Background:

Interactions between honeydew-exuding insects and the ants that tend them shape surrounding arthropod communities and may serve as good indicators of biodiversity and ecosystem health (Andersen & Majer 2004, Stadler & Dixon 2005, Styrsky & Eubanks 2007, Ando & Ohgushi 2008, Ando *et al.* 2011, Lescano & Farji-Brener 2011, Siquera Neves *et al.* 2011). Understanding these interactions and identifying the key players may thus inform restoration, management, and monitoring on prairies in Western Minnesota, many of which are currently fragmented by large-scale agriculture.

Aphids (Homoptera: Aphididae) and hemipterans comprise the most well-studied groups of honeydew-exuding insects (Stadler & Dixon 2005, Styrsky & Eubanks 2007). Aphids feed on carbohydrate-rich, nitrogen-poor phloem sap, consequently consuming more sap than necessary to meet their nitrogen demand. This excess sap is exuded from the aphid abdomen as "honeydew," a carbohydrate-rich energy source consumed by foraging ants (Stadler & Dixon 2005). Similar interactions have been observed in hemipterans, particularly scalebugs (Hemiptera: Coccoidea), which are also commonly tended by ants (Styrsky & Eubanks 2007). Honey-pot ants have been shown to store scalebug honeydew for adverse environmental conditions (Gullan & Kosztarab 1997). Although scientists speculate that ants may also store aphid honeydew, this phenomenon has not been reported (Stadler & Dixon 2005).

Because certain ant species rely on honeydew for energy, they often aggressively protect aphids and hemipterans from other arthropods; ants may carry offending arthropods away from plants, thereby shaping the local abundance and distribution of herbivores, predators, and parasitoids (Stadler & Dixon 2005, Styrsky & Eubanks 2007, Ando & Ohgushi 2008, Siquera Neves *et al.* 2011). Ants alone may be good indicators of habitat biodiversity, offering, arguably, a more fine-scale, dynamic view of ecosystems than plants (Andersen & Majer 2004). Thus, it is essential to understand which ant species are present in prairie communities and how these species are affected by habitat fragmentation. Although several studies in Western Minnesota have examined the ecology of aphid-plant interactions, little is known about which ant species are present in the surrounding prairie preserve and remnants.

Theory suggests that fragmentation would affect insect specialists more than insect generalists (Braschler & Baur 2005), which may particularly impact *Aphis echinacea*, a specialist aphid on *Echinacea angustifolia*, and its associated ant species in prairie remnants. Insect generalists can survive a broad range of habitats and might outcompete specialists or organisms with narrower habitat requirements. Thus, generalist ant species may outcompete specialists on prairie remnants, altering the biodiversity of arthropod communities on these sites.

Invasive and native ant species may also impact the structure of prairie communities differently. Given that the most dominant honeydew-collecting ant species commonly outcompete other ant species with similar ecological roles, invasive ants may potentially displace native ants, especially if they share a common ecological role. A 2009 study from Spain revealed that the invasive ant species, *Lasius neglectus,* collected more honeydew but carried less arthropods than the native species, *Lasius grandis* (Paris

& Espadaler 2009). If invasive and native species differ in the amount of arthropods they carry, then the structure and abundance of arthropod communities may also differ. However, the current ant species (both invasive and native) and the presence of ant specialists and generalists are unknown in Western Minnesota prairies.

To provide baseline data for future projects on tritrophic relationships in prairie preserves and remnants, I plan to determine which species of ants are present in the prairie preserve and remnants in Douglas Co., Minnesota. I will also assess species richness and species abundance of ants on the prairie preserve and the remnants and determine which ant species are associated with *E. angustifolia.* Finally, I will examine whether the ant species associated with *Echinacea angustifolia* differ between flowering and non-flowering plants.

Goals:

For my project, I plan to address the following questions:

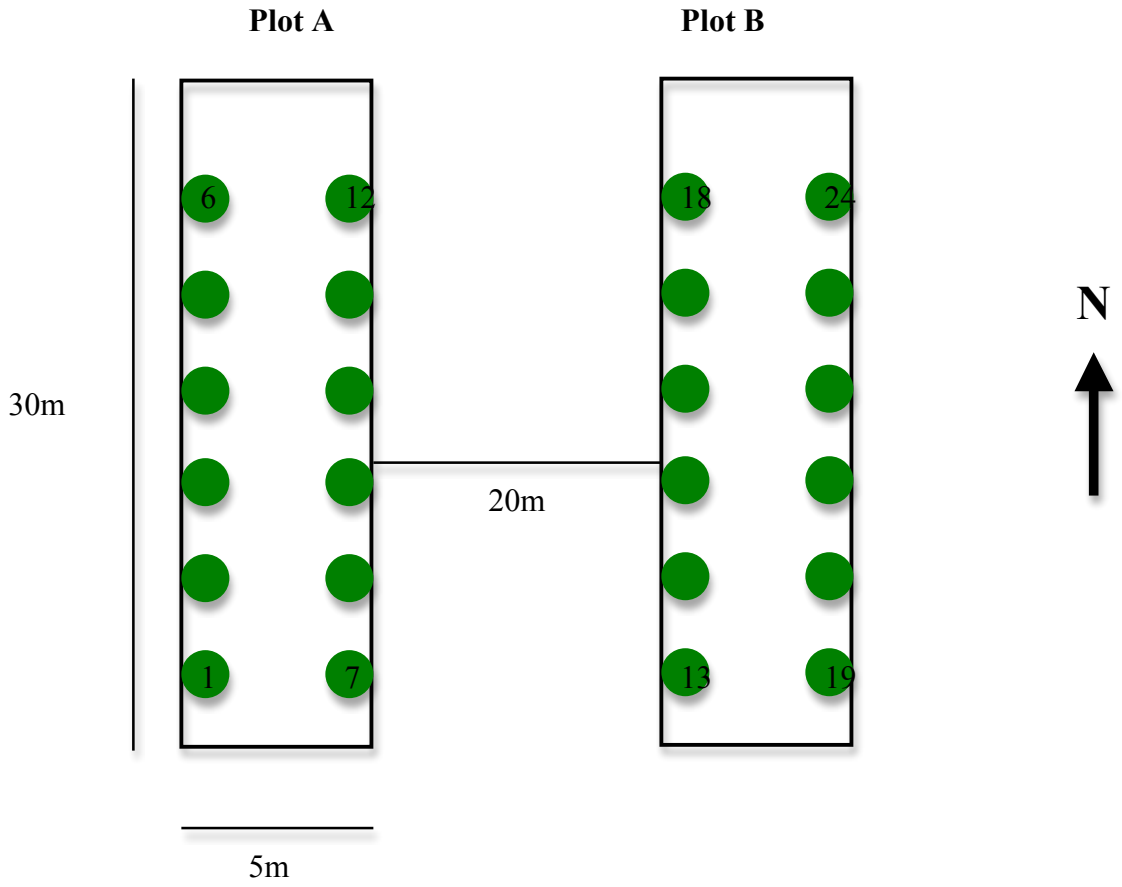
- What species of native and invasive ants (Hymenoptera: Formicidae) are present in the prairie preserve and prairie remnants?
    - Does species richness vary among prairie remnants and the prairie preserve?
    - Does species abundance vary among the prairie remnants and the prairie preserve?
- What ant species are associated with *Echinacea angustifolia* and which species tend *Aphis echinacea*?
    - Is there any difference in the ant species associated with flowering and basal *E. angustifolia*?

Methods:

The study will be conducted July-August 2012 on 4 sites in Western Minnesota, including 4 prairie remnants of varying sizes (Nessman, East Elk Lake Rd., Northwest Landfill, North Northwest Landfill) and the burned and unburned units of Staffanson prairie preserve.

Ant communities

Two 30mx5m plots (A & B) will be oriented North-South on each of the prairie remnants (East-West on East Elk Lake Rd.) with pitfall traps placed 5m apart, for a total of 12 traps per plot and 24 per site. Plot A will be placed around flowering Echinacea plants and plot B around an area without Echinacea. Plots A and B will be a minimum of 20m apart. Four plots will be placed on the prairie preserve, 2 on the western burned area and 2 on the eastern unburned area.



Traps will be filled ¼ of the way with 50:50 propylene glycol-water solution and one drop of soap and will be added to each trap. The soap decreases the surface tension of the solution, drowning the insects more quickly. All traps will be capped for one week after being installed to rule out any effects from soil disturbance. Beginning in July, all traps will be uncapped and specimens will be collected weekly, sorted into Ziploc bags, and frozen for later identification. Collections will continue through the first week of August.

Ant identification will occur throughout the season to the lowest taxonomic category attainable and species richness and abundance will be recorded. If time allows, GIS maps will be drawn up from abundance data at the Chicago Botanic Garden in August.

Ant species associated with E. angustifolia

Individual plants of *E. angustifolia* that flowered last year and individuals that flower this year will be observed on each site to determine if there are any differences in the ant species associated with basal and flowering *E. angustifolia*. Ants will either be identified in the field or captured and identified in the lab. Notes will be made in the field on whether particular ant species are associated with *E. angustifolia* (walk over plants) or physically tend aphids on *E. angustifolia*. Observations will be bi-weekly.

Concerns/Questions:

- Is total site species abundance or spatial-temporal species abundance across individual sites more valuable to The Echinacea Project?
- Should *E. angustifolia* be observed for set amounts of time (e.g. 10 minutes per plant) and should I observe plants more frequently than bi-weekly?
- How many flowering and basal plants should I observe for the season?

Schedule:

June:

- Purchase materials & set up traps
- Flag plants to observe on each site
- Refine methods

July:

- Begin collecting from traps
- Begin indentifying specimens & recording abundance & species richness
- Begin observing ants on *E. angustifolia*

August:

- Wrap up fieldwork
- Look at abundance across the sites (GIS at Chicago Botanic Garden) and over the weeks
- Assess overall species richness and species abundance by month (any seasonal changes in ant communities?)

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