The Influence of Variation in Litter Habitats on Spider Communities

George W. Uetz

Department of Biological Sciences, University of Cincinnati, Cincinnati, Ohio 45221, USA

Summary. Spider communities were sampled over an artificial gradient of litter depth (created by raking) and compared to those of two other forests exhibiting natural variation in litter depth. More species of spiders were present in areas of greater depth and/or complexity in all sites. Relative abundance of Lycosidae decreased, while relative abundance of Clubionidae, Thomisidae and Gnaphosidae increased over gradients of increasing depth and complexity. Similarity of species composition between areas within a forest was related to site differences in litter depth and structure.

As litter depth increased, there were significant changes in prey species richness, litter complexity, and microclimate. Partial correlation analysis of grouped data from early-, mid-, and late season suggests that influential factors change with season. In the early season, prey abundance and temperature variation account for most of the variation in spider species richness. In mid-season, litter complexity and moisture fluctuations appear to influence richness, with complexity relatively more important. In late season, complexity and temperature range were the primary factors, with temperature relatively more influential. The relative importance of these factors in influencing community structure of spiders is discussed.

Introduction

The spider fauna of leaf litter may be divided into various guilds (Root, 1973) based on methods of prey capture and utilization of similar prey resources. One guild, the wandering spiders, may constitute upwards of 43% of ground dwelling spider species in a forest (Drew, 1967), and accounts for a majority of the biomass of spiders (Moulder and Reichle, 1972). These spiders do not use webs in prey capture, but use a "sit-and-wait" foraging strategy, with frequent changes of site (Ford, 1977; Edgar, 1969). Their prey consists mainly of Collembola, Homoptera and small Diptera (Breymeyer, 1966; Edgar, 1969; Moulder and Reichle, 1972). The wandering spider guild includes the families...
Clubionidae, Gnaphosidae, Lycosidae, and Pisauridae, Thomisidae, and some representatives of the Agelenidae and Hahniidae. Enders (1976) has suggested that this group be subdivided into numerous guilds, based on reproductive characteristics and presumed differences in foraging speed. Data on foraging strategies in most spiders are scarce or non-existent, and at this time it is difficult to separate them beyond the original designation of wandering, jumping and web-spinning spiders, as suggested by Balogh and Loksa (1948).

Previous studies have demonstrated that differences in litter type (mull vs mor; maple-beech vs oak) are accompanied by differences in the composition of the spider fauna (Lowrie, 1948; Berry, 1967; Jocque, 1973). Hagstrum (1970) found that litter depth affects spider abundance, with the greatest numbers of individuals occurring in the deeper litter.

In studies of two temperate deciduous forests (Illinois and Delaware), I observed that spider diversity and species richness were correlated with depth and interstitial volume of litter. In this study, I created an artificial gradient of litter depth in an Illinois forest and sampled it periodically for changes in number of species and individuals. The results were compared with those of two other pitfall studies in forests exhibiting natural variation in litter depth (Uetz, 1975, 1976). Changes in species richness and composition were related to variation in aspects of the litter environment likely to change with litter depth (prey abundance, diversity, microclimate, etc.). The guild of cursorial spiders was chosen for this study because of their dominance in forest litter microcommunities over a wide range of habitat types (bare soil to complex litter) and because their wandering habit implies independence from use of habitat structures in prey capture (i.e., web site architecture).

Methods

This research involves 3 studies, separated in space and time, but similar in methodology. Wandering spiders were collected by pitfall trapping over an artificial gradient of litter depth in an Illinois forest, and in 2 other forests (one in Illinois and one in Delaware) exhibiting a wide range of variation in litter depth. The Delaware forest is an Oak-Tuliptree-Maple forest, located on the University of Delaware Agricultural Experiment Station Farm in Newark, Delaware. The forest is mesophytic, and is on level to gently rolling topography. Litter variation in the Delaware woodlot was primarily due to varied species composition and leaf structure in each site. More detailed information on this study area is available in Uetz (1975).

One Illinois field study took place in a streamside forest at Robert Allerton Park near Monticello, Illinois, on the Sangamon River. The study area consists of ca. 1.6 hectares of shallowly sloping flood plain and gradually rising topography. The elevational gradient from the river bank to the uplands provides a continuous forest gradient over decreasing annual flood frequencies (25% at bank level to 0% in the uplands). Forest composition, litter depth and litter structure are all affected by the frequency and duration of flooding at each level. Flood plain areas are dominated by silver maple, while upland areas are dominated by white and black oak. A transition zone exists between them, with representative species from each area, in addition to shingle oak and hackberry. Further information on the study area can be found in Uetz (1976).

The Hart Memorial Woods, owned by the University of Illinois, located along the East bank of the Sangamon River near Mahomet, in Champaign County, Illinois, was the site of the experimental litter study. A recent survey (Root et al., 1971) describes the upland area as somewhat xerophytic, covered by a mixed stand of *Quercus alba* L. (white oak), *Q. velutina* Lau. (Black oak), and *Q*