First Quarter of 2005 Progress Report on the John Day RME pilot project

A Federal research, monitoring, and evaluation (RME) program for the Columbia River Basin, has been called for under the US National Oceanic and Atmospheric Administration Fisheries (NOAA-Fisheries) 2000 Federal Columbia River Power System Biological Opinion (BiOp) and the Federal Columbia River Salmon Recovery Strategy (All-H Strategy). Implementation of this regionally coordinated, programmatic approach to the Tributary Research, Monitoring, and Evaluation (RME) is being tested through pilot projects in the Wenatchee, John Day, and Salmon subbasins, prior to extending it to larger areas. This project seeks to develop the pilot intensive RME program and an Intensively Monitored Watershed Study (IMW) in the John Day basin. To aid in the coordination of the John Day RME program and the IMW Study, four workgroups have been established; the Freshwater Production Group, the Habitat Monitoring Group, and the GIS Group, which are subgroups of the parent coordinating Analytical Framework Group (AFG).

The AFG is charged with developing the overall analytical framework for RME efforts in the John Day basin. The framework attempts: to organize existing and future research activities to identify factors limiting salmonid production; evaluate status and trends of salmonids and habitat; coordinate project implementation and compliance monitoring; assess reach-scale biological and physical impacts up to population level salmonid productivity effects of restoration actions. In the first quarter of 2005, the AFG has conceptually designed a program that addresses these goals. The AFG will develop and test this program under two broad approaches: development of IMWs and the development of a basin-wide RME program.

Development of Workgroups and Products

Workgroups have been developed to help coordinate efforts to compile information, summarize results from related projects, and design projects for the IMW and the watershed assessments. Names in bold are the workgroup leaders.

- GIS workgroup – **Kristin Swoboda**, Lanie Boler, Carol Volk, John Faustini, Francisco Madrinan, Russ Faux, Don Butcher, Steve Rentmeester, Nick Bouwes.
  - Will compile data layers and coordinate distribution. Because there is overlap in the GIS layers needed for each project, this workgroup should determine the most efficient approach to gather this information. There is an opportunity here to divvy up work products that can be shared.
    - Summarize/synthesize current activities
    - Extract relevant information from above relative to needs for monitoring design process
  - <u>Progress to date</u>: inclusion of habitat and fish monitoring information into the Federal RME database and data dictionary

- Habitat Monitoring - **Rick Henderson**, Shannon Hubler, Hiram Li, John Faustini, Jim Ruzycki, Nick Bouwes.
  - Will develop work plan including, but not limited to data compilation, data assessment, indicator/protocol assessment, and performance metrics.
    - Summarize/synthesize current activities
    - Extract relevant information from above for monitoring design process
  - Progress to date: ODFW has completed 2004 annual report on habitat monitoring in the John Day. PIBO has completed a preliminary report on habitat monitoring in the Columbia River Basin for 2004. ODEQ is currently summarizing the past 5 yrs of monitoring. Some of this of information has been presented to the AFG.

- Fish Monitoring - **Jim Ruzycki,** Peter Bayley, Charlie Paulsen, Nick Bouwes.
  - Compile data and define performance metrics.
    - Summarize/synthesize current activities
    - Extract relevant information from above relative to needs for monitoring design process
  - Progress to date: Cooney provided an overview of the BRT work on the status and trends of steelhead and salmon in the John Day. ODFW has completed the draft 2004 annual report describing the fish monitoring over the past year.

Designing the RME program for the John Day

Because the pilot projects are being implemented as means to test and learn about the development of a comprehensive effectiveness monitoring program, the AFG has begun to develop a conceptual framework where we identify where and how restoration actions should be implemented, and how we determine the benefit of those actions with a high degree of certainty and potential for learning. This framework is also the basic premise of experimental management.

The conceptual framework is illustrated in Figure 1. The diagram starts with a goal statement. This statement should be concise as possible to focus the RME process. In the John Day, the goal of the Federal Columbia River Power System (FCRPS) BiOp, is to increase freshwater productivity of salmonids. The AFG plans to help develop the Federal RME program to identify, implement, and measure responses of mitigation strategies. The goal statement is expected to be refined to a hypothesis as we develop specific study designs in the IMWs.

Next, it is important to identify the problem or the factors limiting salmonid production. Most restoration efforts fail because they have not identified the problem, often a general packaged restoration plan is implemented that may or may not be effective. This approach is not likely to be cost effective in the long run. In addition, efforts should be made to describe baseline or current conditions in which to describe status and trends to compare to post mitigation responses. This will require status and trends

monitoring of fish and habitat, and research directed to help understand the mechanisms limiting salmonid production. This information has to be synthesized to identify the problem and to refine broad questions into testable hypotheses. This will likely be an iterative approach. These steps described thus far (open circles in the above diagram) can be considered more exploratory in nature.

Hypotheses should be much more specific than goals (i.e. the presence of fine sediments reduces the survival of steelhead eggs for a given population, or temperatures are above optimal to maximize growth in juvenile steelhead). We can then design an experiment to test this hypothesis. This includes design of effectiveness monitoring and directed research to document mechanisms of the response. The restoration action is then implemented under this experimental design and responses are measure over time. The results of this experiment can be use to make decisions about the effectiveness of this restoration approach and how to proceed with further actions. This may alter the view of these original goals. These steps (shaded circles) are more experimental in nature. Research to date coordinated by the AFG has been exploratory. The goal of the AFG in 2005 is to expand on this exploratory research and design the experimental components of the RME program.

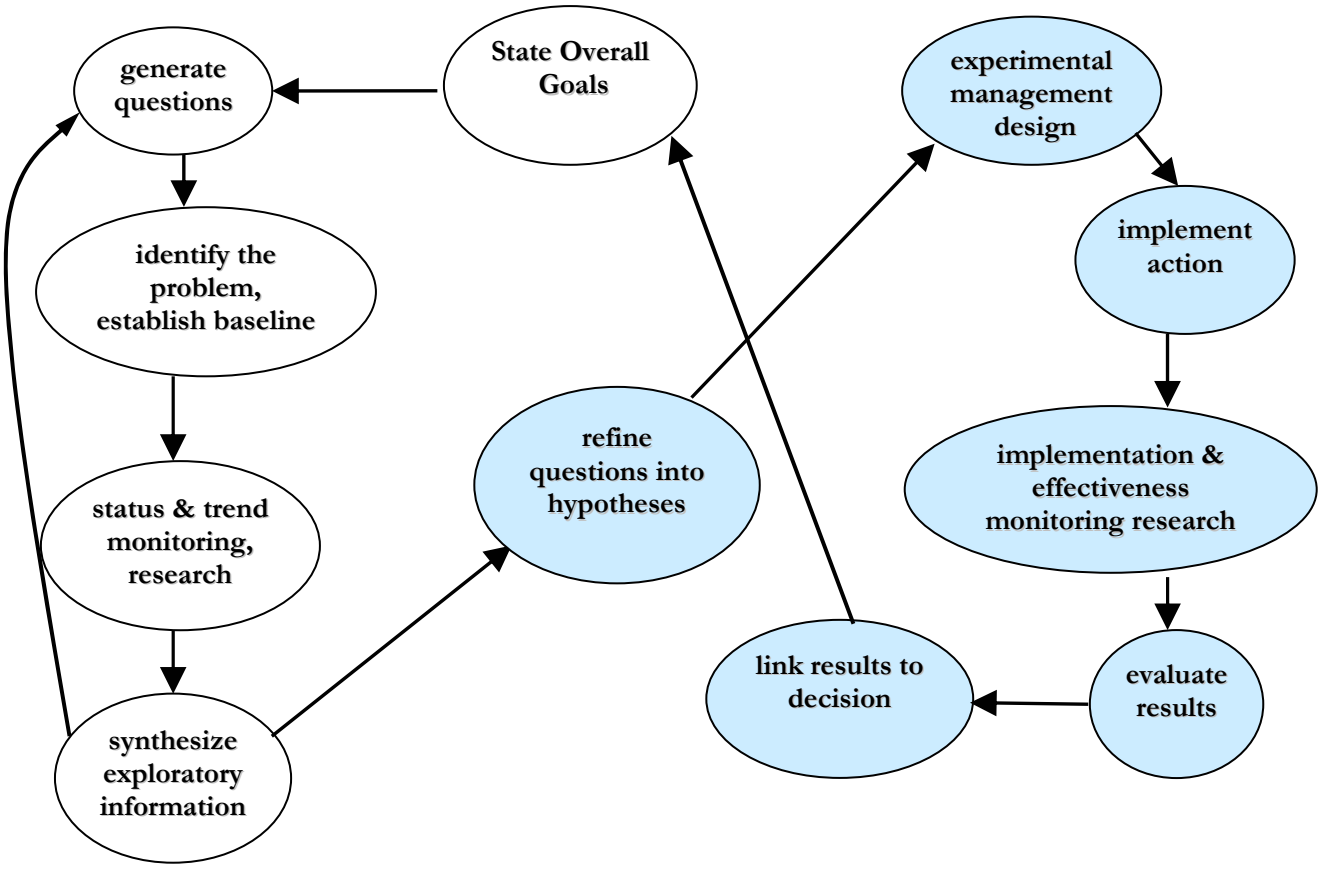

Figure 1: Diagram of the steps to experimental management necessary to identify and test mitigation strategies.

The AFG agreed to attempt to lay out a process by which mitigation strategies in the John Day Basin will be identified, implemented, and their responses monitored. Our first task has been to synthesize current research and monitoring efforts that are described in detail in the 2004 Analytical Framework document (Bouwes 2004). We will then begin to develop experimental management approaches at two different scales and ask the questions:

1) **What are the steps necessary in developing and implementing an experimental restoration program in a given watershed?** We refer to this as the Intensively Monitored Watershed study.

2) **What are the steps necessary in developing and prioritizing restoration efforts, by watershed, and developing effectiveness monitoring programs at the scale of the John Day Basin?** This will initially be a large scale watershed assessment.

Synthesis of research

Researchers are to summarizing current research to date so that synthesis of this research can be used to design IMW and watershed assessments. Progress has been made on research described in the 2004 AFG document. The AFG agreed to try to summarize 2004 research and monitoring by the first quarter of 2005. The AFG will attempt to synthesize this information to refine questions into testable hypotheses for the IMWs. Things to consider:

- Our original problem statement was summer low flow water temperatures and disrupted sediment deposition/transport strongly limits production and distribution of salmonids in the John Day River basin. Has the research to date changed these ideas?

- What is being measured, where in the John Day River basin?

- What scale (time/space) does it represent?

- What are the statistical properties(?) of the data?

- Do we have the monitoring infrastructure in place to assess stream temperatures and sediment process status?

- Do we have salmonid population/productivity monitoring in place to assess status of populations?

- Do we have the monitoring infrastructure in place to assess change in stream temperature and sediment processes?

- Do we have the research and monitoring infrastructure in place to assess change in salmonid population processes that result from changes in stream temperature and sediment supply and transport?
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SUMMARIZE WHAT HAS BEEN DONE TO DATE?

Models

Models can be a very useful tool in organizing monitoring and research and designing experiments. The AFG has begun to consider and develop some analytical models for these purposes. For example, the TMDL model may allow us to play with "what if" scenarios in terms of our ability to alter reach temperature regimes. If, say, under the best case scenario our ability to restore riparian vegetation and hydraulic connectivity will decrease stream temperatures by 1 °C, is it worth attempting to decrease reach temperatures? The development of a fish bioenergetics component to this model has been initiated to better understand the influence of habitat characteristics impacts on temperature and therefore growth of salmonids.

Intensively Monitored Watershed study

The plan is to implement the "ideal" experimental management action within a given watershed as a means of testing the process of developing an RME program. This includes: a process to identify the problem, such as understanding the mechanisms limiting fish production and the landscape context for these interactions; establishment of status and trends of fish and their environment from associated monitoring programs; defining specific hypotheses to test; designing the experimental manipulation that achieves restoration goals while maximizing learning, which include the experimental design (e.g. BACI design), research design, the effectiveness monitoring program (e.g. protocols, sample design, sample sizes, etc.); implementation of the watershed restoration project, research and monitoring. This experiment is expected to happen in one treatment watershed and one to several control watersheds. Developing an RME program for a localized experimental management project, will test the ability of the program to meet the needs of large scale restoration efforts.

IMW design considerations

- Statistical design: We need to determine the experimental design to maximize our ability to detect response. For example, a Before-After-Control-Impact (BACI; Green 1979, Stewart-Oaten et al. 1986) approach could be used, where a control and manipulated watershed would be compared pre- and post-manipulation over time. Underwood (1994) suggests that multiple control areas be used to account for different trajectories that naturally can occur between sites. There are other alternative approaches that may be explored. References will be put on the John Day website.

- Monitoring design: Implementation monitoring (monitoring to determine if the manipulation is still in effect – e.g. if logs were added to create pool, are the logs still there the next year) and effectiveness monitoring (monitoring of response variables to action) programs need to be developed. This includes evaluation of the multiple protocols already used in the John Day to monitor habitat and fish. An evaluation of different habitat monitoring protocols ability to distinguish signal from noise, and estimate the 'truth' will occur this summer and may lead insight into design of a monitoring program. Also, an effectiveness sample design needs to be developed. This design will likely differ from status and trend monitoring in terms of selection and number of sample sites and response variables to measure. Other considerations include a cost:benefit analysis of the alternative approaches, covariates, consideration of variables with quick response times, surrogate measures and indices.

- Research: Currently there are several research projects occurring at multiple scales. The IMW is an incredible opportunity that we should take advantage of to develop research that can be done in contrasting conditions to elucidate mechanisms how fish interact with their environment, and how management might influence those interactions. We need to determine what research should be continued during an IMW, and what other projects should be added to address remaining critical uncertainties.

- Manipulation: There will be several things to consider when determine what manipulation we will test, beyond identifying the main limiting factors.
    - Location-The location of where we can implement an IMW will likely be as important as anything else. By phrasing the question as in question 1, we can choose a watershed for manipulation based on practical considerations and go through the process of developing the best mitigation actions for that given basin (even though it may not be the most widespread problem in the John Day Basin). Practical considerations of where to conduct this study includes the availability of past and current research and monitoring to identifying the problem so that the exploratory steps to experimental management are largely completed, and the experimental component can proceed in the near future. Ownership of the land containing potential watersheds will also affect our ability to conduct an IMW.

    - Logistics/feasibility: Obviously we have to give consideration to the feasibility of implementing a given restoration action. Constraints will be cost, time, and access. It is not clear, at this point, where the money will come from to implement a restoration program, although opportunities do exist. We will be more likely to obtain funding if we shop around with a well thought out plan in hand. We will have to estimate the cost associated with the planned activity and possibly alternatives. We also should consider the time it takes to see a response in determining the restoration action. The IMW has a minimum of 3 years of funding. Future

funding is uncertain so implementing a restoration project that requires 30 yrs to observe a response is not a likely option. We also have to consider the possible hurdles of obtaining the permits to implement a restoration activity such as time required to go through a NEPA process.

- Support: The effort required to conduct an IMW will be large and will require the input from several parties. We need to identify those parties and try to get them involved. Again, it might be best to have a working plan to generate the interest to join in this effort.

- We should review other working examples of IMWs and determine if there are tools or lessons learned from these studies that can be used in developing the IMW in the John Day.

Potential IMW locations

The AFG created a list of potential IMW projects that take the above considerations into account. This information is summarized in Tables 1 through 3. The AFG has begun to develop IMW study designs on a subset of these potential projects.

The South Fork of the JDA. The South Fork of the JDA provides an excellent opportunity to conduct an IMW. A great deal of the monitoring and research coordinated by the AFG occurs in the mainstem South Fork John Day River and its tributaries: Black Canyon, Wind Creek, Deer Creek, and Murderers Creek (see Figure 2). This work includes: GIS analysis of how landuse and landscape patterns impact habitat and fish distribution; LiDAR and FLIR of the SF JDA and some these tributaries; TMDL model development on the mainstem SF; extensive continuous habitat surveys SF JDA and these tributaries; PIT-tagging of fish in each tributary (Figure 3) to track growth and survival of fish residing in each watershed that differ in habitat and temperature regimes; radio-tagging of fish to track movement patterns; screw trap monitoring on the mainstem SF; and snorkel surveys. This information can serves as baseline information as well as a means to identify the major limiting factors in these watersheds.

Stream temperatures in the South Fork approach lethal levels for juvenile steelhead. Juveniles attempt to find cold water refugia throughout the system; however, upstream and downstream migration is constrained by impassible push-up dams. Push-up dams are expected to be removed in the summer of 2005 from the lower mainstem of the South Fork. In addition, the lower portion of Murderers Creek is owned and managed by the state of Oregon, and therefore, through partnership with ODFW, may provide a feasible location to further test the removal of a water diversion. The research in this area will allow for an evaluation of the removal of these dams on habitat selection in the mainstem South Fork and other tributaries. Development of an experimental design is currently underway and is expected to be implemented in the summer of 2005.

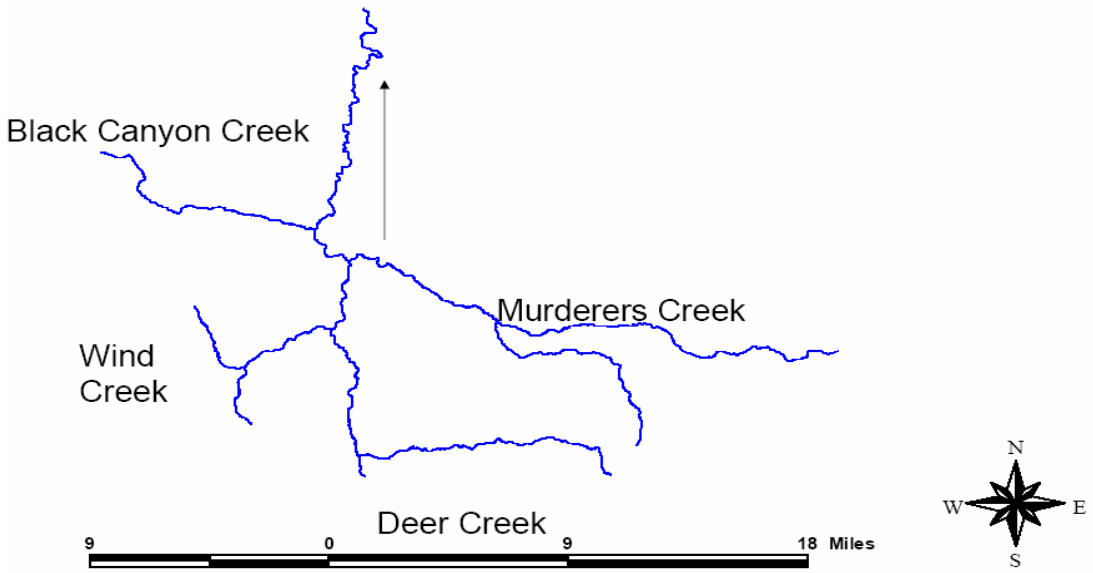

Figure 2. A map of the South Fork of the John Day (the SF flows North as represented by the arrow) and its tributaries.

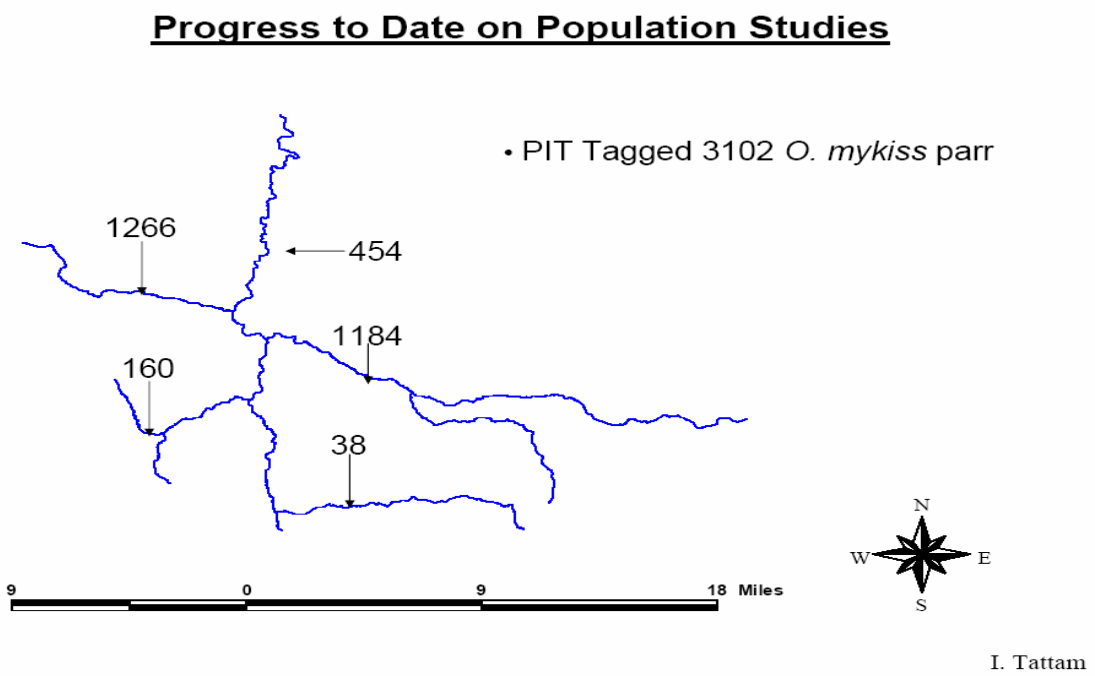

Figure 3. A map of the South Fork of the John Day and its tributaries, showing the distribution of PIT tagged *O. mykiss* parr in 2004.

Bridge Creek. Bridge Creek is a tributary to the lower mainstem of the John Day. Research has been focused on the impacts of grazing on channel incision. Large sections of Bridge Creek exhibit deep channel incision due to the loss of vegetation through grazing and the mechanical disruption of the stream bank from cattle. Stream

elevation and gradient is altered resulting in a lowering of the hyporheic water level. Further loss of riparian vegetation occurs because root structures no longer have access to the water table. Channel incision produces bank erosion and high sediment inputs into the stream channel. Techniques exist to mitigate for the effects of channel incision. This process can be jump started through mechanical manipulation of the stream banks and floodplain allowing for observable effects of restorations in the near term. An IMW study could be designed to follow this potential restoration action. Rock Creek also suffers from channel incision and provide a control watershed in an experimental management approach to this study. Coordination between research in the South Fork John Day and Bridge Creek is underway to maximize sampling of fish utilization and habitat information.

Upper Middle Fork of John Day. This area might also provide an opportunity for an IMW study as a fair amount of information has been collected there and access to MF JDA is possible. Land holdings include: The Nature Conservancy, Confederate Tribe of the Warm Springs Reservation, Federal lands, and one private property, who might be willing to work with us. In addition, several restoration activities have been planned or are currently being implemented. Evaluating these restoration actions that have already received funding may prove to be cost effective. ODFW has recently finished complete habitat surveys of the MF JDA on CTWSR land. In addition, there are chinook spawning grounds surveys, snorkel surveys, and screw trap information to get some information on chinook status. OSU has also conducted research in this area in the past. FLIR surveys have also been collected on the Middle Fork on three different years. Finally, a TMDL model will be available for this reach.

Table 1: Potential Intensively Monitored Watershed studies in the South Fork of the John Day River.

subbasin	location	hypothesis (problem)	manipulation	land ownership	access	pre-info	scale-temporal response	scale -size
South Fork	Mainstem SF	1.) push-up dams restrict movement 2.) push-up dams restrict access to cool water refugia	remove push-up dams/ delay push-dam replacement	private	sampling access	OSU research, FLIR, LiDAR	1+ yrs	reach- 4 km
	Murderers Creek	1.) push-up dams restrict movement 2.) push-up dams restrict access to cool water refugia	remove push-up dams/ delay push-dam replacement	ODFW	sampling access	OSU research, FLIR, LiDAR	1+ yrs	reach- 12 km
	Black Canyon	prohibiting grazing and allowing natural fire cycles can lead to greater fish habitats through input of large wood.	Comparative chronosequence study. Compare with representative streams where grazing and fire suppression is allowed and document large wood, habitat use and fish densities.	Wilderness Area	sampling access	OSU research, FLIR, LiDAR	Use wood coring techniques and historical aerial photographs to compare changes in landscape, river channel and large wood structural attributes	reach-16 km

Table 1 (cont.): Potential Intensively Monitored Watershed studies in the South Fork of the John Day River.

subbasin	location	controls	biological response metric	potential for response	physical response metric	representative	ESA	TMDL ?	cooperators	lead
South Fork	Mainstem SF	Black Canyon, Deer Canyon, Wind Creek, SF mainstem	fish movement (Hughes and Grand), fish growth, fat, production? Secondary production (maybe difficult), ppr	quick, effect size?	Increase connectivity, decrease barriers.	yes	yes, steelhead	yes	AFG	Hiram, Jim, Tim
	Murderers Creek	Black Canyon, Deer Canyon, Wind Creek, SF mainstem	fish movement (Hughes and Grand), fish growth, fat, production? Secondary production (maybe difficult), ppr	quick, effect size?	Increase connectivity, decrease barriers	yes	yes, steelhead	yes	AFG	Hiram, Jim, Tim
	Black Canyon	May require comparisons with other similar watersheds with different fire histories in NFJD, MFJD, and upper mainstem, e.g., Tower fire, Mt. Baldy fire.	Patterns of habitat use and fish density. Relative distribution and extent of redds. Standardize for watershed area, habitat size, stream gradient, valley type, mean annual ppt. and elevation.	Substitute space for time.	Examine factors influenced by fire (e.g., sediment, stream temperature, large wood distribution, retention time & length of nutrient spirals)	With careful selection of other sites, may compare how fire policy can influence habitat restoration.	yes, steelhead	yes	AFG	Hiram, Jim, Tim

Table 2: Potential Intensively Monitored Watershed studies in the Middle Fork of the John Day River.

subbasin	location	hypothesis (problem)	manipulation	land ownership	access	pre-information	scale-temporal response	scale -size
Middle Fork	Mainstem MF	loss of riparian habitat has lead to disfunctional stream system (loss of pools, increase temperature, high sediment). Grazing, fire disturbances, logging on south flowing watersheds	exclude cattle from 5 miles riparian area, Oregon Water Trust may still have a lease on water rights in a key reach in the Austin Junction vicinity. Steven Parrett is contact at Oregon Water Trust. Possible water diversion manipulation on old Vidondo Ranch.	Warm Springs, TNC, Forrest Ranch, Oxbow Ranch, potential for another ranch to participate, Packett property downstream	access to whole study area (but some reaches are still in private hands)	See Powerpoint Slide" OSU Spatial Data", recent ODFW habitat inventory on entire CTWSR	15+ years	Large watershed. Many Subbasins are large (e.g. Big Creek, Granite-Boulder Creek, Camp Creek, Clear Creek, Big Boulder)
	Bridge Creek to mainstem MF	Removal of reservoir would increase fish access decrease water temperatures	small dam removal	ranch and public, USFS, above	likely	spawning ground surveys, BLM Prineville Fish Inventory, late 1980's	1+ years	watershed for movement reach for temperature

Table 2 (cont.): Potential Intensively Monitored Watershed studies in the Middle Fork of the John Day River.

subbasin	location	controls	biological response metric	potential for response	physical response metric	representative	ESA	TMDL ?	cooperators	lead
Middle Fork	Mainstem MF	upstream/ downstream - distance	juvenile abundance/production, spawner abundance	long term	temperature and increase in habitat	Must be careful to avoid confounding effects, (rrigation, grazing, timber harvest, channelization, road construction, mining impacts, wild fire, water donations, passive and active restoration, installation of instream structures, fencing), but basin is large and appropriate contrasts may be possible within drainages.	yes, steelhead, bull trout	yes	CTWSR, TNC, private land owners	Alex
	Bridge Creek to mainstem MF	Clear Creek, Vincent, others?	movement and productivity , juvenile density in reach below dam, redds/mile	quick, effect size?, large below dam	temperature and increase in habitat	somewhat unique but gets at passage and temperature impacts	yes, steelhead	yes in MF		

Table 3: Potential Intensively Monitored Watershed studies in the North Fork and Mainstem of the John Day River.

subbasin	location	hypothesis (problem)	manipulation	land ownership	access	pre-information	scale- temporal response	scale -size
North Fork	Granite Creek to NF	increase in channel complexity and flood plain connectivity to increase spawing habitat	level mine tailings	FS, private	likely high	OSU Spatial Data, EMAP site, FLIR	15+	watershed
	Upper NF/Trail Creek	fire and clear leads to an increase in temperature for large section of the NF	natural restoration	FS	likely high	OSU Spatial Data, EMAP site, FLIR 1998	happen 10 yrs ago, 10+ yrs	large watershed
	Desolation	Installation of instream structures to increase pools, role of which not evaluated.	Evaluate impact of brook trout on bull trout and red band trout? What is the distribution and abundance of natural vs. man-made pools (too few to make a difference). Compare functions and fish densities of natural vs. man-made pools? This gets hairy.	USFS & private in-holdings.	Likely high	OSU Research 1989, but sketchy stuff. I snapshot.	Depends on type of study. Removal of exotics on the production on survival and the degree of hybridization of brookies with bull trout may take less than 5 years.	Large watershed
Lower Mainstem	Bridge Creek to MS	channel inciscion results in loss of rearing habitat, spawing habitat increase temp	sediment traps	Park Service and BLM, private	sampling access	little to no data	10+ years	reach - 10km??
	Pine Creek to Lower MS????	channel inciscion results in loss of rearing habitat, spawning habitat increase temp		Warm Springs, ranch		Wayne Bowers and Tim Unterwegner may have some data as they worked on projects with OMSI in that region.		

Table 3 (cont.) : Potential Intensively Monitored Watershed studies in the North Fork and Mainstem of the John Day River.

subbasin	location	controls	biological response metric	potential for response	physical response metric	representative	ESA	TMDL ?	cooperators	lead
North Fork	Granite Creek to NF	Bull Run, other?	increase redds/mile,	large	channel complexity, temperature	toxins unique, mining broadscale	bulltrout, steelhead	maybe	FS, ODFW	Jeff Neal, ODFW
	Upper NF/ Trail Creek	timeseries appoarch, Baldy or Crane	productivity and redds/mile	large	temperature and increase in habitat	large scale restoration	steelhead and bulltrout	Yes	FS ODEQ	Don
	Desolation	Pre-post study. Possibility of using upper mainstem sites to examine the influence on brook trout on bull trout, redbands, but upper mainstem also has westslope cutthroat trout. Might be able to use Cable Creek, a tributary to Camas Creek as a control.	degree of hybridization and relative composition of pure vs. hybrid bull trout? Compare productivity of natural vs. man-made pools (must understand patterns of movement for this to provide dividends)	Quick?	natural vs. man-made pools. Pool complexity? Additional pool volume and habitat for entire watershed?					Michael Pollock
Lower Mainstem	Bridge Creek to MS	Rock Creek, others?	fish productivity		flow, temperature, sediments, riparian habitat, channel complexity, etc.	yes	yes, steelhead	no	Park Service, BLM	Michael Pollock
	Pine Creek to Lower Mainstem									Michael Pollock

Basin-wide RME program

The IMW can potentially be implemented in the near term. However, there is a need to develop and RME program with the goal to identify mitigation opportunities at the scale of the John Day Basin. While this will be much more difficult, the AFG has begun to outline how progress can be on this while implementing an IMW. The AFG plans to conduct watershed assessments to identify limiting factors, evaluate current restoration activities, prioritize future restoration activities, and develop effectiveness monitoring strategies to compare control and treatment watersheds. A limiting factors analysis will be conducted for all watersheds. This is where the AFG can tie in with other efforts that have been working towards this goal such as subbasin planning, which has used the Ecosystem Diagnostic and Treatment model (EDT) throughout the John Day to identify limiting factors. Other processes will also feed into this larger efforts such as the TRT and watershed and recovery plans. The current exploratory studies coordinated under the AFG will also be useful in this process, especially projects describing how landscape patterns and land use practices relate to habitat and fish distribution at the reach and watershed scale, because these studies occur throughout the John Day Basin (see 2004 AFG document). Some of these studies include the landscape changes and patterns study that will classify watersheds and describe historical data, the TMDL studies, and FLIR surveys that have been collected throughout much of the JDA.

Next, the AFG will prioritize restoration efforts by watershed defined as potential importance for aiding in the recovery of focal species, potential for improvement (perhaps determined from historic to current condition), practicality of implementation (e.g. private landowners, expense, etc.), and the likelihood to detect change given what we learned from the ability of monitoring programs to distinguish signals from noise. These steps are largely exploratory in nature. Multiple restoration projects throughout the JDA will likely be done in cooperation of several interested parties. Lessons learned in the IMW study will be useful in setting these projects in an experimental management approach and developing RME programs to determine benefits from these activities. The larger scale of the John Day may provide opportunities for greater spatial comparisons, higher replicates of treatments and controls, and greater universe of restoration types for extrapolation to other basins.

There may also be opportunities to evaluate existing restoration activities retrospectively. The AFG will need to map out restoration efforts to date throughout the JDA. Much of this information has already been complied NMFS. The AFG will design an effectiveness monitoring program around these restoration projects.