March 16, 2012

Great Northern LCC Project Proposal

Project Title: Incorporating ecological integrity and stream-network connectivity into the Western Governors' assessment of aquatic crucial habitats in Washington and Oregon

Project Coordinator: George F. Wilhere, Senior Research Scientist, Washington Dept. of Fish and Wildlife, Habitat Program, Olympia, WA (360) 902-2369, george.wilhere@dfw.wa.gov

Project PIs: Daniel J. Isaak (disaak@fs.fed.us), Air, Water, and Aquatics Program, Rocky Mountain Research Station, Boise, ID; John Pierce (john.pierce@dwf.wa.gov), Chief Scientist, Washington Dept. of Fish and Wildlife, Wildlife Program, Olympia, WA; Tim Quinn, Chief Scientist, Washington Dept. of Fish and Wildlife, Habitat Program, Olympia, WA.

Partners: Native Fish Conservation and Recovery Program, Fish Division, Oregon Department of Fish and Wildlife (ODFW), Salem, Oregon.

Summary: The Western Governors' Association has sponsored an assessment of crucial habitats which will be used for the evaluation of landscape-scale energy, land use, and transportation projects. At present, this assessment does not incorporate ecological integrity or stream-network connectivity into its assessment of aquatic habitats. This proposal will address in both Oregon and Washington states the need to incorporate ecological integrity and stream network connectivity into the Western Governors' assessment of aquatic crucial habitats.

Need: To improve analysis of landscape-scale energy, land use, and transportation projects as well as land conservation and climate adaptation strategies, the Western Governors Association is supporting a system of state-based and regional-level decision support systems for wildlife corridors and crucial habitat, collectively known as the crucial habitat assessment tool (CHAT).

Crucial habitat will be based on factors such as habitat for species of concern, native species richness, riparian and wetland habitats, important restoration habitat, ecological integrity (i.e., unfragmented habitat), and landscape connectivity (i.e., habitat corridors). All of these factors are relevant to both terrestrial and aquatic species, but, at present, ecological integrity and landscape connectivity have been addressed for terrestrial habitats only. Ecological integrity and stream network connectivity are indicators of highly productive aquatic systems (Karr 1991, Mattson and Angermeier 2007), and therefore, should be factors in any assessment of crucial habitats. This proposal addresses the need to incorporate ecological integrity and stream network connectivity into the Western Governors' assessment of aquatic crucial habitats. Methodology developed through this project will be made available to other states in the WGA.

Furthermore, in recognition of the unique circumstances facing fisheries managers in the Pacific Northwest, namely, the management of commercially valuable, federally-listed anadromous salmon, the states of Washington and Oregon are collaborating on a special effort to address

crucial habitat for aquatic species. Funding this proposal will enable us to incorporate stream temperature into the definition of aquatic crucial habitat and enable us to do a more rigorous evaluation of existing indices of ecological integrity.

Objectives: To incorporate ecological integrity and stream-network connectivity into the Western Governors' assessment of aquatic crucial habitats for Oregon and Washington. The resulting products will be part of the state-based and regional-level CHAT decision support systems.

Methods: The project can be divided into 7 analytical tasks (Table 1). In first task we will bring together WDFW and ODFW experts to develop a conceptual model for assessing crucial habitat. The conceptual model describes what is meant by aquatic "crucial" habitat and it will guide all subsequent tasks. The conceptual model will be formulated as a decision tree which is accompanied by thorough documentation of assumptions and rationale for each node in the tree. The main components of conceptual model for crucial habitat will include aquatic ecological integrity, stream network connectivity, the presence of federally or state-listed freshwater fish, and the presence of other freshwater species of concern. The conceptual model will be subjected to internal reviews at WDFW and ODFW.

Our assessment of crucial habitat will incorporate an indicator of aquatic ecological integrity. *Ecological integrity* has been defined as the ability of an ecological system to support and maintain a community of organisms that has species composition, diversity, and functional organization comparable to those of natural habitats within a region (Parrish et al. 2003). An ecological system has integrity when its dominant ecological characteristics (e.g., elements of composition, structure, function, and ecological processes) occur within their natural ranges of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human disruptions.

We will not develop our own indicator of ecological integrity. An ancillary objective of this project is to develop a crucial habitat assessment that is transferable, in whole or in parts, to other states in the WGA. Therefore, we will exploit existing assessments of ecological integrity that are available for the western states. At present, we know of two ecological integrity assessments that cover all or nearly all western states: the riparian threats score of Theobald et al. (2010) and the index of cumulative disturbance by Esselman et al. (2011). Each index (or score) incorporates different spatial data covering different environmental factors, and hence, generate different values of "integrity." We will evaluate and compare these two indices to exactly ascribe narrative meaning to their different quantitative indices, determine their precision, accuracy, correlations between them, and the degree to which they provide similar (or dissimilar) indications of integrity across space. The result will be a decision about which index to use for our crucial habitat assessment or a determination of how they might best be combined to provide a more comprehensive indicator of ecological integrity.

Theobald et al. (2010) and Esselman et al. (2011) do not directly incorporate stream temperature into their indices of ecological integrity. Increasing stream temperatures, thermal barriers to fish migration, and cold-water refugia have become greater concerns to fisheries managers because

of global climate change. Hence, our third task is to integrate stream temperature information with ecological integrity. Near the end of 2012, predictions of stream temperatures for the present and under different climate change scenarios should be available for all streams in Washington and Oregon (D. Isaak, pers. commun.). To proceed with our third task before the stream temperature predictions are made available, we will create mock stream temperature predictions for streams in Washington and Oregon. The mock predictions will possess the same data structure and qualities of the real predictions. Stream temperature will be used to identify cold-water refugia and also be one factor, along with ecological integrity, affecting stream network connectivity.

In October 2012 the WGA crucial habitats assessment is scheduled to review the various data layers used to assess crucial habitat and begin assembling them into layers that identify crucial habitat. Therefore, before October 2012 we will have ready a prototype assessment of aquatic crucial habitat for Oregon and Washington. At the October WGA review we will receive feedback on our prototype.

After the October WGA review, we will begin our fifth task – developing alternative models of crucial habitat. Any of crucial habitat is based on expert judgment. Even with perfect spatial data on species occurrences, habitat quality, and ecological integrity, assessing aquatic crucial habitat would remain challenging because measures of "crucial" are normative. There is no purely objective "crucial" that can be empirically validated. "Crucial" is based on one's belief of about what is most important, and therefore, it is influenced by personal values. For example, people will answer the following question differently: which is most important, a place with high species richness, a place with federally-listed species, a place with high ecological integrity, or a place with commercially harvestable species? Likewise, how various data should be assembled into an indicator of "crucial" may be different for each person, and therefore, a multitude of different credible indicators can be devised. Nevertheless, scientists and policy makers may reach consensus on what factors should be used to indicate crucial habitat and on the relative influence of those factors. The contribution of policy makers is essential because many decisions regarding the meaning of "crucial" are policy decisions. Scientists who ignore the policy aspects of "crucial" habitat commit inadvertent advocacy (Wilhere 2012).

The fifth task will proceed as follows. ODFW and WDFW staff with solid grounding in both science and policy realms will develop 3 draft alternative models. The alternative models will incorporate stream temperature predictions provided by D. Isaak. These models will be subjected to both technical and policy review within each agency, and the models will be revised in response to these reviews. This cycle will be repeated until we have 3 alternative models approved by both agencies. Policy makers may wish to designate a preferred model, and the preferred models may be different for Oregon and Washington.

The sixth task, which is concurrent with the fifth task, is combining the data layers that comprise each of the alternative models. Depending of the complexity of GIS processing required by each alternative model this task could require 1 to 4 months.

The last analytical task is to compare and evaluate the alternative models for crucial habitat. We will compare the alternative models through correlations and by cross-tabulations that summarize agreement and disagreement among models. We will evaluate the "accuracy" of the alternative models by comparing them against the judgments of regional experts on salmonid abundance and productivity (principally WDFW and ODFW agency biologists).

Deliverables:

1. Mid-project annual report on December 31, 2012;
2. ArcGIS-compatible geodatabase containing results of crucial habitat assessments for alternative models;
3. Full report describing methods and results for tasks 1 through 7.

Project Schedule:

Table 1. Overview of project tasks and approximate timeline for completion.

	Task	2012				2013			
		Q1*	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Developing conceptual models of aquatic crucial habitat	X	X						
2	Comparing and evaluating "ecological integrity" assessments		X	X					
3	Creating mock stream temperature spatial data		X						
4	Designing and assembling prototype model of crucial habitat			X					
5	Designing alternative models of aquatic crucial habitat				X	X			
6	Assembling alternative models of aquatic crucial habitat				X	X			
7	Evaluating alternative models of aquatic crucial habitat						X	X	
8	Writing Report							X	X

* WDFW began collaborating with Oregon Department of Fish and Wildlife in February 2012.

Budget:

Table 2. Budget overview from May 2012 to December 2013

Description	Cost
salaries	36,456
benefits	11,016
goods and services	264
travel	10,000
direct costs	57,736
indirect costs*	13,574
Total Project Costs	71,310

*indirect rate set at 23.51 %

References

Esselman, P.C., D.M. Infante, L. Wang, D. Wu, A.R. Cooper, and W.W. Taylor. 2011. An Index of Cumulative Disturbance to River Fish Habitats of the Conterminous United States from Landscape Anthropogenic Activities. Ecological Restoration 29:133-151.

Isaak, D.J., C.H. Luce, B.E. Rieman, D.E. Nagel, E.E. Peterson, D.L. Horan, S. Parkes, and G.L. Chandler. 2010. Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network. Ecological Applications 20:1350-1371.

Karr, J.R. 1991. Biological integrity: a long neglected aspect of water resource management. Environmental Management 1:66-84.

Mattson, K.M., and P.L. Angermeier. 2007. Integrating human impacts and ecological integrity into a risk-base protocol for conservation planning. Environmental Management 39:125-138.

Parrish, J.D., D.P. Braun, and R.S. Unnasch. 2003. Are we conserving what we say we are? measuring ecological integrity within protected areas. Bioscience 9:851-860.

Theobold, D.M., D.M. Merritt, and J.B. Norman. 2010. Assessment of Threats to Riparian Ecosystems in the Western U.S. A report presented to The Western Environmental Threats Assessment Center, Priveville, OR by The U.S.D.A. Stream Systems Technology Center and Colorado State University, Fort Collins, CO.

Wilhere, G.F. 2012. Inadvertent advocacy. Conservation Biology 26:39-46.

Wilson, E.O., 1998. Consilience: the unity of knowledge. Alfred A. Knopf Inc, New York, New York.