An Evaluation of CRITFC-Coordinated Habitat Restoration Projects and Limiting Factors to Salmon and Steelhead in the Columbia Basin

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Introduction

Several salmon and steelhead populations of the Columbia River basin are currently listed as endangered or threatened, and an active effort to restore and sustain these populations involves the collaboration of several agencies, tribes, and other entities. The Pacific Coastal Salmon Recovery Fund (PCSRF), which is administered by the National Oceanic and Atmospheric Administration (NOAA), provides funding to a wide range of projects that are intended to benefit these fish populations. The restoration of degraded stream habitat in the Columbia River Basin is one of the most critical aspects of the recovery of these fish populations. Contemporary assessments such as subbasin planning (2005) have identified the habitat factors that limit fish production. These limiting factors assessments provide planners with an inventory of where they can direct their efforts for the restoration and conservation of habitat in order to most benefit fish populations, and also offer a benchmark for regional progress towards fish habitat restoration and protection.

There is no clear method, however, to assess whether a particular project or set of projects are addressing limiting factors. While project proponents may have an intimate knowledge of their project area, and monitoring and evaluation efforts may provide insight into individual project success over a long term, it is difficult for funding and coordinating entities to assess habitat projects and their effects on a regional scale without a method that links these proposals to a standard set of known limiting factors.

For this evaluation, we implement a Geographic Information Systems (GIS)-based approach to address this issue by assembling information on major limiting factors, and evaluating the PCSRF projects implemented between 2000 and 2007 by the member tribes of the Columbia River InterTribal Fish Commission (CRITFC). This evaluation illustrates some available data and methods to compare habitat projects and limiting factors, as well as the shortcomings of this approach given current available information. This report is a product of the Pacific Coastal Salmon Recovery Project "PCSRF Evaluation Tools for Habitat Recovery Projects II", which was implemented by staff at the CRITFC with funding from the NOAA.

Methods

We built in a GIS a set of standard limiting factors to aquatic focal species from those generated during subbasin planning. A variety of limiting factors were modeled by subbasin planners through fish survival models (Ecosystem Diagnosis and Analysis (EDT), Qualitative Habitat Analysis (QHA), and other approaches), which were employed selectively to develop subbasin plans. These limiting factor data were obtained by CRITFC staff from disparate sources and products used in subbasin planning, and georeferenced for display and analysis. Each limiting factor was georeferenced as either present or absent to the reach level on the stream network, although in some subbasins they were simply identified in source information to pertain to a particular assessment unit, which is roughly synonymous with the 5^{th} field hydrologic unit (a watershed).

The limiting factors chosen for this analysis are the four major factors most commonly ascribed to salmon and steelhead production limitations in the Columbia Basin: Stream Flow, Stream Temperature, Stream Sediment, and Obstructions to fish passage. Stream flow includes problems with high flow, low flow, base flow, flow variation, and peak flows, but is most commonly related to issues with summer-time low flows. Stream temperature includes problems with both high and low temperatures, but is most commonly related to issues with summer-time high temperatures. Stream sediment includes problems with overall fine sediment load, fine sediment deposited in spawning areas, and general sediment loading, but is most commonly related to issues with excess fine sediment deposited in spawning grounds. Obstructions to fish include problems with habitat fragmentation and discontinuation from physical, chemical, or thermal barriers. Because

obstructions may overlap with the other limiting factors in this dataset, they are perhaps the least useful variable for this analysis, but obstructions were still included because physical barriers to fish, such as culverts, are one of the quickest and easier limiting factors to eliminate as a hurdle to fish population recovery. These limiting factors from subbasin planning models, along with the PCSRF tribal projects administered by CRITFC, may be viewed and queried on our website via an interactive mapping application at http://maps.critfc.org.

We clipped the extents of these GIS limiting factor layers to the ceded area of our four member tribes, which includes the zones where they have treaty fishing rights on their usual and accustomed locations and are co-managers of the fisheries (figure 1). This geographic extent was used for analysis because it is the area where our member tribes are actively involved in the recovery and protection of fish populations, including the elimination or mitigation of limiting factors through habitat restoration projects.

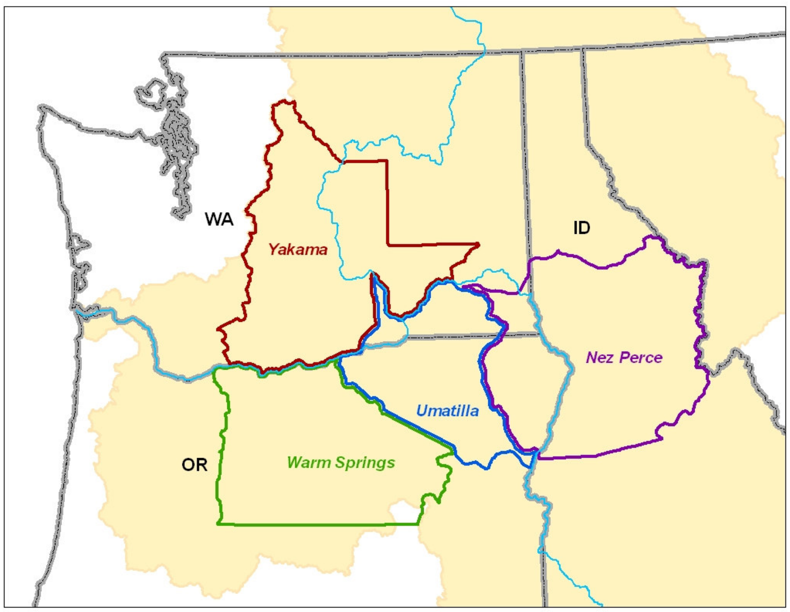

Figure 1: Co-managed areas of the four CRITFC member tribes shown within the Columbia Basin

We examined the project proposals for all of the CRITFC-coordinated projects that were initiated under the PCSRF from inception (2000) to the most recent year with a complete set of available data (2007). Furthermore we included only those projects that implemented habitat restoration or enhancement actions in situ. There are many other CRITFC-coordinated projects that have benefits to fish populations through actions such as supplementation, administration, research, public outreach, and monitoring and evaluation, but only those projects with on-the-ground habitat actions may be directly related to improvements to habitat-based limiting factors.

Using the project proposal to determine how many worksites there were for each project, and the coordinate locations of these worksites (or location descriptions, where coordinates were not available), we mapped each of the worksites for each project into a GIS. All project worksites were established as points in a vector GIS file. These worksites may have encompassed dispersed areas or extended lengths along a stream, so a GIS point, in many cases, is a simplification of a worksite location. For the purpose of this evaluation, we recorded whether a worksite could be confidently placed in a 6th field hydrologic unit, which was our maximum scale. Several project proposals did not include coordinates or sufficient information to identify the location of their worksites to finer scales. Of the 104 worksites identified, 89 could be confidently identified to a 6th field hydrologic unit, while all 104 sites could be confidently identified to a 5th field hydrologic unit. Consequently, the evaluation of worksites at the coarser scales of 4th field and 5th field

hydrologic units included the complete set of worksites (104), while the finer scale analysis of 6th field hydrologic units included a smaller set of worksites (89).

Most worksites treated multiple limiting factors. We evaluated the project proposals to determine which, if any, of the four limiting factor(s) were treated at each worksite. Because a description of limiting factors is not explicitly required as part of the PCSRF proposal process, the determination of limiting factors treated was somewhat subjective. In some cases it was very clear as to whether a limiting factor was intended for treatment. For example, a proposal might state that the work would involve the planting of trees in the riparian zone to provide shade and ameliorate high water temperatures. In other cases it was not clear what limiting factors were to be treated, and in these cases we used the descriptions of work elements and project benefits from the proposals, and our best judgment to ascribe treatments to particular limiting factors.

We used a GIS to overlay three different scales of hydrologic units onto the limiting factors spatial layer and onto the project worksites spatial layer. These scales were: (a) 4th field hydrologic units (huc4), which are referred to as subbasins and delineate large catchments with several major tributaries; (b) 5th field hydrologic units (huc5), which are referred to as watersheds and delineate major tributaries within subbasins; (c) 6th field hydrologic units (huc6), which are referred to as subwatersheds and delineate the major tributaries of watersheds. There are 57 huc4 units, 370 huc5 units, and 1,649 huc6 units within the analysis area. Figure 2 shows an example of the scale of the hydrologic units and the project worksites identified in the Klickitat subbasin. With each analysis, both the worksites and the reaches of the four major limiting factors were associated with the respective hydrologic unit where they fell. Each hydrologic unit was assessed as to the miles of stream containing each limiting factor, and the number of worksites that treated each limiting factor (referred to as the treatments for a particular hydrologic unit and limiting factor).

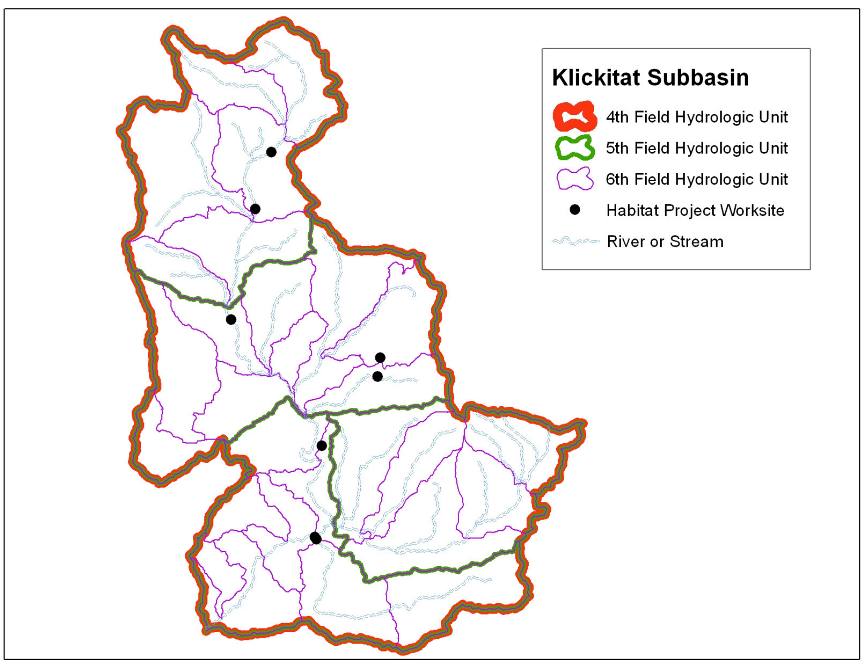

Figure 2: Example of hydrologic unit scale in the Klickitat Subbasin (one huc4 Unit)

Results

The results of the GIS overlay of hydrologic units, modeled limiting factors, and treatments proposed for these limiting factors are shown in table 1. Column A is the scale of each overlay, from a broad (huc4) to a fine (huc6) scale. Column B denotes the limiting factor that was modeled during subbasin planning and was used in each analysis. Column C is the proportion of Columbia Basin hydrologic units in which a subbasin

planning model identified one of the four listed limiting factors. For a unit to be included in this column, some, but not all reaches, in the hydrologic unit must include the limiting factor. Column D is the number of hydrologic units where at least one project worksite was proposed to treat the limiting factor. Column E is the proportion of hydrologic units that had at least one treatment for a limiting factor out of the number of units that were identified in Column C to be limited for this factor. A higher proportion in Column E indicates that the treatments are addressing a larger number of hydrologic units with the habitat limitation (a greater geographic spread of treatments). Column F is the proportion of treatments for a limiting factor (from Column D) that occurred in a hydrologic unit where this factor was identified as limiting in subbasin planning models. A higher proportion in Column F indicates that more of the treatments are matching areas where the limiting factor was identified, while a lower proportion indicates a greater number of worksites are treating for factors in areas where they were not identified as limiting.

Table 1: Results of GIS overlay of hydrologic spatial units, salmon/steelhead limiting factors, and PCSRF CRITFC habitat restoration worksites

(A) Scale of analysis	(B) Modeled limiting factor	(C) Proportion of units modeled with this limiting factor	(D) Number of units where a treatment occurred for this limiting factor	(E) Proportion of units where this limiting factor was modeled that a treatment occurred for the same limiting factor	(F) Proportion of the treatments for this limiting factor that were in a unit where this limiting factor was modeled
Huc4 (57 units)	Obstruction	43/57 (75%)	12	10/43 (23%)	10/12 (83%)
	Sediment	48/57 (84%)	11	11/48 (23%)	11/11 (100%)
	Flow	40/57 (70%)	14	13/40 (30%)	13/14 (93%)
	Temperature	45/57 (79%)	15	15/45 (33%)	15/15 (100%)
Huc5 (370 units)	Obstruction	214/370 (58%)	19	8/214 (4%)	8/19 (42%)
	Sediment	288/370 (78%)	22	21/288 (7%)	21/22 (95%)
	Flow	212/370 (57%)	24	20/212 (9%)	20/24 (83%)
	Temperature	279/370 (75%)	32	31/279 (11%)	31/32 (97%)
Huc6 (1649 units)	Obstruction	899/1649 (55%)	22	9/899 (1%)	9/22 (41%)
	Sediment	1357/1649 (82%)	25	21/1357 (2%)	21/25 (84%)
	Flow	911/1649 (55%)	28	21/911 (2%)	21/28 (75%)
	Temperature	1245/1649 (76%)	42	36/1245 (3%)	36/42 (82%)

There are some noticeable findings in table 1:

First, the geographic scale is influential on the results of the analysis. At a coarse scale (huc4), there are fewer hydrologic units, and in general, a greater likelihood that any given unit will have one of the four limiting factor identified and modeled on at least some of its stream reaches (Column C). It is therefore more likely that a treatment will address this factor somewhere in the unit (Column E) and also more likely that a given treatment will have a matching limiting factor within the unit (Column F). At a fine scale (huc6), the opposite is true, and the correlation between actions and modeled limiting factors is not as strong. The intermediate scale (huc5) may provide the best results for interpretation, being an adequate compromise between the general scale of projects and the distribution and scale of the limiting factors data.

Second, of the modeled limiting factors, the projects in this analysis have the greatest correlation (Column F) to sediment and water temperature, a slightly weaker correlation with stream flow, and generally a poor correlation with obstructions. As mentioned earlier, the obstructions factor may not be a good choice for this analysis because it overlaps with the other three factors, and also because obstructions that are not related to temperature, flow, or sediment in many cases are physical obstructions located at a single point and their treatment is better analyzed individually than at the watershed scale. When considering the other three limiting factors (stream temperature, stream flow, and sediment), the results are much better, and in all cases, worksites link better to existing limiting factors (Column F) than a random placement (Column C) would indicate. Ideally, all treatments should match an existing limiting factor (i.e. the proportions in column F

should total 100%). However, this presupposes that information about the modeled limiting factors and the limiting factors identified by projects for treatment were determined in a similar and standard method. This was not the case in this analysis because of the separate processes used to generate both sets of information and the subjective interpretation of project proposals.

Finally, many areas in the tribal co-managed area are untreated over the 8-year period of these projects (Column E). Figure 3 shows the location of these worksites. There are several possible explanations for the clustered distribution of project worksites in some watersheds and the absence of worksites in other watersheds. First, given limited funding, project proponents likely target their activities in areas where they feel funds will be best spent, perhaps because unique opportunities exist in these areas to obtain habitat, leverage funds for habitat protection or restoration, or because these areas may be critical to certain populations. Second, many of the projects are likely to have benefits outside of their respective watersheds because improvements to water temperature, sediment, or flow are often propagated downstream. Third, because this analysis only evaluates tribal PCSRF restoration projects, it doesn't account for the multitude of other projects that are being completed by various other agencies and jurisdictions, which are likely treating limiting factors in other watersheds.

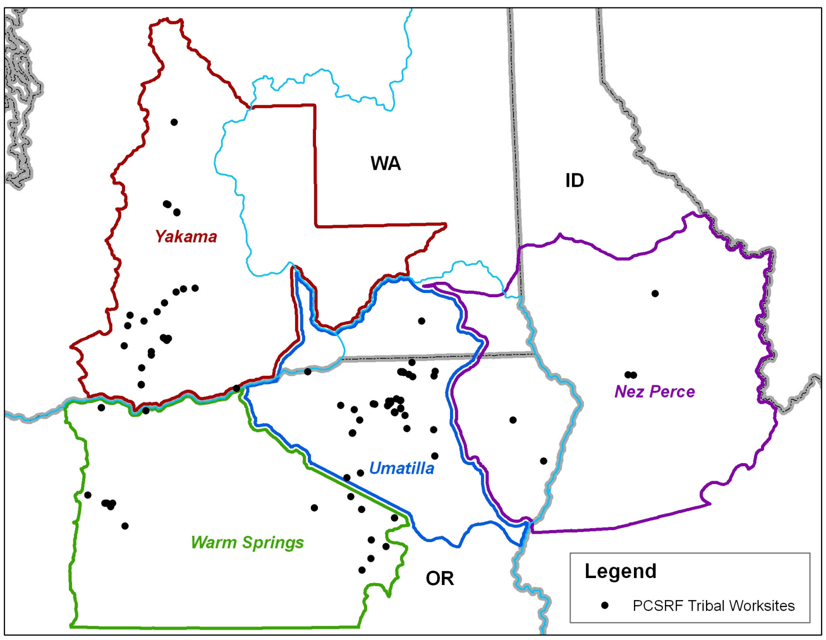

Figure 3: Location of the PCSRF tribal worksites within the tribal co-managed areas

Case Studies

In order to provide some context to the GIS analysis, we examined two case studies of tribal habitat restoration projects that have occurred under the PCSRF funding. These case studies illustrate the tangible benefits of habitat restoration projects, and also give an idea of how well these benefits are represented in a comparison to pre-existing limiting factors such as in the GIS analysis used here.

Case Study #1 – Hancock Springs Site Restoration

The first case study is a project in which restoration work was performed in the Hancock Springs area of the Methow subbasin. The area below Hancock Springs is an example of a degraded stream section that was improved using PCSRF funds. This restoration is a significant success, because in a short period of time the stream section was restored from poor conditions to a habitat where steelhead spawn and rear. The section is

a small (1-mile) side-channel of the upper Methow River and Hancock Creek. It is fed by a spring originating in a nearby hillside, which provides a year-round supply of cool water. A historical dairy operation existed previously on the site, and this coupled with detrimental land use practices including cattle grazing in the riparian zone, had degraded and isolated the habitat from spring Chinook, steelhead, and bull trout. The site was chosen for restoration by the Yakama Nation because it was considered to have a very high potential for adding "high-quality spawning and rearing habitats due to its location and source of high quality, cool, persistent flows."

Restoration work was conducted in two phases under separate PCSRF projects during 2005 and 2006. This work included constructing fencing to restrict cattle access to the creek, removing sediment barriers to adult fish, installing large woody debris to stabilize the banks, and planting riparian vegetation along the creek. Work was conducted with a holistic approach, largely by hand without the use of intrusive heavy equipment. The stream restoration helped achieve the goals of opening up access to the site for salmonids, lowering summer stream temperatures, reducing stream width and increasing channel complexity, producing a more consistent stream velocity, and removing excess fine sediment from the reach. During 2007, it was confirmed that steelhead were spawning in the restoration area (20 documented redds). Prior to the restoration, steelhead spawning was not documented in this reach. In the summer of 2008, we visited the site with Yakama Nation fish biologist John Joregensen, who described the improvements to habitat: figures 4 through 7 are photos of some of these improvements. Monitoring and evaluation of habitat conditions at the site continue.

Figure 4: The Hancock Springs pool site before restoration (photo by Yakama Nation Staff)


Figure 5: Steelhead in the restored Hancock Springs pool site (photo by Yakama Nation Staff)


Figure 6: A cattle crossing at the Hancock Springs site before restoration (photo by Yakama Nation Staff)

Figure 7: Steelhead spawning in the restored Hancock Springs cattle crossing (photo by Yakama Nation Staff)

In this evaluation, the GIS analysis was performed before the case studies were examined in order to remove any bias. Because the restoration work occurred and was funded in two phases, it was represented as two projects in the GIS analysis. The restoration site is fairly discrete, being constrained to a 1-mile section, so each project received one worksite in the GIS analysis centered on the Hancock Springs area. During evaluation of the project proposals, the worksite was deemed to treat all four major limiting factors: (1) It opened access to a previously inaccessible habitat (obstruction); (2) It removed excess fine sediment from the reach and confined cattle from the stream banks (sediment); (3) It regulated flow velocity and provided access to an additional water source (stream flow); and (4) It improved riparian shading and provided access to a cool water source (stream temperature).

This particular stream channel was identified in the limiting factors assessment of the Methow subbasin plan as part of Hancock Creek, and all four of the major limiting factors are attributed directly to this stream section. Figure 8 juxtaposes these limiting factors and the Hancock Springs site location. So, at all scales of analysis, this project is analyzed to produce benefits to all four matching limiting factors for two consecutive years of work. It is unclear whether the obstruction cited by the subbasin plan as a limiting factor on the Methow River pertains to the obstruction actually removed during project work. Clearly, however, the project provides benefits to salmon at this site for all of the four major limiting factors. In this case the limiting factors identified in the project proposal and the limiting factors modeled during subbasin planning appear to be well-matched, and this is represented in the GIS analysis through a positive correlation between the worksite treatments and the limiting factors at all scales.

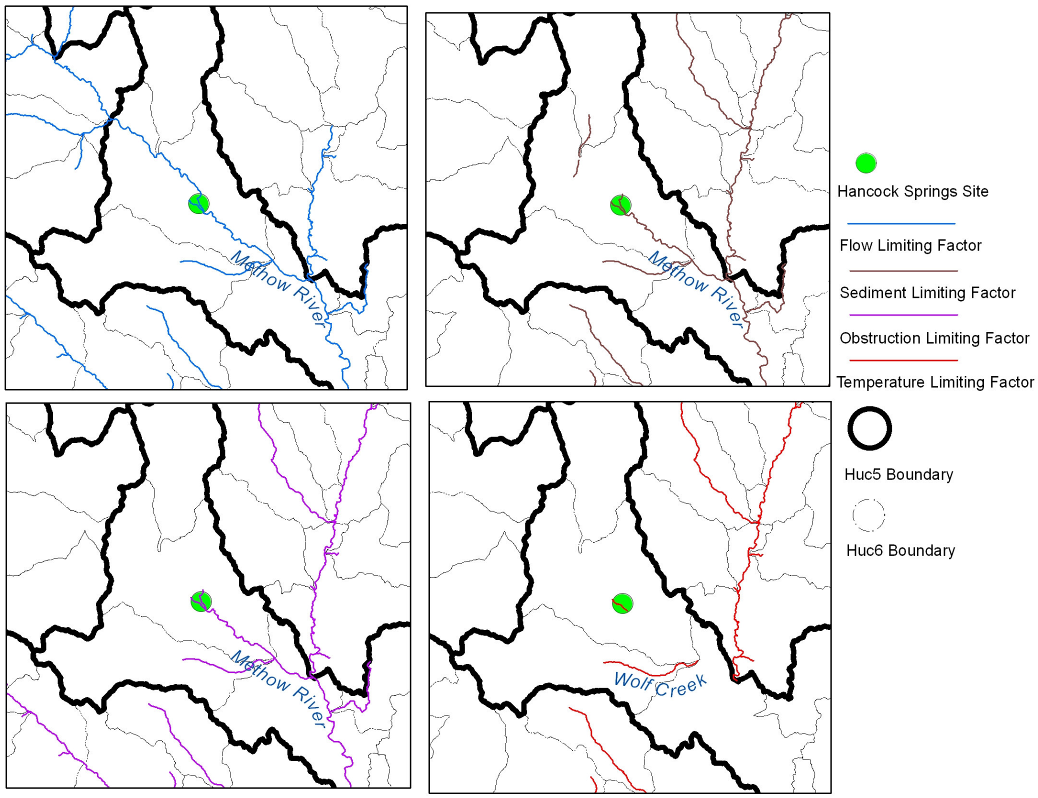

Figure 8: Hancock Springs restoration site and local limiting factors as developed for EDT modeling

Case Study #2 – Holmes Property Acquisition

The second case study involves a project which purchased a side-channel habitat area adjacent to the Yakima River. This project funded (with an accompanying cost-share from other funding sources) the purchase of a 50-acre parcel in 2005. This project also secured a water right that was previously used to irrigate pastureland at the parcel, and diverted this additional flow to the stream for flow augmentation. The parcel is valuable habitat for spring Chinook and Coho, in addition to providing refuge for other native wetland plant and animal species. This project only reflected the purchase of the land and the accompanying water right, and did not include additional habitat restoration work. Passive restoration of the site was expected to occur because of the elimination of cattle grazing in the area. Active restoration work at the site was anticipated to occur in the future under separate funding

After a successful purchase and reallocation of water rights to instream flow, coho salmon were introduced to the site as part of a supplementation program in the Yakima basin. Subsequent community work parties led by Yakama Nation staff have guided volunteers in planting native vegetation on the site to enhance its riparian habitat. Coho salmon have been documented spawning in side channel habitat on the site by Yakama Nation staff (figure 9).

Figure 9: Coho salmon spawning in the Holmes property side channel during 2006 (photo by Yakama Nation Staff)

This case study provides another interesting opportunity to examine how well the GIS analysis links the project treatments with known limiting factors. The property purchase was implemented through two PCSRF projects (in 2002 and 2004) with cost-sharing from other funds, so two work sites were generated for the GIS analysis, both at the Holmes property location. Because the benefits ascribed in the project are primarily concerned with flow from securing the property water right, we interpreted stream flow as the only limiting factor treated. Additional restoration funds would presumably come from other sources and would enact future activities, so to attribute them to this project would be inconsistent with the analysis of other projects that funded these restoration activities directly. It is likely that the passive restoration of the site from the cessation of livestock grazing will provide a tangible benefit to other limiting factors such as sediment and temperature. Because these limiting factors (sediment and stream temperature) were not described in the proposal, though, we made the decision not to include them as direct benefits of the project. This highlights one of the difficulties with the analysis when limiting factors are not defined a priori by the project proponent: it can be a subjective decision as to what benefits to ascribe to the project. Ideally, when information is lacking, one could contact each project proponent individually for an interview about the project. However, this is time-consuming and costly for an analysis of large sets of data, and may be impossible when project staff have left their positions and are no longer working for the implementing entity.

The Yakima River reach adjacent to the Holmes Property was identified with all four major limiting factors (flow, temperature, sediment, obstruction) during Subbasin Planning. Because the treatment of this project was assigned a benefit to stream flow, it matches this limiting factor at all scales of the analysis. And because it is does not directly address the other limiting factors (stream temperature, sediment, obstruction) in the project proposal through the land and water rights purchase, it is not linked to these factors.

Conclusions

This analysis illustrated a straightforward method for using a GIS to link and compare habitat limiting factors and habitat restoration activities. Within its limited scope, it demonstrated a link between these activities with three out of four major limiting factors when examining tribal PCSRF-funded activities. It also suggested an appropriate scale (huc5) for this analysis as a response to the scale and precision of data used. However, this

analysis also demonstrated that regional scale analysis are at best an inexact method for comparing standardized limiting factors and project actions, when data on habitat conditions and habitat treatments are assembled from disparate sources. Much of the success of such an endeavor is dependent on the information that is generated through the project proposal and reporting stage, as well as the completeness and consistent methodology of limiting factor assessments, and the compatibility between both information sources.

In the Columbia Basin, there is currently a heightened interest in assessing and improving the performance of expenditures on salmon and steelhead recovery projects by establishing the relationship between these projects and known limiting factors of habitat and ensuring that the project goals target these factors. It is our hope that this report, while only conducted with a limited set of projects, may help inform these efforts by providing an approach to link projects and limiting factors, and in the process, also illustrate some of the shortcomings that need to be addressed in order for such an effort to succeed on a large scale. We have several conclusions from the analysis, the majority of which highlight shortcomings that this approach faced. Where possible, we included recommendations to how these shortcomings might be overcome if this type of analysis is to be expanded to other projects or areas.

1) Identifying limiting factors from project proposals by a 3rd party is dependent on the quality of information that is available about each project. Even with detailed project descriptions it is still a subjective exercise because the reviewer is dependent upon the narratives of the proposal to determine which limiting factors are being treated.

Recommendation: Project proposals should require a listing of limiting factors and their treatments as part of the proposal process. A well-defined list of limiting factors and treatments along with a user-friendly form for entering the information would aid in developed standardized data while placing the least burden on proposal writers. If this step is not accomplished in the proposal stage, it may be difficult or impossible to gather this information at a later date.

2) Limiting factors addressed by a project may not include the entire suite of benefits that eventually occur. Because habitat restoration projects produce benefits far into the future, in many cases it may only be possible to assess the effect of a project through a long-term monitoring and evaluation program. Generally, these programs are included in PCSRF projects, but they are usually tailored (by necessity) to the characteristics of a project and its worksites, so it is often difficult to assemble standardized monitoring data at the regional scale.

Recommendation: Regional support for monitoring and evaluation programs would yield long-term project metrics, assuming there is a provision that this information be shared at a regional level. The more that these monitoring and evaluation techniques can be standardized, the better utility the information will have in regional analyses.

3) The geographic scope of a project benefit is a difficult issue for any standardized analysis. In this analysis, the geographic scale of the analysis produced very different results when matching project treatments and known limiting factors. Without well-defined project location (locations of project in the past were often not described in detail), it is difficult to confidently apply benefits at a fine scale (e.g. huc6), but at a coarse scale (e.g. huc4), the results are so general that they may not be meaningful. In addition, projects often have benefits far downstream of their implementation. Defining benefits to only one location in the watershed where actions occur may overlook these downstream benefits.

Recommendation: An evaluation that compares project treatments and existing limiting factors will need to be performed at a well-defined geographic scale in order to produce tangible results, and this scale should be chosen based on the precision of the data used for the analysis. Project proposals could require a defined geographic area of benefit in addition to the coordinates (latitude and longitude) for the proposal. This process might be tedious, however, for the proposal writer and requiring this information could risk an overly generalized response because of the complexity of the issue. (For example, how far downstream in a basin do water temperature, sediment, or flow benefits from a project site occur? Should fish populations in adjacent tributaries be given these benefits because they travel through these downstream areas? Shouldn't

benefits be weighted so that they are greater near to the project actions and diminished at greater distances?)

4) In the past, PCSRF project proposals did not require coordinates for work site locations, so placement of projects in a GIS for analysis is subjective to the extent that worksite locations are described.

Recommendation: The current PCSRF project proposal format (for projects 2007-forward) requires worksite coordinates so this process has been improved, as long as the protocol is followed. This information should be a key element of any habitat restoration proposal process. A simple longitude/latitude or UTM coordinate and datum that represent the work site are extremely helpful when mapping these sites in a GIS.

5) Any set of regional limiting factor layers, even when detailed to the reach level, may not adequately express all habitat conditions that will benefit from project habitat treatments. For example, a typical project in this analysis produced benefits to fish by reconnecting a channelized stream to adjacent wetlands in a disconnected floodplain. A typical project may also fence off livestock from the area, and replant riparian vegetation. In reality, this project probably provides benefits for fish by addressing all four major limiting factors (flow, temperature, sediment, and obstruction), but a previous inventory in the area may not necessarily have identified all of these factors, even though they may have reduced salmon or steelhead production.

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Recommendation: An analysis should have a provision to recognize that there are may be additional benefits from project implementation beyond previously identified limiting factors.

6) An analysis is complicated by the fact that all projects are not equal. That is, some projects include a greater level of funding and effort, and presumably greater benefits. And the level of activity may also vary between worksites within any given project. Many projects also include a cost-share, which further complicates this issue. For the purpose of this analysis, we tallied worksites as a simple indicator of treatments, but acknowledge that this does not account for these differences.

Recommendation: A comprehensive analysis may include a uniform metric such as dollars spent that may be compared equitably between projects, or habitat metrics (for example, some metrics collected by NOAA for PCSRF projects are miles of riparian fencing or vegetation planted) to account for differences in treatment between projects and/or worksites, but any measure is probably either (a) an imperfect simplification to allow all projects to be compared to one another, or (b) a series of metrics that are detailed enough to adequately document the benefits of individual projects, but will probably make comparisons between several different projects difficult.

7) A regional analysis should be as comprehensive as possible, including all projects from various funding sources. This may be difficult though, because as projects with disparate reporting methods are added, data consistency becomes more difficult to achieve.

Recommendation: Common reporting standards between different project funders, enacted at the proposal stage would support more consistent metrics by which to analyze the effects of these projects. This would require multi-agency coordination (NOAA, BPA, etc.) to generate consistent metrics, however. Regional workshops to discuss and develop standardized limiting factor definitions and reporting metrics for treatments should be supported.

In conclusion it is probably not realistic to expect that a regional standardized analysis can be the only method to evaluate the effects of funded projects. A regional methodology that could successfully generate a comprehensive set of limiting factors and also standardize and accurately measure all treatments for comparison to these factors is not readily available with existing data and may not be possible to achieve in the near term despite best efforts. Any regional analysis should also be accompanied by an examination of habitat metrics, reporting, and long-term monitoring and evaluation on a project-by-project basis in order to fully understand and illustrate the benefits of habitat restoration and protection activities for salmon and steelhead.