

Chicago Botanic Garden
Illinois Department of Natural Resources / Illinois Wildlife Preservation Fund
Report
Increasing Seedling Recruitment in Populations of *Lespedeza leptostachya* in Illinois
Contract # RC07L01W
For September 18, 2006 to December 31, 2009

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Introduction: *Lespedeza leptostachya* was discovered in Dixon, Illinois in 1981. At that time, there were two subpopulations with a total of 125 plants. In 1986, the Nature Conservancy eliminated grazing on the preserve in 1986, a standard practice throughout the range of *L. leptostachya*. Afterwards, the population exploded to a total of 585 plants across seven subpopulations. Since then, however, the population has been declining. This pattern has been found on sites throughout the range when grazing has been suspended (Nancy Sather, pers. comm.) Using an adaptive management framework, funds were requested to increase the viability of this metapopulation through application of a grass-specific post emergent herbicide (e.g. Poast, Assure II). The recovery target would be a population of more than 500 plants following each of the two growing seasons in this project and, in the long-term, for at least a ten-year period. The effects of this management strategy on adult survival and reproduction will be monitored, as well as juvenile recruitment and survivorship, to inform future management applications. This activity will be conducted over two growing seasons and would include an assessment of the status of managed versus unmanaged subpopulations.

Methods: In 2006, grass-specific herbicide was applied to 15 treatment plots at Nachusa Grasslands. Plots as well as individual plants were monitored both before and after treatment application. Additional treatment and control plots have been added, a total of 90. As of the end of the 2009 field season, a grand total of 415 marked individuals have been identified, marked, and mapped. Data on individual plant performance (height, number of flowers, and number of seeds) are recorded. Plot level responses are also observed, with percent cover of all species recorded. Grass response to herbicide treatment is recorded by measuring the height at five points in each plot (each corner and at the center).

Results: Not all plants make an above-ground appearance in each year, and many seedlings do not survive to the following year. Only a full demographic analysis will be able to distinguish between plant death, and year-to-year dormancy of individuals. However, from 2005 to 2008 (the last year for which full census data are available), the number of total individuals at the Nachusa Grasslands increased from 458 to 598. This represents the total population of the species at Nachusa Grasslands during these years. The increase in plants censused from 2005 to 2008 is likely due to a confluence of factors, including favorable rainfall, consistent prescribed burning as well as the experimental management of using Poast herbicide to decrease grass competition.

A preliminary demographic model suggests that the population at Nachusa Grasslands has a high probability of persisting for a minimum of 50 years under the current management regime, particularly when periodic applications of Poast are used to increase seedling establishment, all other things being equal. Detailed demographic models will enable us to determine the optimal time between management treatments for population growth versus population persistence.

Experimental Results: A total of 415 marked individuals in 90 meter²-plots centered on focal reproductive adults (45 control plots and 45 plots treated with Poast grass-specific herbicide) have been monitored to determine the efficacy of management. **A greater number of new plants are found in treated plots (Treatment Plots = 43 new plants versus Control Plots = 14; August 2008). In addition, significantly more new seedlings have been found in the plots treated with Poast than those left untreated (Treatment: 15, Control: 1 in August 2008). It appears that grass competition inhibits recruitment of both seedlings and juveniles (Goodness of Fit test $G=3.841459149$, d.f. = 1, $P=0.031704209$).** The data for August 2008 show the trend most clearly, as this year there was adequate rainfall in the spring, and the spring burning was consistent for all of the plots in the study, so the effects of the Poast treatment are particularly relevant. We plan to continue the treatments and monitoring of these plots. We will continue to take monitoring data on these plots a minimum of once yearly for the foreseeable future. We are finalizing data analysis on the data collected to-date, and will be modeling the demographic impacts of increased seedling recruitment to determine the effects of using Poast on population growth rates. We expect the results to show that this management activity, especially when combined with fire, is an effective tool in the recovery of this species. We will publish our results in *Biological Conservation* by the end of 2010.

Monitoring at Harlem Hills – In early summer 2005, a population of 39 *L. leptostachya* individuals was transplanted from the South Beloit Prairie INAI site to the IDNR-owned Harlem Hills Nature Preserve in Winnebago County after multiple years of protection efforts at South Beloit Prairie failed. By September of that year (2005) the translocation resulted in a total of 42 individual prairie bush clover plants growing at the site, as three previously unidentified plants emerged from the transplanted sod.

On September 7, 2006 we located all the transplanted *Lespedeza leptostachya* individuals that made an above ground appearance that visit, a total of 33 plants. We marked each individual with a numbered metal tag, and mapped the plants using a Trimble GeoXH handheld GPS device. Data on plant size, the number of branches, number of flowers and number of seeds were recorded. The translocation at Harlem Hill offers an unprecedented opportunity to answer a key reproductive question regarding seedling establishment. Since all individual transplanted plants are known from within the transplanted prairie sod, and no bush clover plants existed at the site previously, any new plants found outside of the transplanted sod will be first-year seedlings. It is hypothesized that high levels of intraspecific plant competition hinders seedling establishment and survival. Purposely, all former vegetation (i.e. Eurasian cool season grass sod) between donor prairie sod recipient cells was scraped and removed, leaving open soil between transplanted prairie sod. **As of 2009, a total of 27 plants were found at Harlem Hill to have survived. No new seedlings have been identified.**

Data on Seed Germination and individual plant growth rates: Courtney Gill, a graduate student at Northwestern University studying in CBG's joint program in Plant Biology and Conservation, has been looking at seed germination rates at different temperatures, as well as the effects of completion on seedling growth rates. She will finish a Master's degree and submit her final thesis by the close of 2010. Courtney's **preliminary results support the findings of the field data: seedling establishment and early growth rates are inhibited under competition with *Andropogon gerardii*.**

Genetic Study – Hybridization: Natural hybridization is common in the genus *Lespedeza*. No hybrids between *L. leptostachya* and *L. capitata* are formally recognized in any of the current floras, however observations in the field suggest that hybridization might occur in many of their shared habitats. Putative hybrids were compared to *L. leptostachya* and *L. capitata* using morphological measurements and screened for the presence of species-specific *trnL-F* gene region (cpDNA) and the ITS gene region (nrDNA). A discriminate analysis of 10 morphological measurements identified the hybrids as intermediate to both parents with two PCA axes explaining 99% of the variation between taxa. The presence of hybrids was confirmed by genetic markers with individuals morphologically identified as hybrids having cpDNA *trnL-F* genotypes identical to *L. leptostachya* and the ITS (nrDNA) phenotypes in most cases contain the ITS genotype of both parents, however, some putative hybrid individuals contained the ITS genotype of only one parents. Those individuals with *L. leptostachya* ITS and *trnL-F* could be a case of misclassification, but the presence of both *L. capitata* ITS genotypes and *L. leptostachya trnL-F* genotypes suggest segregation has occurred, which may result from either selfing or backcrossing.

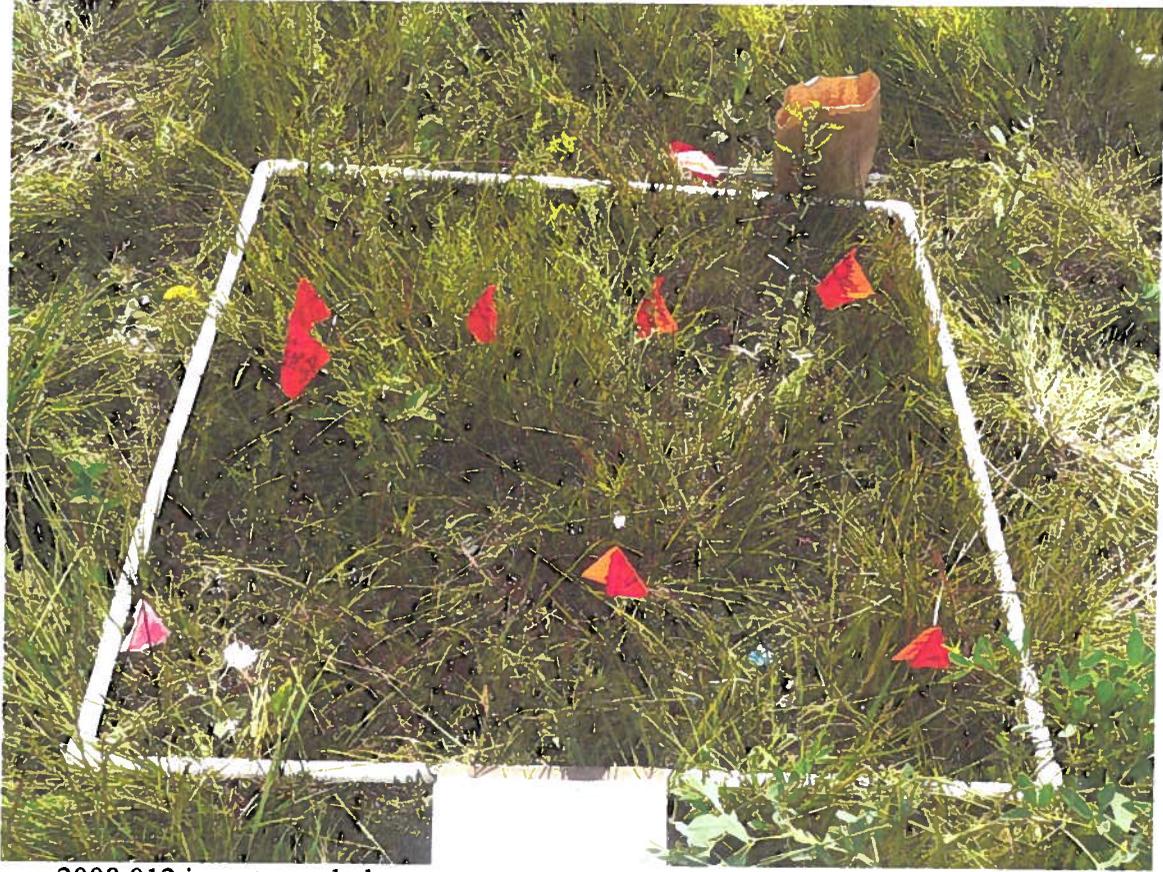
Population Genetic Structure Across Species Range: We have tissue collected across the range of the species, and DNA has been extracted from 274 leaf tissue samples collected. Originally, we thought that we would be able to use ISSR's to undertake a study on the population genetic structure of this species across its range. When we probed to find ISSR markers, we were not able to develop sufficient markers to determine population structure within sites, and thus have turned to using microsatellite markers instead. Samples of *Lespedeza* species from numerous populations in the Midwestern United States have been examined using various primer sets directed to microsatellite DNAs in an attempt to assess the health of the threatened *L. leptostachya*. Significant validation has been required to assess the conditions for which any of these primer sets might be usable for identification of genetic diversity in and between various populations. Analysis of PCR results has been both by agarose gel- and capillary electrophoresis. To date, DNA from approximately 274 samples has been isolated and is at various stages of examination. At this time, four primer sets appear promising; however, significantly more work remains to examine other primer sets and identify discrete haplotypes that descriptive of *leptostachya*, *capitata* and potential hybrids. Jeff Gorra, a trained molecular biologist, will continue working on this project as a volunteer.

Conclusions and Management Recommendations: We have found that treating plots with Poast significantly increases seedling establishment, particularly when the fire regime results in burning up the organic material left by *Andropogon.gerardii*: i.e., when there's more bare ground for the seeds to fall onto. It is also possible that smoke releases seeds from dormancy, as has been shown in other grassland species, and thereby increases germination. However, we have not had enough seeds to specifically test this. When there's been a good fire, and Poast is applied, there is no detrimental effect on *Lespedeza leptostachya* adults (there is on *L. capitata*, however), but there is a significant increase in the number of seedlings found.

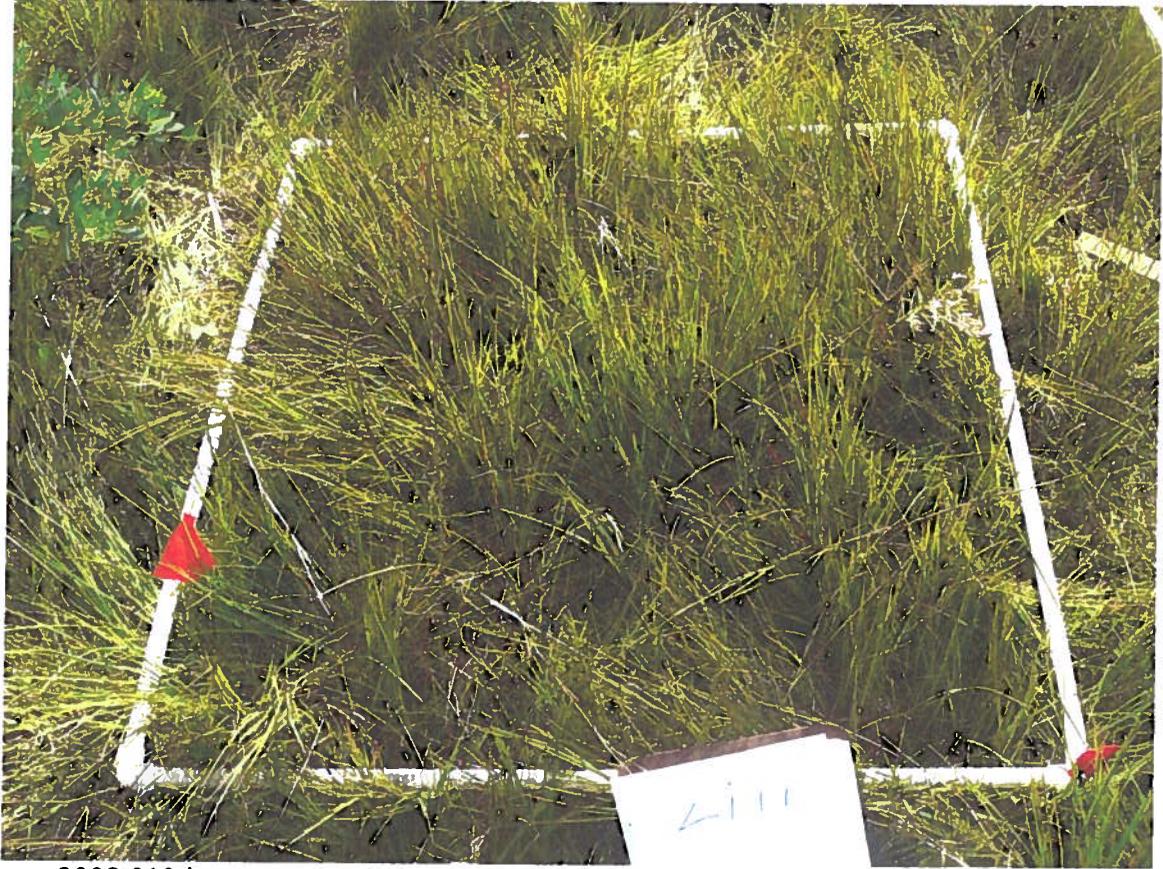
Literature

Bittner, T.; Kleiman, B. 1998. Population Trends and Mangement Requirements for the Federally-threatened Prairie Bush Clover (*Lespedeza leptostachya*) at Nachusa Grasslands. Oglesby, IL: Illinois Department of Natural Resources. p.15.

Bowles, M.L.; Bell, T. 1999. Establishing recovery targets for Prairie Bush-Clover (*Lespedeza leptostachya*). Lisle, IL: The Morton Arboretum and Chicago State University. p.10.



2008 012.jpg - treated plot



2008 013.jpg - untreated plot



2008 005.jpg - measuring plant height on a rare flowering individual



IMG_0398.jpg - the Nachusa Crew and Volunteers



IMG_0400.jpg - Alona Banai, Todd Bittner and unknown Nachusa seasonal collecting data in 2007



IMG_0496.jpg - putative hybrid between *L. leptoschya* and *L. capitata*,
demonstrated to occur by Alona Banai during her Master's work at Northwestern
University



IMG_0401.jpg - the Nachusa Crew and CBG students and volunteers collecting data along Pussy Toes lane



IMG_0403.jpg - the Nachusa Crew and CBG students and volunteers collecting data along Pussy Toes lane, Todd Bittner kneeling in foreground, taking data with Alona Banai (sitting). Bill Kleiman in the back, looking at the camera.