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University of Wisconsin – River Falls
River Falls, Wisconsin
Habitat - Biofuels

FELLOW
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2009 NWF Campus Ecology Fellow
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SCHOOL
University of Wisconsin - River Falls is a 4 year, public university with a student population of 6,728 (2009) located in River Falls, Wisconsin.

ABSTRACT
This project provides a holistically integrated model for optimal biofuels feedstock production from native prairie polycultures in conjunction with optimum management of rare, threatened, and endangered (RTE) grassland species for the sake of profit driven carbon negative climate initiatives in the upper Midwest. The project is in its final phases, drafting a publishable case study utilizing Willow River State Park as a theoretical footprint for a management plan. Costs for this project were largely administrative, with the National Wildlife Federation providing $4000 for administrative salary and thesis credit tuition, $1000 in mileage to and from the park and University, supplies, and miscellaneous expenses, and the St. Croix Institute for Sustainable Community Development providing $1000 of in-kind logistical support. Cost savings and energy contributions are variable depending on the market rate of biofuels feedstocks, biofuels conversion methods, carbon credit market values, and holistic considerations. A portion of the study examined carbon sequestration potential and found 71511 hectares in the St. Croix River watershed within a two county region suitable for restoration on marginal lands, with a total additional sequestration potential of 314648 metric tons of carbon annually in addition to restoring a nearly extinct habitat in North America. These numbers are strictly soil-carbon sequestration and are exclusive of any fossil fuel emissions displaced by the biofuels obtained from the restorations.

GOALS AND OUTCOMES
Goals
Goals for this fellowship study as outlined in the proposal were as follows:

Short-term results
The fellowship will encompass the entire study period and yield a publishable conclusion to the study. Measurable outcomes from the fellowship will be:

~ Provide carbon sequestration data on a per-unit basis that can be extrapolated to broad scale implementation.
~ Define optimal grass (and some woody) species mixes and BMP's not only for grassy biofuels production, but also for maximum biodiversity and RTE grassland species habitat protection .
~ Define optimal annual rotational harvest schedules, seasonal harvest dates, and tract size for grassland fauna in the St. Croix region of Wisconsin and Minnesota .
~ Provide economic benefits of carbon-negative grassland management in terms of estimated carbon credit market values, warm season grasses market values, and solutions in fulfillment of recommendations by the WI Governor's Global Warming Task Force.

Long-term Results
Beyond the scope of the fellowship, the study will provide:
~ An economically viable public model for use in private enterprise that will positively affect climate change, local agriculture, biodiversity, and fuel production.
~ A financial impetus for conversion of degraded agricultural lands back to productive native habitat.

Accomplishments and Outcomes
Goals of the study were largely addressed. An exhaustive, cited literature review and case-study is forthcoming. However, specific information addressing bullet points above include:

- Carbon sequestration data on a per-unit basis was determined and extrapolated to a broad scale. Marginal and forage land was considered for conversion to perennial Low-Input High-Diversity (LIHD) tall grass prairies and below ground net carbon was calculated, yielding 4.4 metric tons of carbon storage per hectare annually.

- Literature reviews established that the more diverse a restoration is in terms of plant taxa, the more stable and productive it tends to be. The largest number of plant species used to determine biofuels efficiency was 16, while the original prairies consisted of a mosaic of over 300 native species. Establishing this number of species, however, could prove difficult. However, a readily available seed mixture of native genotypes in Wisconsin used to restore the prairies at Willow River State Park consists of the following:

  Grasses: Big Bluestem, Little Bluestem, Junegrass, Canada Wild Rye, Needlegrass, Northern Prairie Dropseed, Sideoats, Switchgrass, Woolgrass, Indiangrass

  Forbs: Leadplant, Whorled Milkweed, Oxeye Sunflower, Thimbleweed, Round-Headed Bush Clover, Flowering Spurge, White Prairie Clover, Onion, Purple Prairie Clover, Silky Aster, Ironweed, Boneset, Bergamont, Gray Goldenrod, Yellow Coneflower, Blue Vervain, Partridge Pea, Hoary Vervain, False White Indigo, Cinquefoil, Cream Wild Indigo, Golden Alexander, Butterfly Milkweed, Golden Alexander, Rough Blazing Star, Great St. John's Wort, Dotted Blazing Star, Mountain Mint, Meadow Blazing Star, Pasque Flower, Sky Blue Aster, Silky Prairie Clover, Canada Milk Vetch, Swamp Milkweed, Gigantic Sunflower, Stiff Goldenrod, Showy Goldenrod, Culver's Root, Black Eyed Susan, Spiderwort, Joe Pye Weed, Showy Tick Treefoil, New Jersey Tea, Cup Plant, New England Aster, Showy Sunflower, Evening Primrose, Rose

As this seed mixture is functionally diverse, readily available in the area, and cost-effective (approx. $250/acre), it is the recommended mixture to produce a stable habitat and biofuels feedstock as a carbon sink with the exception that it should also include prairie violet (*Viola pedatifida*), birdsfoot violet (*V. pedata*), and arrowleaf violet (*V. sagittata*) to support populations of Regal Fritillary butterflies, an endangered species in the state of Wisconsin.

- In order to protect declining native faunal species, rotational harvest of biomass is necessary. Primary species of concern in grasslands are obligate bird species, although a lack of research in across other taxa leaves this focus biased. However, due to similar habitats and food-chain effects, management effects that positively affect grassland birds are likely to positively affect a larger number of faunal species. Mowing (harvesting) within 5cm of the soil produces similar results to the traditional method for maintaining prairies: burning. Ideally, harvested tracts should not comprise more than one-third of the effective habitat, with unharvested tracts from 80-250 acres (32-101 hectares) being directly adjacent to harvested tracts. Smaller tracts may lead to population sinks. Rotational schedule should be no less than 2 years, with 3-5 years being ideal. Harvests should not exceed 6 years to avoid encroachment of woody vegetation and ecological succession. Harvest dates should not take place during the primary breeding season of most faunal species. Early spring harvest of residual biomass can avoid this issue. Harvesting adjacent tracts during different times of year could also be beneficial to wildlife in that it provides a mosaic of habitat conditions that could cater to a larger diversity of species. It may also provide more steady income and avoid market flooding as a result. Main season harvest in the upper Midwest should take place after August 1 to avoid affecting breeding populations of most species associated with prairie habitat.

- Current carbon credit market values (as of 3/29/10) are at $0.10 on the Chicago Climate Exchange (CCX). Lands that are managed as permanent grassland can be enrolled through an aggregator. Market value of cellulosic feedstocks are not yet established, as there are no commercial cellulosic biofuels refineries in the United States at this time. One economic model (Miranowski, J. & Rosburg, A.) forecasted break even values were attainable only for wheat straw in the Pacific northwest without subsidies. This study, however, assumed feedstocks were to be grown on productive agricultural land and did not consider the use of marginal lands for native prairie feedstocks. Nor did this study consider residual values of post-fermented feedstocks as agricultural fodder or as co-generation biomass, which would add downstream value to the biomass. While future economic feasibility is difficult to assess due to the non-existence of a current cellulosic biofuels market, it is easily surmised based on the energy inputs required, the lack of fertilizer inputs, the perennial nature of the plants, their ability to grow on marginal lands, current government subsidies percolating into a broader biomass base, the up and coming carbon credit market, and the peak oil crisis that appears to be looming, that cellulosic biofuels from native prairie feedstocks will likely enjoy a highly sustainable market in the future.
  Detailed economic benefits outside the biofuels and carbon markets were beyond the scope of this study. However, it has become readily accepted that large scale ecosystems contribute economic value through the services they provide. These services can include: pollination of food crops, seed distribution, water retention and purification, provision of food and pharmaceuticals, temperature and humidity stabilization through evapotranspiration, soil improvements, natural pest and disease control, waste cycling, and recreation, amongst many others. The value of the world's ecosystems in 2010 US dollars has been estimated at an average 44.5 trillion dollars annually, more than twice the worldwide GNP (Costanza, R. et al., 1997). Since these services are normally provided free of charge and without request, they are often overlooked and can suffer what has come to be known as The Tragedy of the Commons (Hardin, G., 1968).

- Long-term objectives are largely met within the details and management design of the short term objectives, with continued management of native prairies achieving the long term objectives.
  No policies have been adopted as yet. However, the Wisconsin Department of Natural Resources (WDNR) has shown an interest in the findings of this study, along with the St. Croix Institute for Sustainable Community Development. Any attempt to restore native habitat and provide permanent refuge for native species based on the recommendations of this case study will have direct and far reaching impacts on wildlife and the natural environment well beyond the campus.

Challenges and Responses

There were several challenges encountered during the course of this study. First, the holistic nature of this study makes it very broad in its considerations. It has continued to grow in scope throughout as literature searches continuously reveal micro-facets and impacts worthy of (and necessary for) consideration. Creating a distinct boundary in the scope of a study designed to be holistic has proven to be difficult. My response to this challenge was simply to address it. Without addressing the issues and topics that arose, I do not feel like this study would have been complete. Considering the economic breakeven models of cellulosic biofuels feedstocks was not an intended goal at the outset, but I feel this study would not have been complete had it not been considered. Likewise, considering the value of ecosystem contributions, new species of concern within prairie habitats, multiple management approaches, etc became integral to the creation of a viable management case study.

Second, this study was performed solely by me. My advisers have offered suggestions and encouragement while I have worked on it, but staying motivated to wade through volumes of articles, educate myself in the depths of at least three distinct silos of study, and put them all together in one coherent document has often been daunting. Self-directed work is often difficult to stay on task with, but without a tangible material end product (this fellowship project is theory based, not based in project implementations, etc) it has often been challenging to stay on task. Seeing that other fellows also had trouble staying motivated at times in their respective projects has helped me stay motivated. We are all breaking ground in some way. Seeing others struggle, push forth, and continue with their studies has helped. Drawing from their experiences in areas outside this study has also kept me focused on the fact that this study may help others in the future in the same way.

If I were to embark on a similar project in the future, I would change only the involvement of others. Considering such a broad range of species, impacts, incentives, etc would justify the involvement of a few to several researchers, each in a particular topic area.

Campus Climate Action: Your School's Carbon Footprint

This project has directly addressed global climate change. By estimating the added amount of carbon sequestration to create carbon negative biofuels feedstocks, it adds a compelling impetus to the existing facets of the biofuels debate. If these management recommendations are taken into account in the future biofuels market, CO_2 emissions and other greenhouse gases will be reduced at the tailpipe by displacing fossil fuels, while atmospheric carbon will be sequestered in soil organic carbon and mineralized soil carbon through plant uptake. The perennial nature of the plants will ensure that this carbon remains sequestered, rather than released annually when the land is tilled.

The net CO_2e for UWRF is 30,927 metric tons for 2007 as reported on the ACUPCC web site. This fellowship did not address the updating of this number; however, I am currently finishing a separate project to update this emissions total for 2008 and 2009. By May 1 2010 I will have these numbers updated, conduits in place to facilitate annual reporting, and will have co-authored the Climate Action Plan to bring UWRF to carbon neutrality based on our emissions trends as shown in the updated annual emissions totals. If it is decided to re-establish native prairies on any of UWRF's land holdings, my management recommendations and carbon sequestration calculations can be used to offset direct emissions, bringing the campus closer to the goal of carbon neutrality.

ENGAGEMENT AND SUPPORT

Leaders and Supporters

Much of my work was done as class objectives. Being that I am working on a graduate degree, many of the classes I have taken are independent studies geared towards the goals and interests I have defined. Increased carbon sequestration potential for the St. Croix River watershed was estimated using GIS

software (ARC GIS). The end result was directly applicable to this study, but was also a semester project for a graduate level Advanced GIS class. Dr. Charles Rader offered vast amounts of working knowledge of ARC GIS and encouragement through his sincere interest in my project.
An independent study looking at advanced ecologic principles culminated in an exhaustive literature review examining the impacts of prairie restorations on biodiversity; the review was also directly applicable to this study. Dr. John Wheeler offered a wealth of knowledge in broad subject areas centered around ecology and was instrumental in turning me on to prairies as biofuels initially.

An independent study in Climatology and Climate Change produced web presentations looking at the basic science behind these schools of study, adding direct understanding to the phenomena and operationalization to this study based on the basic science overlooked in much of the public rhetoric. Throughout the duration of my fellowship, I have served as a member of the advisory committee for POWERful Choices, a sustainable energy project through River Falls Municipal Utility. Although this was a separate endeavor, working with a public entity gave me insight and understanding as to how public projects were implemented, how a renewable energy portfolio contributes to reductions in emissions and offsets, how cogeneration possibilities exist as part of a renewable energy portfolio, and how individuals from many separate entities can come together to achieve common goals.

The St. Croix Institute for Sustainable Community Development (SCISCD) has been especially instrumental in all of my studies. Kelly Cain, the director of the Institute, has also been my acting advisor. Throughout the entire study, he has offered guidance, encouragement, and knowledge in his strong areas. He has also worked tirelessly to keep me engaged in parallel efforts outside this fellowship that contribute to a more complete experiential education and solid resume in climate change, ecology, and biofuels. The WDNR has contributed significantly to my study. Gregor Schuurman is a conservation biologist with the WDNR Bureau of Endangered Resources (BER) and has been particularly helpful in locating publications, passing my study on to other interested individuals, and reviewing my work. Harvey Halvorsen is the regional Wildlife Biologist in my area and has also been instrumental, especially with prairie restoration information and seed mix information.

Large portions of my management recommendations were taken from a Wildlife Management Plan utilizing Willow River State Park for a graduate level Wildlife Management course. Dr. Mark Bergland offered many recommendations, provided invaluable resources and information on holistic management, and served as the processor for this fellowship. Liz Schlake co-authored this management plan, which Dr. Bergland now uses as an example in his subsequent classes.

Funding and Resources

Tangible costs for this project included $4000 from NWF for salary and thesis credit tuition. $1000 from NWF was used to cover mileage, park entrance fees, journal subscriptions, and other materials (books, etc). Funds in kind from SCISCD covered logistical support, including office assistance (esp. online posting of studies, etc), printing, computers, etc.

Not included in these totals are costs regularly incurred but necessary for this (and most) study, including internet provider fees, computer program purchases, home office costs (paper, ink, etc), etc.
An additional $3000 was provided through a separate fellowship through SCISCD to update the campus emissions footprint and draft a climate action plan. While not a direct part of this Fellowship, it offers an avenue of implementation in climate action plan recommendations.

Education and Community Outreach

Portions of my study have been posted as internet presentations to help with outreach education. In particular, parts of my research of Climatology and Climate Change have been posted on the SCISCD web page, along with findings of my Carbon Sequestration Potential study. This same study was also presented at the Upper Midwest Association for Campus Sustainability conference April 9-10 at UWRF. Sub-communities, such as the WDNR have shown interest in my study outcomes.

CONTACT INFORMATION

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MORE ABOUT YOUR SCHOOL

Campus Sustainability History

The University of Wisconsin - River Falls is the foremost school in the UW system with regards to sustainability. It is the only school in the state and one of the only a handful in the nation to offer an MS in Sustainable Community Development. The program is a inter-disciplinary one, with many resources couched in the St. Croix Institute for Sustainable Community Development (http://www.uwrf.edu/sustain). The SCISCD has been instrumental in several outreach programs including implementing sustainable public power programs, especially a tax-financed renewable energy program (http://www.rfmu.org/environment/default.asp?CategoryNumber=4).

The new University Center is one of the greenest campus buildings in the nation, and student government voted to offset 100 percent of its *and* all resident hall energy usage with renewable energy purchases. Other projects on campus included a composting project implementation that composts food waste from campus cafeterias on University lab farms, greenhouse gas emissions tracking projects, and possible large scale wind and solar energy implementations. UWRF is currently drafting a Climate Action Plan to reach carbon neutrality based on trends found in the greenhouse gas emissions tracking project.

Commentary and Reflection

This project was not without its frustrations and difficulties. One of the largest was staying motivated to wade through the volumes of journal articles that made the literature review portion of this study. Compounding this tedium was the fact that I was the only one participating in this study. Self motivation was mandatory, albeit tough at times (Summer in Wisconsin is not a time to be squandered!).

Listening to other fellows, however, it became apparent that each of us had our own frustrations with our respective projects in one way or another. As I thought about it more, it seems inherent that unique projects like ours are bound to come with difficulties and frustrations. If these projects were easy, they'd already be the status quo! In as much as we are implementing new technologies, techniques, etc, we are also trying to install change - a change in attitudes, routines, lifestyles that leans evermore toward sustainability. Realizing this, it is surprising that there weren't more difficulties for all of us!
This fellowship has made pursuing a meaningful graduate degree possible for me. So many students, I feel, go through the motions and do what is necessary to meet the requirements of their programs simply

to obtain a degree and move on in life. I was looking to do something more important; I wanted to make a difference. This fellowship has provided me the opportunity to dive into the deep end with my studies - to pursue something I'm passionate about that is outside the status quo. I've met wonderful people along the way and built lasting relationships. I've already been able to draw from the pool of knowledge available through the other fellows in their respective projects to assist me in endeavors beyond my own fellowship. The broader implications of my study are yet unknown, but I feel like I can always tell my family and my children that this was my contribution to the future. I am forever grateful to NWF for that.