STUDY PLAN FOR WETLAND ECOLOGY TASK NUMBER 1.7

EFFECTS OF CONSERVATION PROGRAMS ON AMPHIBIANS IN SEASONAL WETLANDS OF THE PRAIRIE POTHOLE REGION'S GLACIATED PLAIN

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BACKGOUND AND JUSTIFICATION:

Human perturbations have altered the health and sustainability of modern ecosystems. In the Prairie Pothole Region (PPR) of North America, an area of considerable value to wildlife and agriculture (Euliss et al. 1999), the primary human perturbation has been land development to facilitate agriculture production. In response to concerns regarding the fate of fish and wildlife habitat and various ecosystem functions (e.g. water quality, sediment and chemical filtration, erosion, nutrient transport, floodwater retention, ground-water recharge, and biological diversity), private and governmental entities have implemented numerous conservation programs to restore basic ecosystem services within the modern agricultural landscape. Although evaluations of these programs to verify and quantify environmental services and benefits are lacking, recent reporting requirements established by the federal government have stimulated

interest in developing monitoring and evaluation protocols for land-use practices implemented under various federal conservation programs.

The United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) and Farm Service Agency (FSA), and the Department of Interior's (DOI) United States Geological Survey (USGS) and Fish and Wildlife Service (FWS) have recently responded to reporting requirements of the Office of Management and Budget (OMB) to quantify the environmental changes attributable to USDA and DOI programs such as the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), and Partners for Fish and Wildlife Program (PFWP). In November, 2004, representatives from USDA and DOI met at the national FWS office in Arlington, Virginia to enter into an interagency partnership for the purpose of developing an approach to quantify a broad suite of ecosystem service responses to land-use change due to USDA and DOI programs. The Memorandum of Understanding being developed for this work will facilitate exploring a process-based (largely abiotic) modeling approach to quantify the change in a broad suite of ecosystem services (e.g. biodiversity, carbon sequestration, sediment reduction, and water quality improvement). The goal is to communicate the effectiveness of conservation programs to the broad interests of the American public and provide the scientific information necessary to guide policy development.

A pilot effort to develop and assess the efficacy of such a model will be initiated in the PPR of the United States. Extending from northern North Dakota to north-central Iowa, the PPR (Figure 1) was created by Pleistocene glaciation and includes several geologic formations, including the Missouri and Prairie Coteaus, the Glaciated Plains,

and the Red River Valley of the North (Figure 1). The Glaciated Plains is an area of minimal topographic relief that contains an abundance of diverse wetland types interspersed mostly within a modern agricultural landscape. Characterized by a dynamic climate, the PPR undergoes periods of abundant rainfall followed by extensive droughts. Often these wet/dry cycles persist for 10 to 20 years (Duvick and Blasing 1981; Karl and Koscielny 1982; Karl and Riebsame 1984; Diaz 1983, 1986).

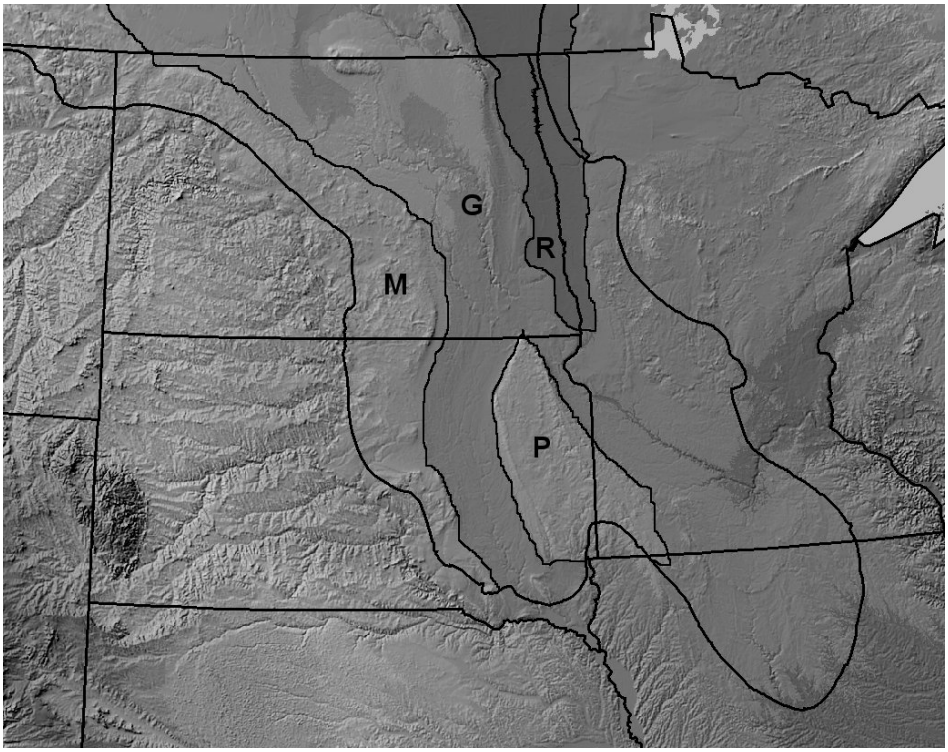

Figure 1. The PPR of the United States: (M) Missouri Coteau, (G) Glaciated Plains, (R) Red River Valley, and (P) Prairie Coteau.

In addition to localized temporal climatic variation, the PPR also exhibits a spatial gradient that is characterized by colder temperatures in the north than in the south and less precipitation in the west than in the east. Collectively, these temporal and spatial variations influence amphibian diversity throughout the PPR. For example, northern

North Dakota hosts nine species of amphibians whereas northern Iowa hosts 15 (Table 1, ARMI 2005). Parallel to the PPR's biological gradient is an agricultural land-use gradient consisting of small grain, dry land farming in the north that gradually transitions into a more diverse crop base in the more temperate climate of the south.

Historically, the Glaciated Plains supported a rich flora and fauna and was the most important area in North America for waterfowl production. However, the rich soils that originally supported native flora also have proven a boon to agricultural production. Consequently, the current landscape consists of myriad land uses varying from relatively pristine sites to areas converted to high production agriculture Anthropogenic disturbances associated with these changes include hydrologic alteration (e.g. drained wetlands), addition of agricultural chemicals (e.g. pesticides, herbicides, and fertilizers), and use of conventional tillage practices. Concerns over the loss of valuable natural habitat and the long-term sustainability of agricultural production in the area have led to the implementation of various programs to facilitate land-use changes designed to improve the overall ecological health of the area and promote sustainable agriculture.

Land-use changes that destroy or degrade critical habitat have been linked to amphibian population declines in the southern (Gray et al. 2004) and northern (Larson et al. 1998, Lannoo et al. 1994, Lannoo 1998, Knutson et al. 1999) Great Plains. Destruction (e.g. wetland drainage) includes the direct loss of habitats important for reproduction, migration, dispersal, and other biological events, whereas degradation includes excessive sedimentation, the transport of agricultural chemicals to wetlands, and loss of structural cover important to reduce amphibian exposure to sunlight, associated desiccation rates, and predation.

Table 1. Amphibian species potentially present at sites near Devils Lake, ND; Morris, MN; and Spirit Lake, IA.

Species	Devils Lake, ND	Morris, MN	Spirit Lake, IA
Northern Cricket Frog *Acris crepitans*	NO	NO	YES
American Toad *Bufo americanus*	YES	YES	YES
Great Plains Toad *Bufo cognatus*	YES	YES	YES
Canadian Toad *Bufo hemiophrys*	YES	YES	NO
Woodhouse's Toad *Bufo woodhousii*	YES	NO	YES
Copes Gray Treefrog *Hyla chrysoscelis*	NO	YES	YES
Eastern Gray Treefrog *Hyla versicolor*	NO	NO	YES
Spring Peeper *Pseudacris crucifer*	NO	YES	YES
Boreal Chorus Frog *Pseudacris maculata*	YES	YES	YES
Western Chorus Frog *Pseudacris triseriata*	NO	YES	YES
Plains Leopard Frog *Rana blairi*	NO	NO	YES
American Bullfrog *Rana catesbeiana*	NO	NO	YES
Green Frog *Rana clamitans*	NO	NO	YES
Pickeral Frog *Rana palustris*	NO	NO	YES
Northern Leopard Frog *Rana pipiens*	YES	YES	YES
Wood Frog *Rana sylvatica*	YES	YES	NO
Plains Spadefoot *Spea bombofrons*	YES	NO	NO
Blus-spotted Salamander *Ambystoma laterale*	NO	YES	NO
Tiger Salamander *Ambystoma tigrinum*	YES	YES	YES

To better understand the nature of these influences on amphibians, we have partnered with NRCS and FSA to explore potential methods of assessing the impacts of conservation programs on amphibian communities in the PPR. Our objective is to begin characterizing the amphibian communities that use seasonal wetlands in the Glaciated Plains of the PPR that are influenced by federal conservation programs. This research will evaluate amphibian communities along a land-use disturbance gradient (native grassland/wetland, restored grassland/wetland from conservation programs, and intensive agricultural production areas) and along the natural climate/biological gradient of the PPR to provide an initial assessment regarding the impact of conservation programs on amphibians of the Glaciated Plains. This two-year effort will provide baseline information necessary to evaluate a methodology that can be applied at a regional scale to evaluate amphibian communities in relation to land-use change and climate driven ecological processes. These data eventually will be used in the broader DOI-USDA partnership to quantify and assess the impacts of conservation programs on ecological services.

OBJECTIVES:

1. Determine amphibian species composition of farmed, conservation program, and natural seasonal wetlands from sampling points near Devils Lake, ND; Morris, MN; and Spirit Lake, IA.
2. Compare amphibian communities of farmed, conservation program, and natural seasonal wetlands using multivariate statistical techniques.

3. Develop logistic regression models that identify best fitting and most parsimonious models describing relationships between amphibian species presence/absence and explanatory environmental variables.

STUDY AREA:

This study will be conducted in cooperation with a larger study being conducted by Northern Prairie Wildlife Research Center (Euliss et al. 2005) to quantify the effects of conservation practices on various ecosystem services provided by seasonal and semipermanent wetlands in the PPR. To account for inherent variation in temperature, precipitation, biological diversity, and land-use in the PPR, the following three study areas have been selected because of their spatial distribution across the glaciated plains of the PPR (Figure 2): north central North Dakota near Devils Lake, west central Minnesota near Morris, and north western Iowa near Spirit Lake. At each study area, we will sample the amphibian communities of four seasonal wetlands across three land-use categories (farmed, conservation program, and native prairie) selected by the larger effort. Four additional seasonal wetlands will be sampled at the Spirit Lake, IA study area to provide representation of the area's large number of newly restored wetlands in the USDA's Wetlands Reserve Program. Thus, a total of 40 seasonal wetlands will be sampled (12 in ND, 12 in MN, and 16 in IA). Seasonal wetlands were targeted for study because of their tendency to be the most anthropogenically affected wetland type due to agricultural perturbations and this type is the most commonly recruited into federal conservation programs. Environmental and landscape data collected from the larger effort (Table 2)

will be used as explanatory variables to interpret any differences we observe in amphibian communities.

Table 2. Environmental and landscape variables being collected by Northern Prairie Wildlife Research Center (Euliss et al. 2005).

Environmental Data	**Local weather, Rain Gauge, Water pH, Water Conductivity, Water Temperatures, Water Levels**
Ground Water	**Ground Water Inputs, Dissolved Gases, Chemistry, Water Table Depth**
Soil Chemistry	**Total: Nitrogen, Phosphorous, Organic Carbon, and Inorganic Carbon**
Green House Gases	**Methane, Nitrous Oxide, and Carbon Dioxide**
Soil	**Sedimentation Rates, Profile, Moisture**
Vegetation Survey	**Identification, Species Richness**
Total Station Survey	**Wetland Area, Catchment Area, Slope, Distance to neighboring wetlands**

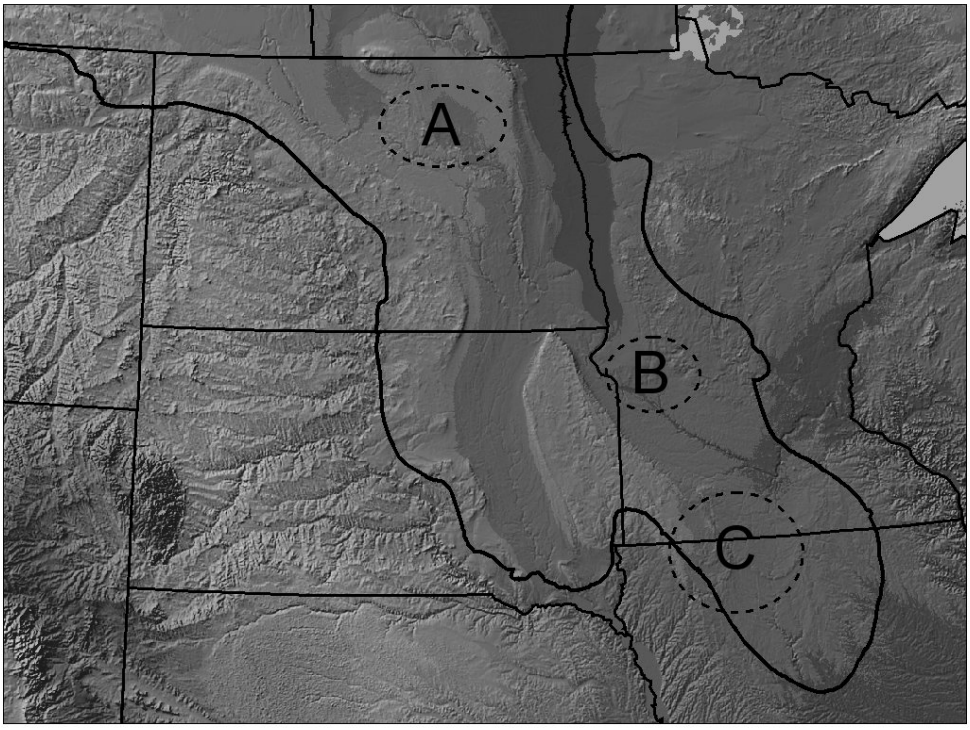

Figure 2. Areas of wetland site selection in the PPR of the United States (outlined in black). (A) Devils Lake, ND, (B) Morris, MN, and (C) Spirit Lake, IA.

PROCEDURES

Amphibian Sampling:

Active breeding and developmental times differ by amphibian species. To account for all species in each area, we will begin sampling the second week in May and continue through the end of September. Since amphibian sampling methods vary in their ability to effectively sample different species, a variety of methods and techniques will be employed to determine amphibian species composition in each wetland as completely as possible. While some abundance data will be associated with individual sampling methodologies, we will be pooling information from all sampling methods to determine species presence/absence for each study wetland.

Call Surveys:

We will erect automated recording stations to record frog and toad calls at each wetland (Bowers 1998, Heyer et al. 1994) bimonthly (i.e. the second and fourth week of each month). Each recording session will last for an 8-hour period beginning at 2230 and ending at 0430 and stations will be programmed to record calls for five minutes every two hours. Automated recording stations will be utilized until the last week of July when most vocalizations and breeding efforts have ceased (Oldfield et al. 1994).

Trapping:

Active trapping using amphibian funnel traps (Mushet et al. 1997) will begin the second week of May and will continue bimonthly through the fourth week of August. Three trapping locations will be selected within each wetland along transects radiating from the

wetland center. Transects will be located along compass bearings 0, 120, and 240 degrees and traps will be placed equidistant between the wetland center and the wetland edge (wet meadow zone). A bimonthly trapping period per wetland will consist of the simultaneous setting of three traps, one at each transect location, with a trapping period lasting for a 24-hour period. A total of eight trapping periods per wetland for each field season will be realized. Captured amphibians will be identified to species, developmental stage, sex (when possible), and number of individuals prior to release.

Visual Encounter Surveys:

Visual Encounter Surveys (Heyer et al. 1994) will be conducted bimonthly for each wetland from May through September. During each survey, the observer will walk the perimeter of the wetland and freely explore all habitats within the wetland basin taking care to minimize disturbance of the habitat. The observer will identify to species and tally all adult amphibians encountered. In contrast, larval amphibians will be identified to species (when possible) and abundance will be estimated based on the following abundance index criteria: a value of 1 will be assigned to small cohorts of amphibian larvae estimated at 1 to 25 individuals, a value of 2 will be assigned to cohorts estimated at 26 to 100 individuals, and a value of 3 will be assigned to cohorts >100 individuals. Species, number or index value, and habitat type being utilized by adults and larvae will be recorded on data sheets in the field. If any unknown larvae are observed, a representative specimen(s) will be collected and transported to Northern Prairie Wildlife Research Center's aquatics laboratory for rearing in aquaria until identification can be made.

Egg Mass Surveys:

Egg Mass Surveys (Crouch and Paton 2000) will be conducted concurrently with visual encounter surveys on a bimonthly basis beginning in May and continuing through the fourth week of August. Searching for egg masses will consist of slowly walking through the lentic wetland environment with freedom being granted to the observer to search the various habitats encountered. The observer will identify egg masses to species (when possible) and will record the location, depth of water, depth of egg mass, and type of substrate utilized. Any unknown egg masses will be documented thoroughly, including its shape, location, depth, and type of substrate utilized

Environmental Variables:

We will measure water conductivity, pH, temperature, and depth at each wetland bimonthly each year. Collection of these variables will be carried out independently of the larger effort being conducted by Northern Prairie Wildlife Research Center (Euliss et al. 2005). However, precipitation data measured by rain gauges installed at each study location by the larger study will be utilized.

Data Analysis:

Information collected from automated recording stations, amphibian funnel traps, visual encounter surveys, and egg mass surveys will be used to determine the occurrence of amphibian species at each site. We will compare amphibian community species composition among land-use treatments and sites using Nonmetric Multidimensional Scaling (NMS) with a Monte Carlo randomization to test for significance (McCune and

Grace 2002). We will develop logistic regression models to explore relationships between species presence/absence data and environmental/landscape variables (Tabachnik and Fidell 1996).

WORK SCHEDULE:

March-April 2005

1. Visit all study sites.
2. Build collapsible amphibian traps.
3. Training to use Anuran Automated Recorders and other recording equipment.
4. Assemble field gear.

May-September 2005

1. Locate transects in all wetlands.
2. Environmental and amphibian sampling.
3. Data analysis and entry: Amphibian identification and recorded tape analysis.

Winter 2005/2006

1. Preliminary analysis of data from year 1.

May-August 2006

1. Relocate transects in all wetlands.
2. Environmental and amphibian sampling.
3. Data analysis and entry: Amphibian identification and recorded tape analysis.

September 2006

1. Remove transect markers and other gear at study sites.

Winter 2006/2007

1. Final data base preparation, analysis, and write-up.

HAZARD ASSESSMENT:

The study will require extensive walking in remote areas where the only anticipated hazards are from stepping in holes or tripping over objects. Crew members will wear personal flotation devices at all times while working in wetlands. A thorough safety orientation will be provided and online safety training will be completed by all crew members before beginning field work. First aid kits and a mobile phone will be provided to enhance our ability to deal effectively with minor and unanticipated emergencies.

ANIMAL WELFARE CONCERNS:

Live amphibians will be captured in this study. However, the funnel traps we propose to use minimize injury rates and deaths (Mushet et al. 1997) and provide captured animals access to the surface for breathing. Traps will be checked every 24 hours to minimize the time captured animals spend in traps. Captured animals will be tallied by species and released immediately in the wetland of capture. All captured amphibians will be handled in strict accordance to Guidelines for use of Live Amphibians and Reptiles in Field Research (American Society of Icthyologists and Herpetologist et al. 1987). There is some potential for injury from other animals captured simultaneously in the traps. However, given our experience with using these traps for 14 years at the Cottonwood Lake Study Area, these types of injuries are rare due primarily to the large size of traps and the relatively short period that captured animals remain in the traps. For

identification needs, larval specimens may be collected and transported to NPWRC for rearing in aquaria. Amphibian larvae reared at NPWRC will be humanely euthanized after identification using a 250 mg/L solution of benzocaine hydrochloride (American Veterinary Medical Association Panel on Euthanasia 2000).

EXPECTED PRODUCTS:

1. Accounts of amphibian species using farmed, conservation program, and natural seasonal wetlands of the PPR.

2. Publications, Masters Thesis, and presentations characterizing relationships between environmental / landscape variables of wetlands along a land-use gradient and use by various amphibian species in the PPR.

3. The addition of amphibian occurrence data to the larger environmental/landscape variable data base being developed for conservation program wetlands.

METADATA COMPLIANCE OBJECTIVES:

Metadata will be prepared and maintained in compliance with the NBII biological metadata standard, the Federal Geographic Data Committee's Content Standards for Digital Geospatial Metadata and Biological Resources Division Policy Issuance Number 8. Compliant metadata will be submitted to the NBII Clearinghouse.

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Chairperson, Animal Care and Use Committee

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Assistant Director _____ 1 July 2005
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Center Director _____ 5 July 2005
Date