NATURAL MORTALITY OF GARLIC MUSTARD *(Alliaria petiolata* (Bieb.) Cavara & Grande) ROSETTES

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Garlic mustard (*Alliaria petiolata* (Bieb.) Cavara & Grande) is a biennial European herb that invades natural areas in the eastern United States (Nuzzo 1993a). *Alliaria petilolata* (henceforth referred to as *Alliaria*) seeds germinate in early spring (Cavers et al. 1979). Seedling density in heavily infested areas ranges from 2200 to 5080/m^2 in northern Illinois (Nuzzo unpubl. data) to 20,000 seedlings/m^2 in Ohio (Trimbur 1973). Cavers et al. (1979) recorded seed production of 62,640 seeds/m^2 in a dry deciduous forest, and estimated that 5% to 9% of seeds would germinate; hence, seedling densities of 3100 to 5600/m^2 could be expected. Seedlings experience 41% to >50% mortality by late spring (Trimbur 1973, Cavers et al. 1979), and attrition continues through summer, fall, and winter; Cavers et al. (1979) indicated that approximately 2% to 4% of seedlings survive to produce flowers the following year.

This study was undertaken to investigate natural overwinter mortality, and to predict total mortality, of *Alliaria* plants, with results applied to timing of control activities.

Two 50-m transects were randomly located within each of three plots established in a degraded dry-mesic upland forest in northern Illinois. Rosette density was recorded within 0.5-m^2 permanent quadrats located at 5-m intervals along each transect, for a total of 20 quadrats/plot. Rosette density was recorded in November 1989 and May 1990. Density counts were tested for homogeneity of variance by Cochran's C test; all were homogenous ($P > 0.05$). Similarity among plots within each season was tested using one-way ANOVA. Both data sets were homogeneous, and therefore plots were pooled by season for analysis with paired t-tests and simple linear regression using Statgraphic software.

In November 1989 rosette density averaged 186.4/m^2 (±85.1). Fall density was highly variable, ranging from 50 to 466 rosettes/m^2. By the following May, rosette density declined significantly ($t=12.8407$, $df=118$, $p < .001$) by 78.6%, to an average of 39.9/m^2 (± 23.8), with actual density varying from 4 to 102/m^2. Over-winter mortality was partially density dependent ($r^2=9.24$, $F=5.9027$, $df=59$, $p=0.0182$) with fall density accounting for 9% of the total variance between fall and spring densities.

Mean seedling density was not recorded in spring 1989. Using a conservative estimate of seedling density derived from Nuzzo (unpubl. data) and Cavers et al. (1979), *Alliaria* mortality from April to November 1989 exceeded 95%, from an estimated 4000 seedlings/m^2 in spring to a mean of 186.4 rosettes/m^2 in fall. Continued attrition during winter reduced rosette density an additional 79% to a mean of 39.9 adults/

m^2 the following spring. Consequently, overall mortality approximated 99%, with 1% of the seedlings surviving to maturity. This survival rate is somewhat lower than the 2% to 4% survival rate indicated by Cavers et al. (1979) for areas in Ontario, Canada.

Control of *Alliaria* is achieved by preventing seed production (Nuzzo 1991a). Because growing season mortality reduces the population by >95% in the first eight months, implementation of active control should be delayed until late fall. Exact timing of control, late fall or early winter, is dependent on the method chosen. Labor intensive methods, such as hand removal of plants or cutting of the flowering stalks, are more efficiently conducted in spring when adult populations are lowest. Weather-dependent control, such as prescribed burning, is equally effective in fall as in spring (Nuzzo 1991a, 1993b) and should be implemented when conditions permit. Chemical control with 2% Roundup reduces *Alliaria* populations equally in both fall and spring, but appears to have a greater impact on some native species when applied in spring (Nuzzo 1991b). Although a larger volume of herbicide is needed to treat a larger rosette population in the fall, the lower risk to the community may make fall a more suitable treatment period.

LITERATURE CITED

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