods (Work Elements);

Task 2.1 Attend pisces training and maintain current knowledge of Bonneville Power Administration contract requirements.
Task 2.2 Prepare and submit accrual reports to the Bonneville Power Administration.

Task 2.3 Prepare and submit pisces 2012 statement of work and budget to the Bonneville Power Administration.
Task 2.4 Abide by the Nez Perce Tribe policies and procedures as required.

Several tasks have been mandated in the day to day administration of project operations. Pisces training will be attended as required and Bonneville Power Administration contracting requirements will be reviewed. Mandated accrual estimate reporting to the Bonneville Power Administration will be completed in June and September. The pisces statement of work will be developed and submitted to the Bonneville Power Administration 90 days prior to contract expiration, and will coordinated for research sufficiency, management, legal, and policy review. Nez Perce Tribe policies and procedures will be adhered to as required (Human Resources, Finance, Resolutions, Administrative Actions, etc.) as will all other policy and personnel directions. Meetings and training will be attended as necessary to ensure policy and management consistency.

Objective 3. Estimate anadromous salmonid escapement into the Secesh River and Joseph Creek. This is equivalent to **Work Element C:70**. Install Fish Monitoring Equipment, **Work Element D: 157**. Collect/Generate/Validate Field and Lab Data, and **Work Element F:162**. Analyze/Interpret Data.

Sub-Objective 3.1: Estimate natural origin adult salmon escapement, spawner abundance, productivity, and migration timing into the Secesh River on an annual basis.

Methods (Work Elements);

Task 3.1.1 Install streambank data collection equipment, DIDSON sonar, temporary structures, and underwater optical validation cameras prior to the salmon migration period.
Task 3.1.2 Operate and maintain the DIDSON salmon escapement monitoring site continuously during the salmon migration period on a daily basis to ensure safe and successful operation of the facility.
Task 3.1.3 Collect DIDSON sonar files and multiplexed DIDSON and validation optical camera information on a daily basis throughout the salmon migration period.
Task 3.1.4 Install constant recording thermographs and collect hourly water temperature data at the DIDSON site.
Task 3.1.5 Collect daily staff gauge information for calculation of stream discharge.
Task 3.1.6 Compress DIDSON sonar files to fish motion-only frames. Read daily sonar files and count adult salmon passages.
Task 3.1.7 Read optical camera multiplexed digital files from a stratified random sample of dates for validation purposes.
Task 3.1.8 Validate DIDSON sonar target counts with underwater optical cameras from the stratified random sample of days.
Task 3.1.9 Quantify daily and total adult salmon passages into the Secesh River on an annual basis. Estimate escapement at the DIDSON monitoring site with associated variance estimators (95% C.I.'s and CV's).
Task 3.1.10. Estimate the total Secesh River adult salmon escapement (natural origin and hatchery origin), natural origin salmon escapement, and natural origin spawner abundance.

Task 3.1.11. Compare the estimated natural origin Secesh River salmon spawner abundance with ICTRT (2007) population viability and quasi-extinction thresholds.
Task 3.1.12 Determine the salmon migration timing at the DIDSON monitoring site. Correlate migration timing with water temperature and staff gage data.
Task 3.1.13 Compare DIDSON salmon escapement estimate with extensive area and index area redd count data upstream of the monitoring site. Conduct regression analysis of escapement and redd count data to examine relationships between these variables. Calculate a fish per redd value upstream of the DIDSOIN monitoring site.
Task 3.1.14 Remove the DIDSON salmon escapement monitoring site after the spawner migration is completed (approximately September 15, or after seven consecutive days of no fish passage in September).
Task 3.1.15 Assist ISS project staff with chinook salmon spawning ground surveys and collection of biological information from salmon carcasses for run reconstruction purposes. Calculate hatchery fraction and prespawning mortality from carcass recoveries on the spawning grounds for estimation of adult spawner abundance.
Task 3.1.16 Calculate productivity (progeny-per-parent) ratios on a brood year basis. Productivity estimates will use two variants of parents: escapement and spawner abundance.
Task 3.1.17 Provide a quality control checked database for all project data that is backed up.

DIDSON technology is a non-invasive technique that does not require capture or handling of threatened adult spring and summer chinook salmon. This eliminates the potential for incidental trapping and handling mortality and impedance related concerns for a listed species. It can be used in an open river channel with minimum structures, and operates equally well under turbid high discharge or low flow stream conditions. DIDSON provides near video quality images for identification of objects under water. By using up to 96 different sonar beams high frequency sound waves are sent through water to register vibrations reflected from an object. DIDSON collects sufficient information to show the size, shape, and direction of movement (upstream or downstream) of an object. The observer views a two dimensional silhouette of a fish swimming, not a sonar blip that requires positive identification in the laboratory. DIDSON operates at ultra high frequencies, at 1.8 MHz and 1.1 MHz, and uses acoustic lenses which allow high quality images. The literature was examined to determine the potential for salmon and steelhead avoidance to these frequencies (Gregory et al. 2001). Chinook salmon, rainbow trout (*O. mykiss*), and atlantic salmon (*Salmon salar*) have demonstrated avoidance behavior at 10 Hertz (Hz) (Knudsen et al. 1997, Knudsen et al. 1994, Enger et al. 1992, Knudsen et al. 1992) which is at a very low frequency. Atlantic salmon have detected sound frequencies below 380 Hz (Hawkins and Johnstone 1978). Some of the Alosidae family, alewife (*Alosa pseudoharengus*), American shad (*A. sapidissima*), blueback herring (*A. aestivalis*), and twaite shad (*A. fallax fallax*), demonstrate avoidance responses up to 162,000 Hz. The frequencies the DIDSON unit operates at appears to be well above the audible range of chinook salmon.

High frequency DIDSON files are recorded at six frames per second, 24 hours per day, and seven days per week during the salmon migration period. Operationally, stream width at the DIDSON site is approximately 26 m and maximum stream depth is 2.1 m. Temporary tripod-supported picket fences are installed to keep salmon from getting too close to the DIDSON unit and to keep them away from undercut banks to ensure collection of clear sonar recordings. Anytime the DIDSON unit is deployed or moved, a calibration target is placed instream from the DIDSON unit surface to the bottom and from the far shore surface to bottom to ensure that the

entire water column is ensonified. If the calibration target is not successfully acquired the DIDSON unit is re-aimed until it is. The DIDSON unit and optical cameras were connected into a topside box where DIDSON files were collected and recorded through use of a laptop computer and an external hard drive. DIDSON file size is 27.3 gigabytes of data per day. Files are processed by a CSOT motion detection algorithm to fish motion-only periods that average about 18% of the original file size and then files are read manually. Improvements in the automated fish counting software continue to be developed and we desire to move toward semi-automated or automated sonar file counting. Validation optical cameras and a DIDSON signal are multiplexed and recorded on a digital video recorder to ensure synchronization in time of both sources. Near simultaneous viewing of DIDSON and the three optical cameras is then possible. Data collected includes number of adult salmon, date, time, and direction of movement. The topside box, DIDSON unit, and optical cameras are powered a solar panel, and by eight 6 volt batteries connected in series, which are charged daily by a generator.

Adult salmon escapement in the Secesh River was determined by calculating the maximum net upstream number of salmon targets that migrated past the DIDSON monitoring site once spawning had commenced. Therefore, the escapement estimate represents the largest number of spawning adults that was available to contribute to salmon reproductive success. In addition, an end of the season escapement estimate was generated to estimate the number of adult salmon leaving the spawning area, and to allow the efficiency of carcass recoveries to be calculated.

Determination of net upstream movement was simply a matter of cumulative addition for upstream movement, or subtraction when a salmon target moved downstream. Salmon escapement was determined by viewing CSOT processed DIDSON files of fish motion-only periods, and manually counting fish targets that were ≥ 50 cm in length. The DIDSON software's measuring tool allowed total length measurement of individual fish targets. This size-based approach allowed enumeration of adult salmon-sized targets separate from other fish species moving through the DIDSON monitoring site. Adult steelhead overlap in size with and could potentially be counted as adult salmon. However, the steelhead spawning migration timing appears to be temporally discrete from the salmon migration timing. Bull trout was the only other fish species large enough to overlap in size with jack salmon (55 cm or greater). Large non-fish targets such as ducks, otters, and debris were identifiable using the lengths and widths (overall shape) and swimming motion of the targets. Identification of non-fish targets improved with observer experience. Confidence in DIDSON target identification was gained when viewing and comparing the relative size of hundreds of salmon with non-salmon species and comparing it with optical camera validation information.

Ssalmon escapement was determined by observers independently viewing CSOT processed DIDSON files of the salmon migration. Data recorded included date, time of passage, the direction of passage (upstream or downstream), total length of the target, and distance from the sonar unit. Random quality control checks of files read by each observer are conducted to ensure accuracy. After the first salmon passage of the season was identified, DIDSON files were read before this date to ensure seven days of no salmon passages prior to the first observed fish. This approach was assumed to account for the first salmon passage of the season. All observers noted targets that were questionable in terms of length, passage direction, or non-fish targets. After all files were viewed, all questionable targets were reviewed by the observers for concensus. Known length carcass trials were conducted to examine the accuracy of manually measured fish lengths using DIDSON software (Kucera 2009). A negative bias in manually measured carcass lengths was reported. To correct for the negative bias an average manually measured reader

length regression formula is used to adjust fish lengths from 50 cm to 55 cm. The data was stratified by time period (early and late season passages), by observer, and by direction of passage.

Three known sources of error were addressed to adjust the estimated adult salmon escapement. The sources of error are CSOT processing error, observer error, and equipment downtime error. A systematic subsample of 15 days of original DIDSON files, not CSOT processed files, was reviewed independently by three reviewers with every fourth consecutive day being read. Date, time, direction, length, and location of salmon targets were recorded. This provided the basis to estimate the proportion of missed passages (error) by direction of passage for each observer, by time period, and for CSOT processed files. All passage discrepancies both within and between the 15 subsample day original files, and the same 15 day CSOT processed files were reviewed to verify missed passages. It was assumed that the maximum number of passages observed by the three independent reviewers, within the subsampled days, represented the true number of passages and that no salmon passages went undetected by all three reviewers. Error was calculated using a single fish passage as the sample unit.

First, CSOT processing error was determined by comparing original DIDSON files with CSOT processed files to ensure that CSOT processed files accurately captured all salmon passages. CSOT error was estimated using the same 15 day systematic sample reviewed for observer error. All passage discrepancies between the 15 days of original files and CSOT processed files were reviewed. Passages that were not present or passages that were represented by a single frame on CSOT processed files were categorized as a CSOT error. CSOT error was calculated as the number of passages missed by CSOT processing divided by the number of passages present on original files. Differences in CSOT error, by direction, were evaluated with a z-test.

Secondly, since CSOT processed files and original DIDSON files were both read manually, observer error (viewer efficiency) was assessed. Individual observer error by direction of passage and time period was determined from the 15 day systematic sample. Each individual's observer error was calculated as the number of passages (by direction) missed divided by the total number of passages (by direction) possible. The individual's observer error was applied by direction to correct each individual's daily observed salmon passages for the entire season. In addition, observer error was estimated for each observer by direction for the six to eight days of CSOT files and for the 15 days of original files. Observation error may be different between CSOT files and original files due to: 1) discontinuity of time and image frames in CSOT files resulting in choppy and erratic image flow making viewing difficult; 2) CSOT processing sometimes resulted in only a few frames of a salmon passage being recorded, making detection of a passage more difficult; and 3) observers may unknowingly be more attentive of fish passages during review when aware that the files are also being reviewed by others. Differences in observation error between observers, by direction, and between file types were evaluated with a z-test.

Analysis is currently underway to examine sources of error between years to examine whether an average reader error and CSOT processing error for all observers can be calculated. In this manner an average reader error might be applied instead of having to read DIDSON files every year for determination of reader error and CSOT error. The average reader error would then be applied for all observers to adjust daily salmon passages. The analysis in not completed but appears promising. It has the potential to save a total of up to 60 days of file reading a year.

The third source of error are salmon passages that potentially could go undetected during periods of DIDSON equipment downtime. Power failures or random computer glitches were generally the cause of longer periods of downtime. Downtime was calculated from time gaps recorded by observers during file review and from time gaps between files. A daily mean upstream passage was used to estimate passages that may have occurred during equipment downtime. Downtime corrections were made to each day that experienced downtime greater than 30 minutes. Corrections consisted of that day's observations added to the mean daily net upstream passage multiplied by the proportion of the day not sampled.

The total net upstream escapement (Total_Net_Up) was calculated by summing the estimated net escapement within stratified time periods (TPeriod_Net_Up) as

$$Total_Net_Up = \sum_{t}^{n} TPeriod_Net_Up_t \, .$$

Where *t* is an individual time period and *n* is the number of stratified time periods within the season. Net escapement within each individual time period (TPeriod_Net_Up) was the sum of the estimated net upstream passages that may have occurred during equipment downtime (DN_Time_Net_Up) and the total adjusted net upstream passages (Adj_Net_Up), adjusted for both observer and CSOT error as

$$TPeriod_Net_Up_t = \left(DN_Time_Net_Up_t\right) + \left(Adj_Net_Up_t\right).$$

Adjustments for the net upstream passages that may have occurred during equipment downtime (DN_Time_Net_Up) was estimated by multiplying the mean daily total adjusted net upstream passages ($\overline{\text{Adj_Net_Up}}$) by the sum of days not sampled (Days_Not_Sampled) within each stratified time period as per the below equation. For downtime periods greater than one day, an average daily passage from the seven days prior to and following the period of extended downtime was used (Chris Beasley and Rishi Sharma, Quantitative Consultants – personal communication).

$$DN_Time_Net_Up_t = \overline{Adj_Net_Up_t} \cdot \sum \left(Days_Not_Sampled\right)_t \, .$$

Days that had downtime adjustments were excluded from the mean. The number of days not sampled could be a whole number or a fraction of a day. The total adjusted net upstream passages (Adj_Net_Up) that occurred within a time period was calculated as the sum of the adjusted viewer observation (Adj_Reviewer_Obs) by direction (d) of passage (upstream and downstream) divided by 1 minus the CSOT error (CSOT_Error) by direction (d) within each time period (t) as

$$Adj_Net_Up_t = \sum \left[Adj_Reviewer_Obs_{t,d} \Big/ \left(1 - CSOT_Error_{t,d}\right) \right].$$

The adjusted reviewer observation (Ajd_Reviewer_Obs) by direction (d) within each time period (t) was calculated as sum of each individual (i) reviewers observation (Reviewer_Obs) divided by 1 minus that individuals (i) observation error (Reviewer_Error) by direction (d) within each time period (t) as

$$Adj_Reviewer_Obs_{d,t} = \sum \left[Reviewer_Obs_{t,d,i} \Big/ \left(1 - Reviewer_Error_{t,d,i}\right) \right].$$

The CSOT error (CSOT_Error) was estimated as the number of observations missed during CSOT processing (CSOT_Obs_Missed) divided by the number of observations possible on original files (CSOT_Obs_Possible) by direction of passage (d) within each time period (t) as

$$CSOT_Error_{t,d} = CSOT_Obs_Missed_{t,d} \Big/ CSOT_Obs_Possible_{t,d}.$$

Individual (i) observation error (Reviewer_Error) was estimated as the number of observations missed (Reviewer_Obs_Missed) divided by the number of observations possible (Viewer_Obs_Possible) by direction of passage (d) within each time period (t) as

$$\mathrm{Re}viewer_Error_{t,d,i} = \mathrm{Re}viewer_Obs_Missed_{t,d,i} \Big/ Viewer_Obs_Possible_{t,d,i\,\mathrm{Re}v}.$$

Variance of Net Upstream Escapement

The confidence interval of the escapement estimate was based on the variance associated with observer error and the variance associated with passages estimated to have occurred during equipment downtime. The variance of the total net upstream escapement (var(Total_Net_Up)) was calculated as the sum of the variance of each individual time period estimate (var(TPeriod_Net_Up)) as

$$var(Total_Net_Up) = \sum_{t}^{n} var(TPeriod_Net_Up_t).$$

Where *t* is the individual time period and *n* is the number of time periods. The variance of net upstream passages within each individual time period (var(TPeriod_Net_Up)) was calculated as the sum of the variance of the estimated net upstream passages that may have occurred during equipment downtime (var(DN_Time_Net_Up) and the variance of the total adjusted net upstream passages (var(Adj_Net_Up) as

$$var(TPeriod_Net_Up_t) = var(DN_Time_Net_Up_t) + var(Adj_Net_Up_t).$$

Variance for equipment downtime (var(DN_Time_Net_Up)) was estimated by multiplying the variance of mean daily total adjusted net upstream passages (var($\overline{Adj_Net_Up_t}$) by the square of the sum of days not sampled (Days_Not_Sampled) during that time period as per the equation below. For periods of extended downtime, greater than 24 hours, we generated a weighted mean of the adjusted net upstream passages for the seven days before and after the period of downtime to generate variance around the interpolation estimate (Chris Beasley and Rishi Sharma, Quantitative Consultants – personal communication).

$$var(DN_Time_Net_Up_t) = var(\overline{Adj_Net_Up_t}) \cdot (\sum (Days_Not_Sampled)_t)^2 .$$

Days that had downtime adjustments were excluded when calculating the variance of the mean. The number of days not sampled could be a whole number or a fraction of a day. The variance of the total adjusted net upstream passages (var(Adj_Net_Up) was calculated using the total adjusted reviewer observations (Adj_Reviewer_Obs) and the associated variance (var(Adj_Reviewer_Obs), and the estimated CSOT error (CSOT_Error) and that associated variance (var(CSOT_Error) by passage direction (d) within each time period (t). The variance of the total adjusted net upstream passages (var(Adj_Net_Up) was calculated as the product of the variance of total adjusted reviewer observations (var(Adj_Reviewer_Obs)) and the variance of CSOT error (var(CSOT_Error)) plus the product of the square of total adjusted reviewer observations (Adj_Reviewer_Obs) and variance of CSOT error (var(CSOT_Error) plus the product of the square of CSOT error (CSOT_Error) and the variance of total adjusted reviewer observations (var(Adj_Reviewer_Obs)) as

$$var(Adj_Net_Up_t) = \sum_{1}^{n} \begin{bmatrix} var(Adj_Reviewer_Obs_{t,d}) \cdot var(CSOT_Error_{t,d}) \\ +(Adj_Reviewer_Obs_{t,d})^2 \cdot var(CSOT_Error_{t,d}) \\ +(CSOT_Error_{t,d})^2 \cdot var(Adj_Reviewer_Obs_{t,d}) \end{bmatrix}.$$

The variance of the total adjusted reviewer observations (var(Adj_Reviewer_Obs)) was calculated as the square of the sum of each individuals (i) observations (Reviewer_Obs) by direction (d) within each time period (t) multiplied by the variance of the individuals reviewer error (var(Reviewer_Error)) as

$$var(Adj_Reviewer_Obs_{t,d,r}) = \sum (Reviewer_Observation_{t,d,r})^2 \cdot var(Reviewer_Error_{t,d,r}).$$

The variance of each individuals (i) observation error (var(Reviewer_Error)) within each time period (t), by direction of passage (d) was estimated as the product of the observation error (Reviewer_Error) and 1 minus the observation error (Reviewer_Error) divided by the sample size (Reviewer_Obs_Possible) as

$$var(Reviewer_Error_{t,d,r}) = \frac{(Reviewer_Error_{t,d,r}) \cdot (1 - Reviewer_Error_{t,d,r})}{Reviewer_Obs_Possible_{t,d,r}}.$$

Similarly, the variance of the CSOT error (var(CSOT_Error) within each time period (t), by direction of passage (p) was estimated as the product of the CSOT error (CSOT_Error) and 1 minus the CSOT error (CSOT_Error) divided by the sample size (CSOT_Obs_Possible) as

$$var(CSOT_Error_{t,d}) = \left[(CSOT_Error_{t,d}) \cdot (1 - CSOT_Error_{t,d}) \Big/ CSOT_Obs_Possible_{t,d} \right].$$

Calculations of the running daily sum of observation, escapement estimates, and confidence intervals were completed to enable the determination of the maximum net upstream passages.

Optical camera and DIDSON multiplexed digital files are reviewed from a stratified random sample of days from throughout the salmon migration season. This is conducted for species identification of DIDSON target counts. This usually provides a sampling rate of 15-20% of all DIDSON files. Optical camera salmon counts are compared with DIDSON target counts by direction of passage and statistically compared for significant difference by a paired t-test at the $p < 0.05$ level. If significant differences exist between optical camera salmon counts and DIDSON target counts, daily salmon passages would be adjusted.

Total Secesh River salmon escapement (natural origin and hatchery origin), natural origin salmon escapement, and natural origin spawner abundance (wild fish) was estimated for population status and trend monitoring and application to listed species recovery metrics. Escapement, as used here refers to a population measure of numbers of adults (including jacks) that have escaped to a certain point, usually the mouth of a stream, and differs from the term

spawner abundance. Spawner abundance is defined as a population measure of the estimated number of total spawners on the spawning grounds. Redd count and carcass data used was collected by the Tribe's ISS project (Lockhart et al. 2008, BPA Project No. 198909802). The DIDSON adult salmon escapement estimate was used to estimate natural and hatchery salmon escapement upstream of the DIDSON monitoring site. The number of redds located downstream of the DIDSON monitoring site are identified from extensive area redd count surveys. The number of redds located downstream of the DIDSON site was expanded by a DIDSON generated fish per redd number. This number was determined by dividing the DIDSON escapement estimate (fish) by the extensive area redd count upstream of the DIDSON site (redds). The DIDSON salmon escapement estimate was summed with the redd count expansion abundance estimate, for redds located downstream of the DIDSON site, to estimate total adult salmon escapement in the Secesh River system (natural and hatchery fish combined). An average hatchery fraction was calculated using values calculated from the Lake Creek underwater video fish counting station and from carcass recoveries in the Secesh River excluding Lake Creek (Faurot and Kucera 2004). It was believed these provided the most accurate estimate of hatchery composition for the entire Secesh River. The estimated natural origin salmon escapement for the entire Secesh River was derived as follows. The DIDSON escapement estimate was added to, the number of salmon redds located below the DIDSON site multiplied by the DIDSON fish per redd number, and then multiplied by the proportion of natural origin salmon in the spawning population. Natural origin spawner abundance relied on use of carcass recovery data to calculate the proportion of females in the spawning population, a wild female prespawning mortality percentage, and the number of wild female prespawning mortalities. The number of wild female prespawning mortalities was then subtracted from the natural origin escapement estimate and provided the estimate of spawner abundance. Salmon harvest (if any) is also accounted for in the escapement estimates. Summarize natural origin escapement and spawner abundance data for status and trend analysis, and provide the time series of data to JCAPE and NEOH monitoring and evaluation projects for supplementation program population comparison. Compare natural origin spawner abundance estimates to ICTRT (2007) viability threshold and provide data to recovery planning agencies.

Assistance is provided to the Tribe's ISS project for salmon spawning ground survey redd counts and carcass recovery data collection. Standard location, date, fork length, sex, marks, scales, genetic samples, and percent spawned data is collected from all salmon carcasses. Information collected from carcasses that specifically applies to this project are determination of hatchery composition on the spawning grounds, scale aging for age at return and adult brood year analysis, and prespawning mortality estimation.

One of the goals of this project is to provide long term salmon productivity information on the natural origin salmon population in the Secesh River for supplementation program reference stream comparison and threatened species recovery monitoring. Progeny-per-parent ratios (adult:adult ratios) will be determined on a brood year basis. This is a derived performance measure that relies on quantification of adult abundance, an index of spawner abundance (redds), spawner abundance, fish per redd, hatchery fraction, age group structure including age at return, spawner sex ratios, prespawning mortality, and tributary harvest (if any). Calculation of adult-to-adult ratios relies on annual run reconstructions and will use two variants of parents; estimated escapement and spawner abundance (Hesse et al. 2006). Age at juvenile emigration and age at adult return, to assign individuals to specific brood years, will be determined through dorsal fin ray aging (primary method) and from scales (if needed). Age determination from all salmon carcasses are used to partition the total escapement estimate. The year class (brood year) that

each returning spawner originated from can then be determined. Aging methods and calculation of adult-to-adult ratios is a coordinated effort for consistency in application because the Secesh River acts as a reference stream for supplementation program comparison (Vogel et al. 2005, Hesse et al. 2006).

Quality control checks occur for all salmon passage data entered into the database on an annual basis. A quality control checked database for all project data is backed up and stored at independent locations to ensure protection and availability of project information. Original and CSOT processed DIDSON files are also stored for potential future review or analysis.

Subobjective 3.2: Estimate natural origin adult steelhead escapement, hatchery composition, migration timing, age structure and life history characteristics in Joseph Creek on an annual basis.

Methods (Work Elements):

Task 3.2.1 Install a resistance board weir (floating weir) with upstream and downstream traps prior to the steelhead migration period.
Task 3.2.2 Operate and maintain the floating weir monitoring site continuously during the steelhead migration period on a daily basis to ensure safe operation of the facility. Collect adult steelhead data for origin, length, sex, marks (fin clip, PIT tag, CWT), scale sample, and tissue sample (DNA)
Task 3.2.3 Install constantly recording thermographs and collect hourly water temperature data at the monitoring site.
Task 3.2.4 Collect daily staff gage information and/or use the Joseph Creek stream flow monitoring station discharge data.
Task 3.2.5 Quantify daily and total adult steelhead passages into Joseph Creek on an annual basis. Estimate the steelhead hatchery composition. Estimate escapement with associated variance estimators (95% C.I. and CV's).
Task 3.2.6 Compare the weir mark recapture steelhead escpement estimate with the PIT tag array escapement estimate.
Task 3.2.7 Determine steelhead migration timing st the monitoring site. Correlate migration timing with water temperature and staff gage or stream discharge information.
Task 3.2.8 Compare mark recapture escapement estimate with steelhead redd count survey data. When time series allows conduct linear regression between escapement and redd count data.
Task 3.2.9 Remove the resistance board weir steelhead escapement monitoring site after the spawner migration is completed.
Task 3.2.10 Provide a quality control checked database for all project information.

The Joseph Creek is a tributary stream to the lower Grande Ronde River and it is approximately 1,215 square kilometers in size. It contains an estimated 223 miles of steelhead spawning habitat (Cat Tracks Wildlife Consulting 2004). Stream discharge data from 2003 to 2009 (Washington Department of Ecology web site) indicates a maximum stream discharge of up to 1,580 cfs, usually during April, depending on the year.

A resistance board weir (floating weir) and traps are proposed for adult steelhead given the desire for not only escapement data but hatchery composition and age structure information on the population (RM&E Workshop). Several uncertainties exist with the selection of this enumeration method. A thorough site reconnaisaance will have to determine if a suitable weir

site exists in lower Joseph Creek. Road access exists in only about five miles of stream in the lower portion of the system. Although resistance board weirs have been used for steelhead escapement monitoring (Mayer et al. 2006, Bill Young – personal communication) it is unknown if the weirs can withstand stream discharge of up to 1,580 cfs. However, it does appear probable that a resistance board weir could be maintained through March when stream discharge in Joseph Creek typically, has been below 700 cfs (depending on year). Previous steelhead escapement estimates In Joseph Creek have ranged from 621 to 945 fish (Cat Tracks Wildlife Consulting 2004), and up to 2,132 steelhead (NOAA Fisheries 2008). If that is the case there should be an opportunity to capture and mark several hundred individuals for population estimates even if the weir can not be fished continually throughout the migration period. Sampling of this number of adults would also allow collection of the desired biological information. The weir may also fish through the entire spring runoff period with varying efficiency. CONTINUE!!! IMPEDANCE CONCERNS. VIDEO APPROACH!!!

POPULATION ESTIMATE METHODS!!!

Work Elements (Tasks) and Methods:
Replace this text with your response in paragraph form)

G. Monitoring and evaluation

(Replace this text with your response in paragraph form)

H. Facilities and equipment

This project has allocated office space at the Department's McCall Field Office for project logistical support and access to the Secesh River DIDSON monitoring site. The Secesh River monitoring site is accessible by road and is located one hour from the McCall Field Office. Office space is cost shared between all Tribal fisheries projects that operate out of this region. Permanent personnel and seasonal field crews are based out of the McCall Field Office. The Field Office provides office space for personnel and a fully equipped shop for project equipment storage and maintenance. Storage space is also rented to provide housing for project equipment and supplies. All major equipment is housed out of the McCall Field Office or storage space. Major project equipment includes the following: project vehicles; two snowmobiles for early season access to monitoring site; two four wheelers borrowed from other Field Office projects; two DIDSON acoustic imaging cameras; stream-side wall tent with flooring that provides a waterproof environment for equipment and supplies; four field laptop computers; underwater video cameras; underwater LED arrays; two waterproof integrated system topside boxes for both DIDSON and validation videotape recording and multiplexing, and power supply; solar panels and generators for remote power supply; artificial bottom substrate; temporary tripod picket structures; Iomega 400 gb external hard drives for DIDSON file data storage; professional VHS tape deck and multiplex units; power tools and tools; satellite phone and hand held radios for remote field site communications; three office computers and office desks, chairs, file cabinets, storage cabinets, etc. for a secure, professional office environment.

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J. Key personnel

Jay Hesse, Research Director – 0.08 FTE

Nez Perce Tribe Department of Fisheries Resources Management

EDUCATION:
M.S. in Fisheries, Michigan State University, 1994
B.S. in Fisheries and Wildlife, Michigan State University, 1992

DUTIES:
Technical direction and oversight of fisheries research projects conducted within the research division. Prepare papers/reports and develop science-based fisheries management recommendations for the Nez Perce Tribe. Provide coordination with and guidance to region on research, monitoring and evaluation issues and activities. Assist with development and implementation of large-scale monitoring and evaluation plans and proposals. Provide tribal fisheries research representation at federal and state meetings.

PROFESSIONAL EXPERIENCE:
Director of Biological Services. Nez Perce Tribe Department of Fisheries Resources Management. 2004 - present.
Fisheries Research Coordinator. Nez Perce Tribe Department of Fisheries Resources Management. 1998 – 2003.
Project Leader, Idaho Salmon Supplementation Study. Nez Perce Tribe Department of Fisheries Resources Management. 1994 - 1997.

RELEVANT PUBLICATIONS:
Everett, S.R., M.A. Tuell, and J.A. Hesse. 2003. Evaluation of potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon dams - 1997-2002 Summary. 2002 Annual Report. Report to BPA. Contract Number 00004046, Project 199700900. Portland, OR.

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Paul A. Kucera, Escapement Monitoring Project Leader – 1 FTE

Nez Perce Tribe Department of Fisheries Resources Management

EDUCATION: Bachelor of Science. 1975.
Utah State University.
Major: Fisheries Management.

Graduate Studies - MS

University of Idaho 1984-1987
Major: Fisheries Management.

PROFESSIONAL EXPERIENCE:

2004-present ` Escapement Monitoring Project Leader with the Nez Perce Tribe Department of Fisheries Resources Management. Responsible for wild stock adult salmon abundance monitoring and salmon abundance validation on the Secesh River.

1992-2004 Director of Biological Services and Acting Fisheries Program Manager for a six month period with the Nez Perce Tribe Department of Fisheries Resources Management. Responsible for research projects, Department program direction and administration of the Fisheries Research Division.

1988-1991 Senior Fisheries Biologist with the Nez Perce Tribe Fisheries Department. Adult salmon population status monitoring and LSRCP hatchery evaluation studies in major river subbasins in the Snake River.

1987-1988 Acting Fisheries Program Manager with the Nez Perce Tribe Fisheries Department. Responsible for fisheries program management and direction.

1984-1986 Senior Fisheries Biologist with the Nez Perce Tribe Fisheries Department. Conducted research on juvenile steelhead trout life history characteristics and abundance in relation to physical habitat parameters on five streams.

1982-1983 Project fisheries biologist with the Nez Perce Tribe Fisheries Department. Responsible for conduct of a physical and biological inventory of streams on the reservation proper with emphasis on anadromous salmonids.

1978-1980 Fisheries biologist with the Colville Confederated Tribes Fish and Wildlife Department. Developed fishery management programs for the Colville Tribe on their 1.3 million acre reservation and the 1.7 million acre ceded area.

1975-1978 Fisheries research biologist with W.F. Sigler and Associates, Environmental Consulting Firm. Ecological and fish life history research on 110,000 acre Pyramid Lake, Nevada.

Unique Abilities:

Certified Fisheries Scientist – AFS
Use of DIDSON for salmon abundance and abundance validation on wild salmon populations.
Population dynamics experience with Pacific salmon in the Snake River.
Experience with Endangered Species Act and management of listed fish species.
Ecological and fish life history research on anadromous and resident fish species.
Snake River water rights adjudication experience.
Familiar with Columbia River basin fisheries management issues.
Certified SCUBA diver - NAUI

Publications

Faurot, D. and P. A. Kucera. 1999. Escapement monitoring of adult chinook salmon in the Secesh River, Idaho, 1997. Annual Report to the Bonneville Power Administration. Nez Perce Tribe Department of Fisheries Resources Management. McCall, Idaho.

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Michael W. Busby, Escapement Monitoring Technician II – 1 FTE

Nez Perce Tribe Department of Fisheries Resources Management

EDUCATION: Bachelor of Science. 1969.
University of Idaho
Major: Zoology, Secondary Science Teaching Certificate

PROFESSIONAL EXPERIENCE:

2001-present ` Technician II, Nez Perce Tribe, Department of Fisheries Resource Management, Adult Chinook Salmon Abundance Monitoring Project. Responsible for the installation, operation, and maintenance of underwater time-lapse video monitoring station on Lake Creek and Secesh River. Aided in the installation, operation, and maintenance of DIDSON acoustic imaging monitoring station on the Secesh River. Collected field data, created and maintained Excel spreadsheets, read video and sonar files.

2000 Project Manager, Nelson Plumbing, McCall, Idaho. Site manager for piping project for new U.S. Forest Service Air Operations Fire Retardant Base in McCall, ID. Interpreted plans and implemented layout and assembly of piping, valves, and pumps. Operated roll groover and pipe threading equipment. Kept field records, daily reports, quality control records, and project completion reports. Coordinated with contractor and subcontractors for efficient project progress. Operated backhoe for trenching, pipe installation, and landscaping. Assisted in service calls for home plumbing remedies.

1997-2001 Carpenter and Handyman. Self-employed, McCall, ID. Skilled in home remodel projects, all phases. Shipwright assistant, tile setter, cabin and landscape maintenance.

1983-1997 President/Manager, Gravity Sports, Inc., McCall, ID. Built and managed an outdoor specialty sports retail/rental business for all season non-motorized activities. Developed and implemented business plan. Hired, trained and supervised three to eight employees. Attended trade shows, purchased inventory, and merchandised products and services. Responsible for payroll, monthly, quarterly, and annual federal and state taxes. Maintained business bookkeeping and prepared spreadsheets for financial statements and balance sheets.

Unique Abilities:

Salmonid species identification.
Operation of DIDSON acoustic camera and software.
Operation of multiplexer, time-lapse underwater video camera and VCR.
Weir construction.
Solar voltaic power station design and construction.
Water flow measurements (Marsh-McBirney).
Temperature loggers (Onset, Hobo).
Snorkeling.
Electrofishing.
Whitewater rafting and safety.
Current CPR and First Aid Certification.
Familiar with GPS and GIS technologies.
Proficient with Microsoft Excel, email, and Internet research.
Familiar with Microsoft Word.
Skilled with carpentry and mechanical tools.
Familiar with Conservation Biology principles and The Endangered Species Act.
Self-employed carpenter in all phases of construction. (1975-1983).
Seasonal fire control with U.S.Forest Service and Bureau of Land Management with supervisory experience as crew boss and squad boss and smokejumper. (1964-1975).

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