

Project FY91-007

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July 31, 1991

William Glass
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100 First National Bank Plaza, Suite 205
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Dear Mr. Glass

Enclosed is my final report for the nongame project entitled "Demography of Threatened Plant Species of Thorn Creek", along with a copy of an abstract published in the American Journal of Botany and slides of *Veronica scutellata* and *Corallorhiza maculata*. The itemized bill is being sent separately.

Sincerely,

A handwritten signature in cursive script that reads 'Timothy J. Bell'. The signature is written in dark ink and is positioned above the typed name.

Timothy J. Bell
Assistant Professor of Botany

Demography of Threatened Plant Species of Thorn Creek

Final Report

Timothy J. Bell

Introduction

The 1986 master plan of Thorn Creek Nature Preserve, conducted by the Illinois Department of Conservation, states that monitoring and research needs include the study of endangered and threatened species of Thorn Creek. Plant species classified as threatened in Illinois (Bowles, 1981) that reportedly occur at Thorn Creek Nature Preserve include Marsh Speedwell (*Veronica scutellata* L.), Schreber's Aster (*Aster schreberi* Nees), and Spotted Coral-Root Orchid (*Corallorhiza maculata* Raf.). Taxonomy follows Gleason and Cronquist (1963).

The population of *Veronica scutellata* at Thorn Creek Nature Preserve has been monitored since 1987. Observations over three growing seasons indicate that the population size fluctuates greatly from year to year. Although a total of 20 individuals of *Corallorhiza maculata* were located in Thorn Creek Nature Preserve in 1987, none were found in either 1988 or 1989. No stands of *Aster schreberi* were located in 1987, 1988, or 1989. These observations indicated that the Thorn Creek population of *Veronica scutellata* may be in danger of extinction and that *Aster schreberi* and *Corallorhiza maculata* may have already been lost from the preserve. Additional searches were required in order to determine whether the original stand of *Corallorhiza maculata* returned and whether stands of *Aster schreberi* could be located. Continued monitoring of *Veronica scutellata* was needed in order to determine the degree of fluctuation in population size and whether it is a normal occurrence.

Very little is known about the habitat requirements and natural history of these three species. In order for conservation and management strategies to be successful it is necessary to determine the reproductive biology of this species and the characteristics of the habitats in which it is found. Demographic information collected can be used to determine whether the populations are declining, stable or growing (Pavlik, 1987).

The specific objectives of this project were to determine, for each species, the: number and location of populations in Thorn Creek Nature Preserve; number of individuals per population; survivorship of individuals; number of flowers, fruits and seeds produced per individual; recruitment of new individuals; phenology of growth and reproduction; and the habitat requirements.

Materials and Methods

During the summer of 1990 a survey of Thorn Creek Nature Preserve was undertaken in order to determine the number and location of populations of the three species. No individuals of *Aster schreberi* were located. Individuals of *Corallorhiza maculata* were located and marked. The number of fruits and flowers was determined for each individual.

The larger numbers of individuals and longer growing season of *Veronica scutellata* allowed for a much more detailed study. In 1989, ten 20 cm x 50 cm plots were established in order to conduct demographic observations. An additional 39 plots were established at the end of the growing season in 1990. In order to determine the seed bank of *Veronica scutellata*, soil samples were collected adjacent to each plot in 1989 and 1990. The soil samples were spread over sterilized soil in 10 cm x 10 cm pots and placed in trays where the soil was kept saturated to mimic marsh conditions. The number of *Veronica scutellata* seedlings emerging were counted.

In 1989, 1990 and 1991 the number of individuals per plot were counted. In 1990 and 1991 each individual found in the plots was marked with an aluminum tag and observations were made throughout the growing season for seedling emergence, survivorship and reproduction.

Soil samples were collected from the *Corallorhiza maculata* and *Veronica scutellata* sites in November, 1990, April, 1991, and June, 1991. On each date three soil samples were collected from each site using a bulb corer with a 5.7 cm diameter. The soil samples were analyzed by Top Soil Testing Service in Frankfort, IL, for nitrogen, phosphorus, potassium, calcium, and magnesium concentrations as well as for pH, cation exchange capacity, and percent organic matter.

Results

No individuals of *Aster schreberi* have been located in Thorn Creek Nature Preserve by Bell, but the preserve's naturalist, Ms. Cherrie Robeson, recently informed me that *Aster schreberi* was observed by another individual in 1990. I will attempt to locate these plants during the 1991 growing season.

A total of 33 individuals of *Corallorhiza maculata* were located in 1990. Twenty-seven of these individuals produced flowers. The number of flowers per individual ranged from 0 to 24 with an average of 11.5. The average number of fruits per plant was 9.0.

The population of *Veronica scutellata* at Thorn Creek Nature Preserve has been monitored since 1987. Observations over three growing seasons indicate that the population size fluctuates greatly from year to year. In 1988 the population was represented by only 26 shoots, which may have represented a single individual. Although over 1000 fruits were observed on these shoots, a majority of them appeared lack viable seeds. In 1989, over 2000 shoots were observed at the Thorn Creek site and a demographic study was begun. The average density dropped from 152 plants/m² in 1989 to 92 plants/m² in 1990. In 1990 there was an estimated seed pool of 1816 seeds/m², which was only 5% of the seeds produced in 1989 (Figure 1, Table 1). 308 seedlings/m² emerged in 1990 (17% of the seed pool). Reproduction occurred in only 11% of the plants (Table 2) and an estimated 2162 seeds/m² were produced in 1990. 3% of the plants survived to the end of the 1990 growing season, but these did not survive through the winter. The seed pool for 1991 was estimated to be 993 seeds/m² (46% of the seed production). Seedling emergence so far in 1991 is 93 seedlings/m², which is 9% of the seed pool. The current average density for 1991 is 61 plants/m². Most of the plants present in the population during any growing season appear to be recruited from the seed pool rather than from plants that survive for more than one year. Flower, fruit and seed production per plant was higher in 1989 than in 1990 (Table 2).

The soil characteristics of the *Veronica scutellata* and *Corallorhiza maculata* sites are similar (Table 3). The marsh where *Veronica scutellata* is located is slightly more acidic than the forest where *Corallorhiza maculata* is found. The marsh also contains less nitrogen, more phosphorus and has a higher cation exchange capacity.

Table 1. Demographic data for *Veronica scutellata* (mean \pm SE)

	1989	1990	1991
Expected emergence (seedlings/m ²)		1816 \pm 785	993 \pm 218
Observed emergence (seedlings/m ²)		308 \pm 71	93 \pm 16
Density (plants/m ²)	152 \pm 32	92 \pm 15	61 \pm 7
Survivorship (%)	76 (N = 21)	4 \pm 2 (N = 143)	
Seeds/plant	424 \pm 212	64 \pm 10	
Seeds/m ²	35410	2162 \pm 796	

Table 2. Flower, fruit, and seed production for *Veronica scutellata* (mean \pm SE)

	1989	1990
N (number of plants)	121	159
Number of flowers / plant	57 \pm 5	19 \pm 3
Number of mature fruits / plant	20 \pm 2	12 \pm 2
Number of seeds / plant	109 \pm 10	64 \pm 10
Percent of plants reproducing		11

Table 3. Soil characteristics of *Veronica scutellata* and *Corallorhiza maculata* sites at Thorn Creek Nature Preserve. Means are for three samples each collected November 30, 1990, April 9, 1991, and June 13, 1991.

	<i>Corallorhiza maculata</i>		<i>Veronica scutellata</i>	
	mean	SE	mean	SE
pH	6.23	0.17	5.52	0.04
buffer pH	6.74	0.07	6.06	0.03
hydrogen (%)	21.24	5.26	48.53	1.40
nitrate nitrogen (ppm)	7.68	2.04	5.01	0.48
phosphorus (#/acre)	17.6	1.4	28.2	2.1
potassium (#/acre)	237.8	16.9	262.2	12.3
potassium (%)	2.38	0.22	1.62	0.07
calcium (ppm)	1575.3	235.3	1446.2	42.8
calcium (%)	54.93	4.17	35.14	0.97
magnesium (ppm)	361.6	49.5	363.1	15.1
magnesium (%)	21.46	1.46	14.69	0.53
organic matter (%)	7.12	0.45	7.44	0.30
cation exchange capacity (meq/100 g)	13.90	1.24	20.59	0.26

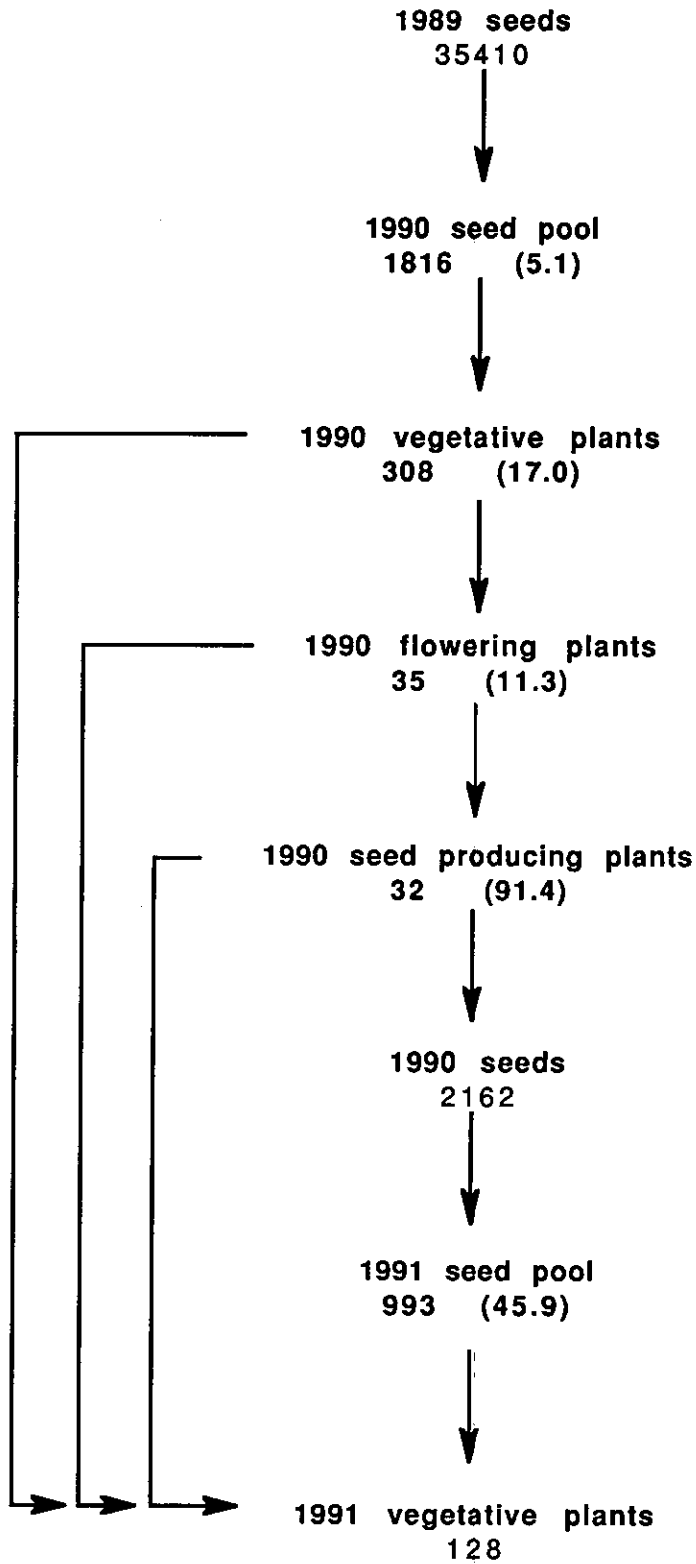


Figure 1. Flow chart of the estimated density (number/m²) of individuals in each stage for *Veronica scutellata* at Thorn Creek. Numbers in parentheses represent the percentage of the previous stage. Numbers in bold are those for which there is greater confidence.

Discussion

The absence of *Corallorhiza maculata* during the summer of 1988 appears to be related to the extremely dry weather conditions experienced during that summer. *Corallorhiza maculata* is a saprophytic orchid with underground perennating structures and may simply not produce aboveground reproductive shoots during poor years. The absence of this species during the summer of 1989 is more difficult to explain since the weather conditions were more ameliorable. A possible explanation is that the individuals were still recovering from the previous year's drought. Although *Corallorhiza maculata* is a perennial, it is difficult to accurately determine the population size because aboveground shoots are only produced during reproductive years. In some saprophytic orchids aboveground reproductive shoots are produced only once every 7 years (Stoutamire, personal communication). This population will continue to be monitored. Individuals that appeared in 1990 were marked in order to determine how often individuals of *Corallorhiza maculata* produce aboveground reproductive shoots and whether those individuals that appear in subsequent years are the same as those that appeared in 1990.

Although no stands of *Aster schreberi* have been located in Thorn Creek Nature Preserve by Bell, at least one stand has been reported by another investigator so this species is apparently not extinct in Thorn Creek Nature Preserve. I will attempt to locate these plants during the 1991 growing season in order to determine the population size, amount of reproduction, and habitat requirements.

This short term study indicates that the Thorn Creek population of *Veronica scutellata* is not stable, but observation for a greater number of years is necessary in order to determine whether the population is growing or declining. The trend over the last three years is a decline in density. The variation in population size and density from year to year appears to be related to the amount of moisture available, since 1988 had the lowest observed population size and was also a year exhibiting extremely dry weather conditions. The population is smaller again in 1991 and rainfall is low again. The population has the ability to recover after a year of low seed production, as indicated by the large number of shoots in 1989, but it is not yet clear how long seeds remain in the seed pool and therefore whether the population has the ability to recover from frequently repeated exposure to drought. A seed pool study in which a known number of seeds is placed in the marsh is planned for the current growing season in order to determine the longevity of seeds under natural conditions.

Because small population size and wide fluctuation in population size can result in local extinction it is important to continue to monitor the Thorn Creek population of *Veronica scutellata*. It is also important to determine the population size and dynamics of other Illinois populations of *Veronica scutellata*. A small project proposal for this purpose has been submitted to the Illinois Department of Conservation for FY92.

Literature Cited

- Bowles, M. L. 1981. Endangered and Threatened Vertebrate Animals and Vascular Plants of Illinois. Illinois Department of Conservation.
- Gleason, H. A., and A. Cronquist. 1963. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. D. Van Nostrand Co., New York.
- Pavlik, B. M. 1987. Attributes of plant populations and their management implications. In Conservation and Management of Rare and Endangered Plants, T. S. Elias, ed. California Native Plant Society, Sacramento.

Summary

Populations of three threatened plant species reported to occur in Thorn Creek Nature Preserve appeared to be either extinct or fluctuating widely with the possibility of extinction in the future. No stands of Schreber's Aster (*Aster schreberi* Nees) have been located in Thorn Creek Nature Preserve by Bell, but at least one stand has been reported by another investigator so this species is apparently not extinct in Thorn Creek Nature Preserve. A population of Spotted Coral-Root Orchid (*Corallorhiza maculata* Raf.) has been monitored since 1987. Twenty individuals of *Corallorhiza maculata* were located in Thorn Creek Nature Preserve in 1987, none were found in either 1988 or 1989, and 33 individuals were located in 1990. *Corallorhiza maculata* has underground perenniating structures and may simply not produce aboveground structures during poor years. The population of Marsh Speedwell (*Veronica scutellata*) at Thorn Creek Nature Preserve has been monitored since 1987. Population size fluctuates widely, apparently in response to moisture. The population has the ability to recover after a year of low seed production, but additional study is required to determine how long seeds remain in the seed pool and whether the population has the ability to recover from frequently repeated exposure to drought.

hypnoides seeds come out of dormancy during burial in flooded than in nonflooded soil. Seeds can germinate at any time during the growing season, whenever the water recedes, because they do not re-enter dormancy. These germination responses are an important ecophysiological adaptation of mudflat species to their temporally unpredictable habitat, and a knowledge of them is a key to understanding the dynamics of the mudflat community.

125

BELL, TIMOTHY J. Department of Biological Sciences, Chicago State University, Chicago, IL, 60628. - Demography of *Veronica scutellata*, an Illinois state threatened species.

Veronica scutellata L. (Marsh Speedwell - Scrophulariaceae) is a rhizomatous perennial found in wet habitats throughout the northern two-thirds of the temperate zone of North America. It is classified as a state threatened species in Illinois because there are only six populations in the state. The purpose of this study was to determine whether the population at Thorn Creek Nature Preserve in Will County, IL, is declining, stable or growing. Observations over three growing seasons indicate that the population size fluctuates greatly from year to year. The number of individuals has been as low as 26 individuals in 1988, when there were extremely dry weather conditions, and over 2000 in 1989. The average density was 152 plants/m² in 1989 and 90 plants/m² in 1990. In 1990 there was an estimated seed pool of 1816 seeds/m², which was only 3% of the seeds produced in 1989. 310 seedlings/m² emerged in 1990 (17% of the seed pool). Reproduction occurred in only 10% of the plants and an estimated 3930 seeds/m² were produced in 1990. 3% of the plants survived to the end of the 1990 growing season. Most of the plants present in the population during any growing season are recruited from the seed pool rather than from plants that survive for more than one year. This short term study indicates that the population is not stable, but observation for a greater number of years is necessary in order to determine whether the population is growing or declining. The variation in population size and density from year to year appears to be related to the amount of moisture available. The population has the ability to recover after a year of low seed production, but it is not yet clear how long seeds remain in the seed pool and therefore whether the population has the ability to recover from frequently repeated exposure to drought.

126

BERTIN, ROBERT I.* AND PAUL PETERS. Department of Biology, Holy Cross College, Worcester, MA 01610. - Paternal effects on offspring quality in *Campsis radicans*.

We investigated paternal effects on seedling performance in a series of 14 experiments with different combinations of pollen donors and recipients in *Campsis radicans*, in relation to patterns of selective fruit abortion. In eight of the experiments significant paternal effects on three or four dependent performance variables were detected by multivariate analysis of covariance. These effects were independent of seed weight, which was controlled in the experimental design or in the statistical analysis. In six of the eight experiments with significant results, the donor that was favored as a pollen recipient produced the more vigorous offspring. In general, therefore, patterns of fruit abortion with respect to outcross donor enhance progeny fitness, although this benefit may be reduced when pollen from several outcross donors is deposited on the same stigma, a likely occurrence in nature. The ability to distinguish among pollen or seeds of different outcross pollen donors is probably less important than the ability to distinguish between self and outcross pollen, and may be an incidental result of selection to allow the latter discrimination.

127

BIER, JAMES. Department of Biology, Indiana University, Bloomington, IN 47405. - Influence of fungal endophytes on the demography of two woodland grasses.
The relationships between grasses (Gramineae) and parasitic fungi (Clavicipitaceae) span the continuum between antagonistic and