

Response of Ground-dwelling Spider Populations to Oak Woodland Restoration

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Aysha gracilis



Schizocosa ocreata



Ozyptila monroensis



Abstract

Ecological restoration efforts rely on the monitoring of indicator species to gauge restoration success. With their position at the top of the litter layer food web, ground-dwelling spiders may serve as indicators of the health of the woodland litter layer and nutrient cycling process. Pitfall trapping in four terrestrial sites representing a restorational gradient in an oak woodland in Cook County, Illinois during the summer of 2005 yielded over 1000 individuals from 33 species and 9 families. Species diversity (H'), richness (S), and evenness (J') were significantly higher in restored areas than in an unrestored control, independent of restoration age. Twenty-three species were unique to restored sites and the number of families present increased from four in the unrestored site to eight in restored sites. The recovery of ground-spider biodiversity occurred in as little as two years after restoration initiation and may suggest positive recovery of the litter food web, nutrient cycling, and overall forest health. This study suggests the value of including ground-spider monitoring in restoration management as they are indicative of litter layer and nutrient cycling function.

Ozyptila praticola



Introduction



Figure 1. Degraded woodland in Mary McDonald Woods.

Clarke and Grant 1968; Lawrence and Wise 2000). Therefore, ground-dwelling spiders are likely to be good indicators of the health of the nutrient cycling system and can be used to monitor success of restoration efforts (Longcore 2003).

Monitoring and management in Mary McDonald Woods (Figure 4) has been ongoing since restoration efforts including controlled burning, removal of exotic species, and re-establishment of native plant species were initiated in 1989. To evaluate the effects of restoration on the litter food web in Mary McDonald Woods, ground-dwelling spider species assemblages were compared among three sites comprising a chronosequence from 1996-2003 and a fourth control site by means of pitfall trapping. Species diversity, richness, and evenness, as well as familial composition of the populations were compared.

Anyphaena sp.



Methods

Study Site. The sites used for this study are located at the Chicago Botanic Garden in the Mary McDonald Woods in Cook County, IL. Restoration in this area's oak woodland was begun in 1989 and the four sites were chosen to represent different ages of restoration. Each plot was identified according to the initiation of its restoration—1996, 2001, and 2003—and a fourth unrestored, buckthorn dominated control plot. All restored plots were subject to a controlled burn in March/April, 2005.

Sampling. At a random location within each site, five pitfall traps were arranged in a 20 meter diameter circular array, filled with a water and detergent solution, and covered by a 22cm translucent square 2.5cm above the soil surface. All traps were installed on June 20, 2005 and checked regularly until August 3, 2005. All adult spiders were identified to species. Juveniles and individuals not identified to species were not included in data analysis.

Results

A total of 1,044 ground-dwelling spiders belonging to 33 species and 9 families were trapped in the four study sites (Handout). One of these species, *Scotinella madisonia*, had not been previously documented in Illinois (Figure 2). Species richness, evenness, and diversity were significantly lower in the unrestored site than in all of the restored sites (Table 1). All of the restored sites were also more similar to one another, having more species in common, than they were to the unrestored site (Table 1). The restoration age of the three restored sites had no significant affect on species richness or diversity (Table 1).



Figure 2. *Scotinella madisonia*.

Species compositions of all restored areas were significantly different from the species composition of the unrestored site ($P < 0.05$). Twenty-three species were unique to the restored sites including three prairie specialists—*Castianeira variata*, *Scotinella madisonia*, and *Drassyllus depressus*. No species were unique to the unrestored site (Handout).

Of the four families present in the unrestored site, 80% of the species captured belong to the Linyphiidae and Lycosidae families (Figure 3). In all of the restored sites, the number of families present was greater than in the unrestored site (Figure 3). Families including Anyphaenidae, Clubionidae, Gnaphosidae, and Salticidae, present in one or more of the restored sites, were absent from the unrestored site.

Sites:	1996	2001	2003	Unrestored
1996	--	0.65	0.68	0.54
2001	13	--	0.63	0.59
2003	15	12	--	0.45
Unrestored	9	8	7	--
H'	1.68	1.84	1.96	0.60
S	24	18	22	10
J'	0.58	0.65	0.64	0.26

Table 1. The number of shared cursorial species between habitats, percent similarity based on number of species held in common (bold), and species diversity (S = richness; J' =evenness; H' =Shannon Weiner diversity index) for each habitat on pit trap samples. Sites arranged in order of decreasing age of restoration from left to right and top to bottom.

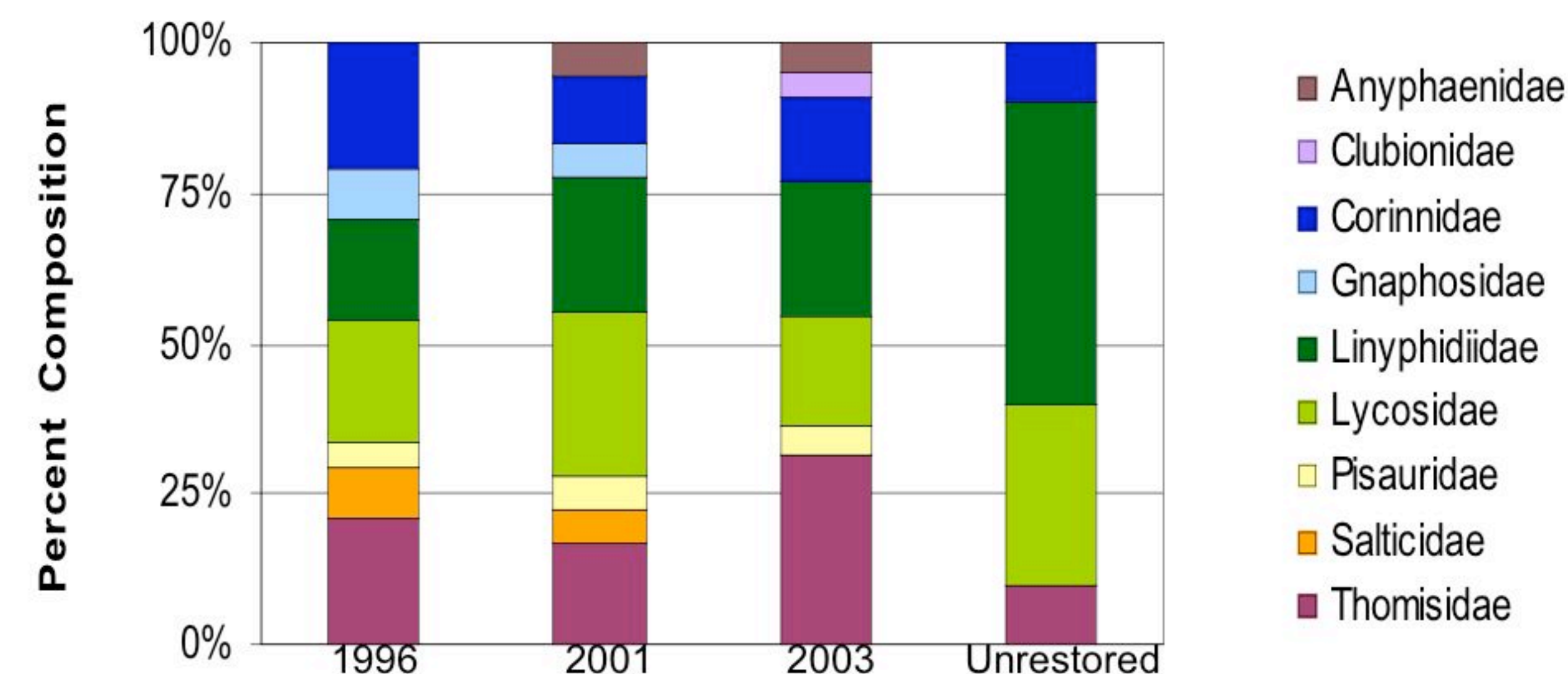


Figure 3. Composition of spiders by family in the four study sites. Sites arranged in order of decreasing age of restoration.

Discussion

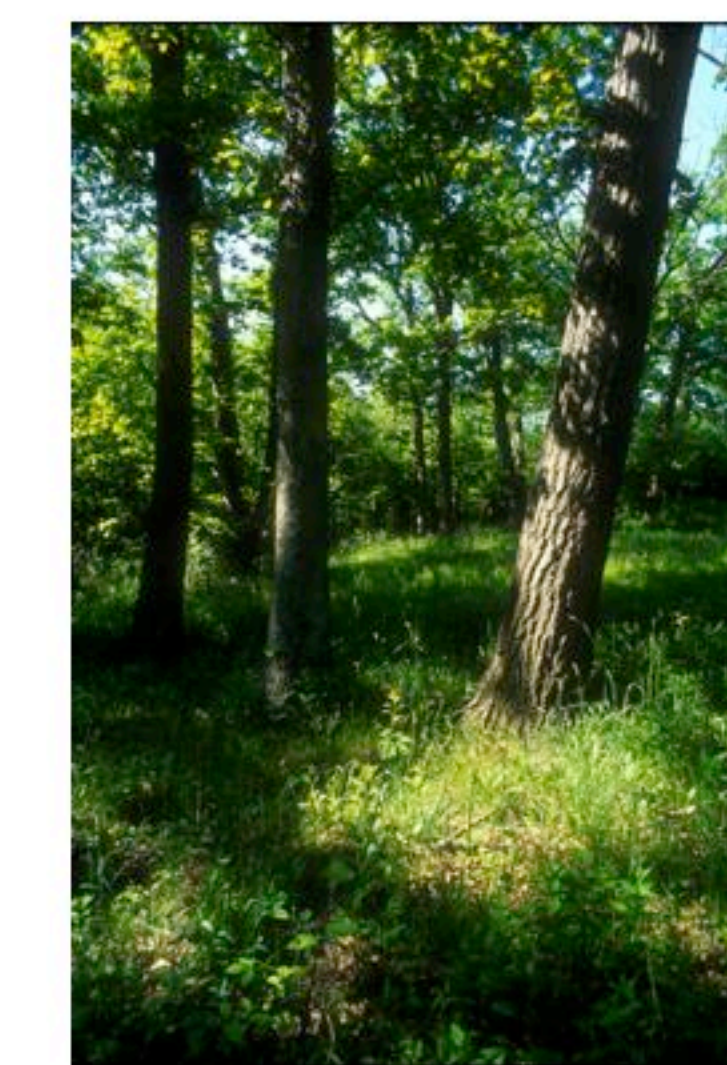


Figure 4. Restored oak woodland in Mary McDonald Woods.

Ground-dwelling spider populations increased in species richness, evenness, and diversity as a response to restoration. Restored areas exhibit increased floral and litter complexity, which has been correlated with increased species diversity, and no doubt plays a factor in this case (Uetz 1979; Coyle 1981; Lowrie 1948). These changes occurred as little as 2 years after restoration initiation and persisted with continuing restoration efforts. Restoration success of litter communities may also vary depending on management, specifically with frequency of controlled burning (Brand 2002).

The increased diversity of the spider population indicates that the litter food web and its associated processes of decomposition and nutrient cycling are likely improving. High abundance of *Pirata minutus*, a species of open habitats, is indicative of the improved light penetration in the restored areas. The presence of prairie specialists in only restored areas suggests positive recovery of the woodland/savanna conditions known to have occurred in this area of McDonald Woods historically. These species were not found in a previous 12 month inventory of spider fauna in five other unrestored sites in McDonald Woods, further supporting that these species are indicative of restoration success (Steffen, unpublished data). It remains unknown, however, if the species composition of restored areas is comparable to that of the area prior to its degradation.

In summary, this study shows that cursorial spider populations undergo significant increases in biodiversity in a relatively short time after restoration initiation, possibly indicating that the functionality of litter layer processes also rapidly improve. Therefore, restoration management and monitoring efforts should be expanded to include spider populations as bioindicators of overall forest health.

Bathypantes concolor



Acknowledgements

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Gnaphosidae sp.

