Independent Scientific Review Panel
for the Northwest Power & Conservation Council
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Memorandum (2018-7) **September 7, 2018**

To: James Yost, Chair, Northwest Power and Conservation Council

From: Steve Schroder, ISRP Chair

Subject: Follow-up Review of the Upper Columbia United Tribes' Monitoring and Evaluation Program (#2008-007-00)

Background

At the Northwest Power and Conservation Council's July 17, 2018 request, the ISRP reviewed a response from the Upper Columbia United Tribes[1] for Project #2008-007-00, *Upper Columbia United Tribes (UCUT) Monitoring and Evaluation (M&E) Program*. The UCUT's response is intended to address the Council's recommendation from the 2017 Wildlife Category Review which incorporated the ISRP's recommendation of "meets scientific review criteria (qualified)" (ISRP 2017-7, pages 22-26).

The ISRP's qualification:

> *The project proponents agreed to submit a progress report for ISRP review in 2018. The report should:*
>
> 1. *provide detailed responses to the ISRP's eight questions from the preliminary review*
> 2. *describe the status of updating management plans to include quantitative biological objectives for each representative cover type, and*
> 3. *describe what a restored habitat looks like relative to the reference conditions.*

On July 16, 2018 the complete submittal was received, including the following.

- Cover letter dated June 6, 2018 (the referenced *2018 progress report* follows)
- Report titled - Upper Columbia United Tribes (UCUT) Monitoring and Evaluation (M&E) Program
- Response to the ISRP
    - Upper Columbia United Tribes Response to the Independent Scientific Review Panel Review of the UCUT Wildlife Evaluation and Monitoring Program-2018

[1] Comprised of the Coeur d'Alene, Colville Confederated, Kalispel, Kootenai, and Spokane Tribes.

- APPENDIX1. Analytical approach
- Table 1. Sampling plan for the UCUT Wildlife Monitoring and Evaluation Program (UWMEP)

This material augmented documents the ISRP considered in its initial 2017 Review:

- View 2017 project summary in Box
- View 2017 response to ISRP in Box
- Background info on the project in cbfish.org: Project overview | Reports | Past reviews

ISRP Recommendation

Meets Scientific Review Criteria (Qualified)

As requested, the UCUT provided a progress report and a response to eight questions from our preliminary review. We appreciate the timely submittal of these documents and thoughtful responses. Although the documents address most of our qualifications and questions, some fundamental questions are not fully addressed. Consequently, we continue to recommend "meets scientific review criteria (qualified)."

The program provides a reasonable approach to assessing large-scale, long-term mitigation efforts. Although we provide specific comments for improvements to project methods below, overall, we find that the UCUT M&E program's methods are scientifically sound.

The primary reason for the continuing "Qualification" from our earlier review is that the UCUT submission does not address Qualification 2: *Status of updating management plans to include quantitative biological objectives for each representative cover type*. The regional M&E program still needs to demonstrate that it will deliver data that enable assessments of progress toward quantitative biological objectives for individual Tribal restoration projects, ones that ultimately lead to improved actions that benefit wildlife. Adaptive management cannot occur until specific quantitative biological objectives are established.

The ISRP recognizes that quantitative objectives and adaptive management plans are best developed at the project level by the Tribal managers. However, there also needs to be coordination between development of individual property plans and the regional M&E program. This will ensure that needed information is being collected and evaluated. In their 2017 response to the ISRP's preliminary comments, the UCUT indicated that: "*The UCUT member tribes plan to meet extensively with the UWMEP principal investigators over the next 6 months to develop comprehensive QBO (Quantitative Biological Objectives) from each cover type from the existing reference site data as descriptors of Desired Future Conditions (DFC).*" We also urge them to work collaboratively to develop adaptive management plans that include scheduled interim assessments for their individual restoration actions. We emphasize that

special consideration will be needed to ensure that the M&E program is collecting information that can be incorporated into Tribal adaptive management processes. The ISRP is concerned that management actions could continue indefinitely with little or no detectable changes in approaches or results over time because the UCUT M&E plan does not fully mesh with the biological objectives of specific projects. Consequently, applied management actions by an individual Tribe may be useful but may also be a sub-optimal use of funds.

Example objectives include:

- A biological objective may be to restore ecological features needed for re-establishment of amphibians within 10 years after restoration is initiated. However, does the UCUT M&E plan collect the appropriate data to assess such an objective?
- For reforestation actions, an objective may be based on stems/ha of suitable trees at specific time intervals after restoration. Objectives need to be based on site productivity information and on rates of succession. They should not be statements of unsupported desired outcomes. Will the current UCUT M&E plan gather information on stem density or solely on community-structure of vegetation?
- A biological objective may be based on general successional paths known for many ecological regions. Does the UCUT M&E plan to collect information on these successional paths? What are the key indicator species and their abundance and/or distribution that need to be monitored to ensure restoration is proceeding?
- If a current restoration action has the potential to introduce invasive species, does the UCUT M&E plan collect the necessary information to assess species invasions?
- The long-term goal of the UCUT M&E is to make future conditions at restoration sites similar to reference sites. If so, the quantitative objectives and intermediate targets of restoration along the way need to be described to allow measurement of progress. There is no point in waiting for 50 years to declare that a project was unsuccessful before developing alternative actions to achieve intended outcomes.

ISRP Comments

The ISRP's 2017 qualification had three elements.

1. *Responses to the ISRP's eight questions*

Please refer to the ISRP comments below.

2. *Status of updating management plans to include quantitative biological objectives for each representative cover type*

See the qualification above.

In addition, the ISRP has concerns about the number of sites to be sampled within habitat types and the types of sampling used within the UCUT M&E program. As noted elsewhere, none of the analyses has any measure of uncertainty to judge if a sufficient number of sites is being monitored to detect meaningful changes over time. The ANOSIM[2] methods used in the progress report, however, did detect evidence of a difference in community structure between reference sites and those just starting on the restoration path. This is reassuring as it suggests that the regional monitoring program will be able to detect whether restoration actions are producing desired effects. However, the ANOSIM methods used to measure similarity should be tested with existing data to see what sizes of "effects" can be detected. Perhaps success will be declared too early based on ANOSIM because of lack of power to detect intermediate differences?

3. Description of restored habitat relative to reference condition.

The major objective of the monitoring program is to describe the biological communities at restored habitats relative to similar habitats at reference sites. This is accomplished using NMDS[3] plots, a detailed listing of community diversity measures, species lists of restored sites relative to reference sites, and a formal ANOSIM analysis. The Eastern Washington University's progress report on the findings from the monitoring efforts in 2011 and 2015 on the Spokane Tribe properties was informative for the ISRP. The report identified the analytical methods to be employed and how the information will be presented. The report indicated that the UCUT M&E program followed the ISRP's recommendation to include a minimum of three reference sites. A brief commentary was presented in the progress report comparing the restoration and reference sites. The ISRP found these analyses to be useful, and their continuation is justified. However, this progress report could be improved in a number of ways:

(1) Consider grouping species in ecologically functional groups. For example, what functional groups of species are lacking/present from management sites relative to reference sites?

(2) Assess diversity with measures that are easy to interpret such as effective number of species (see below). If diversity measures diverge between reference and restoration sites, is this because of invasive species? Or, because of a lack of suitable habitats?

[2] Analysis of similarities (ANOSIM) is a non-parametric statistical test widely used in the field of ecology (Wikipedia).

[3] Non-metric multidimensional scaling (NMDS) is an approach to visualize the level of similarity of individual cases of a dataset (Wikipedia).

(3) Do the findings suggest that changes to management actions are needed (adaptive management)? For example, suppose that a large number of invasive grasses have become established. Can management actions be changed to reduce or prevent this in the future?

(4) Include better descriptions of reference and restoration sites (text, pictures, timeline of restoration activities, land management actions) that would allow users of this document to better understand the measures for comparing reference to restoration sites.

The authors hypothesize that vertebrate species (birds, small mammals, amphibians and reptiles) or communities are "barometers" of environmental conditions. The ISRP suggests that monitoring small groups of species indicative of the reference condition will likely be more sensitive than monitoring the entire community. For example, are the same patterns seen when using NMDS as when examining specific focal species? For instance, if the goal is to establish an overstory of mixed coniferous forest, bird community benchmarks could be shrub bird species being replaced by tree canopy species.

It is not clear why vernal ponds were added as restoration habitat, especially given the lack of reference sites and the major logistical difficulties (relayed in the progress report) of sampling reference and restoration sites using current timelines for sampling. What information is being gained by monitoring vernal ponds?

ISRP Comments on UCUTs Responses to the ISRP's Eight Questions from 2017

The ISRP review questions from 2017 are presented in numbered italics, the UCUT's response follows in Arial Narrow font, and the ISRP's comments generated in this review are boxed.

1. ***ISRP 2017:*** *Current analyses are conducted at the species level without consideration of similarities in form or in function among species. The non-metric multidimensional scaling (NMDS) analyses should be modified to include such considerations, and a comparison of results with and without these considerations should be undertaken to determine which approach may provide better insight.*

UCUT Response: A functional trait approach is one that defines groups of species in terms of shared traits or related ecological roles for the purpose of evaluating between reference and restoration communities. Using this approach with birds is fairly straightforward as broad groups such as raptors, passerines, waterfowl, and scavengers tend to be similar in form and each utilize similar resources within the landscape. To further classify birds into groups useful to our project, traits such as foraging preference, nest type, migration status, and microsite use (e.g. specific location within the canopy or water body) could be organized into a matrix to define key communities within the eight priority habitat types. All of the traits listed above are widely available in public databases so this is fairly easy to implement for this taxon.

By contrast, the complexity and diversity of plants makes identifying functional groups more challenging than for birds. Numerous plant traits have been described (https://www.try-db.org/) but their relationship to ecological functioning may not be clear. Some traits such as form (herbaceous, graminoid, woody), native status, and perennial vs. annual, are already collected. Of the other traits to consider above-ground biomass, clonality, height, palatability, and onset of flowering (Weiher et al. 1999) are just a few of the possibilities. Which traits are the most relevant to consider when defining functional groups in a restoration context? One approach would be to look at the historical composition of reference sites to select traits. For example, native bunchgrasses are a dominant component of shrub-steppe and conifer woodland habitat types with perennial grasses usually absent. Due to moisture or elevation gradients, individual species can vary substantially between locations. Consequently, using native bunchgrasses as a functional group could be useful in analysis of these habitats.

A similar approach could be undertaken for each of habitat type, using reference sites as a guide to select relevant traits. It may be more difficult to identify functional groups for some habitats. For example, we have found that in restored meadows it is common to have a large component of mixed introduced perennials grasses present. If we allow that some of these European meadow grasses are able to function as analogues to native grasses or sedges at the reference site, which particular combination of characteristics are most related to their success? It could be very time consuming to attempt to investigate and confirm appropriate functional groups in complex habitat-types. In 1993 Boutin and Keddy set out to undertake a functional classification of wetland plants in eastern North America. They considered 27 traits from 43 species to provide a comprehensive overview of wetland plant functioning. Their process consisted of (1) defining function, (2) selecting traits that reflect function, (3) screening for those traits, (4) constructing trait matrices, and (5) grouping species according to these traits. Conducting a thorough analysis of plant traits in this manner for a given habitat would be very time consuming and seemingly cost prohibitive for UWMEP. In comparison, a simpler approach could utilize previously collected trait data from a resource such as the USDA's Plant Database (https://plants.usda.gov/adv_search.html) to derive groups based on informed choices. This would be more subjective and limited in scope, however much more manageable and cost effective.

Small mammals as a group are low in species richness when compared to birds and plants. Characteristic assemblages usually have representatives of 3-4 foraging guilds. Small mammals can act as indicators of habitat quality in two ways. First, in predominantly monocultures of invasive grasses, species richness is very low and the numerically dominant small mammal will be an herbivore; whereas insectivores are absent. Second, some individual species are characteristic of ecological condition. For example, *Myodes* is predominantly fungivorous and occurs where forest structure is more mature. Consequently, there is little to be gained by using a functional approach with small mammals.

Boutin, C. and P. Keddy. 1993. A functional classification of wetland plants. *Journal of Vegetation Science, 4*(5), 591-600.

Weiher, E., Werf, A., Thompson, K., Roderick, M., Garnier, E. and O. Eriksson. 1999. Challenging Theophrastus: a common core list of plant traits for functional ecology. *Journal of Vegetation Science*, 10: 609-620.

ISRP Comments 2018:

The UCUT provides an informative discussion of the question and an argument regarding the difficulties of using the functional groupings in the M&E program. However, the current approach, without functional groupings, is less useful because it is hard to determine if a related species is present rather than a specific target species. The ISRP requests that such an analysis be done for birds and plants (the latter using the USDA plant database). The current approach for small mammals should continue. The commentary in the Eastern Washington University progress report comparing reference and restoration sites should include information on the presence or absence of functional groups.

2. ***ISRP 2017:*** *It is unclear how the success of this program will be evaluated. For example, suppose that the analyses fail to show that restoration sites are moving towards the reference sites. How will this lack of movement be validated? Perhaps the method is insensitive to movement (lack of power), or the restoration actions are ineffective? Some quantification of the uncertainty in the similarity measures is needed and should be incorporated into the results and displays.*

UCUT Response: The goal of this program is adaptive management. Lands are being managed by five Tribes across eight habitats with methods that differ in starting point, scope, intensity of management, and timeline. Our prior reports to ISRP consider change across all jurisdictions. As we begin to focus attention to individual mitigation sites, the criteria for success may vary because of the level of management and the response time for a particular habitat. Ultimately, decisions on what is considered success for a particular restoration effort will be made by the management team for each intervention.

We repeat our original rationale for the similarity approach from our 2013 ISRP report in Appendix 1. It seems unlikely to us that similarity approaches would be insensitive to real change in species or functional composition. This could be tested, however, through a series of simulations altering species composition and population size. We are not sure how a sensitivity analysis could be incorporated into an NMDS plot.

ISRP Comments 2018:

The current update does not present a plan to evaluate if restoration actions are successful at the scale of individual projects (i.e., a lack of quantifiable, time-bound biological objectives). Without a measure of uncertainty of the current program, how will such objectives be evaluated? Will success of restoration projects be declared simply when the ANOSIM fails to find evidence of difference in community structures?

The proponents indicate that adaptive management is a goal of the UCUT M&E program, but without clear evaluations and decision rules, how will management actions be adapted? Adaptive management requires checkpoints for adopting new management actions if the

current management actions are found to be ineffective. No structured process is described for implementing adaptive management.

Even though some of the restoration timelines will be very long (e.g., establishment of successional forests), criteria for success at short-, medium-, and long-time intervals for individual restoration projects should be established with approximate time lines. For example, establishment of grasses could be a short-term goal for a project; establishment of quick growing shrubs (if appropriate) could be a medium-term goal, etc.

The NMDS plots in the progress report are interesting but show progression of restoration sites both towards and away from reference conditions. It is difficult to get a feel for what these trends mean with the current display. Many of the reference sites have been measured for three years in a row. "Movements" of the reference sites among years should be added to the NMDS plots to try and "quantify" the amount of noise in these plots when the same (stable) reference sites are measured over short time periods. Similarly, once reference sites are revisited, "movement" of the reference sites over medium time periods should also be shown.

Without quantifiable objectives or measures of uncertainty, traditional measures of the performance of monitoring designs (such as power) cannot be computed. A power analysis using the currently collected data is needed to verify that the small number of sites will be sufficient over the long term. The fact that the ANOSIM currently detects differences in community structure is reassuring that gross effects can be detected, but small sample sizes may lead to success being declared too early.

It also appears that each project conducted by each Tribe will be evaluated separately. While the monitoring methods may be similar for many of the projects (i.e., the regional UCUT M&E program), there does not appear to be intent to form an integrated approach among the Tribes with common goals, quantitative biological objectives, standard methods for monitoring specific biological objectives, or data analysis for individual projects.

Appendix I provides rationale for the use of integrated measures of community, but it does not indicate how the overall restoration program or individual projects will be evaluated. For example, is success declared when the restoration sites are within the convex polygon formed by the reference sites in the NMDS plot? Is success declared when the results of ANOSIM fail to detect a difference in community composition? The latter could occur because of inadequate power.

3. ***ISRP 2017:*** *The current condition of the reference sites may be irrelevant and unachievable in the face of climate change and land use. The reference sites should be sampled at intervals (perhaps 10-year intervals) to measure possible long-term changes in desired future conditions (DFC). Evaluation should also be made in regard to sampling additional reference sites that are currently experiencing conditions similar to those*

forecasted in association with climate change. A sampling plan should be developed to cover these concerns.

UCUT Response: Our report to the ISRP in 2017 indicated that at least for one habitat type (i.e., wetland meadow), it would be valuable to resample reference sites. Mitigation sites showed movement away from the reference condition over time, but the reference sites may have changed as well due to two flooding events.

Our current sampling plan allows us to revisit mitigation sites at 6-year intervals (Table 1). Because of the geographic locations of the current reference sites, we would have to dedicate two field seasons to revisit them all. Alternatively, we could revisit the more challenging ones in one year, and revisit the others while working on mitigation sites. This would be the most cost-effective approach (Table 1).

We have not examined the availability of additional reference sites as described by ISRP. Based on our experience in finding the current set of reference sites, we expect that it will be quite time-consuming to find sites and obtain permission for use. Moreover, such sites are likely to be geographically distant, which would make their inclusion logistically very difficult.

ISRP Comments 2018:

The ISRP has concerns about interpreting Table 1; additional information is needed on how to read the table. For example, no sampling is planned for 2018 (column is blank) but the last row shows 14 sites being monitored. Similarly, the last row does not often match the number of stations sampled in the selected sites. For instance, in 2022, the X indicates that the CCT sites are being monitored with 12 sites but the bottom row total shows 24. Similarly, it appears that the UCUT already plans to sample 24 reference sites (all or the vast majority) in 2023 and 2030. However, the information in the bottom row labeled "Planned # of Sites Per 1 Year(s)" indicates that 11 references sites will be sampled in 2023 and 14 reference sites will be sampled in 2030.

The confusion may be related to the blank column in 2018. If this column is deleted and the remaining columns shifted to the left, the number of sites being sampled appears to be better aligned with the number of sites in each panel.

Other sources of confusion: Initial sampling of reference sites took three years (2009-2011). Future sampling of reference sites is planned for 2023 and 2030. Only a single year is allocated to sample all reference sites in the future. How is this possible? If three years were initially needed because of "first time" effects, this needs to be noted. The proponents also state that "we would have to dedicate two field seasons to revisit them all." It is not clear what the intentions of the UCUT may be relative to sampling reference sites in 2023 or 2030. What proportion of the reference sites would be sampled in a single year, how they would be selected, or the effectiveness of such a monitoring plan for reference sites is not discussed. Because determination of possible change (or stability) in biotic communities at reference sites is a substantial concern and may affect the interpretation of monitoring data from restoration

sites, a clear understanding of the dynamics of biotic communities at reference sites is critical to assessment of the program. The ISRP recommends that sampling design should be modified to allocate 2 years of sampling at reference sites (i.e., 2023 and 2024), or more resources should be obtained so that all reference sites could be sampled in a single year.

One of the dangers of long term monitoring plans is sample attrition. What will be the impact of losing some of the reference sites due to unforeseeable "disasters" (e.g., a large fire). It may be prudent to plan for disaster by identifying potential replacement reference sites in advance and starting some of the time-consuming tasks such as permissions and permits for "just in case."

The inclusion of additional reference sites as proposed by the ISRP is addressed briefly. Arguments are provided that time constraints preclude finding additional reference sites or obtaining permission to access them. Reference sites selected in 2009-2013 may not be suitable reference sites in 2050 due to varying effects (i.e., climate change, resource development, or catastrophic events that set back successional processes). The program needs to select reference sites that may mimic future conditions. For example, if an effect of climate change is reduced precipitation, reference sites that currently experience lower precipitation should be measured now for an indication of what reference sites may look like in the future.

4. ***ISRP 2017:*** *The trajectory towards DFC could be assessed by comparing restoration sites where there has been no restoration to restoration sites where there is consensus that the restoration is moving in the right direction. Are there sites on the landscape that appear to be progressing towards DFC and can they be incorporated into the monitoring plan?*

UCUT Response: This question is somewhat confusing. We are asked to consider sites where no restoration efforts have been undertaken versus those where restoration activities are moving sites closer to a DFC. Because we are examining sites that are under management with the expectation that they are or will move towards a DFC, we believe that there are sites progressing towards DFC and they are already incorporated. Was the question meant to consider incorporation of sites without any interventions to act as a control? In that case, there would be potential to add additional sites. The caveat is that resources would need to be expended to monitor unmanaged sites, which would require reductions in sampling of sites under restoration.

ISRP Comments 2018:

An unstated assumption is that the effectiveness of the proposed management actions is well understood so that formal "controls" will not provide useful information. However, the timing of management actions is staggered so that some sites are "controls" until the management

actions start. Is there monitoring on restoration sites prior to the initiation of management actions that may serve as a baseline? Presumably, the number of sites needing restoration is much larger than the budget available, so some of these would serve as "natural" controls. Given that "management activities" vary tremendously across restoration sites, there may be a natural ordering in the intensity of management actions that could be used to provide a quicker evaluation of management actions under the hypothesis that "more restoration activity" is better.

Again, without a quantifiable objective, how does one know that the management actions are having the desired effect? Perhaps, despite management actions, restoration sites may do no better than sites without management actions.

5. ***ISRP 2017:*** *Small mammal monitoring, especially in grassland steppe habitats, can often suffer from few detections when populations are at low densities. Alternative monitoring methods, such as presence/absence/occupancy should be investigated for cases where the monitoring effort suffers from trying to sample small mammal populations that are not diverse and are at low densities. Are alternate (i.e. cheaper) sampling strategies available for these cases? Perhaps the small mammals monitoring component will be ineffective in light of item (3).*

UCUT Response: In our experience, the densities of small mammals in grassland steppe reference sites were remarkably low over several years. This suggests that environmental factors such as soil type and structure or plant biomass might be responsible for the low densities. We recommend not resampling small mammals at grassland steppe reference sites. Our current sampling approach is the most cost efficient that we have in terms of field time and equipment. Please see the last paragraph from our answer to Q. 3 for further discussion.

ISRP Comments 2018:

The ISRP does NOT concur with stopping the monitoring of small mammals in grassland steppe reference sites and recommends that the UCUT implement an alternate monitoring for these environments such as presence/absence based on direct trapping, sampling of scat, gnawing at bait stations, etc.

6. ***ISRP 2017:*** *How will different management actions be evaluated to investigate which ones lead to better outcomes? What is the suite of management actions currently being monitored? How many samples per management action are currently collected?*

UCUT Response: Member tribes have each developed individual "Site Specific Management Plans" as part of the acquisition process with BPA when they purchase new mitigation properties. These plans detail what management actions will occur on each parcel and serve as a guide for long term planning on the property. While these "Site Plans" provide general information regarding management activities at each location, it is unclear how much data exists on the success or failure of different methods and applications that have been undertaken at these sites. When asked, most of the tribes indicated they would be willing to provide a list of management activities for each mitigation unit which would be a good first step in starting a general database. In the future, one idea would be to pool any data collected in this area to better investigate the question posed (which management actions lead to better outcomes). Including data from across multiple tribal jurisdictions for similar treatments and habitats would be useful. Even sharing simple information related to obvious failures or clear successes could benefit the group.

However, although this sort of data on management outcomes would be extremely valuable, in reality most tribes are probably not currently testing restoration methods, at least in a way that is scientifically valid. Usually the approach wildlife managers take is to select the best-known methods for restoration and proceed with them, since there is not funding to study multiple methods. Some have indicated they are testing a few new things on small plots, but not necessarily in areas surrounding UWMEP restoration sites at the current time. Also relevant is the large scope of the project, which is not a simple study restricted to a couple of sites, but is instead an expansive, multi-faceted land management program encompassing larger, often fragmented acreages on and around five different regional reservations. These are being monitored with a very limited budget and a single team. Yes, it would be possible for the tribes to tailor their restoration efforts around each mitigation sampling point and conduct specific treatments and record what is successful or not in moving those areas toward a reference standard. However, most tribes feel that what they are doing for monitoring is appropriate for the funds they have right now, and are currently focused on retrieving some meaningful data and specific inferences for each tribe from UWMEP. Nevertheless, beginning to collect basic information on what treatments are being undertaken at which sites could be done with little cost and would be useful for managers as a general reference. And because management actions will be judged over time by the results of the M&E reports, it would be beneficial for EWU to have a concise document with this information present to use when analyzing the data.

ISRP Comments 2018:

The UCUT provided a discussion of the problem, but no plan for assessment of different management actions. They acknowledge that "this sort of data on management outcomes would be extremely valuable, in reality most tribes are probably not currently testing restoration methods, at least in a way that is scientifically valid." In the last two sentences of the response, they further concur with the need to identify management actions on restoration sites and relate them to M&E. However, there is no proposal for how this need could be addressed.

The ISRP recommends that the UCUT develop a database identifying the specific treatments that are being applied at individual restoration sites. The database should also indicate when the treatments occurred, the success in the application of treatments, and an analytical approach for how to relate the applied treatments to restoration objectives. For example, what

changes in biotic communities at restoration sites occurred within specific habitat types. Some consideration should be made on how to manage this information (e.g., will it be a shared database, who will host it, and will there be annual meetings?). While there is little deliberate experimentation taking place, opportunities for comparison will arise, such as different machines used for mowing or native plants acquired from different sources, and it would be useful to share these experiences among the UCUT.

7. ***ISRP 2017:*** *Successful restoration often requires engaged stakeholders. The project should ensure that local stakeholders are engaged in the process through such actions as training to collect data, data collection, training for analysis and interpretation, public presentations of results on a regular basis, and such. A plan to engage local stakeholders in the monitoring actions should be prepared.*

UCUT Response: The UCUT tribes have had varied success to date maintaining engaged stakeholders. There are several ways that outreach is attempted. At the onset of land acquisition using BPA funds, one tribe set up public meetings and provided "Site Plans" to the community for comments and suggestions on how to best to utilize the land. The final drafts were submitted to BPA with the comments added. They also developed signage meant to inform the general public as to what they can and cannot do on lands dedicated to the protection, restoration and enhancement of wildlife, and made this information available to the stakeholders on Pisces.

Although all tribes do their best to keep the Tribal membership involved with the Project, some unfortunately discern little interest in the M&E side of things. The Spokane tribe engages stakeholders through their internal NEPA process, public wildlife committee meetings, school outreach, and summer youth internships/employment. Yet as with the Colville Tribes, throughout these opportunities they see very little public interest or trending concerns about the habitat or restoration work that goes into maintaining wildlife populations and recognize there might be room for improvement. One possibility would be discussing with EWU ways to potentially engage summer youth to expand and improve the monitoring program. In the past EWU has attempted to recruit college students from the natural sciences who are tribal members but with limited success. In the cases when a person was hired, they did indeed receive training in data collection and were fully involved in learning about the process of restoration.

Opinions were mixed on if the tribes felt the preparation of a plan to engage stakeholders was necessary. One tribe felt it was a good thing to try and do more in this area. Other tribes have created their own programs that they feel work for them already. One currently uses several avenues to engage with co-managers on project designs, but generally has not involved local stakeholders on Tribal properties, other than those required under BPA NEPA and/or permitting notification.

ISRP Comments 2018:

The UCUT provided a good summary of efforts to engage stakeholders. The ISRP recommends that such efforts continue even if there is no apparent interest from the stakeholders. Regularly scheduled events for information sharing and coordination would be more effective than sporadic, unrelated meetings. At the very least, it may reduce the possibility that stakeholders in the future will argue that they never had a chance to participate. The ISRP is surprised that for some Tribes there is limited engagement by their members. Lack of engagement could lead to problems in the long term in continuing restoration actions if these actions do not have the support of the community. Furthermore, it appears that such actions are somewhat uncoordinated among the Tribes. Important questions include: What lessons have been learned about what works and what does not work? How have these been shared among member Tribes?

The ISRP recommends that a more coordinated plan be developed, such as a common approach to public meetings, communication with non-Tribal members, internship programs, and such.

8. ***ISRP 2017:*** *Now that the initial development is complete, what are the specific, measurable objectives for the next five years?*

UCUT Response: The first objective is completion of the second sampling of all mitigation sites, and potentially resampling some reference sites. The next objective is clearer definition of the DFC as described by the reference sites. This may include functional characteristics of the various taxa. The final objective is analysis of change in species composition, functional traits, and structure for each Tribe.

ISRP Comments 2018:

The three objectives for the next five years for the UCUT M&E plan that are proposed by UCUT are appropriate, but further definition and planning for the achievement of the objectives are needed.

Definitely, the first objective to complete monitoring activities at restoration sites (2016-2022) and resampling of reference sites (2023) is appropriate. However, better definition of this objective is needed particularly in reference to completing resampling of all reference sites. As noted earlier, the ISRP has questions on how resampling of all reference sites can be achieved in a single year given the initial three years required?

The second objective to obtain a better definition of desired future conditions needs to be expanded into a plan to achieve the objective over the next five years. How can a “clearer

definition" of DFC be achieved? What are the specific, measurable objectives with explicit timeframes for this effort? How does UCUT propose to address this need?

The ISRP requires clarification of the third objective, "analysis of change in species composition, functional traits, and structure **for each Tribe**." One of the objectives of the regional monitoring plan should be for coordinated, standard methods of analysis of specific projects by all Tribes, instead of independent activities by each Tribe. Emphasis needs to be on coordination among Tribes.

In addition, the ISRP recommends two further objectives for the next cycle:

(4) Evaluate the M&E program against the adaptive management plans being developed for each project to ensure that the information needed to evaluate the biological objectives is being collected. Some co-ordination between the regional M&E plan and the individual project proponents will be needed.

(5) Establish the common database and management system as noted elsewhere in this document.

Additional ISRP Comments

The report on Spokane monitoring often reports the area, volume, and number of species (e.g. Table 11), but area is reported in m, volume in m^2. The appropriate units for area are m^2 and for volume are m^3.

The progress report uses species richness, Shannon species diversity, and species evenness as measures of community diversity. However, these measures have serious limitations. The proponents should refer to Jost: http://www.loujost.com/Statistics%20and%20Physics/Diversity%20and%20Similarity/EffectiveNumberOfSpecies.htm

> *"… suppose you are comparing the diversity of aquatic microorganisms before and after an oil spill. You wouldn't want to measure that diversity by species richness because even a massive toxic event is sure to leave a few vagrant individuals of each pre-spill species, and species richness doesn't distinguish between one individual of Species X or a million; the pre- and post-spill species counts might not be very different, even if the pre- and post-spill species frequencies are very different. So if you are a good traditional biologist you might use the popular Gini-Simpson diversity index, which is* $1 - \sum_i p_i^2$ *[where* p_i *is a measure of relative abundance for species i]. Suppose that the pre-spill Gini-Simpson index is .99 and the post-spill index is .97. If you are a good traditional*

biologist you would figure out that this drop is statistically significant, but you would conclude that the magnitude of the drop is small. You might even say (very wrongly) that the diversity has dropped by 2%, which sounds like a small drop, nothing to worry about.

The error which virtually all biologists make is that the Gini-Simpson index is not itself a diversity, and is highly nonlinear. The pre-spill community with a Gini-Simpson index of 0.99 has the same diversity as a community of 100 equally-common species. The post-spill community with a Gini-Simpson index of 0.97 has the same diversity as a community of 33 equally-common species. The difference between the pre-and post-spill diversities is in fact enormous. The drop in diversity is 66%, not 2%! This is not just a matter of different definitions of diversity, as some people would like to say. Rather, it is a matter of the indices being nonlinear with respect to our intuitive concept of diversity."

Leinster and Cobbold (2012) defined the diversity profile as series of "effective numbers" dependent on an index q (which ranges from 0 to infinity) and a similarity matrix **Z** (whose (i,j) entry measures the similarity of species i and species j from 0 (not similar) to 1 (completely similar)). The diversity profile is computed as: ${}^{q}D^{Z}(\mathbf{p}) = \left(\sum p_i (\mathbf{Z}\mathbf{p})_i^{q-1}\right)^{1/(1-q)}$ where the vector **p** is the relative abundance of the species present (i.e. excluding species with 0 abundance), and **Z** is the similarity matrix among the vector of species. As shown by Leinster and Cobbold (2012), many of the common diversity indices are special cases of (1). For example, if q=0, (1) reduces to species richness; if q=1 and **Z=I**, then (1) is related to the Shannon Index; and if q=2 and **Z=I**, then (1) is related to the Simpson Index of diversity.

The **Z** matrix (measure of similarity) resolves a number of problems with the common diversity measures. If two species are virtually identical (entries of **Z** close to 1), then the diversity measure (1) effectively treats them equivalently as a single species. The difficulty, is of course, defining this similarity matrix.

The diversity profile summarizes the diversity over a wide range of "scales" from emphasizing rare species (species richness, q=0) to common species (q growing large) and is much more interpretable than the measures used.

Citation:

Leinster, T. and Cobbold, C. A. 2012. Measuring diversity: the importance of species similarity. Ecology, 93, 477-489.

UCUT Response: APPENDIX 1.

Analytical approach

Our monitoring approach anticipates that ecological restoration will result in changes in the composition of biotic communities. This reflects the objective of ensuring that characteristic assemblages are restored on mitigation units. Moreover, it follows the general shift from monitoring strategies that focus on single species ("umbrella" species) or focal taxa to the biotic communities themselves (Su et al. 2004). Plant ecologists pioneered the development of indices to measure the similarity of species composition. Gauch (1982) provides a review and considers how changes in species composition of vegetation over space can be examined via multivariate techniques such as ordination. Recent interest has focused on development of improved estimators of community similarity (Chao et al. 2005). Estimators such as the Chao-Jaccard attempt to compensate for the difficulty of detecting all species and their relative abundances given limited sampling. These probabilistic models incorporate relative abundance and consideration of shared species that might not be detected during sampling for estimating compositional similarity. We note that there are other ways to characterize species composition (e.g., species diversity, evenness, and richness; see discussion in Magurran (2004)). Although such measures have some utility, they prevent direct comparisons of the communities. Moreover, one might demonstrate an increase in species richness, for example, but this might be due to an increase in non-native invasive species.

Chao, A., R. L. Chazdon, R. K. Colwell, and T.-J. Shen. 2005. A new statistical approach for assessing similarity of species composition with incidence and abundance data. Ecology Letters **8**:148-159.

Gauch, H. C., Jr. 1982. Multivariate analysis in community ecology. Cambridge University Press, Cambridge.

Magurran, A. E. 2004. Measuring Biological Diversity. Blackwell, Oxford.

Su, J. C., D. M. Debinski, M. E. Jakubauskas, and K. Kindscher. 2004. Beyond species richness: Community similarity as a measure of cross-taxon congruence for coarse-filter conservation. Conservation Biology **18**:167-173.

Table 1. Sampling plan for the UCUT Wildlife Monitoring and Evaluation Program (UWMEP). Year 1 is project onset in 2009. Reference sites in four habitat types (wetland meadow, riparian shrub, riparian forest, and emergent wetland) were sampled from 2002-2004 as part of the Albeni Falls Wildlife Mitigation Project and are not included above. During the second rotation additional sites were added on both STOI and CDA properties (3 and 5 sites, respectively). In 2017 it was not possible to conduct work on Colville Eastside lands, and so the design plan was modified to sample CDA Restoration sites in their place. CCT Eastside lands will resume next in the rotation. This new order will be maintained going forward.

Panel		Sampling Occasion																							Planned # of Sites
		09	10	11	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
1	Reference Sites	X	X	X													X							X			24
2	STOI Restoration Sites				X					X								X								X	11
3	CCT Eastside Restoration Sites					X							X							X					X		14
4	CDA Restoration Sites						X				X								X								14
5	KT Idaho & KTOI Restoration Sites						X							X							X						15
6	KT Washington Restoration Sites							X							X							X					14
7	CCT Westside Restoration Sites								X							X							X				12
Planned # of Sites Per 1 Year(s)		12	12	12	8	14	20	17	12	11	14	14	15	14	12	24	11	14	14	15	14	12	24	14	11	14	
																					Total # of Planned Sites						104