2011 Project Ideas and Mentor Possibilities

This is a list of potential independent project ideas and mentors. On June 17th there will be a symposium to introduce many of the research projects that are being conducted at Cedar Creek. If you have questions about the projects below or another potential topic you would like to discuss please contact Troy Mielke at tmielke@umn.edu or Kally Worm wormx004@umn.edu.

Mentor: Colleen Satyshur, csatyshu@umn.edu
Interests: Entomology
Project ideas:

- Build native bee traps, test if change in weight can tell how many pupa inside, look at types of pupa etc
- Survey Bombus in old fields-transects with a net. Relate to field age, diversity. Do the same in Savannahs? Need 2 ppl
- Mark recapture of Bombus, estimate flight distances, use old fields, esp ones not directly connected but near each other. If I get a Bombus colony started we could use that.
- Bluegill predation behavior, dragonfly/damselfly defense behavior or study multiple prey, or intraguild predation in this system.
- Adult dragonfly roadkill surveys by Cedar Creek bridges.
- Pitfall trap for Carabids in old fields, try to get an idea of diversity. Relate to field age, or plant diversity or fire freq and to Wildlife&Biofuels plots out west.
- ID Wildlife&Biofuels bees
- ID Wildlife&Biofuels carabids
- Mist net songbirds? Tells what-pop size and diversity. This is probably complicated to set up, permits etc, but would be fun!
- Drag old fields for nesting waterfowl?-no, sandy soil no good
- Look for crayfish burrows, pump for dragonfly larvae.
- Ephemeroptera Plecoptera Trichoptera water quality analysis on Cedar creek, bog, lake.
- Songbird visual/audio surveys in old fields-ends mid June, probably too early, but could try if interested interns.
- Insect sweeps in old fields-pick a reasonable purpose
- Bee bowls in old fields-pick a reasonable purpose

Mentor: Mary Spivey, spive007@umn.edu
Interests: Edeucations and Outreach
Project ideas:

- RHW research – possibility to work with Ari on her RHWP studies
- Continue Juanita Marotta's work at Beckman Lake – involves looking at her master's thesis from 1966 and conducting some of her same investigations to compare Beckman of 1966 to Beckman of today.

- Collect weekly secchi data on Fish Lake for the Minnesota Pollution Control Agency
- Collect data on Cedar Bog Lake – depth, temperature, pH, DO, etc. If possible, compare with Lindeman's work from the late 30's.
- Oak Wilt Study – continue the survey started last year. Locate oak wilt outbreaks on Cedar Creek land and continue surveillance of known sites. Jeff is the lead on this project.

Mentor: Peter Wragg, wragg@umn.edu
Interests: In addition to the suggestions below, I am happy to mentor other projects that interns think of entirely independently, if I am able to contribute. I will be at Cedar Creek at least about half the time throughout the summer, including in the evenings. My earlier research focused on the ecology and evolution of plant-pollinator interactions, and I remain interested in this field. Pollination studies can be well suited to the scope of a summer project, and obtaining a journal publication is feasible. My current PhD work at Cedar Creek includes the response of plant species and communities to global warming, and how that depends on which other species are present, using seed additions in the Biodiversity And Climate experiment. This reflects my broad interest in plant community ecology. I am particularly interested in what controls species diversity and composition, in relation to global changes such as climate change, nutrient deposition, and land use change. I'd be glad to assist with techniques, including statistical analysis, phylogenetic comparative analysis, data management, macro photography, and experimental design even for projects on subjects that I don't know.

Project ideas:

Growth of oak trees in the big biodiversity experiment (E120)
When the "big bio" experiment was established in 1994, bur oaks and pin oaks were part of the 18-species pool from which subsets of 1, 2, 4, 8, or 16 species were planted into each plot. In plots with many species, and even in plots with few species but including a C_4 grass, the oaks had not reached above knee height by 2010. In contrast, in plots with few species and especially those without C_4 grasses, oaks had grown over 3 m tall. Thus, the other species in a plot clearly had a major influence on the oaks' growth. In 2010, interns helped me harvest and weigh all the trees in the big bio plots, and I am using statistics to try to determine how the other species affected oak growth – was it through their effects on fire frequency and intensity, competition for soil resources or light, or some other mechanism? However, because these factors are all correlated, this "snapshot in time" approach can't give us unambiguous answers. Another approach would be for an intern to ask what the trees can tell us about their history. I kept the base of the trunk of each tree, and an intern could measure the widths of the tree rings to estimate each tree's growth rate in each of the past 16 years. The intern could then correlate changes in growth rate through time with changes in fire frequency and resource levels, which have been recorded every few years, to shed light on why trees grow more slowly in more diverse plots.

Is bluestem colonization of old fields limited by mate availability?

Midwest tallgrass prairie and oak savanna was historically dominated by the grasses big bluestem *Andropogon gerardii* and little bluestem *Schizachyrium scoparium*. When prairie or savanna is cultivated and then agriculture is abandoned, bluestems take decades to recolonize the old fields despite being superior competitors. Why is this process so slow? One possibility is that isolated plants that establish in old fields as a result of rare long-distance seed dispersal are not pollinated, preventing them from producing seed. (These grasses are self-incompatible and thus need pollen from another plant to set seed). These bunch-grasses do not spread rapidly by runners, so if they cannot produce seed then, as we observe, colonists may remain isolated for decades instead of spreading. Logical though this seems, there has been only one previous study showing that such reproductive failure at low density can affect the rate of spread of a grass (an invasive cordgrass in a West Coast estuary). The old fields at Cedar Creek provide an ideal opportunity to test this idea, by examining pollen deposition and/or seed set of bluestem plants in relation to distance from other plants of the same species. Testing this idea would advance our understanding of old field succession, and help answer a much more general question: what limits the rate at which a species colonizes (invades) an ecosystem?

Is cottonsedge *Eriophorum virginicum* pollinated by wind or insects?

The vast majority of the 5000+ species of sedges in the world are wind-pollinated. However, a few with conspicuous white or yellow or red flowers have been presumed to be insect-pollinated. Insect-pollination in sedges would be remarkable because, while many lineages have made the transition from insect- to wind-pollination (losing bright colour, floral scent, sticky pollen, nectar, big petals, etc along the way), very few indeed (a mere handful, as far as is known) have made the reverse transition from wind- to insect-pollination. In my Honours thesis, I found the first evidence that at least some sedges, in South Africa, are indeed exclusively insect-pollinated (paper in press at New Phytologist; I can email it to anyone interested.) Hence, I was excited to find the possibly insect-pollinated cottonsedge in a bog beside a boardwalk at Cedar Creek. In 2009 and 2010, Jake Jungers, several interns, and I found that the cottonsedge has a floral scent in addition to white flowers, and is visited by bees and flies, suggesting that it may be at least partly insect-pollinated. However, it may also be partly wind-pollinated. Thus, it may represent an intermediate stage between wind- and insect-pollination. Further investigation of cottonsedge at Cedar Creek, building on the limited preliminary data of previous years, has potential to shed light on this major evolutionary transition. There is plenty of scope for further observational and experimental work, as we work towards understanding it well enough to write a paper on it. This species is self-compatible. Hence, discovering the relative importance of wind- vs insect-pollination will ultimately require determining whether seeds from mesh-covered flowers from which insects (but not wind) were excluded are selfed (indicating no wind-pollination) or crossed (indicating wind-pollination). This would require molecular data such as allozymes or microsats, so someone looking for an Honours project could do the experiment at Cedar Creek over the summer and then do the molecular work at their home institution next year (I don't have molecular skills). There are plenty of opportunities for non-molecular work in the field too, though.

Pollination biology of *Asclepias ovalifolia*

Asclepias ovalifolia is a milkweed that is sparsely distributed through the northern US and southern Canada, with scattered small populations at Cedar Creek. As far as I can tell, its pollination biology has never been studied, so determining its effective pollinators by watching

for insect visits, and catching visitors and examining them for pollinia (the packages into which milkweeds bundle their pollen), would be a novel contribution. Combined with a breeding system study – a simple experiment to determine whether it can self-pollinate, or requires pollen from other individuals to set seed – this would be publishable. Such work appeals to my naturalist side – it's not testing any general theories, but it is a contribution to knowledge which can inform conservation of this particular species (Does it depend on insects to set seed? Are insect pollinators found in small isolated habitat fragments?), and can lead to broader questions of specialization vs generalization (few pollinators or many?), the functional roles of floral traits such as colour and scent in plant-pollinator interactions, etc.

Photographic guide to prairie seedlings

Seedlings play an important role in ecology research for at least two reasons. First, seedlings are a particularly vulnerable life stage due to their small size and poorly developed roots and stems, so seedling survival and growth can be key to determining how species respond to environmental change. Second, adding seed is often the most feasible way to add species to a community to test ideas relating to what controls the number and identities of species in a community. However, to use seedlings in research, we need to be able to identify them! Field guides and keys are little help – seedlings lack many of the diagnostic features of adults. Hence, to investigate the effect of experimental warming on seedlings of a large number of species of prairie plants, I had to plant all these species in monocultures to learn what the seedlings looked like. In 2009, I and two interns took a large number of close-up photographs of seedlings of ~50 prairie species using a macro lens. Compiling the best of these photographs, and potentially new photographs of other species, into a photographic guide would aid seedling research at Cedar Creek and in the wider region. Such a guide would also be useful in restoration. Through such a project, an intern could gain various experiences and skills depending on how they shape it: experience with layout and digital image editing and enhancement; scientific macro photography; collaboration with the Cedar Creek webmaster to produce an online version of the guide; and a "grey literature" publication to add to their C.V.

Mentor: Ari Waldstein, wald0239@umn.edu
Interests: Red-headed woodpeckers
Project idea: Quantify the foraging habitat of breeding red-headed woodpeckers. As opportunistic feeders, these birds often forage on the ground- what are the vegetative characteristics of the foraging areas and are they different from the surrounding habitat?

Mentor: Sasha Wright, sashajwright@gmail.com
Interests: Tree seedling survival
Project ideas:

- Is surface soil drying higher in exposed (bare) areas vs. forested or high cover grassland areas? Decreased surface soil drying may be the mechanism responsible for increased seed emergence and seedling survival in high diversity BioCON plots.
- Are there more small oak seedlings recruiting in high diversity areas vs. low diversity areas in the savanna at CC?