DRAFT

Aquatic Research, Monitoring and Evaluation (RME) Plan.
Prepared by: Washington Department of Fish and Wildlife
April 2004

Local and regional efforts have begun to achieve a coordinated approach in the Columbia River subbasins to recover ESA listed salmon and steelhead. A part of those efforts is the development of Research, monitoring and Evaluation (RME) plans that will help direct limited funds to accomplishing the most critical work.

Within the Tucannon subbasin, work has begun to develop a comprehensive RM&E plan. The plan will pull heavily from regional RME efforts such as the FCRPS Biop plan being developed under the direction of NOAA, the Washington Comprehensive Monitoring Strategy for Watershed Health and Salmon Recovery (CMS), and other similar strategies and plans currently under development.

The RME plan that follows is an attempt to identify priorities in concepts for implementation in the next three to six years. While it would be desirable to have a completed comprehensive RME plan now, the time allowed for its development under the subbasin planning effort is inadequate. This plan will therefore, serve as an interim set of guidelines that will assure a systematic approach to directing and funding RME. Further, this interim plan will serve to facilitate coordination of RME in the Tucannon among management entities, and to help dovetail Tucannon basin actions within the broader Columbia Basin RME effort.

Guiding Principles and Priorities

- Fill EDT data gaps and establish baseline habitat conditions
  - Verify attribute values to validate EDT modeling runs
  - Establish firm baseline of habitat conditions to track change over time or response to habitat improvement actions undertaken in the basin (effectiveness monitoring)
  - Use systematic habitat characterization provided by EDT as basis for future validation monitoring.
- Focus RME efforts on critical data needs for VSP attributes.
- Implementation and effectiveness monitoring to document actions should be funded/undertaken within the basin (Implementation - how much, how many sites, how often, where: Effectiveness – habitat and localized fish response)
- Critical uncertainties? (Causal relationships among actions and population response, and confounding factors that may affect our understanding of those relationships).
- Coordinate with regional efforts (Tier 3 studies)
- Data management and coordination are crucial to meet regional data accessibility needs.
- Methodologies should provide data of known quality (accuracy and precision)

- A systematic approach to project selection and funding will be used that is consistent with, and complementary to, other RME efforts within the Columbia Basin.

Fill EDT data gaps and establish baseline habitat conditions

The EDT model was populated without extensive, but incomplete empirical data for the Tucannon subbasin. In all cases empirical data were used if available. However many habitat attributes were rated based on local knowledge and best scientific judgment. It is clear that such data may inadequately represent habitat, water quality and fish assemblage conditions. The predictive capacity of EDT to help direct recovery actions and assess their potential beneficial effect could be substantially limited by the data quality. Improving data quality by collecting empirical data should be a priority if the following conditions are met:

- Those attributes with the greatest leverage on EDT model outputs (e.g. max width, gradient, habitat type inventories, large wood, bed scour) (From: *Mobrand Biometrics Quick Guide to Developing the Stream Reach Editor*, 2003)
- Data is lacking within priority protection or restoration stream reaches
- Data is limited for attributes that have a broad (subbasin wide) effect on population or habitat status (passage at obstructions, water quality, others?)
- Identified in the Hypotheses and Objectives within the subbasin plan

Focus RM&E efforts on critical data needs for VSP attributes.

Four critical areas were identified under NOAA's Viable Salmonid Population (VSP) treatise. Presently the Interior Columbia TRT is developing an evaluation and rating system for populations within ESUs. Once the methodology is finished, completing a rating exercise for the basin will be necessary. Beyond that action, specific needs have been identified for each of the four areas of VSP:

Abundance

Adult: Run size to the basin (This can be greatly impacted by out-of-subbasin effects but is critical to monitoring population status). Estimates or enumeration of escapement to the spawning grounds, including hatchery interactions in natural spawning areas, is crucial. Harvest within the subbasin including hatchery harvest and incidental hooking mortality of wild fish. Out-of-basin harvest and mortality (up-river subbasins may be prevented from recovering if out-of-basin effects limit adult escapement.

Juvenile: Smolt production at the subpopulation level to reflect freshwater survival and production within the basin. It will be critical in modeling population response to habitat restoration actions.

Diversity	Genetic characterization, life history pathways (juvenile and adult), artificial propagation effects (hatcheries)
Spatial Structure	Distribution of juveniles and adults within the subbasin, habitat limiting factors.
Productivity	Population Growth rate or potential – juvenile and natural return ratio (NRR) for adults (should be above replacement or 1.0). Hatchery effects should not reduce NRR below 1.0

Implementation and Effectiveness monitoring

Documenting the why, where, how much and whether of habitat recovery actions completed in the basin. (Adopt the SRFB Effectiveness Monitoring Statistical Design criteria (see *SRFB Monitoring and Evaluation Strategy for Habitat Restoration and Acquisition Projects*.) Basic M&E actions for accountability can also capture habitat modifications/changes/improvements for future EDT modeling efforts.

Critical uncertainties

Numerous efforts are presently ongoing within the Columbia Basin to recover ESA listed salmonid. Research is underway to document population response to habitat, hatchery, harvest and hydro modifications. During these actions the general understanding of the biology and ecology of salmon and steelhead populations is increasing. There remain significant data gaps and critical uncertainties regarding recovery actions. Limited funds must be used wisely to help ensure ESA populations receive maximum benefit from actions. Many critical uncertainties remain throughout the region, and within the subbasin. These uncertainties must be answered if populations are to be rebuilt and delisted. Such uncertainties may include habitat/life history stage relationships, causal relationships for degraded habitat and depressed or extirpated populations, and understanding the relationship between resident and anadromous O. mykiss subpopulations. These critical uncertainties will be identified in forums such as: Regional salmon recovery planning; Region wide (Columbia Basin) critical needs lists developed by management agencies; NOAA's Comprehensive FCRPS BiOp RME plan; and Washington State's Comprehensive Monitoring Strategy; and the Walla Walla Subbasin Comprehensive RME Plan.

Population management goals

There have been inconsistent and uncoordinated efforts to establish population abundance goals in many subbasins. Washington, the Columbia River Treaty Tribes, and most recently the TRT have suggested management goals. Each of these efforts is based on different assumptions and were accomplished for different purposes. We believe that at least two management goals will ultimately be adopted: a population abundance level sufficient to delist from the ESA, and a more robust level (beyond VSP) defined by the states and tribes that will assure preservation of populations, but also provide for harvest

opportunity. It is likely that the latter goals will be established under the auspices of the Court as part of the US v OR management plan development process. We believe that RME will be instrumental in answering the uncertainties with establishing these goals, and essential to monitoring the attainment of population management goals.

Conclusions and Recommendations

The Tucannon subbasin managers and stakeholders have implemented efforts to coordinate recovery and RME actions within the subbasin through the planning process and previous processes such as the Model Watershed Plan. Those efforts are captured in Table 1 as an assessment of ongoing and needed RME actions. The table is an attempt to identify the current level of effort, and a subjective assessment that effort's progress toward meeting data needs within the subbasin. A complete prioritization of actions within the table has not been accomplished. However, all involved parties committed to completing an RME plan that would eventually address priority actions. Following are broad conclusions and recommendations based on guiding principles and priorities, and the items listed in Table 1. These will serve as generalized high priority (in principle) actions that should be pursued while the more comprehensive RME plan is completed.

1. *Conclusion:* The quality of data used within the EDT attributes and modeling exercise is inadequate. Empirical data of know accuracy and precision is needed for priority areas (habitat inventory using standardized protocols from region that will fit EDT) of the subbasin (see section ???). These data will be used to evaluate the efficacy of EDT in modeling habitat and population response to actions taken within the subbasin, and to evaluate the hypotheses and objectives presented in the subbasin plan.
Recommendation: Fund and implement habitat inventories to collect data necessary to fill data gaps for attributes with high EDT model leverage and evaluation of progress toward subbasin plan objectives.

2. *Conclusion:* Population status monitoring must occur in a systematic manner that will allow managers to evaluate their progress toward delisting from ESA. Criteria established by NOAA and the TRTs under VSP will be used within the subbasin. These metrics will be useful within EDT, and provide a direct relationship between the habitat and population monitoring efforts, through model outputs.
Recommendation: Continue to fund existing monitoring and evaluation actions within the subbasin that fulfill critical VSP data needs.

Recommendation: Fund and implement additional actions to complete basic population status monitoring needs for the subbasin (e.g. Monitor adult steelhead escapement into the Tucannon basin. To fulfill this example, the specific actions or improvements listed below may be needed.

1. Adult counting or trap at Starbuck Dam
2. Smolt trap in upper Tucannon above Hatchery Intake Dam.

Additional VSP related action may be required/recommended as the full RME plan is completed.

3. *Conclusion*: Basic monitoring of restoration actions undertaken within the subbasin needs to occur to ensure that they were completed in accordance with expectations (Implementation monitoring). However, the effects of those actions on the habitat and salmonid populations (Effectiveness monitoring) is costly and should be done on only a portion of completed projects.
Recommendation: Accountability for restoration actions needs to occur for each project. Basic documentation should be completed in a cost efficient manner. A systematic approach to documenting effectiveness is required that provides sufficient accountability without unnecessary redundancy. (e.g. classes of actions my be represented by monitoring a small portion of similar projects)

4. *Conclusion:* Critical uncertainties will be identified in the Comprehensive RME plan and coordinated with other regional forums. Uncertainties must be understood and answered if population recovery is to occur. ESU wide uncertainties may be addressed in the subbain as part of a regional RME effort. Subbasin specific factors may need localized RME efforts to answer.
Recommendation: Fund research on critical uncertainties unique to the Tucannon as a priority for recovery actions in the subbasin. (direct need)

Recommendation: Fund research on critical uncertainties represented in the Tucannon for a broader ESU relevance if not being funded or conducted in other subbasins. (opportunity for coordinated regional effort)

Conclusion: The managers have not established comprehensive population abundance goals for the subbasin. Interim escapement and spawning goals are inconsistent in definition and basis. The subbasin plan and its RME section can provide critical data for establishing these goals in a coordinated and scientifically defensible fashion.

Recommendations: Fund and implement RME that shows a clear link to resolving uncertainty regarding population abundance and management goals.

Table 1. Identified RME opportunities in the Tucannon Subbasin, 2004.

Metric	Life Stage	Performance Measure	Collaboration	Current Effort	Desired Future Effort	Current Funding
Abundance	Adult	Adult returns to Tucannon River	WDFW, USFS	Counts are made at ladders and weirs at two sites in the subbasin. Spawning ground surveys are conducted for SSH, CHF and CHS.	Direct observations should be replaced with passive detections throughout the subbasin, but the ability to sample retained. Passive detection should be established at the confluence with the Snake.	BPA, LSRCP
		Run to mainstem dams	USACOE and Columbia River compact	Passive detections and radio detections are made at all mainstem dams and the estuary.	The current effort is sufficient.	BPA, LSC
		CHS Broodstock Collection	WDFW	Collected from Tucannon River Run CHS. Captive brood from local stock	Broodstock should come from locally adapted naturally producing CHS run	LSRCP, BPA
		STS Broodstock Collection	WDFW	Collected from Lyon's Ferry and temporary weir in lower river.	If experimental endemic program is deemed sustainable, broodstock should be collected from endemic run to upper river.	LSRCP
		Spawner Escapement	USFS, WDFW	Standardized spawner surveys are divided across geographical boundaries, and conducted with low intensity.	Stratified randomized georeferenced surveys.	USFWS, LSRCP, USFS

		Run Prediction	WDFW	Based on CWT returns by BY for hatchery, and predicted SAR from wild smolt estimates		LSRCP
	Juvenile	Parr and pre-smolt Abundance	WDFW (STS, CHS)	Electrofishing and snorkel surveys are conducted for some production areas of the river.	Stratified randomized georeferenced survey design with increased collaboration.	USFS, USFWS, LSRCP
		Smolt Abundance	WDFW (STS, CHS, CHF)	Screw-trap collections near mouth	Additional screw-trap or PIT-tagging effort to develop smolt to smolt estimate.	LSRCP
		Residual Abundance	WDFW	Limited coverage using hook and line and electrofishing.	Stratified randomized georeferenced assessment using hook and line and electrofishing.	LSRCP
Survival and Productivity	Adult	Broodstock Survival	WDFW	Monitored in-hatchery.	The current effort is sufficient.	LSRCP, BPA
		Smolt-to-Adult Return	WDFW (CHS, STS)	Hatchery returns based on CWT recoveries. Natural return metric derived from age at return, PIT tag recoveries, and spawner densities.	Increased PIT-tagging effort for hatchery and wild fish to develop SURPH and CRiSP models.	BPA, LSRCP PSMFC
		Smolt-to-Adult Survival	WDFW, PSMFC (CHS, STS)	Hatchery returns based on CWT recoveries. Natural return metric derived from age at return, PIT tag recoveries, and spawner densities.	Increased PIT-tagging effort for hatchery and wild fish to develop SURPH and CRiSP models.	BPA, LSRCP PSMFC

		Parent Progeny Ratio	WDFW (CHS, STS)	Metric derived from estimates of smolt emigration, age at return, and spawner escapement estimates.	Increased PIT-tagging effort for hatchery and wild fish to develop SURPH and CRiSP models.	BPA, WDFW, PSMFC,
		Pre-spawn Mortality	WDFW (CHS)	Expanded from carcass surveys.	Current effort sufficient for CHS. Expand to include CHF.	LSRCP
		Recruit /spawner (adult to adult)	WDFW (CHS, STS)	Metric derived from estimates of smolt emigration, age at return, and spawner escapement estimates.	Increased PIT-tagging effort for hatchery and wild fish to develop SURPH and CRiSP models.	BPA, WDFW, PSMFC,
	Juvenile	Egg to Fry Survival	WDFW (CHS)	Snorkel surveys	Current effort sufficient. Steelhead survivals dependent on redd surveys in index areas.	LSRCP
		Fry to parr and parr to smolt survival	WDFW (CHS)	Snorkel surveys	Current effort sufficient. Steelhead survivals dependent on redd surveys in index areas.	LSRCP
		Smolt Survival to Lower Monumental Dam	WDFW, PSMFC	Derived from PIT-tag detections	Increased PIT-tagging effort to develop SURPH and CRiSP models.	LSRCP, BPA PSMFC

		Smolt Survival through Mainstem Columbia River	WDFW, PSMFC	Derived from PIT-tag detections	Increased PIT-tagging effort to develop SURPH and CRiSP models.	LSRCP, BPA PSMFC
Distribution and Movement	Adult	Spawner Spatial Distribution	WDFW (CHF, CHS, STS) USFS (BT) USFWS (BT)	Standardized spawner surveys are divided across geographical boundaries, and conducted with low intensity.	Stratified randomized georeferenced surveys.	BPA, USFWS, LSRCP, USFS
		Stray Rate	WDFW,	CWT recoveries from creel and carcass surveys, and scale analysis.	In basin efforts are sufficient, but regional marking needs to increase so that all hatchery releases are represented by an adequate CWT group (data quality for expansions must be sufficient)	LSRCP, BPA
	Juvenile	Rearing Distribution	WDFW, USFS	Electrofishing and snorkel surveys	Stratified randomized georeferenced survey design with increased collaboration and coordination.	USFS, LSRCP
		Residual Distribution	WDFW	Snorkeling and electrofishing.	Stratified randomized georeferenced assessment using snorkeling and electrofishing	LSRCP
Life History	Adult	Run Timing	WDFW	PIT-tag detections, ladder and trap counts, creel surveys and spawning surveys.	The current effort is sufficient.	LSRCP

		Passage efficiency		No current activity	Radio telemetry assessment of passage at EDT identified potential barriers	unfunded
		Age of spawners	WDFW	PIT-tag detections, CWT recoveries, scale analysis.	sufficient	BPA, LSRCP
		Size of spawners	WDFW	PIT-tag detections, CWT recoveries, trapping, creel surveys, and carcass surveys.	The current effort is sufficient.	BPA,LSRCP
		Sex Ratio of spawners	WDFW	PIT-tag detections, CWT recoveries, trapping, creel surveys, and carcass surveys.	The current effort is sufficient.	BPA,LSRCP
		Fecundity	WDFW	Fecundity is measured in the hatchery for both hatchery and endemic stocks, by age	The current effort is sufficient	LSRCP, BPA
		Spawn-timing	WDFW, USFWS	Telemetry, hatchery documentation, spawner surveys, and carcass surveys.	The current effort is sufficient.	BPA, LSRCP
	Juvenile	Size at Release	WDFW	Monitored in-hatchery.	The current effort is sufficient.	BPA, LSRCP
		Release Location	WDFW	Monitored in-hatchery.	The current effort is sufficient.	BPA, LSRCP

		Emigration Timing	USFWS (BT), WDFW (STS, CHS, CHF, BT)	PIT-tag detections and screw-trap collections, radio telemetry.	Additional screw-trap or PIT-tagging effort to evaluate yearling STS production.	LSRCP, BPA
		Age at Emigration	USFWS (BT), WDFW (STS, CHS, CHF, BT)	PIT-tag detections and screw-trap collections, radio telemetry.	Additional screw-trap or PIT-tagging effort to evaluate yearling STS production.	LSRCP, BPA
		Size at Emigration	USFWS (BT), WDFW (STS, CHS, CHF, BT)	PIT-tag detections and screw-trap collections, radio telemetry.	Additional screw-trap or PIT-tagging effort to evaluate yearling STS production.	LSRCP, BPA
		Condition at Emigration	USFWS (BT), WDFW (STS, CHS, CHF, BT)	PIT-tag detections and screw-trap collections, radio telemetry.	Additional screw-trap or PIT-tagging effort to evaluate yearling STS production.	LSRCP, BPA
Fish Health	Adult and Juvenile	Disease Incidence	WDFW	Monthly disease checks in hatchery. Limited sampling of natural populations and no assessment of hatchery-to-natural transmission.	Coordinated surveys of mortalities and carcasses, plus small sub-sample of "healthy" wild fish.	LSRCP, BPA
		Disease Severity	WDFW	Monthly disease checks in hatchery. No coverage in natural populations and no assessment of hatchery-to-natural transmission.	Coordinated surveys of mortalities and carcasses, plus small sub-sample of "healthy" wild fish.	BPA, LSRCP

Genetic	Adult and Juvenile	Genetic Diversity and Integrity	NOAA, WDFW	Allozyme and DNA samples collected from hatchery and wild populations.	Coordinated assessment of genetic characteristics for all supplemented, reintroduced, and listed species.	NOAA, LSRCP, BPA, WDFW
		Reproductive Success	WDFW	Metric developed from estimates of hatchery and wild escapement and comparison of parent to progeny rates and within year variance of smolt production. Genetic monitoring.	Experimental assessment of reproductive success of STS, and CHS at Tucannon Hatchery trap.	LSRCP, BPA
		Effective population size	WDFW (CHS)	Calculated from escapement estimates and genetic samples.	Standardized monitoring of effective population size measured as the rate of decline in genetic heterozygosity	LSRCP
Fisheries	Adult	In-basin harvest	WDFW	Limited coverage using creel surveys plus catch records from volunteers. No trout fisheries monitored.	Stratified randomized creel surveys of entire subbasin plus increased volunteer involvement if fisheries expand.	WDFW, LSRCP
		Out-of-basin harvest	LSRCP, PSMFC	Randomized creel surveys plus CWT and PIT-tag estimates of harvest.	Increased spatial and temporal coverage and consistency in survey methodologies.	LSRCP, NOAA
		Hooking rate	WDFW	Limited coverage using creel surveys plus catch records from volunteers.	Stratified randomized creel surveys of entire subbasin plus increased volunteer involvement if fisheries expand.	WDFW

		Handling mortality	WDFW	Derived from literature based hooking mortality applied to estimated handle rate from creel surveys.	A hooking/handling mortality study should be conducted if fisheries expand.	LSRCP, WDFW
Habitat	Adult and Juvenile	Instream flow	USGS, DOE, WDFW, USFS	Established flow gauges, and IFIM model	Barely sufficient. New gauge in upper basin is desirable.	USGS, DOE, USFS
		Water temperature	WDFW, USFS, CCD, PCD	Stratified random deployment of thermographs	Additional needs in Pataha and upper Tucannon tributaries	LSRCP, USFS, CCD, PCD
		Water quality	DOE, PCD, CCD, USFS	Periodic grab samples, TMDL process, and ISCO sediment samplers	Expanded to establish full baseline water quality.	DOE, PCD, CCD, USFS
		Physical habitat conditions	USFS, WDFW, CCD, NRCS, PCD	Modified Hankin & Reeves or Rosgen surveys.	Addition of EDT-derived metrics such as bed-scour and embeddedness, plus georeferenced survey design.	BPA, LSC, USFS, CCD, NRCS, PCD
		Biological habitat conditions	USFS, WDFW, CCD, PCD, NRCS	For riparian conditions, modified Hankin & Reeves or Rosgen surveys.		BPA, USFS, WDFW, CCD, PCD, NRCS
		Habitat Quantity	USFS, WDFW, CCD, NRCS, PCD	Modified Hankin & Reeves or Rosgen surveys.	Addition of EDT-derived metrics such as bed-scour and embeddedness, plus georeferenced survey design.	BPA, LSC, USFS, CCD, NRCS, PCD

		Passage barriers and diversions	WDFW	Telemetry and spawner surveys.	Full assessment of barriers needs to be completed.	WDFW, LSRCP
		Habitat utilization	WDFW, USFS, USFWS	Derived from juvenile and adult abundance and distribution surveys. Radio telemetry	Georefenced survey design for fish population studies	BPA, LSRCP, USFS
		Smolt production of habitat	WDFW, USFS, USFWS	Derived from juvenile and adult abundance and distribution surveys.	Georefenced survey design for fish population studies	BPA, LSRCP, USFS
Ecosystem	Juvenile and Adult	Trophic relationships		not assessed	Stable isotope assessments plus mass-balance models	unfunded
		Competition		not assessed	Stable isotope assessments plus mass-balance models	unfunded
		Natural mortality		not assessed	Stable isotope assessments plus mass-balance models	unfunded
		Marine ecology		not assessed	Archival tag studies	unfunded
		Redd impacts		not assessed	Stable isotope assessments plus mass-balance models	unfunded
		Carcass impacts	WDFW	Estimates of marine nutrient load	Stable isotope assessments plus mass-balance models	LSRCP