

EVALUATION OF A MITIGATION SITE: AMPHIBIAN POPULATION DYNAMICS

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Problem Statement:

Activities designed to mitigate the impacts on U.S. waters from road construction and other activities associated with such large-scale projects are required by federal and state laws (e.g., U.S. Corps of Engineers, compensatory regulations section 404B-1 guidelines). Early wetland mitigation efforts were often unsuccessful, but stricter requirements and increased knowledge about wetland function have increased the success of such projects. The aggregate pit associated with the re-construction of the road between Moran Junction and Dubois (Wyoming highway 26/287) is located at the U.S. Forest Service Blackrock Ranger Station work compound (Blackrock) on the south side of the Buffalo Fork River in Teton County, WY. The phase I wetland mitigation site excavated near the aggregate pit was designed to provide woody riparian scrub-shrub wetland as mitigation for area lost in the same watershed due to road construction. The wetland mitigation site was constructed in 2007 and vegetated in 2008.

Wetlands harbor a variety of wildlife from large ungulates to amphibians the size of a quarter. Amphibian decline is a problem of global importance, with over 40% of species considered at risk (Stuart et al. 2004). This phenomenon is not limited to the tropics or to other countries. Amphibian species in Wyoming are also declining, contributing to the larger, global phenomenon. For example, the Wyoming toad has been extirpated in the wild and the boreal toad is a species of special concern (Lewis 2011). Habitat destruction and disease are two examples of perturbations contributing to amphibian decline (Collins and Crump 2009).

Four species of amphibians native to Wyoming, including the boreal toad, reside on the Blackrock compound. Our research indicates that the toad population at Blackrock is declining at 5-6% per year and that disease due to the amphibian chytrid fungus is contributing to this decline (Muths et al. 2008, Pilliod et al. 2010, Murphy et al. 2009, 2011). This fungal disease is not particular to Wyoming but is having devastating effects on amphibian populations worldwide (Lips et al. 2006, Skerratt et al. 2007, Muths et al. 2003).

As of 2011, all 4 native amphibian species were observed at the wetland mitigation site at Blackrock and 3 of them, including the boreal toad, were breeding (evidenced by breeding behavior, eggs or tadpoles). These observations suggest that the wetland mitigation site provides at least adequate, if not preferred, habitat for these species. In addition, the wetland mitigation site displays characteristics that are typically “good” for amphibians, permanent water, aquatic vegetation, and adequate shallows. We suspect that insect abundance and hibernation sites are adequate and conducive to the presence of amphibians, but these attributes are unquantified at Blackrock. The traditional breeding site for these amphibians has been an oxbow of the Buffalo Fork River. In the spring of 2011, the dams separating the oxbow from the river were breached by late and heavy spring run-off, most likely destroying amphibian reproductive efforts for that year and possibly altering the oxbow so that breeding is unlikely this year. Because of this event, the habitat provided by the mitigation site may be even more important to the amphibian populations at Blackrock, by providing appropriate, nearby breeding habitat. **The mitigation site and the surrounding wetland landscape provide an excellent natural laboratory to quantify mitigation efforts at Blackrock.** Although long-term efforts are necessary to quantify the ultimate success of the wetland mitigation site, our research over the last 9 years puts us in the unique position of being able to provide quantitative data about the mitigation site in a relatively short time. This project builds on that capability by examining mitigation sites in contrast to reference sites to draw conclusions about the efficacy of the Blackrock wetland mitigation site within the context of the surrounding landscape. In a larger context, understanding use of habitat

by amphibians and their abilities to use mitigation sites is likely to be critical to conservation as climate change impacts amphibian habitat, especially wetlands. The Blackrock site is poised to contribute to these efforts (Corn et al. 2011a).

Research Objectives:

We propose to quantify the success of the phase I mitigation site by: 1) estimating population parameters (e.g., survival) of two amphibian species; 2) surveying invertebrate fauna; and 3) assessing site characteristics relative to amphibian success (e.g., depth and percent shallows over time), and comparing results between the phase 1 wetland mitigation site, the nearby swan pond and 2 reference sites. Results will inform the construction of phases 2 and 3 of the wetland mitigation site at Blackrock. **More broadly, results will provide information for future mitigation efforts in this and similar types of habitat and provide evidence of successful wetland mitigation efforts.**

(1) Approach: Data collection will be tiered. A) We will conduct intensive monitoring at 4 focal sites including determining demographic characteristics and disease status for two species of amphibians, surveys of invertebrate fauna, and intensive site characterization; B) As time and funding permit, we will assess amphibian occupancy across the landscape around the mitigation site (as evidenced by the presence of breeding amphibians, eggs or larvae) and characterize habitat at occupied sites. This effort will assist in determining the importance of the wetland mitigation site at a broader landscape scale. For example, understanding the degree of isolation of this population of toads will help to determine its importance as a breeding site and thus the importance of the mitigation site in providing habitat to a species of concern.

Amphibian population characteristics: We have capture-recapture data on boreal toads from the nearby oxbow since 2003 and data from the wetland mitigation site on toads and boreal chorus frogs since 2010. One additional year (2012) will allow preliminary estimates of survival and recruitment at the wetland mitigation site. We will also initiate capture-recapture work for these 2 species and tiger salamanders at 2 additional sites. Capture-recapture efforts provide data necessary for modeling exercises that estimate a number of demographic parameters including survival, recruitment of new individuals to the population and population size (Burnham and Anderson 2002). Capture-recapture methodology involves capturing animals, giving them a unique mark (the mark depends on the species, all methods used have been approved by the appropriate animal care committees at USGS) and then using program MARK (White and Burnham 1999) to assess the data. We have experience with these statistical methods and program MARK (e.g., Muths et al. 2010, Muths et al. 2011, Muths and Scherer 2011). Automated call recording units (ARU, a technology we have also used, e.g., Corn et al. 2011b) will be located at 4 sites to record amphibian breeding choruses (chorus frogs, spotted frogs). These data will indicate when amphibians are breeding at the instrumented sites which will help us characterize differences and similarities between mitigation and reference sites. These recordings will also capture bird call data that will add to our understanding of the sites (e.g., warblers typically indicate quality wetlands).

Landscape occupancy: As time and funding allow we will use visual encounter survey methods (Heyer et al. 1994, Muths et al. 2005) and multiple site visits to determine occupancy of

amphibians at water bodies in the vicinity of the mitigation site. These methods incorporate detection probability which allows a better estimate of occupancy than presence/absence surveys that do not account for detection probability (e.g., Mackenzie et al. 2003). Analysis of the occupancy data will use program PRESENCE (www.mbr-pwrc.usgs.gov/software.html).

Disease: The amphibian chytrid fungus (*Batrachochytrium dendrobatidis*, Bd) is a concern, especially for boreal toads. We will non-destructively sample for Bd in conjunction with the capture-recapture work. Amphibian skin is swabbed and the swab is preserved in ethanol and sent to a laboratory (Washington State University, where our previous samples from Blackrock have been tested) where swabs are tested using molecular methods (PCR, polymerase chain reaction) for the presence of DNA from the amphibian chytrid fungus. Limited disease testing is currently funded, but additional testing will allow us to explore host-pathogen relationships among the fungus, a susceptible species (the toad), and a species that is a putative carrier of the disease, but not significantly impacted by it (the chorus frog). As time and funding allow, additional samples and species can be tested and water bodies can also be tested for the presence of the fungus, shedding more light on prevalence of this disease at the Blackrock site.

Other organisms: We will describe the community structure of wetland invertebrates which can be a key indicator of wetland health (e.g., Wray and Bayley 2006, Sharma and Rawat 2008). We will sample 6 sites (including the wetland mitigation site, the oxbow and the swan pond) once in the spring and once later in the summer, in multiple years. We will use sweep nets to collect invertebrates, preserve them in ethanol and then identify them to family and some to species (sensu Hossack et al. 2010). Characterization of the invertebrate community may include additional sites in the vicinity as time and funding allow.

Physical site characteristics: Basic site characteristics, including percent of shallows present, water depth, percent of emergent vegetation, and availability of potential hibernacula for toads, will be tracked throughout the season. These efforts will be focused on the 6 sample sites, but may include additional sites in the vicinity as time and funding allow. Methods will follow Heyer et al. (1994) and Muths et al. (2005).

(2) Involvement from the Wyoming Department of Transportation: This project requires minimal involvement from the Department. We would need access to the wetland mitigation site. It would be helpful to continue discussions concerning the original plans and engineering details of the wetland mitigation site construction and seeding plans. It would be useful to have access to any water quality data that have already been acquired. We would anticipate that personnel from the Department will be engaged in our discussions about the site and be available to answer questions that might come up during the research.

(3) Anticipated budgetary needs and time duration: To determine the long-term efficacy of a mitigation project, long-term data are necessary to evaluate it. We propose WYDOT funding for 3 years starting in 2012, to be matched by USGS. While three years is enough time to accumulate the minimum amount of data needed estimate important demographic parameters such as survival, confidence intervals are likely to be wide. An additional three years would allow further data collection and greater confidence in the results. WYDOT funding for these first three years will support a 2-person field crew for about 2 months each year; allow increased

testing for Bd, and analysis of invertebrate data. USGS will provide investigator salary support, some vehicle costs, and some disease testing. Involvement by the Northern Rockies Conservation Cooperative will significantly lessen overhead costs.

Study Benefits:

Wetland mitigation efforts are applied to a landscape with the aim of being permanent or at least persisting for a reasonable number of years. The Blackrock project proposed here is invaluable because it already has a jump start on data collection and can provide a quantitative evaluation of amphibian use of the wetland mitigation site relatively soon. Mitigation is a required activity. Proof of successful mitigation efforts, including quantification of wildlife population success and specific characteristics of wetland habitats, is useful documentation and can be applied to streamline design decisions for future wetland mitigation projects. Specifically, The Army Corps of Engineers has special conditions requiring shrub wetland creation, a habitat type which is often difficult to establish (B. Bonds, pers. comm.). An important aspect of this project is that it is likely to provide evidence that more open, less shrubby wetlands are also critical wildlife habitat such that this type of wetland and construction can be substituted for shrub wetlands with the same positive results for wildlife. **Wetland mitigation with this type of wetland as an endpoint rather than the typical shrubby endpoint could make wetland mitigation simpler and construction more successful. Furthermore, required monitoring could be concluded sooner, saving considerable costs.** The Blackrock project is an excellent opportunity for collaboration among the Wyoming Department of Transportation, the U.S. Forest Service and the U.S. Geological Survey. The data gathered will be used not only to inform and support mitigation efforts, but also to inform management decisions about amphibians on the Bridger-Teton National Forest and specifically at Blackrock. This project provides excellent opportunities for public outreach and education.

Work Plan and Scope:

Much of the planning and hiring have been accomplished for this field season, because work was anticipated for this season, simply at a lower level of intensity because of limited funding. If this project is funded by WYDOT, we will be able to increase the level of work in the field this year and continue with the project in subsequent years. We plan to be at the site this spring (exact dates depend on snowmelt and temperatures, but likely in late May). We will initiate the work described above in the approach.

Work Schedule:

Each year:

--May – July - Field work (capture/recapture, invertebrate sampling, landscape occupancy, visual encounter surveys, ARUs).

--August – February – data quality assurance, analysis, writing.

Cost Estimate:

~~\$86,562.00~~~~\$150,000~~. Please see Budget (below).

Implementation Process:

Our work underscores the importance of understanding the role of amphibians in this type of wetland and their habitat-specific needs. This information will provide another tool for the mitigation toolbox, perhaps expanding alternatives for wetland mitigation activities. This project will determine the suitability of the wetland mitigation site for amphibians as it currently presents itself (“a lower functioning wetland”). Typically “higher functioning wetlands” include mature willows of a particular density and size, but such characteristics may not be appropriate for amphibians. Given the plight of amphibians at a global, national and regional scale, a “lower functioning wetland” that is providing preferred habitat to species of concern may be a preferable goal for mitigation. Amphibians are generally present at wetland sites; they eat a variety of invertebrates and may be prey items for birds, snakes, some invertebrates and occasionally mammals. Thus, they are important components of wetland sites and contribute to a healthy wetland ecosystem. The information that we provide from this research may have substantial impact as WYDOT defines alternative actions or alternative endpoints that could be implemented during subsequent mitigation, potentially saving time and costs.

Urgency:

This research should be implemented this spring. The wetland mitigation effort (phases 2 and 3) at Blackrock are immediately pending and such efforts may impact amphibian populations residing at the wetland mitigation site. The likelihood of impact increased significantly with the destruction of the levees between the oxbow and the Buffalo Fork River last spring and the likely destruction of breeding efforts by boreal toads and other species that have bred in the oxbow for at least the last 15 years. We know that toads move between the oxbow and the wetland mitigation site and we know that toads breed at both sites. We suspect that many more toads will breed at the wetland mitigation site this spring because of the levee breach and subsequent flow of cold water into the oxbow. Because we are currently working at the Blackrock site, implementation of the additional research described will be seamless. Our budget allows us matching dollars and we are committed to the scientific results and integrity of the project.

Technology Transfer:

We plan to provide updates to WYDOT through presentations at the Wyoming Department of Transportation and Wyoming Contractor’s Association Training Conferences, or other venues such as meetings with the Forest Service. We will also present results at least 3 professional meetings and will publish at least two peer-reviewed papers over the course of the project. In addition to WYDOT, other agencies may find our results useful including the US Forest Service, the National Park Service and various state agencies involved with amphibian conservation such as the Wyoming Game and Fish and the Colorado Boreal Toad Recovery Team.

Staffing:

- Technicians will be competitively hired each year.
- Please see the CVs of each of the collaborating scientists (submitted with pre-proposal).
- Jason Wilmot, The Northern Rockies Conservation Cooperative will be administrating the funding, hiring and purchasing with direction from the collaborating scientists.

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PROJECT TITLE: Evaluation of a mitigation site: Amphibian population dynamics

AGENCY: U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Ave. Bldg. C, Fort Collins, CO 805256, in collaboration with Northern Rockies Science Center, Missoula, MT and Forest and Rangeland Ecosystem Science Center, Snake River Field Station, Boise, ID

P.I.: Erin Muths

BUDGET PERIOD: 1 May 2012 – 1 May 2014

Research Agency: Northern Rockies Conservation Cooperative, Jason Wilmot, 185 Center St., P.O. Box 2705, Jackson, WY 83001, 307-733-6856, FAX: 307-733-6574, nrcc@nrccooperative.org

CONTRACT PERIOD: 3 years

BUDGET:

	Funds Requested
	WYDOT
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A. Personnel	
Early/late season technician (6 wks of work)	\$1,000.00
2 technicians 4 – 12 weeks	\$46,512.00
Invertebrate identification	\$4,500.00
Disease sampling	\$2,500.00
B. Equipment	
Field computer	\$1,500.00
Automated recording units	\$3,000.00
Vehicle for technicians	\$6,750.00
Waders/ misc. field equipment (e.g., nets)	\$1,000.00
Marking supplies	\$2000.00
C. Technology Transfer	
Travel to site (Muths, Corn, Pilliod, Hossack)	\$8,000.00
Accommodation for technicians (trailer)	\$3,200.00
Travel to meetings/ presentations to WYDOT	\$1,500.00
TOTAL	\$81,461.00
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D. Overhead (6%)	\$5,100.00
GRAND TOTAL (=total WYDOT cost)	\$86,562.00