2013

Effects of Flooding on the Flora and Fauna of a Reconstructed Tallgrass Prairie

Andrew J. Ridgway
University of Northern Iowa

Mark C. Myers
University of Northern Iowa

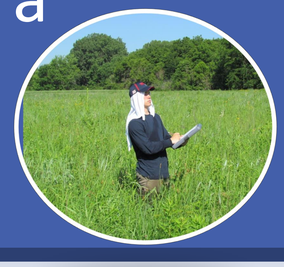
See next page for additional authors

Authors
Andrew J. Ridgway, Mark C. Myers, and Benjamin Hoksch

Effects of Flooding on the Flora and Fauna of a Reconstructed Tallgrass Prairie

Andrew Ridgway with Dr. Mark Myers and Benjamin Hoksch

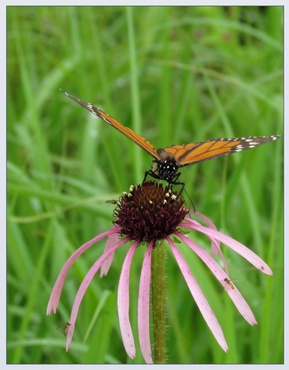
Department of Biology and Tallgrass Prairie Center, University of Northern Iowa

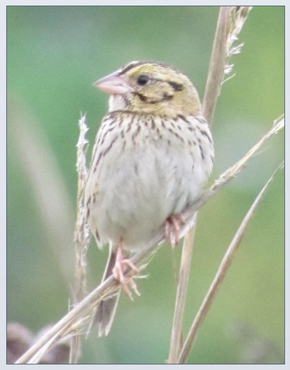


Background

Ecosystem conservation has been an area of concern for ecologists of Iowa, as the severely decreased area of native prairie, from 85% to 0.1% of total area (Ehresman 2000) has led to a rapid decline in native wildlife abundance and diversity. These trends have crippled the ecosystem of North America and altered the landscape beyond recognition of its former self. Human influence on this landscape in terms of row crops, field drainage and stream manipulation will result in less frequent but more severe flooding (Bertrand 2013). Changes in frequency and severity will influence ecosystem composition and function in areas previously unaffected by rapid water level fluctuation.

The effects of flooding are specifically relevant to areas that have been managed as row crop fields and converted back into prairie reminiscent of the native vegetation. Due to the lack of root mass and efficient drainage of these fields, fluctuation of water levels may have a much greater influence than in established prairie areas. The trends observed in the first few years of a prairie restoration will be particularly relevant in deciding which areas are suitable for treatment via the Conservation Reserve Program. In this study we used bird and butterfly frequency statistics to examine the effects of flooding on the relative health of the ecosystem.





Methods

Research was conducted in a prairie restoration approximately 40 hectares in size (1 ha= 10,000 m^2) in the Cedar River Natural Resources Area. Observations were recorded over an area in which three soil types (Loam, Sand and Clay) were observed. These three soil types were divided into 48 plots and seeded with equal but random distribution of one of four seed mixes which include a switchgrass monoculture, warm season grass mix, biomass mix, and prairie mix. Vegetation, bird and butterfly surveys have been conducted on these plots during similar intervals for four years.

- Flower Survey: A fifty meter transect across each plot and, starting at a random meter 1-10, flowering nectar sources were observed within a 1 m^2 area randomly selected 1-3 meters from the left or right of the transect every 2 meters for 40 meters
- Bird Survey: Bird species and behavior were observed and recorded as we walked the entire length of each plot along the transect line. Surveys were conducted primarily in the morning and only in conditions suitable for normal bird activity levels
- Butterfly Survey: Butterfly species and behavior was observed along the same fifty meter transect as floral surveys. Walking the transect line for precisely five minutes, the observer recorded activity within three meters of his position

Abstract

Prairie restoration for the purpose of biofuel production has the potential to be much more beneficial than using corn-based ethanol. These benefits include less damage to soil from fertilizers or pesticides, less management and greater suitability for native fauna. The current study of this restoration consists of surveying vegetation characteristics on four different soil types seeded with four different mixes, as well as observing bird and butterfly use of the restoration. In the fourth year of management of this particular prairie restoration a great deal of flooding occurred. The frequency and intensity of the flooding had a great affect on the vegetation in terms of what was able to survive long periods of saturation. Species abundance and richness for both butterflies and birds dropped significantly this year compared to the past three years of management. These factors lead to the conclusion that periodic flooding will alter flora and fauna composition of restored prairies and sets a basis for further observations of the effect on the ecosystem. As prairie restorations take several years to fully express, the full impact of the flood may take some time to determine.

Fig 1. Bird Abundance Over 3 Years

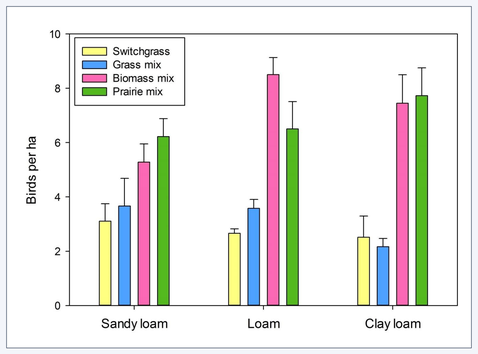
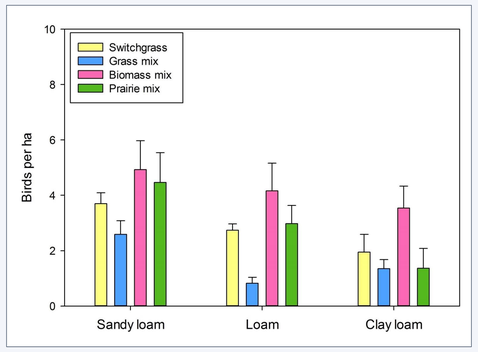
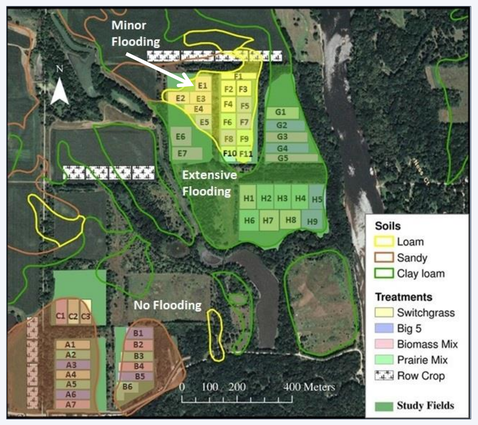


Fig 2. Bird Abundance 2013



Map of Flooding Extent in Research Plots



Heavily flooded areas submerged at river level higher than 10 ft.

Areas with minor flooding submerged at river level higher than 12 ft.

Fig 3. Butterfly Abundance Over 3 Years

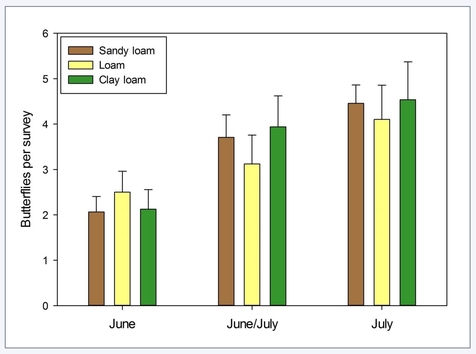
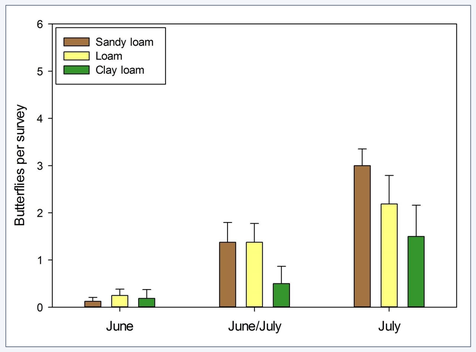
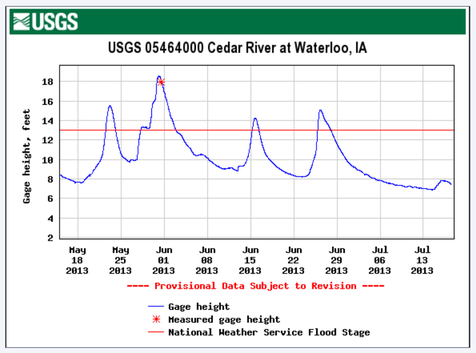


Fig 4. Butterfly Abundance 2013



Cedar River Hydrograph May-July



Results

Since we have access to data for this site for the past three seasons, we were able to compare abundance of birds and butterflies between the previous three years in which there was no flooding, to this past year in which flooding greatly influenced the site. A PERMANOVA statistical analysis gave us a quantifiable basis to determine the effects of flooding on this ecosystem.

Birds

- Overall abundance of birds is lower in 2013 than in previous years (figures 1,2) with the most noticeable difference in the heavily flooded clay loam and moderately flooded loam soil types
- Bird abundance varies between treatments (PERM Tr p=0.0001), this statistic applies to both 2013 and 3-yr average data. In addition, time (PERM Ti p=0.0001) is a significant factor, showing that there is a difference in abundance from 3 year avg to 2013
- When examining interactions between factors, we find that there is a significant interaction between treatment and time (PERM TrxTi p=0.0003) and between soil type and time (PERM SoxTi p=0.0049)
- Taking the statistics one step further, there is a significant interaction between soil type and time from the soil type that was not flooded and the two that were (PERM Soil: 1,2 p=0.0216) (PERM Soil: 1,3 p=0.002)
- Unique observation of Dickcissel (Spiza Americana): Observations in first three years averaged 118 on clay loam soil. This soil was heavily flooded in 2013 in which three total observations were recorded

Butterflies

- Butterfly abundance dropped significantly in each session in 2013 from the previous years (figures 3,4) with the most noticeable difference being on the clay loam (heavily flooded) soil type
- Abundance varies significantly in relation to session (PERM Se p=0.0001), from June to July, and time (PERM Ti p=0.0001), from the 3 year avg to 2013
- There is a significant interaction between soil type and time (PERM SoxTi p=0.0399) which is remarkably similar to the bird data of the same type
- A significant time interaction was found between the 3 year avg and 2013 between the sandy (not flooded) soil and heavily flooded (clay loam) soil types (PERM Soil: 1,3 p=0.0173)

Conclusion

Flooding of tallgrass prairie has been shown to have a wide range of effects on the ecosystem. In the short term, extended periods of submersion may alter the composition of the vegetation in favor of plants that can survive that level of saturation. Alterations in the vegetation, in turn, may change factors that determine nesting conditions for various species of birds, such as Dickcissel (*Spiza Americana*) which was observed only three times in heavily flooded areas in which it was very prominent in previous dry years. These vegetation changes also may alter butterfly populations through destruction of larval host plants and different nectar sources being available throughout the year.

Over the long term it will be interesting to see what plant composition will be expressed in the heavily flooded areas and how it differs from non flooded areas. This will surely alter the species composition of the area for all fauna that inhabit the area.

Sources

Justin Murdock, et al. "Influence Of Macroconsumers, Stream Position, And Nutrient Gradients On Invertebrate Assemblage Development Following Flooding In Intermittent Prairie Streams." *Hydrobiologia* 714.1 (2013): 169-182. *Academic Search Elite*. Web. 30 July 2013.

Ehresman, Marlene. "Ecology College: Prairie Management." *Ecology College: Prairie Management*. Iowa Natural Heritage Foundation, n.d. Web. 30 July 2013.

Hoksch, Benjamin. "Current Research."*Never Been Tilled*. N.p., n.d. Web. 31 July 2013. <http://neverbeentilled.com/category/current-research/>.