A FIELD MANUAL
for the
Capture, Handling, and Tagging of Wild Salmonids in the Upper Columbia River Basin using Passive Integrated Transponder (PIT) Tags

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Introduction

Columbia River Basin anadromous salmonids have exhibited precipitous declines over the past 30 years, with several populations now protected under the Endangered Species Act (ESA) (Schaller et al. 1999; McClure et al. 2002). A comprehensive monitoring strategy needs to be implemented to reduce the uncertainties surrounding the declines, and the strategies required to reverse this trend. Data collected from current and historical monitoring programs are generally not adequate or reliable enough for the purposes of ESA assessments and recovery planning (Tear et al. 1995; Campbell et al. 2002; Morris et al. 2002). In addition, monitoring programs for anadromous salmonids in the Columbia River Basin have typically been initiated to evaluate the effects of specific management actions, such as the demographic effects of hatcheries. As such, data are most appropriately viewed at the scale of the subpopulations and populations for which they were derived. However, the ESA requires assessments of species and their habitat at multiple spatial scales – from specific reaches, to subpopulations, populations, and the ESA management unit of Pacific salmon, the Evolutionary Significant Unit (ESU), which is a distinct population or group of populations that is an important component of the evolutionary legacy of the species.

Current monitoring programs for Pacific salmon did not develop as a cohesive design, thus aggregating existing data from a myriad of independent projects creates challenges in addressing these spatially complex questions. These problems arise because information is often not collected in a randomized fashion (Larsen et al. 2004), sampling techniques and protocols are not standardized across programs, and abundance, distribution, population dynamic, and demographic data for species and their habitat is often not available (Tear et al. 1995; Campbell et al. 2002; McClure et al. 2002). As recovery planning has focused more effort on tributary habitat restoration to mitigate for the mortality resulting from the Federal Columbia River Power System (FCRPS) the limitations of historic and ongoing sampling programs have become increasingly apparent.

The Integrated Status and Effectiveness Monitoring Program (ISEMP – Bonneville Power Administration (BPA) project #2003-0017) has been created as a cost effective means of developing protocols and new technologies, novel indicators, sample designs, analytical, data management and communication tools and skills, and restoration experiments. These tools are designed to support the development of a region-wide Research, Monitoring and Evaluation (RME) program to assess the status of anadromous salmonid populations, their tributary habitat, and restoration and management actions.

The ISEMP has been initiated in three subbasins: Wenatchee/Entiat, WA, John Day, OR, and Salmon River, ID, with the intent of designing monitoring programs that can efficiently collect information to address multiple management objectives over a broad range of scales. This includes:

• Evaluating the status of anadromous salmonids and their habitat;

• Identifying opportunities to restore habitat function and fish performance, and

• Evaluating the benefits of the actions to the fish populations across the Columbia River Basin.

Background and Objectives

Little is known regarding the life history of juvenile steelhead *Oncorhynchus mykiss* or stream-type Chinook *O. tshawytscha* in the Wenatchee and Entiat subbasins. The use of Passive Integrated Transponders, or PIT tags, is one tool that the ISEMP project is using to answer scientific uncertainties that underlie status, trend and effectiveness monitoring in the Wenatchee and Entiat subbasins. Specifically, PIT tags can be used as a tool by which growth, survival, and migratory patterns of juvenile steelhead and stream-type Chinook can be examined and quantified. PIT tags have been shown to have high retention (Dare 2003) with no impact on growth or survival (Petersen et al. 1994), and are primarily used to determine the migration timing and estimate survival of smolts migrating through Columbia River hydroelectric projects (Achord et al. 1996), as well as smolt to adult survival of returning adults. PIT tags have also been used successfully to monitor the growth and movement of resident salmonids (Wipfli et al. 2003).

Mark-recapture techniques have been used extensively in fisheries research in the Columbia River Basin and PIT tags, in particular, have been utilized to evaluate survival across a variety of life stages for anadromous fishes in the Columbia River and its major tributaries. More recently, there has been an increase in the use of PIT-tags in small stream applications to investigate factors (i.e., abiotic parameters) affecting the survival of resident and anadromous fishes within small tributaries. Juvenile production from various tributaries or from entire basins is important information used not only in the ISEMP, but also as part of the monitoring and evaluation program associated with hatchery programs in the Wenatchee subbasin. Smolt traps have been deployed in the Wenatchee and Entiat Rivers and several of the Wenatchee's major tributaries (Nason and Chiwawa). These traps are intended to provide smolt production estimates for the entire subbasin (i.e., Monitor smolt trap and Entiat smolt traps at the river mouth and RM6) or from a major spawning area (i.e., Nason Creek).

Passive instream antennae (PIA), which are operationally similar to those present at the major hydropower facilities on the Columbia and Snake River systems, have been installed in many tributary systems. PIAs allow for individual passive recaptures of fish marked with PIT-tags as they migrate through a PIA system within a river channel; thus additional recapture events are possible, resulting in more precise estimates within mark-recapture analyses. Timely and accurate information derived from PIT-tag technology is increasingly critical to resource stakeholders in developing recovery programs and in assessing the effectiveness of efforts to enhance survival of juvenile and adult salmonids. Continued development of PIT-tag technology will enable researchers to address issues expressed in the NMFS biological opinions for operation of the Federal Columbia River Power System.

The ISEMP remote PIT tagging study focuses on within-subbasin steelhead and stream-type Chinook survival, growth, distribution and life-history, and emphasizes developing information helpful to effectiveness monitoring. The goal of the remote PIT tagging study is to compare steelhead and stream-type Chinook salmon habitat use, life-history, and life-stage specific survival rates between sub-populations that rear in tributary streams versus those that rear in the mainstem Wenatchee and Entiat Rivers. PIT tagging is focused on Nason Creek and the Chiwawa River as "tributary" populations, on the "mainstem" populations in the upper and lower Wenatchee, and in the Entiat and Mad Rivers. Fish are sampled at both smolt traps and

non-smolt trap locations and tag deployment is taking place for a minimum of 5 years (i.e. one salmon/steelhead generation) to ensure an adequate sample size over multiple year classes. However, tag deployment should occur over multiple salmonid generations (i.e. 10 or more years) to accommodate a larger representation of natural variability.

The remote PIT tagging study design requires that PIT tags be detected at multiple locations within the Wenatchee and Entiat subbasins. By the fall of 2008 PIAs will be in place at 11 locations in the Wenatchee and Entiat subbasins: upper, middle and lower Wenatchee, upper and lower Chiwawa, upper and lower Nason, Peshastin Creek, upper and lower Entiat, and the Mad River. These detector arrays will not be 100% efficient and it is estimated that detection efficiencies will range from 50 to 80% at each array depending on configuration and stream conditions. These arrays will be deployed in close proximity to existing smolt traps.

The objectives of the PIT tagging study are:

1) To determine migratory patterns and spatial and temporal distribution of juvenile steelhead and stream-type Chinook within the Wenatchee and Entiat subbasins.

2) To estimate life-stage specific survival of juvenile steelhead and stream-type Chinook within the Wenatchee and Entiat subbasins and as returning adults.

3) To determine if juvenile salmonids captured in a smolt trap are representative of the non-migratory population. Parr detected at the PIAs are assumed to be representative of the non-migratory population for the purposes of this comparison.

The Upper Columbia Monitoring Strategy (Hillman 2006) recommends that at least 5,000 juvenile stream-type Chinook and 5,000 juvenile steelhead be PIT tagged in order to estimate life-stage survival rates. The sample size of 5,000 for anadromous populations in the Upper Columbia Basin was estimated by the Action Agencies/NOAA Fisheries Monitoring Group. This is a very rough estimate of the minimum number needed to estimate life-stage survival rates (Hillman 2006). Annual target numbers of wild steelhead and stream-type Chinook to be tagged at the smolt traps and at remote locations are shown in Tables 1 and 2.

Table 1. Target numbers of wild steelhead and stream-type Chinook to be tagged annually at the smolt traps in the Wenatchee and Entiat subbasins.

Smolt Traps	Target Sample Size	
	Wild Steelhead	Wild Stream-type Chinook
Chiwawa	500 - 2,000	2,500 - 8,000
Nason	500 - 2,500	500 - 2,000
Upper Wenatchee	50 – 250	500 - 1,000
Lower Wenatchee @ Monitor	500 - 2,500	1,000 - 2,000
Entiat trap at river mouth and RM6	500 - 2,500	2,000 – 6,000
Total	2,050 - 9,750	6,500 - 19,000

* past seasonal catches of steelhead at the Upper Wenatchee trap have been less than 100

Table 2. Annual target numbers for remote PIT tagging wild steelhead and stream-type Chinook salmon in the Wenatchee and Entiat subbasins.

Remote Locations	Target Sample Size*	
	Wild Steelhead	Wild Stream-type Chinook
Upper Wenatchee between Tumwater and Lake Wenatchee	500 - 2,000	500 - 2,000
Chiwawa River upstream of the smolt trap	500 - 2,000	500 - 2,000
Nason Creek upstream of the smolt trap	500 - 2,000	500 - 2,000
Entiat and Mad rivers	500 - 1,000	100 – 1,000
Total	2,000 – 7,000	1,600 – 7,000

* Actual sample sizes will be a function of capture efficiency and budget-based restrictions on fishing effort. Previous work in the Entiat and Wenatchee suggest we may catch 50 fish of each species per day. Our sample sizes will likely be on low end of the range.

The objective for this document is to establish interim working protocols for the capture, handling, and tagging of wild salmonids in the Upper Columbia River Basin using PIT tags. Final protocols will be developed pending additional review after these interim protocols are evaluated during the 2008 field season.

The goals of developing standardized protocols are 1) to reduce injury and mortality of captured, tagged, or handled fish, 2) to reduce potentially confounding between-crew measurement error that could arise if crew-specific field practices introduce variability in tag shed rates or post-tagging mortality, 3) to facilitate the logistics of intra- and inter-agency collaboration in the use of PIT tags for research and monitoring in the Upper Columbia, 4) to insure that PIT tagging operations at smolt traps do not compromise the ability to calculate smolt production estimates, and 5) to facilitate future applications for permits and funding.

This protocol was developed in collaboration with the ISEMP, Washington Department of Fish and Wildlife (WDFW), NOAA-Fisheries (NOAA), Chelan Public Utility District, Yakama Nation (YN), U.S. Fish and Wildlife Service (USFWS), the Colville Confederated Tribes (CCT)[1], and the Upper Columbia Regional Technical Team (RTT) Monitoring Committee.

This interim protocol was first applied by crews collaborating with the ISEMP Program in the Wenatchee, Entiat, and Methow rivers in 2006 and the Okanogan in 2007. Results of the application of this protocol will be reviewed prior to the adoption of a final protocol. This delay in adopting a final protocol is also intended to allow other Upper Columbia agencies an additional opportunity to provide input on this document. This protocol will be revised annually until a final version is achieved that meets the needs of the ISEMP and the various contractors using it. Changes made to this document as a result of fine-tuning are tracked using endnotes.

Protocol Common to All PIT Tagging Regardless of Location

General

All the necessary permits required for fish capture, handling, and tagging operations must be obtained. Collectors and PIT taggers are responsible for obtaining and maintaining all necessary permits. The provision of tags or funding for these operations by NOAA does not confer permit authorization.

Individual agencies may have additional protocols that govern the capture, handling, and tagging of wild salmonids. Care should be taken in the application of other protocols so they are at least, if not more, conservative regarding fish health and scientific study designs. Logistical difficulties that could arise from the application of additional protocols should be worked out and documented among the affected parties. Differences between other agency requirements and this document should be noted for subsequent revision of this document.

All capture, handling, and tagging should be undertaken within a proper study design that describes, at a minimum, the capture, tagging, and release locations, species, life-stage, number of individual fish to be tagged, and how these goals were developed as well as the information that will be provided as a result of tagging. Individual fish to be tagged should be larger than a minimum fork length, given by species in Table 3.

Table 3. The minimum size of juvenile salmonids that will be PIT tagged.

Species	Minimum fork length (mm)
Chinook	60
Steelhead/Rainbow trout	60
Sockeye	80
Coho	60

Distinguishing between ocean-type vs. stream-type Chinook for tagging purposes

Stream-type Chinook and steelhead are the target species of this PIT tagging program, and as such it is necessary to try and avoid tagging ocean-type Chinook during times when the stream-type and ocean-type Chinook runs overlap. However, differentiation of juvenile Chinook by run type is problematic at certain times of the year. Depending on the year, the timing of adult returns to the basin can mean that the majority of both runs deposits their eggs within the same spawning reach and differ in spawn timing by only weeks to a month. Therefore, the progeny emerge in similar locations and differ little in their opportunity for growth prior to emigration. Several methods have been used to differentiate juveniles by run class: known differences in life history traits, emigration timing and, to some extent, growth. Based on life history parameters, stream-type Chinook complete freshwater rearing within higher order tributaries and emigrate to the ocean as yearlings the following spring. Conversely, ocean-type Chinook have a propensity to emerge, complete freshwater rearing, and emigrate to the ocean or mainstem reservoirs of the Columbia River in their first season. Based on these assumptions any

yearling Chinook encountered at the Entiat traps (primarily March – June) are assigned a stream-type Chinook designation, while any emergent fry are classified as ocean-type Chinook. Early in the season, distinct differences in size between yearling and sub-yearling Chinook make this designation of ocean-type versus stream-type Chinook relatively easy. Stream-type Chinook yearlings are generally much larger in size (100-150 mm) in comparison to newly emergent ocean-type fry (32-45 mm), an observation that is validated through scale samples which show a "winter check" on the yearlings. This identification becomes much more difficult in late summer and early fall as the yearling stream-type Chinook catch becomes infrequent and sub-yearling ocean-type Chinook dominate the catch, exhibiting a range of sizes and differing peaks in emigration timing. Clear delineation of the two Chinook run types by size is difficult during this time. To facilitate separation of the stream-type and ocean-type sub-yearlings a date is chosen in which the peak migration of one group of sub-yearling Chinook can be separated from another. This type of methodology is not new and is commonly used to separate adult returns to the Columbia River where fish arriving at each dam are counted into a particular run based on the date of arrival. Fortunately sub-yearling juvenile Chinook exiting the Entiat consistently produce two peaks in catch abundance delineated by a distinct nadir. This occurs annually in mid-August to early-September as ocean-type Chinook juveniles exit the system, diminishing from mid-ocean-type peaks, and stream-type Chinook sub-yearlings begin to increase with mid-autumn peaks in abundance. Past the nadir into autumn, any overlap in stream-type and ocean-type Chinook migrating as sub-yearlings are split solely by nadirs in fork length. This assumption is based on differences in adult spawn timing leading to a detectable population difference in juvenile growth, where stream-type Chinook emerge earlier and have greater time and opportunity for growth.

USFWS has monitored total catch from both Entiat Screw traps and plotted Chinook catch by day. When catch dwindled and a relative nadir was reached in early September (see Figure 1), Chinook of a PIT tag length (>60 mm) were identified as stream-type run. Fry below the 60 mm threshold were labeled as sub-yearling ocean-type Chinook. In this example, September 7th was used to segregate the two runs. Undoubtedly, some Chinook will be identified improperly using this method. However, this method has worked successfully for prior seasons and presents a management plan that can adapt to variations in run timing over many seasons. The implementation of a genetic sampling program in the latter part of the migratory season would help validate this method.

To determine a cut-off date after which juveniles over 60mm in length are considered stream-type Chinook and therefore should be tagged in the Wenatchee subbasin, the WDFW have length-at-age scale analysis (2000-2007) for the fish that overlap in size (105-115mm). This happens when the yearling fish (stream-type Chinook) and the subyearling (ocean-type Chinook) are close to the same size, usually in late June and July when most yearlings have already emigrated past the trap. In addition, WDFW has genetic information that supports the designation of yearling fish as stream-type Chinook (96% accurate) during the stream-type emigration.

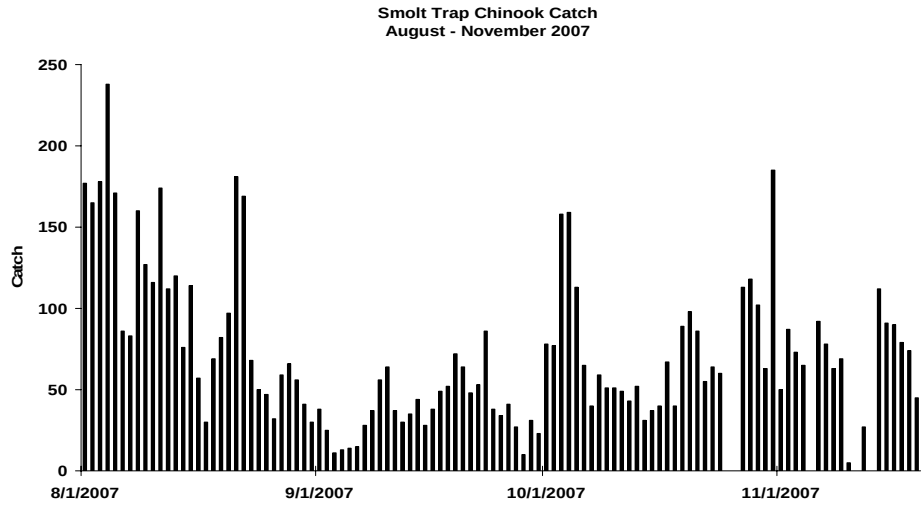

Figure 1. Numbers of Stream-type and ocean-type Chinook caught at the Entiat River screw traps from August to November 2007.

Capture, Handling, and Tagging at Non-Smolt Trap Sites

Collection

The location of fish collection and tagging will be determined by the needs of the specific study and should be done in coordination with other researchers who might be snorkeling or collecting fish for other purposes in the same areas. If study designs do not specify otherwise, fish will be collected and tagged from areas of high parr concentration located by snorkeling in advance of collection.

To minimize collection stress, all fish collection, handling, and tagging activity will be curtailed when water temperatures reach 17º C, as recommended by PTAGIS, or when any other occurrence suggests fish are being stressed. Fish may be held in live boxes and tagged the following day if water temperatures allow. Otherwise, fish will be tagged and released immediately upon recovering from the anesthetic. Oxygen will be supplied to fish-transfer and recovery containers during tagging operations.

Three collection methods will be used: electrofishing, low-impact seining, and angling. In general, seining will be the preferred method due to its relative benefits to fish health and its capture efficiencies, but the actual method to be used will depend on fish density, site characteristics, and study design.

Seining

Seining is most feasible in pool, run, and meadow habitats where the substrate is fine-grained and wood is sparse, and where fish densities are high. Position one seine securely across the lower end of a run or pool and place a second seine across the stream, approximately 10 m upstream. Move the upper seine downstream, gently crowding fish toward the lower seine. As the lead line of the upstream seine crosses the lead line of the downstream seine, pull the lower seine up out of the water, trapping the fish. The use of snorkel seining or "snerding", in which snorkelers herd fish into a stationary net that is lifted to hold and capture juveniles can also be effective[i].

Captured fish can be maintained in ambient water by allowing the center of the seine to remain submerged. Fish will be transferred from the seine in a watertight sanctuary dip net (Matthews et al. 1986) to a 20-L bucket. When approximately 30-50 fish have been collected they will be portaged to live cages for subsequent tagging in a 20-L carboy container equipped with an oxygen-based aeration system mounted on a backpack frame.

Electrofishing

Electrofishing will be used in streams where low fish densities or difficult terrain preclude successful seining. Operate the electrofisher according to manufacturer, NOAA and other appropriate agency guidelines. Stunned fish will be collected from the river with standard netted dip nets and placed in 20-L buckets and portaged to the live cages as described above. When electrofishing the following additional procedures should be conducted:

Record the conductivity or adjust settings based on previous sampling. Start at the most downstream collection site and work upstream. In medium-sized streams use a crew (3 + 1) on each side of stream consisting of a shocker, a netter, a bucket-person with fish counter, and a fish packer/redd/adult spotter. Electrofishing should be carried out in water no greater than one meter in depth. Let off power once fish turns and quickly net them and put in bucket. Transport fish after 30-50 parr (20-30 if mixed species) are collected in the bucket or at least every hour, replace/add fresh water to bucket frequently and make sure the oxygen is working properly. If the spotter finds adult fish or redds, the crew will exit the stream and reenter upstream at a point that will ensure protection. Use care in entering/exiting stream, so not to break banks down. The shocker will call out the number and species of fish observed (but not collected) that are to be counted by the bucket-person. The bucket-person will tally, using the multicounter, all fish observed but not collected and all fish captured and placed into the bucket. Record all information on the data sheet. After tagging, all fish will be released throughout the area from which they were collected.

Angling

Angling may be used in most situations, especially in cases when other capture techniques are not efficient at capturing all target life stages. This capture method, particularly

[i] This technique was effectively utilized by USFWS in Peshastin Creek for stream-type Chinook juveniles in 2004 and 2005. However, this technique was not as effective on steelhead juveniles as angling.

when done in waters closed to public angling, requires close coordination with local law enforcement and heightened public outreach.

Single barbless hooks will be used at all times. If multiple methods (i.e., seining and angling) are used during the same day, anglers should be upstream of the other crew and whenever possible avoid disturbing fish by walking on the edges of the stream. All fish captured will be recorded. All target species will be placed in 20-L buckets and portaged to the live cages as described above. Non-target species will be immediately released. When all sampling is completed, tagged fish will be released throughout the area from which they were captured.

Other methods

Some permit holders may be allowed to capture fish by other methods. For example, USFWS is permitted to capture fish with fyke nets, minnow traps, and dip nets[2]. These capture techniques will be applied according to protocols determined by the permitted agency. All fish captured will be recorded. All target species will be placed in 20-L buckets and portaged to the live cages as described above. Non-target species will be immediately released. When all sampling is completed, tagged fish will be released throughout the area from which they were captured.

Inserting PIT tags

Fish will be tagged using individual modified syringes and hypodermic needles (Prentice et al. 1990). To minimize disease transmission, tags and all associated equipment will be disinfected for a minimum of 10 min with isopropyl alcohol.

Tagging will be conducted at portable stations designed and constructed specifically for use beside streams. These stations may either be trailer-mounted stations constructed by Chelan PUD or will be constructed following the guidance of Prentice et al. (1990) and Achord et al. (1996).

Fish will be dipped from the live cage with a sanctuary dip net and poured into a plastic pan containing a stock solution of tricaine (MS222, final concentration of about 40 mg/L). A comparable concentration of sodium bicarbonate will help reduce the acidic properties of an MS222 solution. After anesthesia, fish of other species and target species not suitable for tagging (i.e. injured or too small) will be sorted and removed for recovery and released back to the stream. Each remaining target fish will be injected with a PIT tag following procedures published by PTAGIS.

Tagged fish will then be passed through a detector loop to record the tag code in the computer-tagging file that includes species, run and rearing type, and file header information specified above. The fish will was measured to fork length (to nearest mm) and weighed (to nearest 0.1 g) and species, run, life stage, and conditional comments will be recorded.

After tagging, fish will be allowed to recover in fresh water, transferred back to a live cage in the stream, and will be held for a minimum of 0.5 h before being released as close as possible to the location where they had been collected. A random sample of a minimum of 10%

of fish per remote site will be held in a live box for 24 h to evaluate tag loss and delayed mortality.

Capture, Handling, and Tagging at Smolt Traps

Identify and ensure all smolt trap tagging and release locations are downloaded from PTAGIS. Table 4 provides current codes and descriptions.

Table 4. Current PTAGIS tagging and release location codes and descriptions for the Upper Columbia.

Trap Location	Description	PTAGIS code	RKM
Chiwawa trap	Rkm 1.0 on Chiwawa River	CHIWAT	754.077.002
Chiwawa River	Trap efficiency release location	CHIWAR	754.077.003
Upper Wen. Trap	1.0 km below Lake Wenatchee	WENA2T	754.086
Lower Wen. Trap	Trap at West Monitor Bridge	WENATT	754.010
Wenatchee River	Trap efficiency release location	WENATR	754.029
Nason Creek trap	Rkm 0.8 on Nason Creek	NASONT	754.089.001
Nason Creek	Trap efficiency release location	NASONC	754.089.002
Upper Entiat River trap	Rkm 11 on the Entiat River	ENTIAR	778.011
Entiat River	Upper trap efficiency release location	ENTIAR	778.017
Lower Entiat River trap	Rkm 1.8 on the Entiat River	ENTIAR	778.002
Entiat River	Lower trap efficiency release location	ENTIAR	778.002
Methow River trap	Trap at McFarland Bridge	METTRP	843.030
Methow River	Trap efficiency release location	METHR	843.036
Twisp River trap	Rkm 2.0 on the Twisp River	TWISPT	843.066.002
Twisp River	Trap efficiency release location	TWISPR	843.066.003

1. Operate smolt traps in accordance with the ISEMP Smolt Trap and Efficiency Trial Protocol (Tussing 2008).

2. Smolt traps are checked every morning at a minimum.

   2.1. The smolt trap operator will scan all salmonids regardless of species and origin for PIT tags and is responsible for uploading recapture files to PTAGIS at least weekly (every Monday in the Wenatchee). This will happen at Monitor but CPUD will be given recaptures at the Chiwawa and Lake traps for this process.

      2.1.1. All non-target fish will be sampled (measured, weighed, etc.) per the ISEMP Smolt Trap and Efficiency Trial Protocol (Tussing 2008).

      2.1.2. Any target fish initially identified to be in poor health (i.e., injury, >20% descaling) shall be enumerated and released by the smolt trap operator.

2.1.3. All recaptured PIT tagged fish will be recorded as a recapture and sampled (measured, weighed, etc.) per the ISEMP Smolt Trap and Efficiency Trial Protocol (Tussing 2008) and will be released downstream from the trap.

2.1.4. Non-tagged target fish will be placed in a live box for up to two days before tagging although daily tagging will be the default.

3. Non-tagged target fish will be removed from the live box and tagged.

3.1. PIT tagging will follow procedures published by PTAGIS.

3.2. Fish will not be PIT tagged when water temperatures exceed 17ºC.

3.3. For each PIT tagged fish, PIT taggers will measure fork length (to nearest mm) and weight (to nearest 0.1 g), and will identify each fish by species, run, life stage, and condition.

3.4. To document injury or mortality, to relieve stress, and to check for tag retention all PIT tagged fish will be held in a separate live box after tagging until fully recovered. This live box will be different from live boxes used for trapping operations or used for holding un-tagged fish.

3.4.1. Fish from the live box will be released to the stream by the smolt trap operators depending on the needs of the smolt trap operators. Each release from the live box will constitute a "release group" and will be treated as such in PIT tag files[3].

3.4.1.1. In general, fish will be released below the trap. However, in some cases, fish will be released upstream of the trap as part of a trap efficiency trial.

3.4.1.1.1. If no trap efficiency test is planned, fish will be released below the trap after being held for 24 hours.

3.4.1.1.2. If a trap efficiency test is planned and requires the accumulation of fish from multiple days, the release group must include some individuals that have been held for a minimum of 24 hrs to assess mortality and shed rate.[ii]

3.4.1.1.3. When possible, fish intended for use in trap efficiency trials will be sampled and marked per smolt trap operation protocol simultaneously with PIT tagging operations.

3.4.1.2. In all cases, fish will be released from the post-tagging live box within 3 days.

[ii] Pending assessment of tag retention and mortality in 2007, we may require a smaller fraction of fish to be held for a minimum of 24 hours after tagging compared to the approximately 2/3 that will be held for 24 or 48 hours under these protocols.

3.4.1.3. No fish will be held for more than a total of 3 days from the time they were removed from the trap.

3.4.2. PIT tagged fish may be externally marked with fin clips for trap efficiency trials or for tissue sampling but care will be taken to ensure that all fish from a release group are equally likely to be externally marked (e.g. for a release group accumulated over 3 days, do not clip only fish caught on the same day; instead, select fish equally from across the 3 days catch).

3.4.3. In 2006 and possibly subsequent years, WDFW will evaluate trap efficiencies at the Chiwawa River trap using paired releases of PIT tagged and fin clipped fish to determine whether PIT tagged fish could replace the use of fin clipped fish in trap efficiency tests.

4. PIT tagged fish will be released by the smolt trap operator at the end of the post-tagging holding period. All mortality and shed tags will be recovered and delivered to the PIT tagging crews as well as release information, including time and location.

4.1.1. The smolt trap operator will decide on the disposition of tagged fish: they will be used either for trap efficiency trials or will be released below the trap. Trapping crews will notify the tagging crew of the disposition of each batch of tagged fish; this information will affect the final tag file name. The default disposition will be that fish will be used for trap efficiency trials except at Monitor and the Upper Wenatchee trap where the assumed disposition will be that fish will be released below the trap. Fish may be used in trials at Wenatchee Lake in 2008, depending on numbers captured.

Data handling, analysis and reporting

Data management framework

The ISEMP Data Management effort is designed to develop standardized tools and procedures for the organization, reduction, and communication of monitoring data and methods within ISEMP pilot basins located in the Wenatchee and Entiat subbasins, WA, John Day, OR, and Salmon River, ID. Beginning in 2004, a pilot project has been under development aimed at integrating four primary data management tools: Automated Template Modules (ATMs), the Status Trend and Effectiveness Monitoring Databank (STEM databank), Protocol Editor (PE), and the Aquatic Resources Schema (ARS). The STEM Databank is the central data repository for the ISEMP project. It was developed by the Scientific Data Management Team at NOAA-Fisheries to: (1) accommodate large volumes of data from multiple agencies and projects; (2) summarize data based on how, when, and where data were collected; (3) support a range of analytical methods; (4) develop a web-based data query and retrieval system, and (5) adapt to changing requirements. This fully-normalized database structure allows the incorporation of new attributes or removal of obsolete attributes without modification of the database structure. Data can be summarized in a variety of formats to meet most reporting and analytical requirements.

Successful data management systems require a user interface that is intuitive to the user and that increase the efficiency of the user's workflow. The Automated Template Modules (ATMs) are a collection of forms that allow users to enter and view data in a format that is familiar to biologists. Each ATM has forms for entering new data, reviewing existing data, and updating existing data. Additionally, each ATM has a switchboard to help guide the user to the correct forms.

The general layout of the forms includes a header section to display information about the data collection event and a series of tabs that display detailed observational data. The header section describes the general characteristics about when, where, and how the data was collected or observed. The header section always includes the site, the start date and time, and the protocol. Additionally, the header section may include general characteristics about the sampling reach or unit, environmental conditions, weather conditions, water temperature and visibility, presence of fish, and protocol deviations. A series of tabs below the header section display detailed observations that occurred during the data collection event in spreadsheet format. Tabs vary between the different ATMs, but typically include a tab for crew and for equipment.

Data entry forms perform the critical function of validating data at the time of data entry. For categorical attributes, users are only allowed to select from acceptable categories as defined by the protocol. Similarly, values entered for continuous attributes are checked to ensure values are within the expected range. Data entry forms are "protocol aware". The database includes tabular data that specifies details about the protocol. All categorical fields on data entry forms have pull-down lists that limit the values a user can enter for the field. The pull-down lists reference the protocol documentation tables and only display values that are defined for the active protocol. Similarly, for continuous values, the forms check the expected range as defined in the protocol and warn the user if the entered value falls outside of the expected range. Users can choose to modify the value or accept the value as it was entered. The use of "soft" bounds on continuous values is an effective validation strategy for ecological data, where data often follows a normal distribution with long tails as opposite to a discrete distribution common to financial data.

The ATMs also apply an innovative approach to solving the species code issue. Short species code abbreviations are often used by field biologist to speed data recording in the field. However, every agency or program uses a uniquely defined set of species codes that are appropriate for their geographic location and data gathering requirements. When data containing these idiosyncratic species codes are submitted to regional data warehouses, the codes often become meaningless or indecipherable. A simple solution requires field biologist to define their species codes as tabular data in the database. The definition for each species code includes the scientific name, life stage, age class, run, and origin. Scientific name is the only required field and the name must be recognized by a taxonomic authority. Forms in the ATMs allow users to select from the list of defined species codes. When a species code is selected, the forms store all five fields in the data table. This ensures that the definition of the code is never separated from the raw data and facilitates efficient analysis by allowing users to select or aggregate on any one of the five fields that make up a species code.

Protocol Editor is a data dictionary, user-friendly tool for describing the list of all attributes collected by a given protocol that includes a description of the data type, units of measure, number of characters or digits, number of decimal places, and list of acceptable values for all attributes collected by a protocol. Protocol Editor allows the ATM to be calibrated to a given protocol and allows the ATM to ensure consistency between the protocol and the data entered for that protocol. Protocol Editor follows the same rules established by Protocol Manager (a protocol documenting tool being developed by USBOR). A protocol is defined as a collection of methods, where each method consists of the list of attributes to be recorded by the data collector. The name of attributes is restricted to attributes defined by the ARS; however, users are allowed to create an alias name for the attributes. Metadata entered into Protocol Editor can easy be exported in a tabular format for importing into Protocol Manager.

The ARS is the collection of database tables that store data entered into the ATM forms. The ARS was developed to support agencies within the Columbia River Basin manage, document, and analyze aquatic resources data. The ARS aims to define a standardized data structure for storing and processing water quality, fish abundance, and stream habitat data. The ARS is robust against variations between data collection protocols, supports procedures for increasing data integrity at the time of data entry, and supports proper analysis and summarization of aquatic resources data.

There are multiple observation methods used to document fish abundance – electro-fishing, snorkeling, seining, observation stations, and a variety of traps. Regardless of how the observations are made, all fish observations are stored in the fish table and the observation method is recorded in the data collection event table. Fish can be observed as individuals (potentially including length, weight, sex, activity, etc) or as a count of individuals with similar characteristics (e.g. count by species and size class). Again, both types of observations are stored in the same table, where count is set to "1" if the record represents an individual. Foreign keys allow fish observations to be associated with an electro-fishing pass or a habitat unit within the site. Fish can also have individual tags (e.g. pit and radio), group tags (e.g. code wire tags), or group markings (e.g. fin clip). Tags and markings are all sorted in a single table. A many-to-many relationship exist between tags and fish, such that a fish can have many tags and a tag can belong to many fish. Finally, lookup tables are used to define species codes and fish size class.

Data handling

The CCPUD is responsible for uploading all data from PIT tagged fish into PTAGIS P3 software in the Wenatchee subbasin, and the USFWS is responsible for uploading all data from PIT tagged fish into PTAGIS P3 software in the Entiat subbasin. The PIT tagging crews will upload tagging files to PTAGIS at least twice per week[4]. Data should be loaded from P3 into the smolt trap ATM provided by ISEMP on a regular basis by WDFW, YN and USFWS and should be sent to the Upper Columbia Data Steward in December of each year for uploading into the STEM Databank.

PIT Tag File Naming Convention

A standardized approach to naming PIT tagging files will assist with data transfer, storage, and analysis. The following naming convention is an extension of the PTAGIS naming

convention that allows for eight characters preceding the decimal point and three characters following the point. These 11 characters will denote information described in Table 5 and Table 6. For example, a file called <ARM06123.AAB> would contain data collected by a crew working for Andrew R. Murdoch for steelhead tagged on the 123rd Julian day of 2006 at the Chiwawa River smolt trap that were released as part of a trap efficiency trial. The information coded in the final character is up to each agency's discretion. Care should be taken to make sure fish are released prior to submitting tagging files to PTAGIS to avoid the possible need to edit a previously submitted file.

This format does not apply to PIT recapture files. PIT recapture files will be submitted weekly using variable release times (VRT). File names of recapture files will be determined by the agency submitting the files[5iii].

This naming convention allows for many additional locations, capture methods, and release dispositions to be recorded. Suggested additions to Table 6 should be forwarded to the group of agencies who developed these protocols[i]. These agencies will further develop this document in the fall of 2008 and will determine a way to promptly update elements of this document, like Table 6, during sampling periods.

Table 5. A description of the 11-character file naming convention for PIT tag files.

Variable	Example	Description
Character 1-3	ARM	PIT tag coordinator initials
Character 4-5	06	Year tagged
Character 6-8	123	Julian day of the year
Character 9	A	Location(see Table 4)
Character 10	A	Capture method (see Table 4)
Character 11	B	Various (see Table 4)

Deleted:

i Pamela Nelle has a current contact list as of 2/19/2008

Table 6. Codes and descriptors for the three character spaces to the right of the decimal point in PIT tag file names 2008.

Code	Location (Character 9)	Capture Method (Character 10)	Disposition/File Number (Character 11)
A	Chiwawa	Smolt trap	Chinook efficiency trial
B	Nason	Angling	Steelhead efficiency trial
C	Upper Wenatchee	Snorkel seining	All fish efficiency trial[iv]
D	Lower Wenatchee	Minnow Trap	All fish release below capture site
E	Wenatchee	Dam Location	Chinook recaps release at trap
F	White	Electro-Shock	Steelhead recaps release at trap
G	Peshastin		Chinook release at trap
H	Entiat		Steelhead release at trap
I	Mad		Bull trout- Juvenile
K	Methow		
L	Twisp		
M	Chewuch		
N	Okanogan		
O	Little Wenatchee		
P			
Q			
R			
S			
T			
U			
V			
W			
X			
Y			
Z			Mixed species release at capture site
1			Entiat upper trap efficiency release*
2			Entiat upper trap non-efficiency release*
3			Entiat lower trap efficiency release*
4			Entiat lower trap non-efficiency release*
5			
6			
7			
8			
9			
0			

[iv] Yakama Nation combines stream-type Chinook and steelhead in each file.

PIT Tag File Contents

Data that will be recorded in the PIT tag file header template will include:

a. Tag date and time
b. Tag file name
c. Session message: The session message will record the location of the catch and release sites in latitude/longitude in decimal degrees following rules in Table 7[6]. These rules are necessary to allow for automated extraction of GPS data within the Upper Columbia data management system that is under construction. Use GPS datum NAD83. Additionally, houses in order by comma separated values: trap status (Complete, Incomplete, or Pulled and comments about operation if necessary), trap efficiency release with species/run/rear/# released and # recaptured.
d. Tag site code (e.g., Trap code)
e. Tagger
f. Coordinator ID
g. Organization
h. Tag method (i.e., hand)
i. Tagging temperature
j. Migratory Year (i.e., current year)
k. Capture method code
l. Release kilometer
m. Release date and time

Data that will be recorded in the tagging file will include:

a. Species Run Rear
    i. Wild stream-type Chinook
    ii. Chinook, unknown run, Wild
    iii. Wild ocean-type steelhead
    iv. Wild ocean-type sockeye
    v. Wild coho
    vi. Hatchery stream-type Chinook
    vii. Hatchery ocean-type steelhead
    viii. Hatchery ocean-type sockeye
    ix. Hatchery coho
    x. Other species are included with the appropriate PTAGIS code (i.e. Lamprey) or as “other fish” and are denoted by species in the additional comment field.
b. Length (Fork length to the nearest mm)
c. Weight (Weight to the nearest 0.1g)
d. Conditional comments

i. All applicable miscellaneous injury or mortality codes
ii. Subyearling or yearling (Chinook only)

e. Additional positional field[7]
   i. Stage of smoltification (Smolt, transitional, or parr) code: S, T or P
   ii. Trap efficiency trial (if applicable), trap specific defaults will be determined; code: E

Table 7. Format convention of catch and release site location data to be included anywhere within the session message.

Catch and release locations should be included in the session message in the following manner: CATLAT(xx.xxxxxx)CATLONG(yyy.yyyyyy)RELLAT(ww.wwwwww)RELLONG(zzz.zzzzzz)
Where: xx.xxxxxx = latitude of catch site in decimal degrees with 6 decimal places yyy.yyyyyy = longitude of catch site in decimal degrees with 6 decimal places ww.wwwwww = latitude of release site in decimal degrees with 6 decimal places zzz.zzzzzz = longitude of release site in decimal degrees with 6 decimal places
Note that latitudes have 2 characters before the decimal and longitudes have 3 characters before the decimal. The GPS units may vary on how many decimal places they provide – either round down to 6 places or add trailing zeros if necessary but always use 6 places after the decimal.
Use the codes "CATLAT()" "RELLAT()" "RELLONG()" to identify the fields and be sure to use this standardized spelling, including parentheses so lat;long data can be automatically extracted from these files. Do not use commas, other punctuation, or any extra spaces to separate the fields.

Data analysis

The data collected by recapturing PIT tagged fish, either at the smolt traps or passively at the PIAs will be used to generate summary metrics. See the ISEMP Smolt Trap and Efficiency Trial Protocol (Tussing 2008) for a description of the summary metrics to be generated from data collected at the smolt traps and the ISEMP Field Manual for the Construction, Installation, Operation and Maintenance of Passive Instream Arrays in the Upper Columbia Basin (Nelle 2008) for a description of summary metrics from data collected at the PIAs.

Data reporting

A summary of the PIT tagging effort each year, including numbers by species and location tagged, method of capture and effort expended should be included in the annual report that each agency submits at the end of their annual contract with BPA. In addition, the Upper Columbia Data Steward is responsible for generating an annual report to the Watershed Action Teams, Project Sponsors and monitoring agencies that will include a summary of the number of fish PIT tagged each year by species and location.

Personnel requirements and training

Each monitoring agency is responsible for training the personnel who will be carrying out the capture, handling and PIT tagging of the fish, and loading the data into P3 and uploading the data to an ATM and to PTAGIS.

Appendix

Contact information

Name	Agency	Email	Phone
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*Mike Ward	Terraqua	wardski@televar.com	486-2426

* denotes PIT tag coordinator

Archived material

Table 3. Codes and descriptors for the three character spaces to the right of the decimal point in PIT tag file names for 2006.

Code	Location (Character 9)	Capture Method (Character 10)	Disposition/File Number (Character 11)
A	Chiwawa	Smolt trap	Chinook used in efficiency trial
B	Nason	Seining	Steelhead used in efficiency trial
C	Upper Wenatchee	Snorkel seining	All fish used in efficiency trial
D	Lower Wenatchee	Electroshock	All fish released downstream of capture location
E	Wenatchee	Angling	All fish released upstream of capture location
F	White	Snorkeling	All fish released at capture location
G	Peshastin	Tumwater Fish trap	
H	Entiat	Dryden Fish trap	
I	Mad	Wells Dam	
K	Methow		
L	Twisp		
M	Chewuch		

N	Okanogan		
O	Little Wenatchee		
P			
Q			
R			
S			
T			
U			
V			
W			
X			
Y			
Z			
1			Number of files with identical name
2			Number of files with identical name
3			Number of files with identical name
4			Number of files with identical name
5			Number of files with identical name
6			Number of files with identical name
7			Number of files with identical name
8			Number of files with identical name
9			Number of files with identical name
0			

Table 3. Codes and descriptors for the three character spaces to the right of the decimal point in PIT tag file names 2007.

Code	Location (Character 9)	Capture Method (Character 10)	Disposition/File Number (Character 11)
A	Chiwawa	Smolt-trap efficiency	Hatchery stream-type Chinook smolt
B	Nason	Smolt-trap non-efficiency	Hatchery stream-type Chinook parr
C	Upper Wenatchee	Seining-released above	Wild stream-type Chinook smolt
D	Lower Wenatchee	Seining-released below	Wild stream-type Chinook parr
E	Wenatchee	Seining-released at site	Hatchery steelhead migrant
F	White	Snorkel-seining-released above	Hatchery steelhead non-migrant
G	Peshastin	Snorkel-seining-released below	Wild Steelhead migrant
H	Entiat	Snorkel-seining-released at site	Wild steelhead non-migrant
I	Mad	Angling-released above	Wild bull trout juvenile
J	Methow	Angling-released below	Wild bull trout adult
K	Twisp	Angling-released at site	Hatchery coho migrant
L	Chewuch	Snorkeling-released above	Hatchery coho non-migrant
M	Okanogan	Snorkeling-released below	Wild coho smolt
N	Little Wenatchee	Snorkeling-released at site	Wild coho parr
O	Omak Creek	Electroshock-released above	Hatchery ocean-type Chinook juvenile
P	Omak Cr. Weir	Electroshock-released below	Wild ocean-type Chinook juvenile
Q	Tumwater trap	Electroshock-released at site	Adult stream-type Chinook
R	Dryden trap	Dam/trap/weir-released above	Adult steelhead
S	Twisp weir	Dam/trap/weir-released below	Adult ocean-type Chinook
T	Wells Dam		
U	Beaver Creek		
V	Gold Creek		
W	Libby Creek		
X			
Y			
Z			Mixed species
1			Entiat upper trap efficiency release*
2			Entiat upper trap non-efficiency release*
3			Entiat lower trap efficiency release*
4			Entiat lower trap non-efficiency release*
5			Number of files with identical name
6			Number of files with identical name

7			Number of files with identical name
8			Number of files with identical name
9			Number of files with identical name
0			

*also can be used to differentiate between multiple tagging events on same day (ie. remote tagging).

[1] The CCT began using the protocol in 2007.
[2] Dip net language added in 2007
3 USFWS noted that the protocol already designates each individual fish as either an efficiency (i.e. “E”, see text comments under pit file comments) utilized fish or not (a blank indicates that the fish was released below the trap). Also, different files can have the same release date and time in which to query an individual release group.
[4] Clarified in 2007

[5] In the spring of 2006 USFWS used a tag file (.HAG) with all recaptures denoted with a VRT extension. Tag actions were used to identify the source of recaptured fish (i.e. “Mad River remote tagged 2005”, “efficiency release on 4/15/06”, etc.) which automatically marks these fish with an “RE” in conditional comment and relevant message into the text comment field of the daily tag file. Based on tag actions identifying the source of the fish, the determination whether to include or exclude the recapture from the daily total (remote tag vs. efficiency release) was made. Although removing recaptures from daily tagging files worked, it was at times tedious and slowed the upload process and tag actions only work if you have updated knowledge of the tags being released above your trap. This may be difficult for sites such as the lower Wenatchee trap.

[6] Dave Marvin (PTAGIS) intimated (To Rebecca Christopherson, USFWS) that a field in the header for LAT/LONG will NOT be incorporated into the P3 header. He suggested that this information be housed in the "Session Header Note" (not the "Session Message" which is used to describe the study) if it is needed. Marvin feels that LAT/LONG information is redundant if the work is being done at an established trap site or hatchery, as it is already housed within the PTAGIS database. It is, however, pertinent in remote tagging situations. There is also a "Transect" field in the header that can be activated. USFWS are probably going to use this field in the future to distinguish between upper and lower trap sites (while this field contains a limited number of characters, it has no drop-down list or template to fill in but verbose description, codes, or GPS coordinates can be used). Matt Cooper has created an example showing how the "Session Header Note" can be used to house Lat/Long as well as other information, and shows that all of the information in this field is visible once the file has been submitted. The first fish in the sample file illustrates how the "Additional Positional" field can be used to record additional data on a specific fish (trap efficiency usage, stage, scale and genetic sample info, etc.)

```
  FILE TYPE                : TAGGING
  PROGRAM VERSION          : PITTAG3 1.4.2
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
JUVENILE SALMONID POPULATION MONITORING
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
FILE TITLE               : MRC06304.HA2
TAG DATE                 : 10/31/06 09:54
TAGGER                   : HALLMAN J
HATCHERY SITE            :
STOCK                    :
BROOD YR                 :
MIGRATORY YR             : 06
TAG SITE                 : ENTIAR
RACEWAY/TRANSECT         :
CAPTURE METHOD           : SCREWT
TAGGING TEMP             : 00.5
POST TAGGING TEMP        :
RELEASE WATER TEMP       : 00.5
```

TAGGING METHOD : HAND
ORGANIZATION : USFWS
COORDINATOR ID : MRC
RELEASE DATE : 10/31/06 09:54
RELEASE SITE : ENTIAR
RELEASE RIVER KM : 778.011

CATLAT(47.414770)CATLONG(120.192200)RELLAT(47.413570)RELLONG(120.190750),
TRAP STATUS = COMPLETE, START TIME= 10/30/06 09:00, STOP TIME =
10/31/06 09:54 TURBIDITY
= 1.0, WEATHER = 3, CFS = 250, CHINOOK TRAP EFFICIENCY RELEASE = 100
CHINOOK RECAPTURE = 25, STEELHEAD TRAP EFFICIENCY RELEASE = 50,
STEELHEAD RECAPTURE = 10, ETC., ETC.,

1 3D9.1BFEXAMPLE 11W E T GE01 SC01
1|0|
2 ..... 11W T
15|0|
3 ..... 32W P
2||
4 ..... 7RW
1||approx. 275mm
5 ..... A0W AM
21||
6 ..... 90U DACE
1||
7 ..... 90U WHITEFISH
2||
8 ..... 90U WHITEFISH
2|M|

CLOSE DATE : 01/19/07 15:08

[7] Changed from “Text comments” in 2007