Environmental and reproductive factors influencing population size of the Illinois endangered species *Camassia angusta* (Wild Hyacinth)

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Abstract

Wild hyacinth (*Camassia angusta*) is a perennial species native to mesic prairies of the midwestern and south central United States. In Illinois, the only extant population of this endangered species is in a small section of degraded black soil prairie along a railroad track right-of-way south of Elwin, Macon County. The objectives of this research were to determine the population status, seed production, and germination requirements of *C. angusta* of this population. The population was surveyed in June from 1990 to 2006 by counting the number of flowering wild hyacinth plants. A survey of other plant species present was conducted in 1999 to assess its quality. Seed production of *C. angusta* was estimated, and germination trials for seeds from the site were conducted. The population of *C. angusta* fluctuated significantly from 1990 to 2006 (28 to 168 plants). The site consisted of approximately ¾ native and ¼ introduced species. Prescribed spring burns and a construction equipment disturbance may be partially responsible for these fluctuations. A large percentage of undeveloped fruit, resulting in low seed production (< 3000), may be responsible for this population's inability to increase consistently. In the laboratory, germination of wild hyacinth seeds was very low (8%). Future research efforts should take into account the results from this study in order to further develop management strategies.

Introduction

Wild hyacinth, *Camassia angusta* (Engelm. and Gray) Blankenship (Liliaceae), is a mesic prairie forb listed as endangered in IL and IN. Distributed throughout much of the south-central U.S., it also occurs in IA, KS, LA, MS, MO, OK, and TX.

The only extant population in IL occurs along a 2 km railroad right-of-way south of Elwin, between agricultural fields and IL Route 51.

Much of the community is degraded by fire suppression, woody species invasion, exotic taxa, and disturbances by construction and railroad activities. Threats to this species in IL make it important to understand its reproductive biology to improve management decisions.

The objectives of this study were to: 1) determine the number of individual *C. angusta* plants at the site over 17 years; 2) determine what other plant species were present to assess the prairie quality prairie; 3) estimate the *C. angusta* seed production; 4) determine its germination requirements; and 5) determine the effects of burns and disturbances on the population.

Materials and Methods

- Surveys were conducted from 1990-2007 by counting the number of inflorescences. The population consisted of 7 colonies.
- Prescribed burns were conducted in 1993, 1994, 1997, 1998, and 2000 between March 1 and April 15.
- In 1999, all observed vascular plant species were recorded.
- The height of each *C. angusta* inflorescence was measured, and the numbers of pedicels, flowers, and/or fruits/ plant were counted.
- 60 fruits of were collected from 18 plants. The number of seeds/fruit was counted and an estimate of total seed production was calculated.
- 3 seed treatments were used: control, scarification, and stratification (5 replications; for a total of 50 seeds/treatment). Seeds were scarified by nicking the apex with a razor blade. Seeds receiving stratification were soaked in water overnight, placed in moist paper towels in a Ziploc™ bag, and stored at 8°C for 63 days.
- Germination trials were conducted in Petri dishes on 2 layers of filter paper, wetted with 5 ml of dH_2O, and placed at 25°C (16 hr-light/8 hr-dark; 47 µmol/m2/sec). Germinated seeds were counted daily for 40 days. Seeds that failed to germinate were tested for viability using 2,3,5-triphenyl tetrazolium chloride (TTC).

Results

- The number of inflorescences of *C. angusta* fluctuated significantly (Table 1). In terms of the total number of inflorescences per year, the highest (169 plants) was in 2006, and the lowest (28 plants) was in 1994.
- In 1999 this prairie consisted of 74 native and 27 introduced species (Table 2).
- Approximately 25% of pedicels produced fruit. Fruits had an average of 7 seeds. An estimate of the total seed production of the population was <3000 (Table 3).
- None of the control or scarified seeds germinated after 40 days. Germination of stratified seeds (8%) was significantly higher. TTC tests showed that 100% of the tested, ungerminated seeds were viable.
- In seasons after a prescribed spring burn, 43% of colonies showed an increase in inflorescences, while 31% showed a decrease and 26% remained the same (Figure 1). After non-burn seasons, 42% of colonies showed an increase, 43% showed a decrease, and 15% remained the same.
- The significant decrease from 1993 to 1994 may be due to a disturbance by construction equipment (Table 1). In the spring of 1994, equipment was driven over several of the colonies (1, 3, and 4), as evidenced in the reduction of flowering plants from 152 to 7.

Table 1. Number of inflorescences in each colony of wild hyacinth (*Camassia angusta*) in a population near Elwin, Illinois (Macon County) during June 1990 to 2007.

	COLONY								
YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**total**	**change**
1990	57	2	2	4	6	2	8	81	
•	136	10	nl	16	6	ns	ns	168	87
•	7	15	0	0	6	nl	nl	28	-140
•	45	69	0	1	5	23	7	150	122
•	18	12	0	0	6	12	4	52	-98
•	9	11	0	3	0	8	2	33	-19
•	3	0	0	0	14	36	15	68	35
•	9	0	0	1	4	4	15	33	-35
•	11	6	3	1	0	14	7	42	9
•	14	11	2	0	2	17	3	49	7
•	36	16	0	2	7	28	12	101	52
•	24	30	0	0	9	16	6	85	-16
•	33	28	0	1	1	17	6	86	1
•	31	23	0	0	5	20	1	80	-6
•	65	50	0	2	12	31	9	169	89
•	0	12	5	0	12	18	0	47	-122
Mean	31.1	18.4	0.8	1.9	5.9	17.6	6.8	79.5	
s.d.	33.9	18.6	1.5	3.9	4.2	9.7	4.8	46. 6	

nl = not located; ns = not surveyed

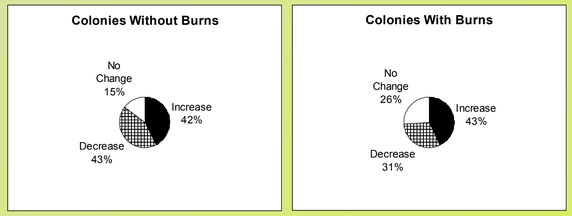

Figure 1. Effects of prescribed burns on change in number inflorescences the following June.

Table 2. Species list for the *C. angusta* site south of Elwin.

MONOCOTS

COMMELINACEAE
Tradescantia ohiensis Raf.
CYPERACEAE
Carex cristatella Britt.
Carex granularis Muhl.
Carex gravida Bailey
Carex pellita Willd.
Scirpus atrovirens Willd.
IRIDACEAE
Iris shrevei Small
LILIACEAE
Allium canadense L.
**Allium vineale* L.
**Asparagus officinalis* L.
Camassia angusta (Engelm. & Gray) Blankinship
**Hemerocallis fulva* (L.) L.
POACEAE
**Elytrygia repens* (L.) Desv.
Andropogon gerardii Vitman
**Bromus inermis* Leyss.
**Bromus tectorum* L.
Calamagrostis canadensis (Michx.) Beauv.
Dichanthelium oligosanthes (Schult.) Gould
Elymus canadensis L.
Elymus villosus Muhl.
Elymus virginicus L.
**Festuca pratensis* Huds.
Glyceria striata (Lam.) Hitch.
Hordeum jubatum L.
**Lolium perenne* L.
Muhlenbergia frondosa (Poir.) Fern.
Panicum virgatum L.
Phalaris arundinacea L.
**Poa compressa* L.
**Poa pratensis* L.
Schizachyrium scoparium (Michx.) Nash
Sorghastrum nutans (L.) Nash.
Tridens flavus (L.) Hitch.
TYPHACEAE
Typha latifolia L.

DICOTS

ACANTHACEAE
Ruellia humilis Nutt.
ANACARDIACEAE
Rhus glabra L.
Toxicodendron radicans (L.) Kuntze
APIACEAE
**Conium maculatum* L.
**Daucus carota* L.
**Pastinaca sativa* L.
**Torilis japonica* (Houtt.) DC.
APOCYNACEAE
Apocynum cannabinum L.
Apocynum sibiricum Jacq.
ASCLEPIADACEAE
Asclepias syriaca L.
ASTERACEAE
Ambrosia artemisiifolia L.
Ambrosia trifida L.
Brickellia eupatorioides (L.) Shinners
Cirsium discolor (Muhl.) Spreng.
Conyza canadensis (L.) Cronq.
Coreopsis tripteris L.
Erigeron annuus (L.) Pers.
Euthamia graminifolia (L.) Nutt.
Helianthus grosseserratus Martens.
Oligoneuron rigidum (L.) Small
Ratibida pinnata (Vent.) Barnh.
Rudbeckia hirta L.
Silphium integrifolium Michx.
Silphium laciniatum L.
Solidago canadensis L.
Solidago nemoralis Ait.
**Tragopogon dubius* Scop.
Vernonia missurica Raf.
CAPRIFOLIACEAE
**Lonicera maackii* (Rupr.) Maxim.
Sambucus canadensis L.
CARYOPHYLLACEAE
**Saponaria officinalis* L.
Silene antirrhina L.
CONVOLVULACEAE
Convolvulus arvensis L.
ELAEAGNACEAE
**Elaeagnus umbellata* Thunb.
EUPHORBIACEAE
Euphorbia corollata L.
FABACEAE
**Melilotus alba* Medic.
**Melilotus officinalis* (L.) Pallas.
**Trifolium pratense* L.
HYPERICACEAE
Hypericum sphaerocarpum Michx.
LAMIACEAE
Monarda fistulosa L.
**Nepeta cataria* L.
Stachys palustris L.
MORACEAE
**Maclura pomifera* (Raf.) Schneider
**Morus alba* L.
LYTHRACEAE
Lythrum alatum Pursh
NYCTAGINACEAE
**Mirabilis nyctaginea* (Michx.) MacM.
ONAGRACEAE
Oenothera biennis L.
PHYTOLACCACEAE
Phytolacca americana L.
POLYGONACEAE
Persicaria amphibium (L.) S.F. Gray
Rumex altissimus Wood.
**Rumex crispus* L.
PRIMULACEAE
Lysimachia ciliata L.
Lysimachia lanceolata Walt.
ROSACEAE
Fragaria virginiana Duchesne
Geum canadense Jacq.
Geum laciniatum Murr.
Rosa carolina L.
Rubus allegheniensis Porter
Rubus flagellaria Willd.
RUBIACEAE
Galium aparine L.
SALICACEAE
Salix interior Rowlee
SCROPHULARIACEAE
**Verbascum thapsus* L.
Veronicastrum virginicum (L.) Farw.
SOLANACEAE
Physalis heterophylla Nees
Solanum carolinense L.
VITACEAE
Vitis aestivalis Michx.
Vitis vulpina L.

*introduced species

Table 3. Influorescence, fruit, and seed characteristics of wild hyacinth (*Camassia angusta*) plants in the population.

	Mean ± s.d.	**minimum**	**maximum**
Total # pedicels	50.0 ± 20.0	23	97
# pedicels w/fruit	12.6 ± 8.8	1	36
# pedicels w/out fruit	37.4 ± 17.3	14	76
% pedicels w/fruit	25.2 ± 14.8	2.7	55.6
Inflorescence height (cm)[z]	16.9 ± 6.2	6.5	27.2
# inflor./population	33	--	--
# seeds/fruit	7.0 ± 4.5	0	18
# seeds/population (est.)	2911	--	--

[z]height from lowest pedicel to top of inflorescence

Discussion

- Competing vegetation may be affecting the population. Its presence along a railroad and agricultural cropland may subject it to periodic herbicide applications. IDOT has signs along the roadway that say "Prairie Do Not Mow or Spray," but there is no such protection along the privately owned fields. There were 27 introduced species found in the area. Most of the competing plants overlie the *C. angusta*.
- While fire positively affects flowering and reproduction of many prairie grasses, spring burns only stimulated a moderate decrease in the number of colonies that declined (43% to 31%) and did not change the number that an increased. Spring burns could stimulate wild hyacinth, but it also stimulates competition from exotic, cool season grasses.
- The reduction of plants in colonies 1, 3, and 4 in 1994 is likely due to equipment damage. In 1994, IDOT ran trenching equipment over this area, causing very prominent crushing and trampling of vegetation.
- Germination trials determined that scarification does not overcome seed dormancy, but stratification does increase it to a limited extent. Seeds that were stratified yielded 8% germination. A possible reason why it was so low might be inadequate stratification techniques, since seeds were viable. Higher percentages may be obtained by using lower or fluctuating temperatures, longer treatments, or different media.
- <3000 seeds produced in 1999, together with low fruit set (only 25% of pedicels had fruit) and low germination (only 8%), puts this species in jeopardy of disappearing from IL. Other species grow over the *C. angusta*, which might make it difficult for pollinators. Factors after pollination also could influence its reproduction, such as limited seed development or competition from other species.

Conclusion

In order for this population to remain viable and expand, further research must be conducted to learn more about this plant's reproductive biology. Alternative management strategies may be necessary to maintain this species.

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