

Echinacea Project Research Proposal  
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**Assessment of the Effects of the Introduction of Non-native Echinacea Species in the  
Pollination of Native *Echinacea angustifolia* in Western Minnesota**

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Abstract

The narrow-leaved purple coneflower *Echinacea angustifolia* (Asteraceae) is the only native Echinacea species found in Minnesota tallgrass prairies. Due to high levels of habitat fragmentation in this area, many restoration projects have been developed in these tallgrass prairies recently. Some of these restoration efforts have introduced non-native Echinacea species (*Echinacea pallida* and *Echinacea purpurea*). These species could potentially have detrimental effects on the native Echinacea species, as well as on the arthropod communities that depend on this plant. A specific concern is the invasion by hybridization between native and non-native echinacea species. Last year we successfully tested the likelihood of hybridization between *Echinacea pallida* and *Echinacea angustifolia* using artificial crosses and demonstrated that each species accepts interspecific pollen and seedling results. Because we still do not have any evidence that such hybridization occurs in nature, we will identify and contrast the pollinator species that visit each echinacea species to determine the ultimate possibility of hybridization among these plant species. Simultaneously, we will study echinacea plants in the field to quantify synchrony in the time of flowering between the local and the introduced species. We will observe, record, and collect pollinators for later identification using high resolution cameras and an existing reference pollinator collection. Because both species are visited by generalist pollinators, we hypothesize that the introduced species are very likely to hybridize and may displace the native species in nature. The information we gather from this research will indicate how important it is to use local flora in restoration projects.

## Background

The introduction of non-native plant species can alter the ecological functioning of an entire ecosystem. Therefore, it is crucial to know and understand the specific characteristics of a habitat before introducing new species in it. *Echinacea angustifolia* (Asteraceae) also known as the narrow-leaved purple coneflower has been historically the only member of the Echinacea family present in the Minnesota tallgrass prairie. However, restoration efforts in this state have introduced other varieties of echinacea (*Echinacea pallida* and *Echinacea purpurea*) instead the native *Echinacea angustifolia*. Since as *Echinacea pallida* as *Echinacea purpurea* are species with a broader geographic range than *Echinacea angustifolia* (USDA Natural Resources Conservation Service, 2013), these species are more likely to be present in a much great variety of restoration manuals, horticultural guidebooks, and the general seed market. Consequently, the availability of their seeds will be greater while their cost will be considerably inferior. These facts may be behind the introduction of nonnative echinacea species in western Minnesota restored areas. This is a particular cause of concern since *Echinacea pallida* has been observed outcompeting *Echinacea angustifolia* in other areas of the United States (Snyder et al, 1994). Thus, the introduction of these non-native echinacea species could potentially have detrimental effects on the native Echinacea species, as well as on the arthropod communities that depend on this plant. A specific concern is the invasion by hybridization between native and non-native echinacea species.

Sanford et al, 2013 (unpublished) successfully tested the likelihood of hybridization between *Echinacea pallida* and *Echinacea angustifolia* using artificial crosses and demonstrated that each species accepts interspecific pollen and seedling results. Indeed, Sanford's data suggest that both species are more likely to accept pollen from interspecific mates than from intraspecific mates. Also, it was found that *Echinacea angustifolia* was more prone to accept interspecific pollen than *Echinacea pallida*. All these results confirmed the ability of *Echinacea pallida* to outcompete *Echinacea angustifolia* and consequently the probability of an invasion by hybridization. However, we still do not have any evidence of the likelihood that such hybridization would occur in nature. Therefore, we will identify and contrast the pollinator species that visit each echinacea species to determine the ultimate possibility of hybridization among these plant species. Simultaneously, we will study echinacea plants in the field to quantify synchrony in the time of flowering between species. We will observe, record, and collect pollinators for later identification using high resolution cameras and an existing reference pollinator collection. Because both species are visited by generalist pollinators (Stuart Wagenius, personal communication), we hypothesize that the introduced species are very likely to hybridize and may displace the native species in nature. Also, I will use data from previous echinacea project teams to determine the efficiency of the pollinators that are shared by the two types of echinacea plants. It will provide a much accurate view of how possible is hybridization in nature. The information we gather from this research will indicate how important it is to use local flora in restoration projects.

### **Research Questions:**

What effects can have the introduction of *Echinacea pallida* and *Echinacea purpurea* in restored prairies of western Minnesota

- 1- Is hybridization between Minnesota nonnative *Echinacea* species and *Echinacea angustifolia* possible in the prairies of western Minnesota?
- 2- Is pollinator fidelity of *Echinacea angustifolia* visitors decreased by the presence of other *Echinacea* species in the same habitat?
- 3- Do pollen limitation in *Echinacea angustifolia* increase with other *Echinacea* species in the same habitat?

### **Methods:**

Pollinator visitation will be observed at Hegg Lake Wildlife Area (HLWMA). This site provides the most ideal conditions since it has *Echinacea pallida* and *Echinacea angustifolia* populations in close proximity. In this site, we will find the same set of environmental conditions for pollinators and plants. Therefore, Hegg Lake Wildlife Area (HLWMA) is the most indicated site to assess if both species of plants share pollinators and synchrony in flowering. Identification of pollinators will be done through observation of ten minutes at two meters from the plant. We will take video combined with observation. It will add more data in the same period of observation time. It also will help to identify pollinators more accurately. Synchrony among these species will be assessed by recording and contrasting flowering dates between the two different species populations. An existing pollinator collection and online insect database will provide the guide to identify pollinator species. Data will be collected in a spreadsheet designed for this research (See next page).

### **Identification Keys:**

[http://echinacea.umn.edu/summer/field\\_guide\\_to\\_Echinacea\\_visitors.pdf](http://echinacea.umn.edu/summer/field_guide_to_Echinacea_visitors.pdf)

<http://echinacea.umn.edu/insects/EchinaceaInsects.htm>

**Data Collection**

Plant Specie: Echinacea angustifolia ( )					
Echinacea pallida ( )					
Time :					
Plant Tag #:					
	Visitation		Weather Conditions	Pollinator collected	Vial Number
Pollinator	Count	Time	(Cloudy, Sunny, or Windy)	(Y/N)	
<b>Andrenidae</b>					
Andrena rudbeckiae					
Andrena rudbeckiae					
Pseudopanurgus albitarsis					
Ceratina calcarata/dupla					
Melissodes bidentis					
Melissodes subillata					
Melissodes trinodis					
Apis mellifera					
Bombus fervidus					
<b>Colletidae</b>					
Colletes kincaidii					
Hylaeus cressoni					
Hylaeus modestus					
<b>Formicidae</b>					
Formica sp.					
Lasius sp.					
<b>Halictidae</b>					
Agapostemon virescens					
Augochlorella aurata					
Lasioglossum heterognatum					
Lasioglossum near rowheri					
Lasioglossum pilosum					
Lasioglossum pruinosum					
Lasioglossum pectorale					
Halictus ligatus					
Agapostemon texanus					
Lasioglossum imitatum					
Lasioglossum tegulare					
Lasioglossum albipenne					
Lasioglossum admirandum					
Halictus confusus					
Halictus rubicundus					
<b>Megachilidae</b>					
Megachile brevis					
<b>Diptera</b>					
<i>Sarcophagidae</i>					
Sarcophagidae sp.					
<i>Scathophagidae</i>					
Scathophagidae sp.					
<i>Syrphidae</i>					
Eristalis? sp. 1.					
Eristalis? sp. 2.					
Helophilus? sp.					
Sphaerophoria? sp1					
Sphaerophoria? s					

## Literature Cited

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7. Wagenius, S., and Pimm S. (2010). Reproduction of *Echinacea angustifolia* in fragmented prairie is pollen-limited but not pollinator limited. *Ecology*, 91(3): 733-742