Response to ISRP

James G. Hallett and Margaret A. O'Connell, Eastern Washington University

200800700 - The UCUT Wildlife M&E Program (UWMEP)

Sponsor: Upper Columbia United Tribes
Province: Intermountain **Subbasin:** Columbia Upper
Budgets: FY10: $220,000 FY11: $220,000 FY12: $220,000
Short description: UWMEP is a five-nation cooperatively managed, habitat and wildlife monitoring program for evaluating the effects and outcomes of protection and restoration projects in and proximate to the reservations and aboriginal lands of the Member Tribes.
Recommendation: Response requested

Before responding to the ISRPs comments about this project, we wanted to clarify its relationship to other projects. Beginning in 2001, we assisted in the development of the Albeni Falls M&E plan and began full implementation of the plan in 2002 on properties of the Kalispel Tribe. All data collected between 2002 and 2006 for small mammals, birds, amphibians, and vegetation are being incorporated into the UWMEP database. These include reference site data for four habitats, as well as data for mitigation sites. These data are being used to assist us in developing a website (www.uwmepdata.org) for data query and dissemination. This website will be modified as necessary to make access to data and data products better tailored to those who use it. This work has required restructuring of the data tables both to accommodate the broader scope of the project and to make data queries more efficient. Microsoft SQL Server 2008 is the database engine.

At present, all UWMEP data is being maintained on servers at Eastern Washington University, and being mirrored at a commercial web host. Because we are responsible for data collection, this approach assures that all of our quality control measures are implemented before the data becomes available.

1. include the statistical information from the presentation in the proposal;

The summary of data in the proposal was meant to be indicative and not exhaustive. Because we have a manuscript close to completion, we would prefer not to revisit the proposal. All of the data, as well as a review copy of the manuscript, will be available at www.uwmepdata.org.

2. include a detailed list of criteria used for selection of reference sites;

Reference sites serve both to inform management decisions for mitigation lands and to provide a way to measure restoration success (Hobbs and Norton 1996, Ruiz-Jaen and Aide 2005). We have employed multiple criteria for selecting appropriate reference sites, which we consider in three broad categories. First, specific ecological characteristics of potential reference sites must be present. Second, the logistics of working at potential reference sites must be acceptable. Third, we have tried to establish sample sizes and sampling regimes for reference sites that account for intersite and interyear variability, but are realistic with respect to budgetary constraints.

With respect to the ecological characteristics of potential reference sites, we have identified the following criteria. (1) Reference sites should accurately represent each of the eight habitat types chosen for restoration activities: shrub-steppe, grassland steppe, conifer woodland, mixed conifer, riparian forest, riparian shrub, wetland meadow, and emergent wetland. We define accurate representation by both composition and structure of the vegetation. For composition, the species present on reference sites should include predominantly native species. The degree of structural complexity will be habitat specific. For example, forested reference sites should have a well-developed over- and understory with a diversity of ground cover species, whereas shrub-steppe reference sites should have a diversity of shrubs of different heights and a diversity ground cover species. We further define accurate representation to include that vegetation is well matched to land to be restored, and that key components specific to each habitat type (e.g., large trees in forests, cryptogam crust in shrub-steppe) are present. (2) Reference sites should support wildlife assemblages characteristic of the habitat (e.g., birds, mammals, amphibians). (3) When possible, selection of reference sites should take into consideration historical accounts of pre-settlement vegetation structure. (4) Natural processes should be factored into reference site selection; for example, fire return intervals in ponderosa pine forests (see also our response to question 3). (5) Reference sites, in so far as possible, should represent future conditions that are naturally sustained without constant management.

From the perspectives of both experimental design and logistics, reference sites should meet the following criteria. (1) To minimize edge effects, reference sites ideally should be in relatively large parcels of land (as opposed to a tiny "remnant" bordered by matrix of other habitats) with $\geq$ 500 m from any transition to a different habitat type and $\geq$ 50 m from any two-lane road. Note, however, that some habitats, such as riparian forest, never occur in large blocks. (2) To be accessible for field crews, reference sites should be <1.6 km (1 mile) from an access road and have $< 20^{o}$ slope.

The number of reference sites and sampling return rates represent a trade-off between sampling effort and feasibility. Following Ruiz-Jaen and Aide (2005), we have selected a minimum of two reference sites for each of the eight habitat types. Each site will be sampled for 3 consecutive years to determine interyear variation. Incorporating a sampling regime that accounts for such variability is important because mitigation sites will typically not be monitored simultaneously with their matched reference sites.

3. could reference sites include post-disturbance successional states (e.g. post fire)?

Certainly reference sites can, and in some cases do, include post-disturbance successional states. For example, this is particularly appropriate for conifer woodland, which is mostly second-growth in our region. Rather than trying to locate reference sites that have undergone natural disturbances, however, we have chosen areas that have been managed (e.g., by thinning) to mimic the corresponding stand structure. This approach better reflects how management activities will actually occur on the ground.

4. regarding the choice of indicator species, amphibians, mammals, and birds, will these same indicator species be used on dry upland sites?

The same indicator species, amphibians, small mammals, and birds, will be used on dry upland sites. Larval sampling of amphibians on upland sites will be conducted when areas of open water occur within 500-m of the sampling point (e.g. riparian areas, temporary vernal pools). In cases where no suitable sites exist for placement of larval traps, the other 2 taxa (birds and small mammals) will be used as the primary indicators for changes in animal species composition.

The absence of amphibian data in upland areas does not pose a problem for scientific analysis of change in species composition with restoration activities. Ruiz-Jaen and Aide (2005) recommend at least two variables of "diversity" should be used to measure a particular site (based on Society of Ecological Restoration International guidelines [SER 2004]), and in every case we have at least three or four. Amphibians, which generally are associated with more mesic places, will be more highly valued as an indicator in the wetter habitat-types (e.g. emergent wetland, riparian shrub, riparian forest, wet meadow). As such they will take on a lesser role at upland sites.

5. give more details of how the data will be analyzed, including an expansion of how the species metric will be analyzed with an example data summary; the test statistics suggested for analyzing response of the metric; and the statistical power and probability levels they anticipate using;

Data analysis for multi-species communities generally cannot be conducted with ANOVA or MANOVA approaches because the number of sampling sites required would be far too great. Other metrics, such as species richness or species diversity, can be analyzed with ANOVA, but discard important information about species composition. Consequently, our initial efforts to explore the Kalispel data began with ordination techniques (e.g., Bray-Curtis). Application of such techniques led to consideration of the underlying distance or similarity measure. Difficulties with incidence-based (i.e., presence/absence) measures of similarity (e.g., Jaccard) quickly become apparent for data sets such as ours because of the large numbers of infrequently observed species. These methods consistently underestimate actual similarity and are being replaced by probabilistic measures that use information on relative abundance to estimate unseen species (Chao et al. 2005).

At present, probabilistic measures of similarity appear to be the most cost-effective means of assessing change in community composition. The next issue is how one examines the patterns of similarity. We have not yet completed an exhaustive examination of the approaches for doing this, but we sketch one here that we believe has merit. Good (1982) presented a permutation approach for examining clusters in a similarity matrix. Smith et al. (1990) demonstrate how Good's approach provides an analog to ANOVA in environmental management. The test statistic, a measure of separation, is $L = \bar{B}/\bar{W}$, where $\bar{B}$ is the mean between group similarity and $\bar{W}$ is the mean within group similarity. Suppose we have three samples from each of two treatments (see Table 1 for example data taken from Smith et al. 1990). For any given similarity table, the total similarity (T) is a fixed number. Say we create a new matrix by swapping one or more values between groups. If there is no difference between groups, we would expect little change in the value of L. If there are substantial differences between groups, the permuted value of L should show a large change. By calculating all permutations, we create a sampling distribution with which we can test *L* from the original matrix. If *L* is more extreme than 90% of the permuted values we would conclude that that restoration is not yet complete.

We have not fully assessed the appropriate number of mitigation sites to be sampled, particularly for habitats added to the M&E program. We plan to do some preliminary sampling during the next two field seasons to get a better handle on this.

Table 1. Hypothetical data from three replicate sites for two treatments (possibly sites above and below a source of pollution) and five species. Similarity matrix using cosine measure. Triangles contain within similarities while rectangle contains the between similarities. All possible similarity estimates for all possible permutations of the data are presented below the similarities

Treatment	Rep.	Sp1	Sp2	Sp3	Sp4	Sp5
1	1	10	5	8	2	1
1	2	12	2	9	5	0
1	3	18	9	4	1	2
2	4	5	7	9	15	5
2	5	3	4	6	12	9
2	6	4	8	2	16	8

Estimated similarities

Rep.	1	2	3	4	5	6
1	1.00	0.955	0.908	0.685	0.556	0.486
2		1.00	0.836	0.717	0.586	0.506
3			1.00	0.515	0.413	0.444
4				1.00	0.946	0.925
5					1.00	0.941
6						1.00

Permutations

Permutation	Trmt 1	Trmt 2	Total	Within	Between
1	1, 2, 3	4, 5, 6	10.42	5.51	4.91
2	1, 2, 4	3, 5, 6	10.42	4.15	6.27
3	1, 2, 5	4, 3, 6	10.42	3.98	6.44
4	1, 4, 3	4, 5, 3	10.42	3.82	6.60
5	1, 4, 3	2, 5, 6	10.42	4.14	6.28
6	1, 5, 3	4, 2, 6	10.42	4.02	6.40
7	1, 6, 3	4, 5, 2	10.42	4.08	6.34
8	4, 2, 3	1, 5, 6	10.42	4.05	6.37
9	5, 2, 3	4, 1, 6	10.42	3.93	6.49
10	6, 2, 3	4, 5, 1	10.42	3.97	6.45
11	4, 5, 1	6, 2, 3	10.42	3.97	6.45
12	1, 4, 6	2, 3, 6	10.42	3.93	6.49
13	1, 5, 6	4, 2, 3	10.42	4.05	6.37
14	4, 2, 5	1, 5, 3	10.42	4.08	6.34
15	4, 2, 6	5, 1, 3	10.42	4.02	6.40
16	5, 2, 6	4, 1, 3	10.42	4.14	6.28
17	4, 5, 3	1, 2, 6	10.42	3.82	6.60
18	4, 6, 3	1, 5, 2	10.42	3.98	6.44
19	6, 5, 3	4, 1, 2	10.42	4.15	6.27
20	4, 5, 6	1, 2, 3	10.42	5.51	4.91

6. what is the rationale for sampling reference sites for 3 years at the beginning but not revisiting these sites? Or will reference and mitigation sites be sampled simultaneously? A timeline (e.g. 20 years) might help reviewers interpret the sampling strategy;

The reference represents a desired future condition for mitigation areas where restoration activities will be undertaken. The reference does two things: (1) it provides a model for managers conducting restoration projects and (2) it gives a benchmark for evaluating the success of these projects. We have attempted to locate reference areas that are the best examples of intact habitats. Clearly we also must characterize both the spatial and temporal variability in species composition at each reference location. To do this, we have sought two spatially-independent locations for each habitat reference, and we resample each reference for 3 years. By sampling for 3 years we hope to capture the interannual temporal variation inherent in nature (White and Walker 1997). This dataset provides an independent benchmark for interpreting the success or failure of restoration at mitigation sites as they are monitored in future years on a 5-year rotation.

The structure and composition of the flora and fauna on the reference sites may certainly change over time. But such changes can be caused by a variety of factors including catastrophic events, changes in adjacent land use, and changes in management practices. Although these changes may be interesting, they are not informative in assessing the success of restoration activities. Additionally, because some reference sites are located on lands managed by entities other than the Tribes, future access to these sites is not guaranteed. Consequently, for our purposes, after the initial 3-year sampling period, data collection at the reference sites will be considered complete. Future resampling of reference sites may be useful for addressing other questions, but it is unnecessary for this project and thus outside of its scope of work.

The following is a general sampling strategy for the first 20 years of this project:
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2009 - Year 1 - Reference Sites (also: data for determining sample sizes for shrub-steppe)
2010 - Year 2 – Reference Sites (also: data for determining sample sizes for steppe)
2011 - Year 3 – Reference Sites
2012 - Year 4 - Mitigation Group 1 (Spokane, E Colville)
2013 - Year 5 - Mitigation Group 2 (W Colville)
2014 - Year 6 - Mitigation Group 3 (Coeur d'Alene)
2015 - Year 7 - Mitigation Group 4 (Kalispel WA)
2016 - Year 8 - Mitigation Group 5 (Kalispel ID, Kootenai)
2017 - Year 9 - Resample Mitigation Group 1
2018 - Year 10 - Resample Mitigation Group 2
2019 - Year 11 - Resample Mitigation Group 3
2020 - Year 12 - Resample Mitigation Group 4
2021 - Year 13 - Resample Mitigation Group 5
2022 - Year 14 - Resample Mitigation Group 1
2023 - Year 15 - Resample Mitigation Group 2
2024 - Year 16 - Resample Mitigation Group 3
2025 - Year 17 - Resample Mitigation Group 4
2026 - Year 18 - Resample Mitigation Group 5
2027 - Year 19 - Resample Mitigation Group 1
2028 - Year 20 - Resample Mitigation Group 2

7. the scale and duration of the project present obstacles for sampling.

Yes. We completely agree! And that is why we have invested a considerable amount of time in our initial efforts to develop a monitoring plan. We began by visiting the mitigation areas of all five Tribes, obtaining and developing GIS products for these lands, and working with Tribal managers to prioritize the mitigation lands to be sampled. We will continue this work in 2009 and 2010 by conducting preliminary vegetation sampling on shrub-steppe and steppe habitats to get a better handle on both logistics and sampling requirements. Although developing a sampling scheme is difficult because of the spatial scale of the project and budget limitations, we think that by revisiting mitigation sites at 5-year intervals and by judicious selection of sampling sites, we can create a workable plan.

Unfortunately, habitat restoration rarely proceeds quickly. We hope that a lack of commitment to long-term monitoring efforts in the past is not prelude to the future. Conservation efforts have not been well served by short-term thinking.

Literature cited

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