Diversity of ground-dwelling spider populations in restored areas of an Oak Woodland Habitat

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Abstract. -- Restoration efforts have become critical to the conservation of natural communities.. Restoration within the McDonald Woods in Cook County, Illinois have been ongoing since 1989. Being at the top of the litter layer food web, ground-dwelling spiders are potential indicators of community health. Pitfall trapping in four sites of varying restoration age was conducted in the summers of 2005 and 2006. The 2006 sampling yielded a total of 515 adult spider specimens (697 total individuals including immature spiders) that represented 10 families and 27 genera. A total of 34 species of ground-dwelling spiders were collected. Species diversity (H'), richness (S), and evenness (J') were calculated and compared between years. All study plots, with the exception of the 2003 site have increased in diversity from 2005 to 2006. This increase in diversity may suggest positive recovery of the litter layer food web, nutrient cycling and overall forest health.

Introduction. —Ground dwelling spiders are widespread and diverse predators of woodland litter. Many of these species actively pursuit their prey as a foraging strategy making them well suited to pitfall trapping techniques. Although these spiders are small and difficult to observe, their high diversity may make them useful as indicators of woodland health (Mallis & Hurd 2005). Most oak woodlands in the Midwest are degraded and are in a state of decline. In McDonald Woods, where out studies were conducted, common buckthorn (*Rhamnus cathartica*) and other exotic species have changed the rate of decomposition of the litter by altering the quality of the litter entering the system (Ashton et al. 2005). High level of nitrogen in the litter from exotic plants and activity of exotic earthworms has greatly increased the rate of litter decomposition. This can be seen in the comparison of litter from restored and buckthorn invaded sites (Figs. 2 & 3). As a continuation of a 2005 study, we hope to verify the observed increase in diversity with age of restoration and document any changes related to time since last controlled burning of the restoration sites. All restoration sites were last burned in the spring of 2005. All study plots have been designated by the year of initial restoration management. We hypothesized that the restored plots would exhibit a more diverse spider population than the unmanaged control. We also predicted a correlation between diversity and age of restoration.

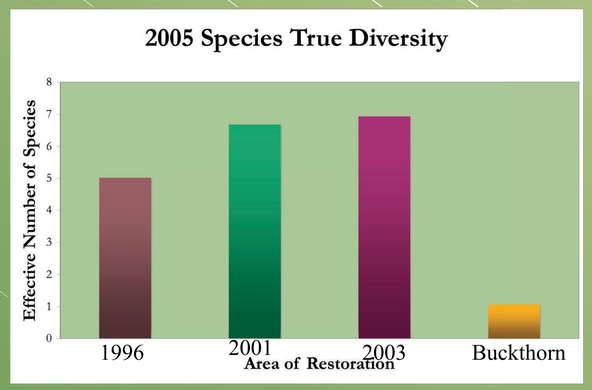
Figure 1. Pitfall trap set in the 2003 site with collection cup to the left.

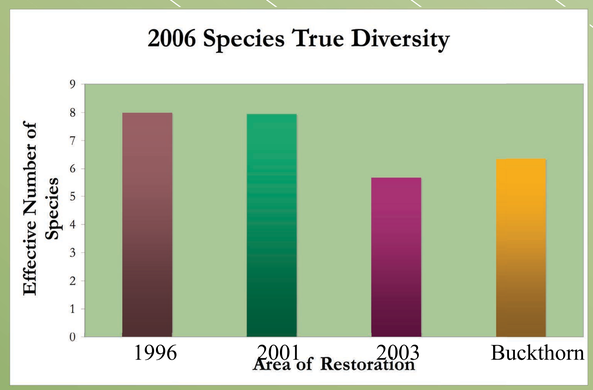
Study Site.—The study was conducted in McDonald Woods at the Chicago Botanic Garden, owned by the Forest Preserve District of Cook County, managed by the Chicago Horticultural Society.

Sampling.-- We sampled at each of four sites with an array of five pit-fall traps arranged evenly spaced around the circumference of a randomly located 20 m diameter circle. The first pit was established based on a random compass angle. Each subsequent pit was place at 70-degree intervals around the circle. A translucent fiberglass cover with four wooden, 1X8 inch supports on the underside acting as drift fences, were place over each trap to keep out rain, debris, and mammals (Figure 1). The trap consisted of a 16 oz. plastic cup with an 8 oz. cup suspended inside. A water and dish detergent solution was added to each 8 oz. cup. Traps were emptied on a daily basis between mid-June and early August 2006. Trap contents were brought to the lab and spiders sorted and placed in 70% ethanol for species determination

Figure 2. Leaf litter layer within the 1996 site boundaries.

Figure 3. Leaf litter layer found within the Buckthorn site.





2005 Data	1996	2001	2003	Buckthorn
Species Richness (S)	19	16	23	8
Number of Individuals (N)	381	239	141	172
Shannon Weiner Index (H')	1.61160782	1.89990967	1.9370361	0.06060697
Effective Number of Species	5.01086133	6.68529052	6.9381565	1.06248125
Species Eveness (J')	0.53423081	0.64542847	0.6574349	0.30859065

2006 Data	1996	2001	2003	Buckthorn
Species Richness (S)	21	19	18	9
Number of Individuals (N)	157	166	143	49
Shannon Weiner Index (H')	2.07809741	2.07272332	1.7342346	1.84688866
Effective Number of Species	7.98925417	7.94643461	5.6645903	6.34006268
Species Eveness (J')	0.68256925	0.70394508	0.600004	0.84055525

Results. --- This study yielded a total of 515 adult spiders (697 total individuals including immature spiders) that represent 10 families and 27 genera. A total of 34 species were collected from three restoration plots and one unmanaged plot. Five of the species (*Phrurotympus borealis, Bathyphantes concolor, Eperigone autumnalis, Pirata minutus, and Schizocosa ocreata*) were found to be common to each plot. Eighteen of the other species were found to be unique to only a single plot. Seventeen of the species were found only to occur on restored plots. Two exotic species (*Trochosa ruricola and Ozyptila praticola*) were found to be common during the study. Trochosa was only recently described for the state of Illinois, while O. praticola was found to be a new documented record for the Great Lakes region south of Canada. The most abundant species observed B. concolor, accounted for 34% of the total adult spiders. The 1996 plot, which represented the oldest restoration, had the highest species richness (S), and greatest diversity based on Shannon (H') and Effective Number of Species. However, the evenness (J) of this plot was the second to lowest. The 2001 plot had H' and Effective Number of Species comparable to the oldest restoration although its richness was lower it had the second highest evenness of all four plots. It also had the second lowest richness. The unrestored Buckthorn area had the least amount of species richness. However, it does have the greatest amount of evenness. The Buckthorn exhibited the second lowest overall diversity.

Discussion.-- When compared to data collected during the previous year (Price et al. 2005), it is apparent that all of the study sites with the exception of 2003 have increased in diversity. All restoration plots were burned in March of 2005. Studies have shown that species richness experiences an initial decrease after burning, followed by a gradual increase (Moretti 2000). This could account for the increased diversity in both the 1996 and 2001 plots. However the 2003 plot decreased in diversity. This might be explained by the increase in herbaceous cover on the 2003 plot since the 2005 sampling. Ground-dwelling spiders are mobile predators that actively pursuit prey. Increase herbaceous cover may have resulted in increase prey abundance making it less necessary for spiders to travel great distances in search of food. Since pit-fall traps measure spider activity, reduced movement of the spiders would result in lower numbers of individuals and perhaps species encountering the traps. More study is suggest to investigate the relationship between herbaceous cover and litter spider diversity.

The buckthorn plot showed an increase in Shannon diversity over the 2005 data and also a greater diversity than the 2003 plot. This could be the result of the influence of a single dominant species (*Bathyphantes concolor*). When examining the richness for the buckthorn plot, it can be seen that it had less than half the richness of the other plots. Also, if the Bathyphantes data are excluded from the Shannon calculations for all plots, the buckthorn plot shows the lowest Shannon diversity.

This study found two exotic species of spider to be common in McDonald Woods (*Trochosa ruricola and Ozyptila praticola*) (Figure 4 & 5). While *T. ruricola* could be found in multiple sites, *O. praticola* was observed primarily in the unrestored Buckthorn site. This suggests that *O. praticola* could be used as an indicator species found in disturbed, unhealthy habitats.

Figure 4. Ozyptila praticola.

Figure 5. Trochosa ruricola

Literature Cited.

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