PROJECT PROPOSAL

John Day Basin Partnership Resiliency and Prioritization Analysis

February 10, 2017

Prepared for:
Grant Soil & Water Conservation District
Attention: RFP - Resiliency and Prioritization Analysis
721 South Canyon Boulevard
John Day, Oregon 97845

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Jason Kehrberg, Manager
Grant Soil & Water Conservation District
721 South Canyon Boulevard
John Day, Oregon 97845

Dear Mr. Kerhrberg;

Attached is our proposal in response to your RFP, "John Day Basin Partnership Resiliency and Prioritization Analysis." Our objective is to provide the John Day Basin Partnership with a spatial database comprised of data suitable for identifying and prioritizing habitat restoration needs in the John Day Basin. We will work with the Partnership to identify data gaps, and discuss how these gaps can affect future analyses, and what steps could be taken to alleviate the issues. Finally, we will propose prioritization frameworks and strategies that are well supported by the available data, and consistent with the objectives outlined in your Strategic Action Plan. Outputs from this effort will be made available within your existing DataBasin web portal. In this way, the database can become a collaboration tool for the Partnership, allowing stake holders to interactively explore data without the need an outside expert or expensive software.

Cramer Fish Sciences has an exceptional technical team and direct experience in the John Day basin. I will serve as the Lead Investigator, working closely with our biometrician, Dr. Kai Ross, to select the most effective data structures to enable sorting and analysis of data from diverse sources, and to provide the inputs to frameworks that can help you choose and justify optimal sequences of actions to achieve your vision for a restored ecosystem. Steve Cramer will serve as Senior Advisor to connect the team with data and analyses already assembled by CFS. Finally, Dr. Phil Roni will lend his considerable restoration expertise to advise us on prioritization frameworks and review our final report.

We are especially pleased to work with the newly formed John Day Basin Partnership, because the vision and guiding principles expressed in your Strategic Action Plan and Memorandum of Understanding create a structure for collaboration that greatly enhances your ability to make meaningful progress toward restored function and productivity of the John Day Basin. We would count it a privilege to join with you in that pursuit. We look forward to the next phases of the process, when we can meet and discuss ideas, data, and capabilities that the Partnership needs in order to develop effective strategies for restoring the ecological and socioeconomic productivity of the basin.

Sincerely yours,

Raymond Timm, PhD

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INTRODUCTION

Cramer Fish Sciences is pleased to submit the following proposal to assist the John Day Basin Partnership (Partnership) in developing a Resiliency and Prioritization Analysis (Analysis). Specifically, we will work with the Partnership to: 1) Develop a robust, comprehensive collection of existing data that are most appropriate to analyzing, planning, managing, and monitoring watershed restoration activities within the John Day Basin; 2) Identify data gaps that limit objective and repeatable assessment of conditions and strategies; and, 3) Develop recommendations for specific models to aid in prioritizing watershed restoration efforts that offer greatest potential to provide long-term ecological benefits for native fish species in the region. Our approach is to first identify and then quantify the degree to which existing datasets overlap spatially and are relatable to each other in time (year, season, event) in order to determine which can be used in a watershed assessment to prioritize restoration actions. We will then assemble this information in a user-friendly database that enables the Partnership members to query and retrieve data suited to topics, locations, or time periods of their interest. With this information, we will be able to suggest prioritization frameworks that are best suited for application of the specific datasets that exist for the John Day Basin, and to address the objectives of the Partnership. We understand it is the Partnership's desire is to give priority to Ecosystem Restoration Actions that are financially sustainable, positive economically for local communities, improve fisheries and harvest opportunities, address water quality problems including TMDLs, and are consistent with federal, state, and tribal fish recovery plans. We will coordinate closely with the John Day Basin Partnership, Grant Soil and Water and Conservation District, and your project partners to accomplish these tasks.

PROJECT TEAM

The team we are proposing from Cramer Fish Sciences (CFS) was chosen for their expertise at assessing the productivity and limiting factors of watershed landscapes from ridge to ridge including riparian areas, fish populations and their habitats. For nearly 30 years, our staff that is now over 35 scientists has empowered natural resource managers and stakeholders with cutting-edge science and practical solutions to fisheries and watershed management challenges. We recognize that the ability to choose successful restoration actions derives from good data, involves appropriate analytical methods, and builds on cooperative interactions among the involved parties. Scientists at CFS have played prominent roles in several high-visibility salmon recovery and watershed restoration efforts. We are well-known for applying quantitative spatially explicit methods to determine habitat process linkages across scales that determine fisheries population conditions (Figure 1). Because we start by asking "*where*" questions at every scale, we can set up hierarchical analyses to quantify causative relationships among the physical, chemical, hydrological, and biological components of basin, watershed, riparian, and river ecosystems to design ecologically-based restoration. We look at *where* key interactions occur using GIS as the foundation of all database activities. Spatially-explicit models prioritize restoration actions and generate specific site prioritization that reflect watershed processes, site conditions, and desired outcomes. Our team has developed and published watershed and riparian restoration models, life cycle models for most anadromous species, and continue to pioneer methods such as environmental DNA (eDNA) to prioritize habitat restoration and management planning.

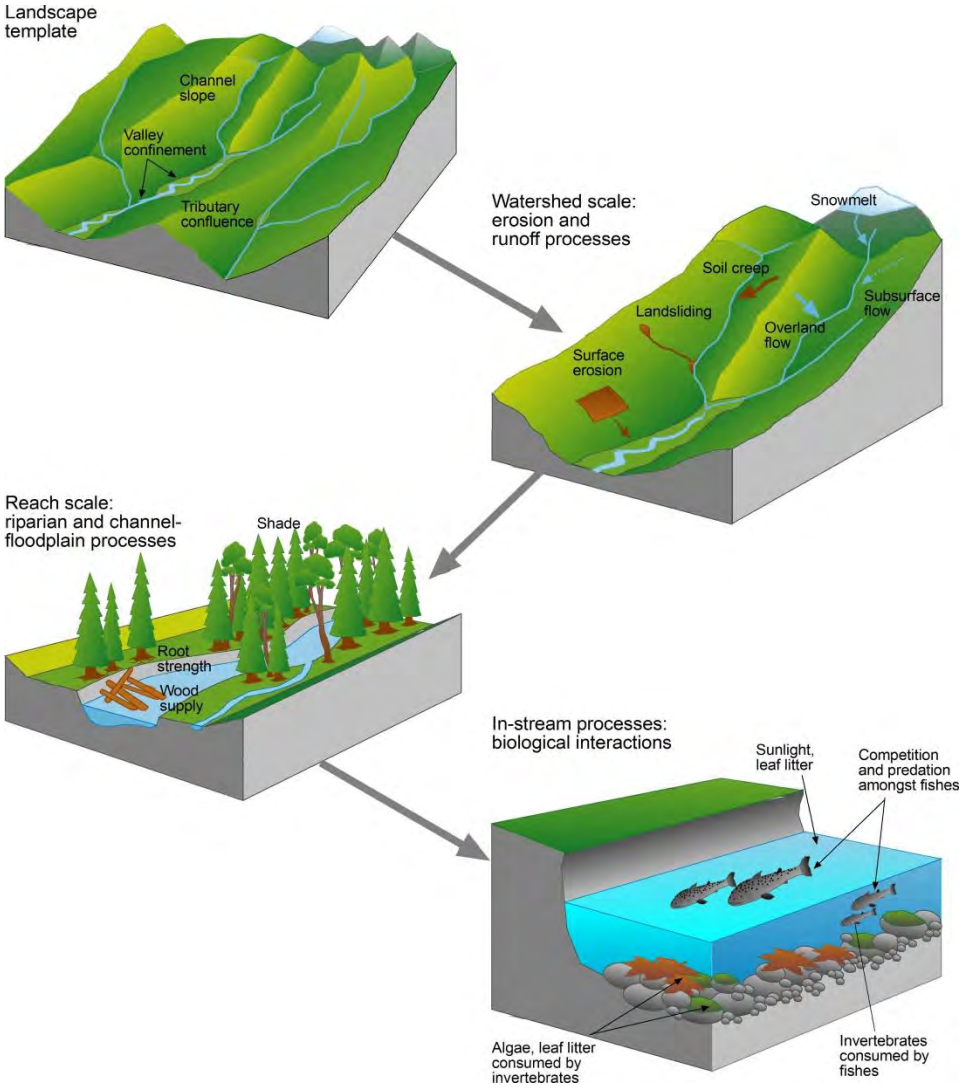


Figure 1. Hierarchically nested scales of processes from landscape to reach scales that contribute to habitat conditions at the site scale (from: Beechie et al. 2013).

We have a strong history and publication record of assessing watershed and riparian habitat conditions, identifying impacts and mechanisms and developing prioritization strategies for ecosystem recovery and protection. We perform these analyses and generate results in a spatially explicit way using rigorous quantitative methods and the latest GIS tools. Our team is comprised of leading experts in spatial analysis, watershed ecology, salmon, stream and riparian restoration. We have extensive experience identifying underlying causes of habitat degradation. Equally important, we bring a high level of experience throughout the Columbia River Basin, and in the John Day Basin particularly, assisting regional governments, local communities, tribes, and agencies with prioritization and restoration efforts. Below we describe our team organization, and the roles of team members. A brief bio of each key team member is provided below in the proposal (See Appendix A for full resumes).

Project Team Structure/Internal Controls

Dr. Raymond Timm as project lead and Dr. Kai Ross as technical lead will work closely with the John Day Basin Partnership on overall project management and expected outcomes. In addition, Steve Cramer, our founding scientist, and Dr. Phil Roni will play critical roles as liaisons with the Partnership and stakeholders, as technical advisors on data mining and analysis, and as reviewers of deliverables. Raymond Timm has invested his training

and career in identifying and modeling the connections of fish populations to stream habitats and watershed function, and brings the experience of having served on multi-agency coordinating bodies to guide restoration activities in Puget Sound. Kai Ross is trained as a mathematician and biometrician, and is one of the most skilled professionals we have encountered as designing and programming databases. Ray and Kai have worked together to create and apply databases for resolving habitat-related issues with native fish production in the Lewis and Sanpoil rivers (see Project Descriptions)

Our team will work hand-in-hand with the Partnership to ensure we assemble the best available data suited to meet the purposes of the Partnership, and that tasks are completed on schedule consistent with Partnership expectations. Once the *synthesis of all existing information* is completed and all useful *data compiled*, and *data gaps identified*, the three most *effective prioritization approaches will be identified* and suggested in the final report. This will require close coordination between the consulting team and knowledgeable Partnership experts. The work plan proposes ongoing team meetings to ensure consistent communication among those working on the plan. Philip Roni will provide document and model review and project oversight. Kai Ross will oversee database design and assembly, gap analysis, model selection, and report writing. Raymond Timm will have lead authority and responsibility for the work. Finding, assembling and quality control of best available data will be accomplished by two of our biologists, Lindsey Belcher and Andrew Muller, who have extensive experience with field studies fish population, stream, and watershed conditions. Lindsey has lived and worked in the John Day Basin for ODFW. Both Lindsey and Andrew, are effective at connecting with people, working with data, and searching the web for information.

Project Understanding

Consistent with goals outlined in the John Day Basin Partnership's Strategic Action Plan (SAP), this project will provide the assembly of information and database tools necessary to identify and prioritize the most beneficial projects for restoring aquatic habitats and imperiled species in the John Day Basin. We have demonstrated success in other Columbia River watersheds developing tools that identify important spatial and temporal overlap in datasets from the watershed to sub-watershed, buffered reach, and site scales. In our experience, this is the first, most critical step because it determines which datasets can be included in objective and repeatable prioritization and restoration models. Linking watershed ecosystem principles through nested scales provides the analytical framework to incorporate broad scale information like forest cover type and stand age with finer scale phenomena like watershed road density and stream crossings, and riparian stand conditions. Once these linkages are established quantitative prioritization and relative importance of impacts can be determined. Of equal importance is the need to integrate management objectives, landowner needs, and restoration and stewardship activities in an open and repeatable process that is clear and accessible for all levels of stakeholder interaction.

Our proposal focuses on providing tools that help the Partnership maximize utility of the considerable investment in ecosystem data that exist in the basin. The Partnership has already identified numerous sources of data related to watershed conditions, land uses, stream habitats and fish populations in the John Day Basin SAP. Our spatially explicit databasing approach employs GIS as the foundational tool for compiling and synthesizing all existing data elements most appropriate to analyzing, planning, managing, and monitoring watershed restoration activities. We recognize that ultimately, the Partnership will use this database tool to prioritize actions intended to maximize long-term ecological and economic benefits from site to the basin scale. Prioritization of watersheds and specific restoration actions will be focused by rankings of projects within those watersheds. The key biological outcomes derive from prioritizing limited habitat restoration funds to most effectively achieve a long-term increase in fish populations and opportunities to harvest fish. The focal fish species identified in the SAP are summer steelhead, spring Chinook salmon, bull trout, westslope cutthroat trout, interior redband trout, and Pacific lamprey. Accordingly, the prioritization framework will need data and analytical functions that distinguish benefits for each species. Both Steve Cramer and Phil Roni have worked

extensively on identifying the physical habitat attributes that influence capacity and survival of these species. Because the habitats for these species would be improved through restoration of instream, riparian corridor, and upland habitat conditions, other native wildlife and plant communities in the basin would also benefit.

This project will assemble and organize that information into a comprehensive database for the Basin that is designed to efficiently access, sort and analyze available data by topic and by 4th order HUC. We will add codes to enable sorting down to the 5th and 6th order HUC, as the data allow, because most restoration projects are likely to focus at the watershed and smaller scale. The project will also provide a review of frameworks suitable for prioritizing restoration projects based on the available information and suggest three appropriate options. The available data will be compared to the input demands of the prioritization frameworks to identify any critical data gaps that limit confidence in project prioritization. The Partnership intends to seek restoration funding through Oregon Watershed Enhancement Board's ("OWEB") Focus Investment Partnership ("FIP") Program, under the Aquatic Habitat for Native Fish Species Priority. Accordingly, the database and prioritization frameworks assembled in this project will be used by the Partnership to analyze and substantiate the expected benefit of restoration projects they propose.

We understand that available data are widely dispersed among agencies and organizations interested in management of natural resources in the basin, and that much of that data is likely stored in filing cabinets or computer files that are not covered in the list of information sources already compiled by the Partnership. We will communicate with lead workers in each member organization of the Partnership to identify possible existence of such information

The Partnership has identified principles and criteria for prioritizing restoration activities, so the prioritization frameworks must address the level of detail and type of outcomes the Partnership desires. The Action Plan calls for prioritizing projects in a sequence that first addresses factors that most often limit the success of restoration projects, and secondarily addresses habitat enhancements. The Plan frequently cites the restoration planning principles and methods described in Roni (2008) and Beechie (2008), which we agree provide strong foundations for prioritizing restoration activities.

Approach and Methods

Task 1 – Contract Coordination

At contract initiation, CFS staff will work with the Partnership to schedule in-person meetings to review proposed technical approach, budget, and performance schedule for completing the specific tasks outlined below. AS the project progresses, CFS will provide the District and Partnership with mid-term project updates detailing the work completed, issues encountered, and current timelines. We will use phone calls, regular briefings, and discussions of documents and analyses via Go-to-Meeting to maintain close collaboration with the District as work progresses. Lastly, a final in-person meeting will be arranged to present the complete report, and transfer all data and project materials to the Partnership. Throughout the contract CFS will coordinate with the District and Partnership to ensure appropriate communications and to complete this project with excellence.

Task 2 – Compile Existing Data

A crucial step in a data driven analysis is understanding what data are available. We recognize that there is a vast array of data associated with the John Day Basin collected over multiple decades, and stored by a variety of agencies, institutions, and partnerships. We will begin with the databases held by the partners. We recognize there are likely to be multiple individuals and locations where useful data may be obtained from each member organization of the Partnership, so we will contact each partner to obtain lists of people, offices, and websites where data might be held. The Partnership's SAP provides lists of planning documents (SAP Table 1) and local data sources (SAP Table 12), and we will contact lead workers in each member organization of the Partnership

to obtain those data sources, and to identify the existence of any additional data or sources. We will also seek data from web sites, State and Federal GIS data stores, and research institutions.

We will design the database we assemble to be user friendly, efficient, easy to update, and verifiable. A key step in assembling databases suitable for many different users is quality control. We will confer with Partnership members on how they would like us to address differences in data quality in the database. Once accrued, all data will be re-projected into a uniform Coordinate Reference System (CRS) for analysis. GIS tools and techniques will be the primary method to store, organize, and arrange all project data. Identifiers will be added to all spatial data that will allow the data to be aggregated by HUC units up through HUC 4. After the data are standardized, we will present a preliminary list of data sources to the partnership detailing the providence, quality, temporal range, and spatial scale of each data source (Table 1). Subsequent to QA/QC and revision by the District and Technical Working Group, we will add the data to the partnership's Data Basin Portal, and provide several sample visualizations of the data using both the Data Basin web-portal, and standalone GIS software.

Table 1. Example Data Source Table.

Data set	Type	Source	Providence	Extent	Temporal Range	Notes
10m DEM	Raster	USGS	3DP Inventory	FULL	2014	
Grazing lands	Polygons	County	County digital Inventory	FULL	2014 (current)	May be updated to 2017 version soon
Stream Temperature	Points	USFS	NorWeST Stream Temperature	FULL	1985-2013, + Climate scenarios	Interpolated between observed points
Riparian survey	Points	ABC	Gathered for 2011 Salmon study	Main stem only	Summer 2011	Uneven coverage of tributaries

Task 3 – Data gap analysis

The scope and framework of spatial analysis depends on the available data. With an area the size of the John Day sub basin, we expect there to be many surveys and datasets that only partially cover the landscape. In addition to spatial coverage, the timing of the surveys and studies will also determine how relevant the data is for future use, and if meaningful trends can be identified. Working with the partnership, we will undergo a data gap assessment to locate and justify data gaps, and provide recommendations to address them.

Once the data are found, standardized, and uploaded in task 2, we will make recommendations on additional data that would be beneficial to the partnership. Data will be analyzed for spatial and temporal gaps, as well as comparisons related to data resolution, quality, and providence. Automated approaches using R statistical software and Structured Query Language (SQL) will be developed that allow rapid assessment of multiple datasets and strong QA/QC procedures. Missing data deemed beneficial will be identified through literature review, communication with the Partnership, and expert opinion. We will provide tables detailing the data gaps in context of the study area (Table 2) and work with the Partnership to discuss the ramifications of these data gaps, and propose recommendations to help address or alleviate the issues. Final databases will be delivered in geodatabases compatible with Microsoft Access unless other file formats are specified by the Partnership.

Table 2. Example Data Coverage Table. Green cells marked with an "X" indicate that the data is available for that reach.

Reach	Habitat Data	Stream Temperature	OSU Monitoring	Pools data	Roads	Trails	Spawning Data
1	X	X	X	-	X	X	X
2	X	X	X	X	X	-	-
3	X	X	-	-	X	-	-
4	-	X	-	X	X	-	-
5	X	X	X	-	-	X	X

Task 4 – Recommend prioritization frameworks

Numerous methods exist for prioritizing restoration and conservation measures, ranging from professional opinion to complex computer models (Roni et al. 2002; Roni et al. 2013b). Selecting a proper prioritization framework will depend on the several factors including the available data, the partnership's objectives and limitations, and the desired outcomes. We will work with the partnership to identify appropriate prioritization schemes, and detail the differences in data needs and analysis potential.

Although the exact framework will depend on the outcomes of these discussions, we propose a generalized hierarchical structure to prioritization frameworks, where the simplest prioritization framework is used as input for the next (more complex) framework. For example, a prioritization scheme based purely on habitat conditions and potential influence on Steelhead can determine which locations/watersheds should be considered high priority for restoration. Equation 1 demonstrates a sample ranking framework based on the percent change in diversity, productivity and equilibrium abundance of steelhead that a site would receive from full restoration:

$$P_{rank} = \Delta Div\% + \Delta Prod\% + \Delta NEQ\% \qquad (1)$$

Being able to incorporate both technical and other information for prioritization of restoration projects is critical. While technical issues can limit extent and costs of restoration, social and economic constraints frequently limit the pace and extent of restoration actions. Design and construction can be a lengthy process for large phased-restoration actions and stakeholders should be engaged throughout the process to assure expectations are explicit and transparent (Beechie et al. 2013). Typically, there are a diversity of values that often exist from stakeholders in a subbasin. Therefore, the best and most transparent approach for incorporating not only biological (e.g., fish numbers, diversity), physical (e.g. project size, habitat type, process restored), socio-economic (e.g., cost, cost-benefit), and other factors is a broader prioritization framework often called multi-criteria decision analysis or MCDA (Beechie et al. 2008; Roni et al. 2013a). While MCDA is relatively straightforward, it is important to follow a series of steps to assure that the process is rigorous, transparent, and repeatable (Figure 2). This is important as projects typically need to be reprioritized periodically as projects are completed, new information becomes available or project costs and other factors change. Therefore, the framework is iterative, and dependent on the previous prioritization that determines which locations would stand to benefit most from restoration.

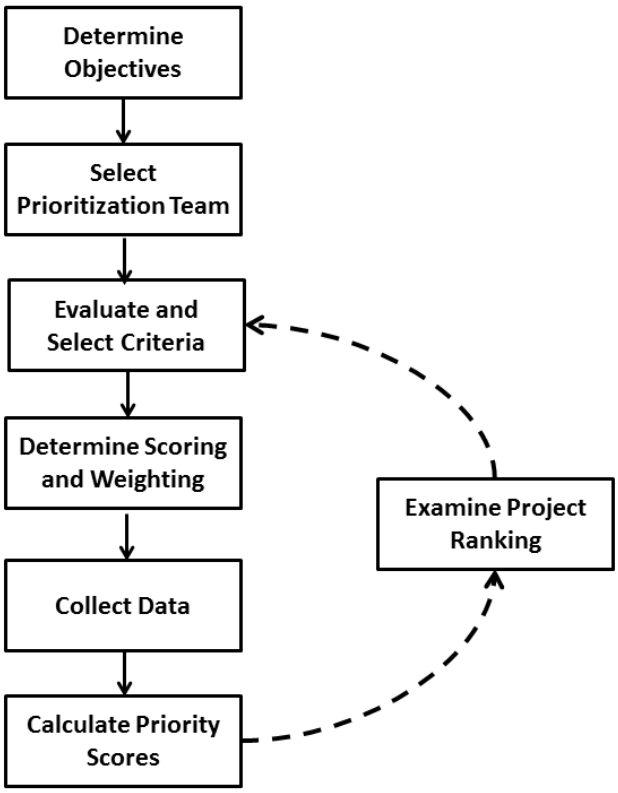


Figure 2. Example of a MCDA framework for prioritization.

Extending the framework further, the MCDA can serve as input to a rigorous Decision Support Tool (using integer optimization modeling or other approaches) that would allow managers to compare the tradeoffs between sets of proposed projects and timelines (Figure 3). Mathematical optimization formalizes assumptions, and allows managers to document the decision making process. Additionally, managers are able to certify that the proposed solution is optimal, and that no better selection exists under the current assumptions.

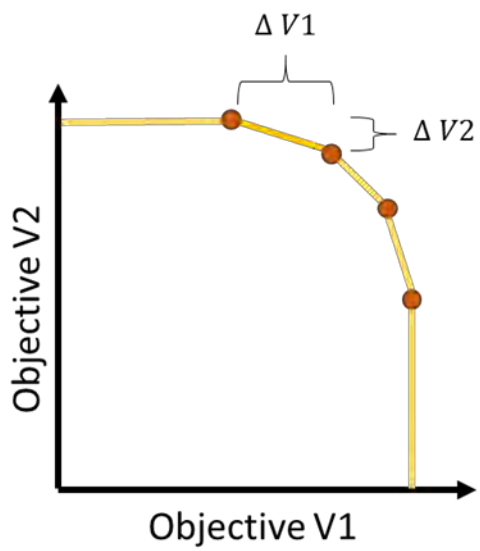


Figure 3. Example solution frontier comparing tradeoffs between two conflicting objectives. Red points represent potential solutions resulting from competing objectives. Comparing two solution points shows the "tradeoff" between objectives V1 and V2.

In summary, this hierarchical prioritization framework uses physical environmental conditions to inform a broader prioritization ranking that incorporates societal and stake holder values, which can be used to select an optimal set of projects to enact (Figure 4).

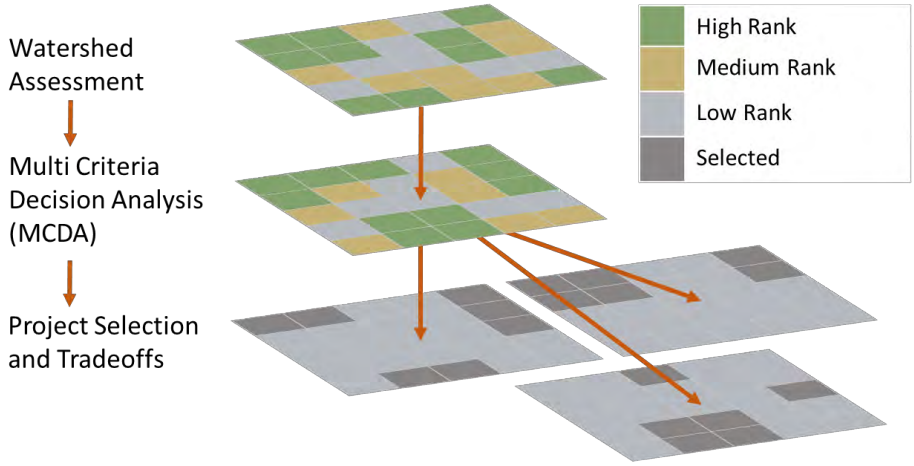


Figure 4. Example hierarchical framework of prioritization strategies. A watershed assessment provides rankings that feed a Multi Criteria Decision Analysis that incorporates societal and stake holder information, which is used to determine the tradeoffs between proposed sets of actions.

Deliverables

1. After satisfactory collection and standardization of data, a preliminary list of data sources (Table 1) will be provided to the District Writing Group for comment and revision.
2. Once discussion and revision of the data sources is complete, we will provide tables detailing gaps in the aggregated data sets (Table 2). Tables will be presented to the Partnership electronically, and will be incorporated into the finalized project database.
3. A mid-term report outlining the previous term's work activities, findings, and challenges will be presented to the Partnership. Progress towards deliverables and remaining tasks will be specified and reconciled with the Partnership.
4. All relevant project data will be transferred to the Partnership within a geodatabase that is compatible with both ArcGIS and Access. We will provide the partnership with GIS project files (.mxd) containing all project data pre-loaded along with sample visualizations, and a data dictionary outlining the included data. Additionally, we will work with the Partnership to identify pertinent data to upload and visualize on the Partnership's Data Basin web portal.
5. We will present a final written report that summarizes the work completed over all tasks, including methods, tabulated data, recommended prioritization schemes, findings, supporting visuals (e.g. maps, charts, graphs, photos, etc.), list of applicable referenced materials, and responses to draft comments.
6. Near to complete drafts (80%) of deliverables 4 and 5 will be presented to the District Technical Working Group for review and comment. All comments will be addressed for the final versions of the deliverables.

Staff and Corporate Qualifications

The team at Cramer Fish Sciences is comprised of highly technical applied scientists with a project history of organizing, mapping, and querying spatial datasets to generate objective and repeatable watershed assessments and restoration plans. Our experience extends to incorporating climate predictions into management and

restoration planning scenarios. However, the characteristic that makes CFS the right firm for this project is our extensive experience in the John Day Basin. Steve Cramer, our founding scientist, has conducted work in the basin during each of the last three decades and has developed relationships with many of the managers and landowners that have interest in this project. In addition, both Lindsey Belcher and Andrew Muller have employment history with agencies in the Basin and familiarity with staff and data sources that might not be readily available except through direct contact with appropriate staff at the various entities in the basin. Brief bios for key staff are included in the section below.

Raymond Timm, PhD

Senior Restoration Ecologist, Cramer Fish Sciences

Dr. Timm is a senior restoration ecologist with over twenty years of experience in project management, habitat restoration, ecological modeling, environmental assessments, and geographic information systems (GIS). He has led multiple efforts investigating the effectiveness of restoration and mitigation projects, water quality assessments, analyzing the effects of floods, water management actions, land-use regulations, and shoreline development. He employs a variety of quantitative tools to assess watershed conditions and restoration potential and has published numerous government reports and peer-reviewed papers on the topic. Ray also has extensive experience performing monitoring and evaluation of habitat and restoration projects. Ray will serve as project manager and technical lead and will provide technical oversight to spatial analyses and modeling, will assist with coordination, and will lead synthesis and restoration planning efforts. In addition, he will assist with technical support on other tasks as needed.

Kai Ross, PhD

Biometrician/ Modeler, Cramer Fish Sciences

Kai Ross is a data scientist with an extensive background in mathematical modeling, spatial analysis, and data visualization. His work focuses on providing decision support for forest and riparian management through mathematical and statistical modeling, exploring and visualizing data, and quantifying scenario exploration. He has broad experience with mathematical modeling including optimization modeling (integer and multi-objective models), simulation modeling (agent/individual-based models, growth and yield), statistical modeling (model and parameter fitting, both frequentist and Bayesian), and spatial analysis using geographic information systems (GIS). He has prior experience serving as a project data steward, and is comfortable designing, maintaining, and updating spatial databases. Kai will lead the spatial assessment, analysis, and compilation of data, and will work to identify data gaps. In addition, he will develop visualizations and outputs to convey the projects results.

Phil Roni, PhD

Principal Scientist, Cramer Fish Sciences

Dr. Philip Roni has 25 years of experience as a fisheries research scientist and manages the Northwest science team for Cramer Fish Sciences (CFS). He is an internationally renowned expert on habitat restoration, monitoring and salmon recovery. Prior to joining CFS, Dr. Roni led the Watershed Program at the NOAA Northwest Fisheries Science Center where he directed more than 20 scientists conducting habitat research and providing regional guidance on restoration, salmon recovery and monitoring. He has authored numerous publications on evaluations of methods for restoring stream habitat, and on frameworks for prioritizing which actions to take first. Phil will serve in an oversight and review capacity on this project, ensuring consistency with salmon recovery plans and Puget Sound Partnership (PSP) recovery strategies.

Steve Cramer, M.S.

Founding Scientist, Fisheries Biologist

Steve Cramer, founder and principal of Cramer Fish Sciences, has led teams of scientists for over 43 years in the design and analysis of research efforts to resolve fisheries issues with passage at dams, habitat productivity, stream flows, hatchery supplementation, and harvestable surplus. For the past 30 years, Steve has been a fisheries consultant to state and federal agencies, Indian tribes, and private firms. He served the

first 13 years of his career with the Oregon Department of Fish and Wildlife, where he directed major research programs on the Rogue and Columbia River basins. The focus of his research and consulting has been the quantitative analysis of population dynamics for salmon and steelhead, especially as it relates to assessing benefits or impacts to fish from a variety of human actions. Steve has led multiple projects to assemble available data in the John Day Basin and assess the productivity and status of its steelhead populations and their habitat. Most recently, he led an analysis of available monitoring data to detect possible effects of grazing on stream habitats and fish populations in the John Day Basin.

Project Implementation and Schedule

To complete the project in a timely manner, our plan would follow the schedule outlined below in Figure 5.

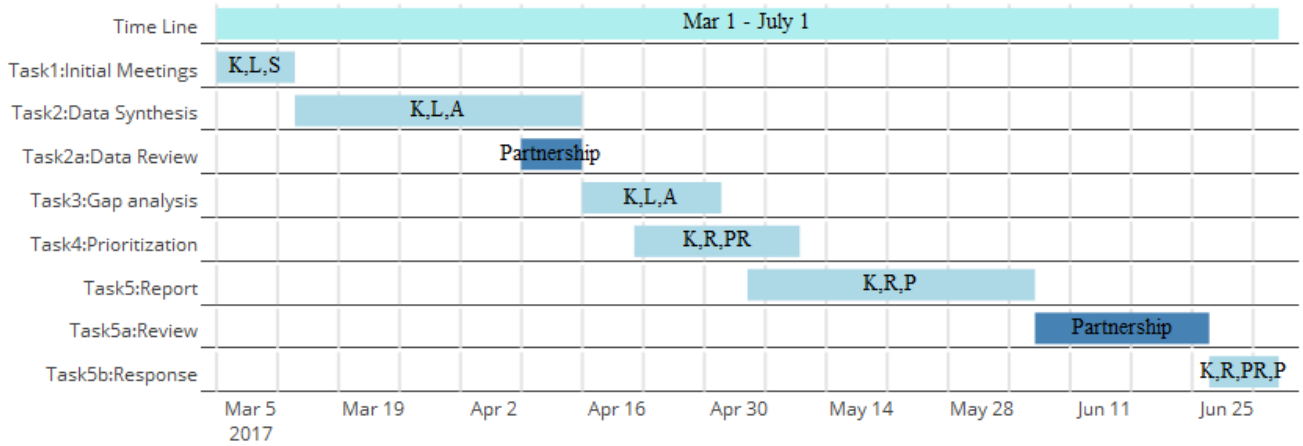


Figure 5. Proposed timeline of tasks.

Bid Budget

BUDGET										
	Projected Hours								Expenses	
	$101.00 GIS Analyst	$90.00 Biologist	$125.00 Biometrician	$174.00 Sr. Scientist	$111.00 Technical Writer II	$225.00 Principal Scientist	$225.00 Principal Scientist	Labor		
Objectives and Tasks	Andrew	Lindsey	Kai	Ray	Phil G.	Phil R.	Steve C.	Subtotal	Travel	Totals
Task 1 Contract Coordination								$0		$0
Task 1.1 Introductory Meeting		8	8	2			8	$3,868	$500	$4,368
Task 1.2 Mid-term Meeting			2	2				$598		$598
Task 1.3 Final Meeting			8	2			8	$3,148	$500	$3,648
Objective 1 Subtotal	0	8	18	6	0	0	16	$7,614	$1,000	$8,614
Task 2 Compile Existing Data	72	36	24					$13,512	$500	
Objective 2 Subtotal	72	36	24	0	0	0	0	$13,512	$500	$14,012
Task 3 Data gap analysis	40		20					$6,540		$6,540
Task 3.1 Mid-term Report	8		8					$1,808		$1,808
Objective 3 Subtotal	48	0	28	0	0	0	0	$8,348	$0	$8,348
Task 4: Recommend prioritization frameworks			16	4				$2,696		$2,696
Task 4.1 Package up Spatial Databases	8		4					$1,308		$1,308
Objective 4 Subtotal	8	0	20	4	0	0	0	$4,004	$0	$4,004
Task 5: Final Report			24	8	8	4	4	$7,080		$7,080
Objective 5 Subtotal	0	0	24	8	8	4	4	$7,080	$0	$7,080
Total Project Hours	128	44	90	10	0	4	16			
Total Project Costs	**12,928**	**3,960**	**11,250**	**1,740**	**0**	**900**	**3,600**	**$40,558**	**$1,500**	**$42,058**

Work Product Samples

Following are three, one-page reports detailing recent projects demonstrating our quantitative approaches and outputs from similar projects:

CRAMER FISH SCIENCES®
An Employee Owned Consulting Company

Adequacy of Grazing Move Triggers to Protect Steelhead

John Day River Basin– Washington

Experience related to this project:

- **Review and summary of stream habitat and fish use data**
- **Identification of physical and biological data influencing fish production**
- **Evaluation of factors confounding interpretation of land use effects on stream habitat and fish**

Cramer Fish Sciences was contracted by land users in the John Day Basin to determine if available data on physical and biological attributes of stream reaches within the Basin were sufficient to distinguish insipient levels at which roading and grazing negatively impacted production of ESA-listed steelhead. We assembled data on grazing intensities, road densities, climate, elevation, stream channel attributes, stream temperature, riparian vegetation, and land uses to analyze for possible relationship to the quality of steelhead habitat. We focused analysis on data collected by the PACFISH/INFISH (PIBO) Effectiveness Monitoring Program that was specifically designed to examine whether or not current management practices on national forest lands were achieving the desired results.

We found that only two of the variables measured by the PIBO monitoring had been demonstrated in published studies to directly influence steelhead rearing density [pool depth (positive correlation) and percent fines in pool tailouts (negative correlation)]. Our exploratory analyses with the PIBO dataset showed the significance of any indicator variable effect on steelhead habitat changed substantially depending on what other covariates were included in the analysis. Analyses of the data subset most suited to the questions we addressed revealed differences in natural landscape and climactic characteristics between reference and managed watersheds that were independent of grazing or roading. Those natural differences between study sites, combined with substantial variation in other land use activities between sites, confounded any inference regarding grazing effects on stream habitat. In the final analysis, landscape and climactic factors largely overwhelmed any detectable short-term effect of grazing on steelhead habitat. Further, the low range of grazing intensities included in the PIBO study made in unlikely to detect a grazing intensity at which steelhead habitat would be affected.

PIBO study reach differences, John Day Basin

	Managed		Reference	
Metric	n	Mean	n	Mean
Elevation (m)	69	1,412	20	1,263
Precipitation (mm)*	69	714	20	1,153
Watershed Area (km^2)		38.8	20	49.7
Gradient (%)	69	2.7	20	2.1
Bankfull Width (m)*	69	4.4	20	9.1

We concluded that optimized triggers for moving grazing livestock will only be identified and confirmed by controlled experiments that test a wider range of grazing intensities and where environmental factors are balanced between test sites. We recommended study designs, and involvement of stakeholders and regulators to make the study both possible and credible.

Client: Grant County, Oregon
Contact: Jason Kehrberg (541) 575-0135 or Ron Yockim (541) 957-5900
Years: 2009-2014

CRAMER FISH SCIENCES®
An Employee Owned Consulting Company

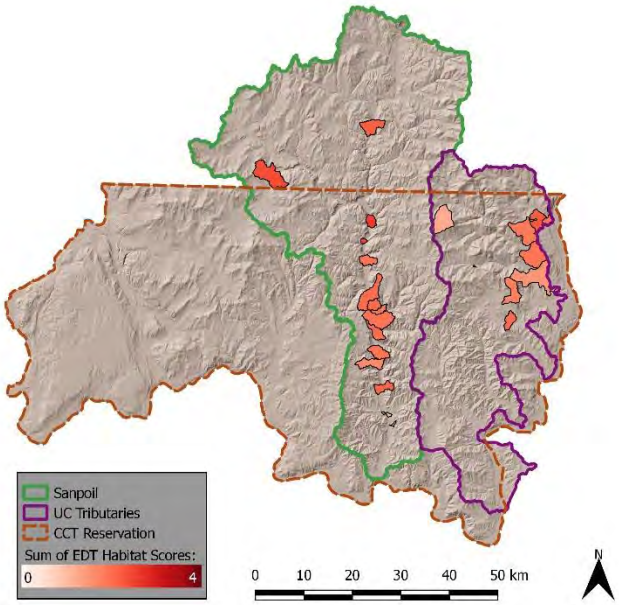
Habitat Restoration Plan for the Upper Columbia and Sanpoil

Upper Columbia tributaries and Sanpoil River– Washington

Experience related to this project:

- **Discovery, review and summary of habitat data**
- **Watershed assessment**
- **Identification and prioritization of habitat restoration opportunities**
- **Data gap recommendations**

Cramer Fish Sciences was contracted by the Confederated Tribes of the Colville Reservation to summarize available data and modeling results, to conduct a watershed assessment and restoration prioritization plan for the Sanpoil River, and Upper Columbia tributaries in northeast Washington State. The assessment focused on restoration of Redband Trout and their habitats. We identified intact habitats for protection, degraded habitats for restoration, the potential mechanisms of degradation, and restoration measures that directly address the processes affecting habitat conditions. Data were compiled from multiple sources and included physical habitat data for the entire basin from multiple jurisdictions and ownerships (CCT, USFS, WDNR), habitat survey protocols (CHaMP; LRHIP, ODFW), and Ecosystem Diagnosis and Treatment (EDT) model outputs. The spatial database incorporated modeled and measured stream and river geomorphology data (e.g. channel type, gradient), measured and interpolated stream temperature data, land classification data, as well as variety of surveyed data from multiple legacy projects. Our nested evaluation integrated conditions from ridge-to-ridge watershed extents down specific reaches to identify and prioritize restoration actions specific to the habitat conditions and needs of life history stages of Redband Trout known to use these reaches. Twenty five priority reaches were identified that if fully restored, are expected to improve Redband Trout productivity, diversity, and abundance by as much as 38% according to EDT estimates. Finally, we provided recommendations on approaches to facilitate robust, open, and repeatable stakeholder involvement in stewardship and restoration planning.



Twenty five high priority reaches identified through the watershed assessment, symbolized according to their respective EDT habitat scores

Client: Confederated Tribes of the Colville Reservation
Contact: Jason Mclellan, Senior Fisheries Biologist
Year: 2016

CRAMER FISH SCIENCES®
An Employee Owned Consulting Company

Comprehensive Guide to Stream and Watershed Restoration

A guide to restoring riverine processes and habitats

Experience related to this Project:

- **Restoration planning**
- **Watershed assessments**
- **Limiting factors analysis and life cycle modeling**
- **Prioritizing restoration actions**
- **Restoration techniques and design**
- **Monitoring and evaluation of restoration effectiveness**

Millions of dollars are spent annually to restore salmon habitat, but many of these well-intentioned efforts fail to meet their objectives because they ignore watershed processes or do not follow key steps needed to adequately plan, implement, and evaluate restoration. We synthesized the latest science in one comprehensive book to provide a clear stepwise process that helps assure that restoration projects are successful. Each chapter synthesizes the latest science and provides detailed guidance on how to assess watershed conditions, identify restoration actions, select and prioritize restoration techniques and evaluate restoration projects. We provide examples of successful methods, analysis or models used to address each of these key steps and case studies from around the world demonstrating successful implementation. Key points from each chapter include:

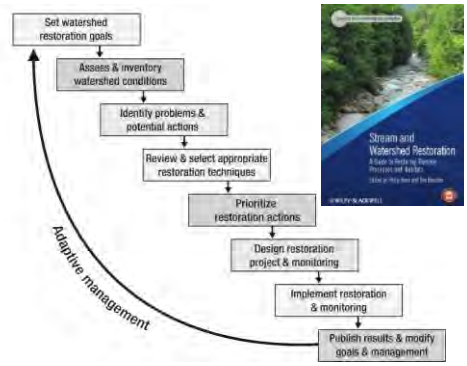


Fig. 1. Key steps in restoration process

- Clearly defined restoration goals and objectives are needed to drive each step in the restoration process
- Assessment of watershed processes and habitat should include assessment of potential and current conditions, and identify the causes of habitat degradation and loss.
- When selecting restoration actions, it is important to understand if the actions addresses underlying problem or simply enhances habitat
- Multi-criteria decision analysis is the most transparent way to prioritize restoration actions
- Design of restoration project requires identification of the underlying causes of degradation, investigative analysis and alternatives evaluation.

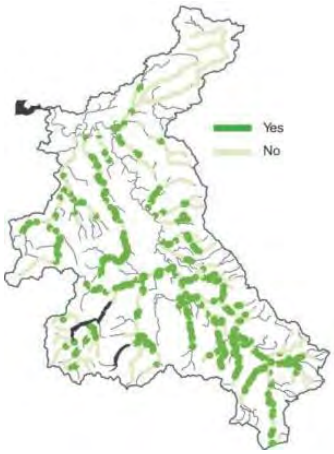


Fig. 2. Watershed assessment of banks damaged by livestock grazing (yes/green)

- Monitoring of restoration projects needs to be designed well before restoration is implemented and should have clear testable hypotheses and rigorous study design

The tools and techniques outlined in this detailed guide are being used by restoration practitioners throughout the world to assure that restoration actions are effective at restoring watersheds, rivers, and fish populations. It also serves as a text for courses on river restoration for both students and seasoned restoration professionals. (www.wiley.com/buy/1405199563)

Client: Wiley-Blackwell, Ward Cooper, +44 (0) 1353 648258
Key Personnel: Philip Roni
Years: 2010 – 2012

References

Contact information for references regarding the previously described work:

Jason Kehrberg, Manager
Grant Soil & Water Conservation District
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John Day, Oregon 97845

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PacifiCorp Energy
825 NE Multnomah – Suite 1500
Portland, OR 97232
(503) 813-6657
todd.olson@pacificorp.com

APPENDIX A: RESUMES

RAYMOND TIMM, PHD

Senior Fisheries Restoration Ecologist

Years of Experience

- 21 years. Professional start date: March 1994

Education

- PhD, Aquatic and Fishery Sciences, University of Washington. 2013.
- MS, Environmental Studies, Eastern Michigan University. 1996.
- BS, Biology, Northern Michigan University. 1992.

Dr. Timm is a senior restoration ecologist with more than twenty years of experience in project management, habitat restoration, ecological modeling, geographic information systems (GIS), and environmental assessments. His Master's Thesis focused on analyzing changes in the ecology of Lake St. Clair following the invasion of the zebra mussel using LANDSAT TM imagery, and his Doctoral Thesis focused on disturbance-mediated channel and riparian dynamics and their implications for salmonid restoration.

Prior to joining Cramer Fish Sciences, he was a Senior Aquatic Scientist for the King County Department of Natural Resources and Parks, working on the Watershed Ecological Assessment Team. In this role, he was a project manager and lead scientist on multiple projects investigating water quality, and analyzing the effects of floods, water management actions, land use, and shoreline development on natural resources. He also authored a fluvial geomorphic and biological assessment of the Stuck River levee repair and was the lead scientist on a spatially explicit water quality study in Soos Creek to assess restoration potential related to temperature and dissolved oxygen problems. He has considerable experience with identifying and prioritizing restoration actions. He employs mapping and spatial modeling, including wetland and watershed mapping and assessment, in all of his habitat characterization and restoration potential assessments, and has published several papers on the topic.

Employment History

Senior Scientist, Cramer Fish Sciences, Lacey, Washington. December 2014 – present.

Senior Aquatic Scientist, King County Watershed Ecological Assessment Team, Water and Land Resources Division, Seattle, WA. April 2006 – 2014.

Seattle Public Utilities, Seattle, WA. January – September 2005.

Consultant, King County Department of Natural Resources, Seattle, WA. Summer 2000, Spring 2004.

Business Owner and President, Geographic Information & Solutions, Inc. Ann Arbor, MI. November 1996 – December 2000.

GIS Manager, Institute for Geospatial Research and Education (IGRE), Eastern Michigan University, Ypsilanti, MI. February 1998 – April 1999

Staff Scientist, J & L Consulting, Ypsilanti, MI. May 1992 - November 1996.

Staff Scientist, Johnson, Johnson & Roy, Inc., Ann Arbor, MI. March 1994 - April 1995.

Selected Publications

Timm, R.K., and R.C. Wissmar. 2014. Influence of natural and anthropogenic disturbances on spawning sockeye salmon (*Oncorhynchus nerka*) distributions in the Cedar River, Washington.

Transactions of the American Fisheries Society. 143(3):709-720 DOI:10.1080/00028487.2014.890131

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Wissmar, R.C**., R.K. Timm,** and M.D. Bryant. 2010. Radar-Derived Digital Elevation Models and Field-Surveyed Variables to Predict Distributions of Juvenile Coho Salmon and Dolly Varden in Remote Streams of Alaska. Transactions of the American Fisheries Society. 139 (1): 288-302.

Timm, R.K. 2009. Fluvial Geomorphic Evaluation of a Bioengineered Revetment in the White River – Before and One Year after Construction. King County Water and Land Resources Division. Seattle, WA.

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Wissmar R. C. and **R. K. Timm**. 2006. Effect of landcover change on the hydrology of urbanizing watersheds. Proceedings of the ninth biennial watersheds management council conference: Watersheds across boundaries: Science, Sustainability, Security (eds.) C. W. Slaughter and N. Berg. Watershed Management Council. Water Resource Center Report 107, University of California, Berkley, CA.

Pess, G. R., S. R. Morley, J. L. Hall, and **R. K. Timm**. 2005. Monitoring Floodplain Restoration. *In*: P. Roni (ed.) Methods for Monitoring Stream and Watershed Restoration. American Fisheries Society, Bethesda, MD.

Timm, R. K., R. C. Wissmar, J. W. Small, T. M. Leschine, and G. Lucchetti. 2004. A Screening Procedure for Prioritizing Riparian Management. Environmental Management. 33(1) 151-161.

Wissmar, R. C., **R. K. Timm**, and M. L. Logsdon. 2004. Effect of Changing Forest and Impervious Landcovers on Discharge Characteristics of Watersheds. Environmental Management. 34(1) 91-98.

KAI ROSS, PHD

Modeler-Biometrician

Years of Experience

- 7 years. Professional start date: September 2009

Education

- PhD, Quantitative Ecology and Resource Management, University of Washington, 2016.
- MS, Environmental Systems: Mathematical Modeling, 2011.
- BA, Applied Mathematics, Humboldt State University, 2007.

Kai Ross is a data scientist with an extensive background in mathematical modeling, spatial analysis, and data visualization. His work focuses on providing decision support for natural resource management through mathematical and statistical modeling, exploring and visualizing data, and quantifying trade-offs.

He has broad experience with mathematical modeling including optimization modeling (integer and multi-objective models), simulation modeling (agent/individual-based models, growth and yield), statistical modeling (model and parameter fitting, both frequentist and Bayesian), and spatial analysis using geographic information systems (GIS). He enjoys data visualization and has created maps, graphs, and figures used in peer reviewed articles, as well as interactive web-apps meant for public outreach. He is a strong speaker and has enjoyed presenting at academic conferences, professional meetings, and public schools.

Kai has provided quantitative support for variety of ecological systems and goals including forest harvest-scheduling, river restoration, and determining wilderness camping quotas. He has worked with managers, stakeholders, and academics while serving as the data steward, lead modeler, and public face. In each case, sophisticated quantitative methods were applied, which required clear and concise explanations of the methodology, its limits, and its interpretation.

Employment History

Biometrician / Modeler, Cramer Fish Sciences, Issaquah, WA, June 2015-present.

Research Assistant, Forest Informatics Lab, University of Washington, Seattle, WA, September 2014-present.

Teaching Assistant, Department of Quantitative Sciences, University of Washington, Seattle, WA, January 2015-April 2015.

Research Assistant, Forest Informatics Lab, University of Washington, Seattle, WA, June 2013-September 2014.

Research Assistant, Humboldt State University, Arcata, CA, September 2009-July 2011.

Selected Publications

Ross, K. (2016). *Extending Harvest-Scheduling Using Spatial Optimization: Road Access and Edge Effects.* (PhD dissertation, University of Washington).

Ross, K. L., & Tóth, S. F. (2016). A Model for Managing Edge Effects in Harvest Scheduling Using Spatial Optimization. *Scandinavian Journal of Forest Research*, 31(7), 646-654.

Van Kirk, R., Martin, S., **Ross, K.**, & Douglas, M. (2014). Computer simulation modeling to determine trailhead quotas for overnight wilderness visitor use. *Journal of Park and Recreation Administration*, *32*(3).

Ross, K. (2011). *A simulation model for wilderness use in Yosemite National Park* (Master's Thesis, Humboldt State University).

Recent Presentations

Presented at the Precision Forestry Cooperative (PFC) meeting at the Center for Urban Horticulture, University of Washington (2015)

Presented twice at the Symposium for Systems Analysis in Forest Resources (SSAFR) in Uppsala Sweden (2015)

Presented at the Washington State Society of American Foresters / Wildlife Society annual meeting in Grand Mound, WA (2015)

Presented at the Institute for Operations Research and Management Science (INFORMS) annual conference, San Francisco, Environment and Sustainability & Ecology and Optimal Harvest Scheduling sections (2014)

Attended and presented at the Washington Department of Natural Resources Spatial Optimization workshop at Pack Forest (2014)

PHILIP RONI, PHD

Vice President, Principal Scientist

Years of Experience

- 25 years. Professional start date: December 1989

Education

- PhD, Aquatic and Fishery Sciences, University of Washington. 2000.
- MS, Fisheries Science, University of Washington. 1992.
- BA, Business Administration (Marketing), University of Washington. 1987.

Dr. Roni has 25 years of experience as a fisheries scientist and manages the Northwest science team for Cramer Fish Sciences (CFS). Prior to joining CFS, Dr. Roni led the Watershed Program at the NOAA Northwest Fisheries Science Center where he directed more than 20 scientists conducting habitat research and science to support salmon recovery. Phil focuses on designing, implementing, completing, and publishing definitive studies to address pressing questions related to protection, management, and restoration of aquatic systems and salmon recovery. He has published numerous papers and guidance on restoration and recovery including the books "Stream and Watershed Restoration: a guide to restoring riverine processes and habitat" (2013 Wiley-Blackwell) and "Monitoring Stream and Watershed Restoration" (2005 American Fisheries Society). Recent research projects include estimating Chinook salmon egg-to-fry survival, evaluating the effectiveness of large restoration programs, and salmon and steelhead response to whole watershed restoration. He received a Presidential Early Career Award (2004) from the US President and a Certificate of Achievement (2012) from the AFS for his contributions to restoration science. He is an Affiliate Professor at both the University of Washington School of Aquatic and Fishery Sciences and at Oregon State University Department of Fish and Wildlife.

Employment History

Vice President/Principal Scientist, Cramer Fish Sciences, 2015-present.

Watershed Program Manager/Research Scientist, Northwest Fisheries Science Center, National Marine Fisheries Service (NMFS), 1995-2015.

Fisheries Biologist, Washington Department of Fish and Wildlife, 1994-1995.

Aquatic Ecologist, Beak Environmental Consultants, Inc., 1992-1994.

Research Biologist, University of Washington and Washington Department of Fisheries, 1991-1992.

Research Biologist, Center for Streamside Studies, University of Washington, 1989-1991.

Additional Professional Experience

Book editor for Stream and Watershed Restoration (2013) (Wiley/Blackwell).

Book editor for Monitoring Stream and Watershed Restoration (2005) (AFS).

Selected Publications and Reports (12 of >100)

Roni, P., Johnson, C., T. DeBoer, T. and G. Pess. 2016. Interannual variability in the effects of physical habitat and parentage on Chinook salmon egg-to-fry survival. Canadian Journal of Fisheries and Aquatic Sciences 73:1-13.

Roni, P., T. Beechie, G. Pess and C. Jordan. 2015. Basin scale monitoring of river restoration: recommendations from case studies in the Pacific Northwest USA. Managing the impact of Human

Activities on Fish Habitat: American Fisheries Society Symposium 78: 1-26.

Roni, P., T. Beechie, G. Pess, and K. Hanson. 2014. Wood placement in river restoration: Fact, fiction and future direction. Canadian Journal of Fisheries and Aquatic Sciences. DOI 10.1139/cjfas-2014-0344.

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Roni, P. and 8 coauthors. 2012. Factors affecting migration timing, growth and survival of juvenile coho salmon in two coastal Washington watersheds. Transactions of the American Fisheries Society 141: 890-906.

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Roni, P., T.J. Beechie, R.E., Bilby, F.E. Leonetti, M.M. Pollock, and G.P. Pess. 2002. A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. North American Journal of Fisheries Management. 22:1-20. (#2 NAJFM Most Read and Most Cited Paper).

STEVEN P. CRAMER, MS

Founding Scientist, Fisheries Biologist

Years of Experience

- 42 years. Professional start date: June 1974

Education

- MS, Fisheries Science, Oregon State University, 1974.
- BS, Fisheries Science, Oregon State University, 1972.

Steve Cramer, founder and principal of Cramer Fish Sciences, has led teams of scientists for over 40 years in the design and analysis of research efforts to resolve fisheries issues with passage at dams, habitat productivity, hatchery supplementation, and harvestable surplus. For the past 29 years, Steve has been a fisheries consultant to state and federal agencies, Indian tribes, and private firms. He served the first 13 years of his career with the Oregon Department of Fish and Wildlife, where he directed major research programs on the Rogue and Columbia River basins. The focus of his research and consulting has been the quantitative analysis of population dynamics for salmon and steelhead. Steve has led more than a dozen projects to assess status and viability of ESA-listed populations, and numerous projects to develop life-cycle models capable of simulating benefits to fish from a variety of human actions. He is frequently called upon as a speaker at scientific symposiums and as an expert witness in regulatory hearings and lawsuits.

Mr. Cramer has led studies on several fish population issues related to hydroelectric dams and water diversions. He served as team leader and technical reviewer, under sole source contract from BPA, to complete a series of 11 reports by leading consultants in the Northwest on juvenile and adult passage issues in the Columbia River. Steve has also completed detailed studies of the feasibility of reintroducing extinct salmon species into several rivers in the Columbia Basin. He led studies for ODFW of downstream fish passage and predation on juvenile salmonids at Columbia River Dams. He has also been the lead author on over a dozen major reports supplied to NMFS for ESA status reviews of coho, Chinook, and steelhead populations. He led consultant teams in detailed status reviews of mid-Columbia steelhead in 2003, 2005, and again in 2010. He has also led consultant teams to complete regional status reviews of fish populations, including spring Chinook in the Willamette Basin, steelhead in the lower Columbia Basin, steelhead in the mid-Columbia Basin, Chinook in all of Puget Sound, and coho in Oregon. He has led and contributed analysis to many ESA consultations concerning salmon and steelhead.

Mr. Cramer has led numerous evaluations of harvest rates, contributions of hatchery fish to ocean and river fisheries, and impacts of hatcheries and harvesting on wild fish populations. He completed extensive analyses of coded-wire tag recovers to estimate survival and harvest rates of Chinook and coho salmon for several projects. He completed six genetic risk assessments for hatcheries, and was a key contributor throughout the planning process for Nez Perce Tribal Hatchery. Mr. Cramer has designed and led several innovative projects that have related fish carrying capacity and survival to habitat features. He has developed habitat-based models for estimating stream carrying capacity for steelhead, spring Chinook, fall Chinook, bull trout, and cutthroat trout. He has applied these models to estimate response of fish populations to such actions as agricultural pesticide use, forest harvesting, urban development, habitat restoration, water withdrawals, and flow management.

Selected Publications

Teply, M., **S. Cramer**, and Nicholas Poletika. 2012. Ecological risk assessment for salmon using spatially and temporally explicit exposure modeling: moving forward. Pages 197-210 in K. Racke, J. Cowels,

T. Hall, S Jackson, J. Jenkins, J. Johnston, and B. McGaughey, editors. Pesticide Regulation and the Endangered Species Act, American Chemistry Society Books.

Pyper, B. J., **S.P. Cramer**, R.P. Ericksen and R.M. Sitts. 2012. Implications of mark-selective fishing for ocean harvests and escapements of Sacramento river fall Chinook salmon populations. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science, 4(1):373-390. Available online at http://dx.doi.org/10.1080/19425120.2012.679575.

Teply, M., **S.P. Cramer**, and N.N. Poletika. 2012. A spatially and temporally explicit model for determining the exposure of juvenile salmon to agricultural pesticides in freshwater. Integrated Environmental Assessment and Management 8(2):271-284.

Poletika, N.N., M. Teply, L. Dominguez, **S.P. Cramer**, M.J. Schocken, C. Habig, M. Kern, H.Ochoa-Acuña, and G.C. Mitchell. 2012. A spatially and temporally explicit risk assessment for salmon from a prey base exposed to agricultural insecticides. Integrated Environmental Assessment and Management 8(2): 285-300.

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Underwood, K. and **S. P. Cramer**. 2007. Simulation of human effects on bull trout population dynamics in Rimrock Reservoir, Washington. American Fisheries Society Symposium 53:79–95.

Cramer, S. P. 2000. The effect of environmentally-driven recruitment variation on sustainable yield from salmon populations. Pages 485- 503 *in* E.E. Knutsen, C.R. Steward, D.D. McDonald, J. E. Williams, and D.W. Reiser editors. Sustainable Fisheries Management: Pacific Salmon. Lewis Publishers, New York.

Cramer, S.P. 1997. Use of managed pulses in flow to stimulate outmigration of juvenile salmon. Proceedings of the 27th Congress of the International Association for Hydraulic Research, Volume 1: 563-568. American Society of Civil Engineers, New York, New York.

Evenson, M. D., and **S.P. Cramer**. 1984. An evaluation of recycling hatchery spring Chinook salmon through the sport fishery in the upper Rogue River. Information Report Series No. 84-10, Oregon Department of Fish and Wildlife, Corvallis, 18p.

Lichatowich, J. and **S. Cramer**. 1979. Parameter selection and sample sizes in studies of anadromous salmonids. Information Report Series, Fisheries No. 80-1, Oregon Department of Fish and Wildlife, Corvallis, 25p.

LINDSEY BELCHER, BS/BA

600 NW Fariss Rd
Gresham, OR 97030
V 503.491.9577
lindsey.belcher@fishsciences.net

Biological Technician

Years of Experience

- 4 years. Professional start date: April 2012

Education

- BS/BA, Environmental Science, The Evergreen State College, 2010.
- Assoc. of Technical Arts, Business Administration, South Puget Sound Community College, 2007.

Lindsey Belcher is an experienced biological technician with substantial fieldwork and analytical skills. Her work at Cramer Fish Sciences has included leading weekly downloads and maintenance of a large radio telemetry array at Merwin Dam (Lewis R., WA) including assisting in mobilization and demobilization of equipment. She also provided weekly downloading, maintenance and de-mobilization of the acoustic telemetry array deployed at Swift Reservoir (Lewis R., WA). In addition, she has performed fish habitat surveys, habitat modeling, telemetry data coding and statistical analysis and reporting functions.

In her previous positions for the Oregon Department of Fish & Wildlife, Lindsey conducted spawning ground surveys of Chinook, Coho, and steelhead on the Clackamas, Salmon, Sandy rivers, and John Day Rivers; designed and maintained a 10-day surveying schedule of more than 40 river segments; maintained and operated six rotary screw traps used to capture and PIT-tag out-migrating juvenile Chinook and steelhead in the John Day Basin; conducting seining operations requiring extensive jet boat operation to capture and PIT tag out-migrating Chinook and steelhead; surgically implanted radio tags in juvenile salmonids and subsequently tracked the tagged fish utilizing mobile receivers and inflatable kayaks. She also served as a crew leader responsible for mark-recapture surveys using visual marking, PIT tags, backpack electrofishing, dip nets, and e-herding; revised and implemented snorkel survey protocols to evaluate adult steelhead wild:hatchery ratios in pools and collected and analyzed scales, otoliths, DNA, sex, length, and other biological information from carcasses. She executed and processed topographic stream surveys using electric total stations and ArcGIS, and also conducted physical stream surveys for channel composition, large woody debris, macroinvertebrate drift, particle size and distribution, pool tail fines, riparian structure, solar input, stream discharge, water chemistry, and water temperature. Lindsey was responsible for organization of field equipment, contacting landowners to arrange for access, maintaining and revising sampling schedules, data entry, and data QA/QC.

As a fisheries technician for the Pacific States Marine Fisheries Commission, Lindsey supported the acoustic tagging of over 21,000 juvenile salmon as part of the US Army Corps of Engineers study evaluating juvenile salmonid passage and survival at John Day Dam. She also monitored water temperature, dissolved oxygen, and fish conditions of juvenile Chinook and steelhead pre and post-surgery and assisted in the demobilization of the wet lab, tagging equipment, telemetry arrays, and autonomous receiver arrays. Lindsey is an effective communicator with a strong background in developing, implementing, and revising field protocols, and considerable experience with statistical analyses, report writing, and public presentations.

ANDREW MULLER, BA

GIS and Biological Technician

1125 12th Ave NW
Issaquah WA 90027
andrew.muller@fishsciences.net

Years of Experience

- 8 years. Professional start date: June 2009

Education

- Graduate Certificate in GIS, Active, Portland State University, Oregon.
- BA, Geography; Environmental track, 2011, University of Oregon, Oregon.

Andrew has extensive experience with both fisheries and GIS research throughout the Pacific Northwest. He previously worked on monitoring projects in eastern Oregon and Washington surveying stream reaches with robotic total stations. He has worked with multiple habitat protocols including CHaMP and Aquatic Inventories. His work also included snorkel and redd surveys in areas ranging from the Lewis River, WA to the Wenaha River, OR. In addition, he is currently pursuing a graduate certificate in GIS through Portland State University. He has worked with GIS on a variety of projects, including habitat modeling, statistical analysis, and map production.

Employment History

Cramer Fish Sciences (July 2016-present)
Biological Technician
Work consists of collecting and processing data for a variety of projects throughout the northwest, typically within the Columbia Basin including the middle fork John Day river. Projects involve surveying streams for a variety of physical and biological attributes, such as stream bed profile, riparian cover and large wood. GIS is a significant portion of workload, including map processing, automation with ArcPy and locating data from throughout the Columbia basin. Data that we collect is commonly used in conjunction with other data sources, such as the Oregon spatial data library and Washington geospatial clearinghouse.

United States Geological Survey (June 2015-March 2016)
Biological Science Technician
Worked in the North Fork Lewis River system on multiple research projects focused on salmon reintroduction. Majority of work was electrofishing for abundance/PIT tagging juvenile Coho as well as performing snorkel surveys. Less frequently, I collected benthic macroinvertebrate samples, installed temp loggers/pressure transducers, collected sediment samples and entered data.

Powder Basin Watershed Council (September 2014-October 2014)
Fish Habitat Surveyor
Surveyed small tributaries in the Powder river basin in northeast Oregon using the Aquatic Inventories protocol. Assessed stream dynamics by quantifying stream and riparian habitat for Bull Trout recovery. Collected biological information for streams such as substrate composition, habitat type (pool, riffle, etc.), slope and percent shade.

Oregon Department of Fish and Wildlife (June 2014-September 2014)
Experimental Biology Aide
Primary duties were to perform detailed surveys of stream habitat and channel topography using the Columbia Habitat Monitoring Program (CHaMP) protocol throughout northeast Oregon. Performed

habitat surveys in the John Day basin, primarily in the south fork John Day subbasin. Once data was collected I processed maps in ArcGIS to create digital elevation models for quantifying stream habitat and juvenile salmonid populations. Surveys included quantifying in-stream and riparian habitat, collecting biological information such as macroinvertebrate samples and water chemistry such as alkalinity. Also performed snorkel and redd surveys for salmonids.

Eco Logical Research (July 2012-October 2012)
Fish Habitat Specialist
Primary job duties were to perform detailed surveys of stream habitat and channel topography using the Columbia Habitat Monitoring Program (CHaMP) protocol. Operated a Total Station and produced detailed maps of sites in GIS. Helped in habitat restoration by installing in-stream structures for fish cover and habitat complexity. Performed a variety of GIS tasks such as map processing, locating and processing remotely sensed data.

Friends of Buford Park (April 2011-October 2011)
Habitat Restoration/Nursery Intern
Worked in Friends of Buford Park native plant nursery propagating native plants that are used in habitat restoration throughout the park. Helped implement and maintain floodplain restoration for salmonid recovery. Responsibilities included planting grasses, flowers and shrubs, as well as maintaining planting beds, and transplanting plants.

The Nature Conservancy (June 2009-September 2009)
Native Habitat Restoration Intern
Worked on the Portland Area Preserves Stewardship Team, restoring habitat along the Sandy River. Surveyed plant species and collected data on public and private land to monitor the projects' progress. Collected data for Japanese knotweed based on size, height and area for the restoration project.