

5-YEAR REVIEW
Eastern Prairie Fringed Orchid
(*Platanthera leucophaea*)

GENERAL INFORMATION:

Species: Eastern prairie fringed orchid (*Platanthera leucophaea*)

Date listed: September 28, 1989

Federal Register (FR) citation(s): 54 FR 39857-39863

Classification: Threatened

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BACKGROUND:

The eastern prairie fringed orchid is a large and showy North American orchid species adapted to fire and drought. It occurs in Illinois, Indiana, Iowa, Maine, Michigan, Missouri, Ohio, Virginia, and Wisconsin. The main threats to *P. leucophaea* are the lack of land management of high quality wetland habitats on which this species depends, including increased development, spread of exotic species, and fire suppression. See the 2016 eastern prairie fringed orchid 5-year Review for more information on existing threats to *P. leucophaea* (U.S. Fish and Wildlife Service [USFWS] 2016).

Most recent status review: USFWS. 2016. Eastern prairie fringed orchid (*Platanthera leucophaea*) 5-year Review: Summary and Evaluation. Chicago ES Field Office, Chicago, Illinois. 62 pp.

FR Notice citation announcing this status review: 85 FR 53842. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of Fourteen Listed Animal and Plant Species August 31, 2020.

ASSESSMENT:

USFWS's Chicago, Illinois ES Field Office conducted this 5-year review. We contacted the

following species experts: Steve Buback, Natural History Biologist, Missouri Department of Conservation (MDC), Tom Swinford, Assistant Director of Division of Nature Preserves, Indiana Department of Natural Resources (IDNR), Michelle Pearion, a Botanist with the United States Forest Service (USFS), Stan Kutcha, a Trustee with the Michigan Nature Association (MNA), Andy Bacon, Conservation Director with the MNA, John Pearson, an Ecologist with the Iowa Department of Natural Resources (IDNR), Kevin Doyle, the State Botanist for the Wisconsin Department of Natural Resources (WDNR), Scott Kobal, an Ecologist with the Forest Preserve District of DuPage County (FPDDC) in Illinois, Pati Vitt, Manager of Ecological Restoration from the Lake County Forest Preserve District (LCFPD) in Illinois, Darrel Murray, Professor of Botany from the University of Chicago (UIC) retired, John Townsend, Staff Botanist, Virginia Department of Conservation and Recreation, Division of Natural Heritage.

Information acquired since the last status review:

1. New information on the species' biology and life history:

Further research on *P. leucophaea* as a mycorrhizal specialist has continued since the last 5-year Review (USFWS 2016). New records of fungi from additional *P. leucophaea* populations indicate that the majority of isolates are assigned to the genus *Ceratobasidium* and the remainder to *Tulasnella* (Thixton *et al.* 2020). Using *P. leucophaea* seeds and *Ceratobasidium* mycorrhizae, Dr. Elizabeth Esselman (Southern Illinois University, Edwardsville, Illinois) has been successful with in vitro symbiotic seed germination (Esselman, pers. comm. March 2020). *P. leucophaea* seedlings have been out planted at Nachusa Grasslands, Illinois in 2020 (Esselman, pers. comm. March 2020) where they will be monitored for survival.

2. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historical range (e.g., corrections to the historical range, change in distribution of the species within its historical range):

The eastern prairie fringed orchid's distribution has not changed appreciably since 1991, however, three newly discovered populations were added since the last 5-year review in 2016 (USFWS 2016).

A new population in Iowa, owned by The Nature Conservancy, was initially documented by Dale Maxson in July of 2018 (Maxson, TNC, July 10, 2018 pers. comm.). Again in 2018, another previously undocumented population was discovered in Illinois by Kim Roman (Illinois Nature Preserves Commission (INPC)). At this site *P. leucophaea* seed was introduced in 2002 (Roman, July 9, 2018, pers. comm.). Not until 2018 did Kim Roman observe 7 blooming *P. leucophaea* plants at this site (Roman, July 9, 2018, pers. comm.) although it had been searched in the past. In 2019, in Illinois, a previously undocumented population (one blooming plant) was discovered by Erin Faulkner (Faulkner, July 14, 2019, pers. Comm.).

Contact with a private landowner of another Illinois *P. leucophaea* population (Hironymous Prairie) was reinstated in 2019 after having no contact for approximately nineteen years. In 2019 this population had ninety-four blooming plants. Although this population is not a new population, it had not been included in the previous 2016 Five Year Review.

One population from Augusta County, Virginia is still considered extant although it has not been seen in many years due to landowner denial for access to the site. For this reason, at this time, there is insufficient data to determine its population viability.

Criterion 1 of the Eastern Prairie Fringed Orchid Recovery Plan (1999) requires twenty-two populations distributed across plant communities and physiographic regions within the historic range of the species (USFWS 1999). Currently ninety-six populations exist throughout the range of the species; however, the populations are not distributed as specified in the recovery plan (i.e., by plant community, and physiographic region). The

populations must occur in three plant communities (prairie, sedge meadow, or minerotrophic sphagnum peatland) within seven physiographic regions to achieve this criterion (USFWS 1999). Currently, ninety-six populations occur in all three plant communities, however these populations occur in only three of the seven physiographic regions suggested in the Recovery Plan (1999). Therefore, Criterion 1 has not been met.

3. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:

Criterion 2 in the 1999 Recovery Plan calls for twenty-two populations to be highly viable range wide (USFWS 1999). A highly viable population typically has more than fifty flowering plants; a population trend that is stable or increasing over a monitoring period of five years; available habitat of at least fifty hectares (125 acres) in size; assurances of ongoing management to reduce impacts from drainage, invasive non-native plant species or woody vegetation encroachment; and protection through long-term conservation easements, legal dedication as nature preserves, or other means. According to the most recent Population Viability Assessment (Appendix 1) using demographic data from 2015 through 2019, twelve populations are highly viable, twenty-nine populations are moderately viable, and fifty-one populations are of low viability (Table 1). Three populations were unable to be assessed due to insufficient data and one population is not included in the rangewide total number of viable populations for reasons described below. Criterion 2 has not been met.

Per state, Illinois supports forty-two *P. leucophaea* populations (five are highly viable), Indiana supports one population, Iowa supports five populations, Maine supports one population, Michigan supports eighteen populations (one is highly viable), Missouri supports one population, Ohio supports ten populations, Virginia may support one population, and Wisconsin supports seventeen populations (six are highly viable). The Wisconsin *P. leucophaea* population located at the University of Wisconsin (Madison) Arboretum Greene Prairie ranked as highly viable, but because it has a small number of blooming plants per year it can be considered a “collection” as opposed to an ecological functioning unit, and therefore it is not included in the rangewide total number of highly viable populations.

Table 1: The number of highly viable *P. leucophaea* populations needed for recovery and where they are suggested to occur (plant community, physiographic region, state) according to the Recovery Plan (1999) along with each population’s viability (low, moderate, high) depending on which year (1999, 2007, 2014, 2019) the Population Viability Index was conducted. In 2019, three populations have insufficient data to determine viability and therefore are not included.

<u>COMMUNITY / Physiographic Region / State</u>	<u>Number of high viability populations needed for recovery</u>	High Viability 1999, 2007, 2014, 2019	Moderate Viability 1999, 2007, 2014, 2019	Low Viability 1999, 2007, 2014, 2019	Extirpated 1999, 2007, 2014, 2019
<u>PRAIRIE</u>					
Kansan Till					

Iowa **	2		1, 2	2	
Missouri			1	2	
Wisconsinan drift					
Illinois	4	1, 2, 3, 4	10, 8, 7, 8	7, 12, 15, 17	3, 1
Indiana				1, 1	
Wisconsin	3	2, 1, 1, 4	5, 6, 6, 2	2, 5, 4	
Rock River Hill Country					
Illinois		1, 1	1		
Lake Erie Lake Plain	2				
Michigan			1, 1	2, 3	
Ohio		2	4, 2, 6, 3	1, 3, 2, 1	
Lake Huron Lake Plain	3				
Michigan *		2, 2, 1	3, 2, 1	3, 7, 8, 7	1
Lake Michigan Lake Plain	2				
Illinois			1, 1, 2, 3	1, 3, 3, 2	1
Wisconsin		1, 1, 1	1, 2	1, 1, 2, 2	
Southern MI / Northern IN Drift Plains					
Michigan				2, 2	
SEDGE MEADOW	3				
Iowan Surface or Southern Iowa Drift Plains - glaciated					
Iowa			2	2	
-					
Wisconsinan drift- unglaciated					
Illinois*		1	2, 2, 3, 4	3, 3, 3	1
Ohio		1	3, 4, 1, 1	1, 4, 2	
Wisconsin		1, 1, 1	1	2, 2, 2	
Unglaciated					
Iowa			1, 1	1	
Lake Erie Lake Plain					
Ohio			1, 2		
MINEROTROPIC/ SPHAGNUM PEATLAND	3				
Maine			1, 1, 1	1	
Michigan			3, 1, 1	2, 2, 4	1
Wisconsin		1, 1, 1	1		
Totals	22	6, 11, 9, 12	37, 29, 32, 29	16, 36, 55, 51	7, 1

* (2014) * (2019) One population is extant within this state, physiographic region, and community but was unable to be included in this table due to the lack of sufficient data to determine viability.

4. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding):

Claire Ellwanger (2016) conducted a rangewide genetic study of *P. leucophaea*. Highlights and a brief summary are provided here although more detailed information can be found in Ellwanger (2016).

Ellwanger's (2016) objectives included:

- To determine range wide genetic patterns in *P. leucophaea*
- To determine the relationship between population size and genetic variation
- To determine the relationship between the degree of isolation and genetic variation
- To provide information relevant to conservation planning rangewide for recovery of the species.
- Monitor genetic change in Illinois populations that have undergone genetic management through hand pollination and seed addition from nearby populations.

Within each state where the species is considered extant, Ellwanger (2016) targeted populations that were historically the largest (based on available census sizes). Forty populations were selected across the range of the species for sampling.

Summary from Ellwanger (2016):

- No state or geographic region in the contiguous range was genetically depauperate, with lower diversity or higher inbreeding.
- All populations showed minimal genetic structure, suggesting high genetic similarity to each other, which is likely due to historically high connectivity between populations.
- Populations with a census size of ten or less individuals had lower genetic diversity and higher inbreeding compared to larger populations.
- Larger populations (>10 individuals) showed no correlation to genetic diversity or inbreeding with overall size. Additional analyses are in progress (Ellwanger 2020, personal communication).
- Populations with a census size of ten or less had negative inbreeding (F_{is}) values, indicating non-random outcrossing is occurring, something not typically observed in wild populations.
 - Hypothetically, these negative values are a result of individuals with high selfing dying from inbreeding depression at earlier life stages (seed & vegetative plant). It is likely that these small populations are experiencing very high rates of inbreeding. Therefore, populations that are consistently hovering around a census size of 10 could be considered populations of high genetic priority for management.
- The combination of hand pollination and seed addition led to an increase in genetic diversity over time. Hand pollination alone and no genetic management showed little to no change in genetic diversity. Populations which received both hand pollination and seed addition experienced a slight decrease in inbreeding, and populations with only hand pollination had a slight increase in inbreeding over time.
- Both hand pollination and seed addition are important genetic restoration techniques for this species.

- Natural fruit set was very low in some populations, suggesting lower abundance of pollinators at some sites. For these populations, hand pollination is needed to maintain fruit set.
- Seed viability at some sites had critically low (<20%) viability. This is likely due to underlying genetic causes, such as high inbreeding. This suggests that genetic augmentation, especially bringing in pollen and seeds from outside populations, should continue to increase genetic diversity and minimize the risk of inbreeding depression in these populations.
- Preliminary results suggest that the combination of hand pollination within the same site and seed addition between populations will lead to an increase in seed viability and reproductive fitness over time. Ellwanger (2016) suggests continuing hand pollination with pollen from the same site, but also including pollen from outside populations. In addition, occasional seed addition from nearby populations with similar habitat is beneficial.
- Results suggest that outcomes from the management portion of the study (to move seed and pollen between populations) would be applicable to any population in the range.

5. Taxonomic classification or changes in nomenclature:

There are no changes in taxonomic classification or nomenclature.

6. Habitat or ecosystem conditions (e.g., amount, distribution, and sustainability of the habitat or ecosystem):

Consistent land management is needed to maintain suitable habitat for *P. leucophaea* and is considered vital to the survival and recovery of populations range wide. Removal of invasive species, the use of prescribed fire, and the control of exotic species allows for the persistence and expansion of populations.

Many private and publicly owned populations range wide are not being managed to promote the persistence of this plant species. Although restoration efforts increase the abundance of *P. leucophaea*, implementation of those efforts can be difficult and challenging for reasons such as inadequate staff and/or funding.

Summary:

Three new populations have been recorded since the last review resulting in a total of ninety-six populations range wide.

As described above, the recovery criteria outlined in the Recovery Plan (1999) has not been met. Criterion 1 suggests twenty-two populations distributed across plant communities in seven physiographic regions and Criterion 2 suggests that these twenty-two populations be highly viable (USFWS 1999). Currently, twelve highly viable populations occur in three of the seven physiographic regions outlined by the Recovery Plan Criterion. Therefore, neither Criterion 1 nor Criterion 2 has been met.

No new threats have been documented since the last 5-year review.

Conclusion:

After reviewing the best available scientific information, there is no new information to indicate that the species' status should change. Therefore, we conclude that *P. leucophaea* remains a threatened species. The data collected for this review from all populations for the years 2015 through 2019 indicate that the recovery criteria outlined in the Recovery Plan (1999) have not been met.

RECOMMENDATIONS FOR FUTURE ACTIONS:

The Service provides the following recommendations:

1. Protect habitat.
2. Manage habitat to support *P. leucophaea* populations through prescribed burning, control of exotic invasive species, etc.
3. Annual census (counting the number of blooming plants per year) of all *P. leucophaea* populations range wide.
4. Recruit Volunteers to annually census 17 of the 18 *P. leucophaea* populations in Michigan.
5. Increase the size and genetic diversity of existing populations through cross pollinating between populations and moving seed between populations.
6. Continue research to identify and evaluate the effectiveness of recovery actions.

Current Classification: Threatened

Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Lead Field Supervisor, Fish and Wildlife Service

Approve: Louise Clemons Date: 12/15/2020

References

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Appendix 1:

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Illinois	Wisconsinan drift	Prairie	Abbott Park	0	1	1	0	1	0	0.16	Low	
Illinois	Wisconsinan drift	Sedge Meadow	Ascension Sedge Meadow FP	3	3	1	2	2	2	0.72	Moderate	
Illinois	Wisconsinan drift	Prairie	Bunker Hill	0	0	0	1	2	2	0.27	Low	
Illinois	Wisconsinan drift / unglaciated	Sedge Meadow	Bystricky Prairie NP	0	1	1	3	3	2	0.55	Moderate	
Illinois	Wisconsinan drift / unglaciated	Sedge Meadow	Bystricky Prairie (Steadman Parce)	3	3	1	2	1	1	0.61	Moderate	
Illinois	Wisconsinan drift	Prairie	Churchill Prairie Nature Preserve	0	2	1	3	1	1	0.444	Low	
Illinois	Wisconsinan drift	Prairie	Dokum Mskoda Nature Preserve	1	2	1	3	3	1	0.61	Moderate	
Illinois	Wisconsinan drift	Prairie	Florsheim Nature Preserve	0	0	0	3	1	1	0.27	Low	
Illinois	Lake Michigan lake plain	Prairie	Gensburg-Markham Prairie Nature Preserve	0	2	1	3	3	2	0.61	Moderate	
Illinois	Wisconsinan drift	Prairie	Glenview Air Station Prairie	2	3	1	2	2	2	0.66	Moderate	
Illinois	Wisconsinan drift	Prairie	Grant Creek Nature Preserve	3	2	2	3	3	2	0.83	High	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Illinois	Wisconsinan drift / unglaciated	Sedge Meadow	Harrison Benwell	0	0	1	2	0	0	0.17	Low	
Illinois	Wisconsinan drift	Prairie	Helm Road	3	2	0	0	1	0	0.33	Low	
Illinois	Wisconsinan drift / unglaciated	Sedge Meadow	Hildy Prairie Nature Preserve	2	2	1	3	2	3	0.72	Moderate	
Illinois	Wisconsinan drift	Prairie	Hironimus Prairie	2	3	1	1	1	1	0.5	Low	
Illinois	Wisconsinan drift	Prairie	HUM RR Prairie NP	0	0	0	3	2	2	0.38	Low	
Illinois	Wisconsinan drift	Prairie	Hybernia Nature Preserve	1	2	1	3	2	1	0.5	Low	
Illinois	Lake Michigan lake plain	Prairie	Illinois Beach State Park Nature Preserve	0	2	2	3	3	2	0.66	Moderate	
Illinois	Wisconsinan drift	Prairie	James Woodworth Prairie	0	0	0	1	1	1	0.16	Low	
Illinois	Wisconsinan drift	Prairie	Loda Cemetery Nature Preserve	0	2	1	3	2	1	0.5	Low	
Illinois	Wisconsinan drift	Prairie	Lone Grove FP	2	2	1	2	2	1	0.55	Moderate	
Illinois	Wisconsinan drift / unglaciated	Sedge Meadow	Long Grove Nature Preserve	1	2	1	3	1	1	0.5	Low	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Illinois	Wisconsinan drift	Prairie	Lyons Prairie & Woods Nature Preserve	3	3	1	3	2	2	0.77	High	
Illinois	Lake Michigan lake plain	Prairie	Miami Woods FP	0	0	1	2	1	1	0.28	Low	
Illinois	Wisconsinan drift	Prairie	Middlefork Savanna Nature Preserve	0	1	1	3	2	1	0.44	Low	
Illinois	Wisconsinan drift	Prairie	Munson Cemetery Prairie Nature Preserve	1	0	1	3	2	1	0.44	Low	
Illinois	Rock River Hill Country	Sedge Meadow	Nachusa Grasslands NP	3	3	1	3	2	2	0.77	High	
Illinois	Wisconsinan drift	Prairie	Nippersink/ Glacial Park	0	0	1	2	2	1	0.33	Low	
Illinois	Lake Michigan lake plain	Prairie	Paintbrush Prairie Nature Preserve	0	1	1	3	2	2	0.5	Low	
Illinois	Wisconsinan drift / unglaciated	Sedge Meadow	Queen Anne NP	0	1	0	3	1	1	0.33	Low	
Illinois	Wisconsinan drift	Prairie	Rudd Farm	0	3	0	0	1	1	0.27	Low	
Illinois	Wisconsinan drift	Prairie	Schiller Woods FP	0	3	1	2	1	1	0.44	Low	
Illinois	Wisconsinan drift	Prairie	Somme Woods Nature Preserve	3	3	1	3	3	2	0.83	High	
Illinois	Wisconsinan drift	Prairie	Somme Woods Prairie FP	3	2	1	2	3	2	0.72	Moderate	
Illinois	Lake Michigan lake plain	Prairie	Sundrop Prairie Nature Preserve	2	3	1	3	2	2	0.72	Moderate	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Illinois	Wisconsinan drift	Prairie	Swift Prairie	1	2	1	3	1	1	0.5	Moderate	
Illinois	Wisconsinan drift	Prairie	Truitt-Hoff Nature Preserve	0	2	2	3	2	1	0.555	Moderate	
Illinois		Prairie	Vaught Pauper Cemetery Prairie	0	0	0	3	1	1	0.27	Low	
Illinois	Wisconsinan drift	Prairie	Wadsworth Prairie Nature Preserve	3	2	3	3	2	1	0.77	High	
Illinois	Wisconsinan drift	Prairie	Wayside Prairie	0	0	1	2	2	1	0.33	Low	
Illinois	Wisconsinan drift	Prairie	Wolf Road Prairie Nature Preserve	0	2	1	3	3	1	0.55	Moderate	
Illinois	Wisconsinan drift	Prairie	Wrigley Tract	2	2	2	0	2	1	0.5	Moderate	
Indiana	Wisconsinan drift ?	Prairie	Lowe Prairie	0	1	1	2	1	1	0.33	Low	
Iowa	Iowan Surface	Sedge Meadow	Muskrat Slough Wildlife Management Area	3	?	2	2	3	2	0.66	Moderate	
Iowa	Iowan Surface	Sedge Meadow	Williams Prairie State Preserve	0	0	1	3	3	2	0.5	Low	
Iowa	Southern Iowa Drift Plain	Prairie	Garden Grove (private)	?	?	?	0	2	?	?	Insufficient data to determine	
Iowa	Southern Iowa Drift Plain	Prairie/Sedge Meadow	Swamp White Oak TNC preserve	2	?	1	2	2	2	0.5	Low	
Iowa	Southern Iowa Drift Plain	Sedge Meadow	Baldwin Marsh Wildlife Area	3	1	1	2	2	1	0.55	Moderate	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Maine	NA	Minerotrophic/ Sphagnum Peatland	Crystal Bog	1	2	0	0	3	2	0.44	Low	
Michigan	Lake Huron lake plain	Prairie	Bradleyville Road	1	1	1	1	1	0	0.28	Low	
Michigan	Lake Huron lake plain	Prairie	Sebewaing Bay South	3	1	3	1	1	1	0.55	Moderate	
Michigan	Lake Huron lake plain	Prairie	Essexville Prairie	0	1	1	0	2	1	0.28	Low	
Michigan	Lake Erie lake plain	Prairie	Point Mouillee North	0	0	1	0	0	0	0.05	Low	
Michigan	Lake Huron lake plain	Prairie	Harsons Island- Middle Channel Golf Course	?	?	?	?	?	?	?	Insufficient data to determine	
Michigan	Lake Erie lake plain	Prairie	Point Mouillee South	1	1	1	1	0	0	0.22	Low	
Michigan	NA	Minerotrophic/ Sphagnum Peatland	George Reserve	0	0	1	1	2	2	0.33	Low	
Michigan	Lake Huron lake plain	Prairie	Cotter Road North / Coryeon Point	0	0	1	1	2	0	0.22	Low	
Michigan	Lake Huron lake plain	Prairie	Saginaw Wetlands (Wildfowl Bay Prairie)	3	3	3	2.5	2.5	1.5	0.86	High	
Michigan	NA	Minerotrophic/ Sphagnum Peatland	Yankee Springs	0	?	1	1	2	1	0.33	Low	
Michigan	NA	Minerotrophic/ Sphagnum Peatland	Little Cedar Lake	2	?	1	1	2	1	0.46	Low	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Michigan	Lake Huron lake plain	Prairie	Dickinson Island	0	0	1	0	2	0	0.17	Low	
Michigan	Lake Huron lake plain	Prairie	Zilwaukee	0	0	1	0	1	0	0.11	Low	
Michigan	Southern Michigan/Northern Indiana Drift plain (?)	Prairie	Tamarack Lake	0	?	1	0	2	1	0.27	Low	
Michigan	Lake Huron lake plain	Prairie	Clements Airport	0	?	1	0	0	0	0.07	Low	
Michigan	Lake Huron lake plain	Prairie	Fish Point	0	0	1	1	2	1	0.28	Low	
Michigan	Southern Michigan/Northern Indiana Drift plain (?)	Prairie	Williams Lake	0	?	0	1	?	?	0.11	Low	
Michigan	NA	Minerotrophic/ Sphagnum Peatland	Dowagiac Creek - LaGrange Lake	0	?	0	0	1	2	0.2	Low	
Missouri	Central Dissected Loess/Till Plains	Prairie	North Evans	2	2	2	2	2	2	0.66	Moderate	
Ohio	Lake Erie lake plain	Prairie	Mallard Club Wildlife Area	2	2	1	2	1.5	1	0.53	Moderate	
Ohio	Lake Erie lake plain	Prairie	Maumee Bay	2	1	3	2	0.5	1	0.53	Moderate	
Ohio	Lake Erie lake plain	Prairie	Metzger	0	1	1	0	0	0	0.11	Low	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Ohio	Lake Erie lake plain	Sedge Meadow	Ottawa NWR Crane Creek	3	1	2	3	2	2	0.72	Moderate	(.72+.36+.72) / 3 = Moderate
Ohio	Lake Erie lake plain	Sedge Meadow	Ottawa NWR Cedar Point	0	0	1	3	1.5	1	0.36	Low	
Ohio	Lake Erie lake plain	Sedge Meadow	Ottawa NWR Cedar Young	3	1	2	3	2	2	0.72	Moderate	
Ohio	Lake Erie lake plain	Prairie	Pickrel Creek	3	3	1	2	1.5	1	0.64	Moderate	
Ohio	Lake Erie lake plain	Sedge Meadow	Wightman's Grove	3	2	1	2	2.5	2	0.69	Moderate	
Ohio	Lake Erie lake plain	Prairie	Yodonta Road	0	0	1	0	0.5	1	0.19	Low	
Ohio	Wisconsinan drift unglaciated	Sedge Meadow	Dayton (Medway)	2	3	1	0	0.5	0	0.36	Low	
Ohio	Wisconsinan drift unglaciated	Sedge Meadow	Killbuck SM (Cemetery Road)	0	2	1	2	1.5	1	0.42	Low	(.42+.42+.58) / 3 = LOW
Ohio	Wisconsinan drift unglaciated	Sedge Meadow	Killbuck SM (Holmesville)	0	2	1	2	1.5	1	0.42	Low	
Ohio	Wisconsinan drift unglaciated	Sedge Meadow	Killbuck SM (State Route 83)	2	3	1	2	1.5	1	0.58	Moderate	
Ohio	Wisconsinan drift unglaciated	Sedge Meadow	Leadingham	3	3	1	2	1	0	0.56	Moderate	
Virginia			Augusta County	?	?	?	?	?	?		Insufficient data to determine	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Wisconsin	Lake Michigan lake plain	Prairie	Bain Station Road Prairie	0	0	1	0	1	1	0.16	Low	
Wisconsin	Wisconsinan drift	Prairie	Pell Lake Railroad Prairie	0	0	0	0	1	1	0.11	Low	
Wisconsin	Wisconsinan drift	Prairie	Koshkonong Wetland	3	3	1	3	2	2	0.77	High	
Wisconsin	Wisconsinan drift	Prairie	Snapper Prairie	3	3	1	3	3	2	0.83	High	
Wisconsin	Wisconsinan drift	Prairie	Uihlein (Waukau Marsh)	3	2	3	3	1	1	0.72	Moderate	
Wisconsin	Lake Michigan lake plain	Prairie	Chiwaukee Prairie - South	3	2	3	3	3	2	0.88	High	(.88+.83+.25) / 3 = .65 MODERATE
Wisconsin	Lake Michigan lake plain	Prairie	Chiwaukee Prairie	2	3	2	3	3	2	0.83	High	
Wisconsin	Lake Michigan lake plain	Prairie	Chiwaukee Prairie - Carol Beach Low Prairie	0	0	1	1.5	1	1	0.25	Low	
Wisconsin	Wisconsinan drift	Prairie	Taylor Creek Prairie	0	0	1	0	0	0	0.05	Low	
Wisconsin	Wisconsinan drift	Prairie	Young Prairie	0	2	3	3	3	2	0.72	Moderate	
Wisconsin	Wisconsinan drift	Prairie	Faville Prairie	1	2	3	3	3	2	0.77	High	
Wisconsin	Wisconsinan drift	Prairie	Scuppernong Prairie	0	2	3	3	3	3	0.77	High	

State	Physiographic Region	Community	Site name	Population size ¹	Population trend ²	Habitat size ³	Protection status ⁴	Successional status ⁵	Management needs ⁶	PVI ⁷	Viability ⁸	Average Viability ⁹
Wisconsin	Wisconsinan drift	Prairie	Newark Road Prairie	0	1	1	3	1	2	0.44	Low	
Wisconsin	Wisconsinan drift	Patterned peatland	Cedarburg Bog - Patterned Fen	3	2	3	3	3	2	0.88	High	
Wisconsin	Wisconsinan drift	Prairie	UW-Madison Arboretum - Greene Prairie	1	3	1	3	3	3	0.77	High	
Wisconsin	Wisconsinan drift	Shrub-carr and Tamarack Swamp	White River Prairie Tamaracks	0	2	3	3	3	3	0.77	High	
Wisconsin	Wisconsinan drift	Prairie	Oshkosh-Larsen - Allenville	0	0	0	3	3	2	0.44	Low	(.44+.27+.27) / 3 = .32 LOW
Wisconsin	Wisconsinan drift	Prairie	Oshkosh-Larsen - Maxwell	0	0	0	3	1	1	0.27	Low	
Wisconsin	Wisconsinan drift	Prairie	Oshkosh-Larsen - Breezewood	0	0	0	3	1	1	0.27	Low	
Wisconsin	Lake Michigan lake plain	Prairie	Des Plaines River Prairie - West	0	0	1	0	0	1	0.11	Low	
Wisconsin	Lake Michigan lake plain	Prairie	Heide Prairie	2	2	1	3	2	2	0.66	Moderate	

Footnotes: Appendix 1

1. Population size: Eastern prairie fringed orchid population size is drawn from annual flowering plant census data. Flowering plant numbers are important because populations appear to rely on seed production for their maintenance. Population size estimates can be based on mean annual flowering plant census data. Mean annual flowering plant census data is assigned a value and applied to the index as follows: 0 = fewer than 10 flowering plants; 1 = 10 to <25 flowering plants; 2 = 25 to <50 flowering plants, 3 = greater than 50 flowering plants (USFWS 1999; Bowles et al. 1992). For this exercise, the mean is over a five year period.

It is believed that populations with, on average, fewer than 10 plants are highly vulnerable to effects of chance genetic, demographic, or environmental events that could lead to population extirpation and a population size of more than 50 plants would be more resistant to these types of chance events (Bowles and Bell 1999).

2. Population trend: Estimates of the population trend indicate whether the population size is stable, increasing, or decreasing over time. This variable is a correlation of annual population size with time (5 years) and is assigned values and applied in the index as follows: 0 = plants absent; 1 = decreasing; 2 = stable; 3 = increasing (USFWS 1999; Bowles et al. 1992).

3. Habitat size: Larger habitats will support higher numbers of orchids, and may provide greater opportunity for survival from changing environmental conditions since orchids may colonize suitable areas if current habitat becomes unsuitable. Chances of extirpation might be highest in habitats smaller than 1 hectare (2.5 acres). Habitats larger than 50 hectares (125 acres) will support large numbers of plants. Values assigned to habitat size in the population viability index are applied as follows: 0 = habitat less than 2.5 acres; 1 = habitat 2.5 to <62.5 acres; 2 = habitat 62.5 <125 acres; 3 = habitat greater than 125 acres (USFWS 1999; Bowles et al. 1992).

5. Protection status: Protection status is a function of ownership and legal deed restrictions. Public or private tracts protected under legal conservation easements which include dedication under state nature preserve acts, have the highest level of protection. Public land that is preserved in perpetuity and/or provides for regulatory protection would be examples of land that would be considered highly viable (USFWS 1999). Habitats in public ownership that are not legally protected may have formal protection status but can be subject to management or use that could conflict with orchid habitat maintenance (USFWS 1999). Private land not protected by legal conservation easements might have some informal protections, but long-term land use remains at the discretion of the landowner. This variable is assigned a value based on ownership and legal deed restrictions as follows: 0 = private ownership with no protection; 1 = private ownership with informal protection agreements but without legally binding protection; 2 = private or public ownership with formal but not legal protection; 3 = private or public ownership with legally binding protection (USFWS 1999; Bowles et al. 1992).

5. Habitat successional stage and condition: The successional stage is an indicator of past or current disturbance to vegetation. Highly viable

eastern prairie fringed orchid populations occur in late-successional habitat in high quality natural areas that are free of invasive species. Fire and other management techniques that mimic natural disturbance are typically required to control or eliminate invasive species and to maintain stable late- successional vegetation. Although early to mid-successional communities can support large orchid populations, these habitats are successionaly unstable. Values assigned to this variable are based on the degree of disturbance (i.e. natural quality grade) or habitat successional stage and are as follows: 0 = very heavily disturbed (grade D) or early successional; 1 = heavily disturbed (grade C) or early successional; 2 = moderately disturbed (grade B) or mid-successional; 3 = lightly or undisturbed (grade A) or late-successional (USFWS 1999; Bowles et al. 1992).

6. Management condition: The eastern prairie fringed orchid occurs in grass- and sedge dominated communities that require fire and other management techniques that mimic natural disturbance to prevent woody vegetation encroachment, to control or eliminate invasive species, and to maintain stable late-successional vegetation. Most sites need almost continual management. Moderate management needs are for threats that are not directly impacting orchid populations, such as invasion of early stages of woody or non-native plant species, or surrounding land use. This variable is assigned a value based on the degree of management needed to maintain the plant community as follows: 0 = severe; 1 = moderate; 2 = low; 3 = none (USFWS 1999; Bowles et al. 1992).

7. Population Viability Index (PVI): The Population Viability Index (PVI), for each population, is determined mathematically after all variables are assigned a numerical ranking. Because the highest ranking for each variable is three, and six variables are used, the dividing factor is 18 ($3 \times 6 = 18$). The values of the variables for each population are added together and divided by 18. $PVI = (A+B+C+D+E+F)/18$. The resultant number is then used to determine the Viability of a population (USFWS 1999).

8. Viability: A population is ranked as having low viability if the PVI number is ≤ 0.50 , moderate viability if the PVI is $>0.50 - 0.75$, and high viability if the PVI is >0.75 (USFWS 1999).

9. Average Viability: Four *Platanthera leucophaea* populations are considered to have separate subpopulations. Reasons for this include instances where within one site individual plants are separated by a road, or when different groups of people monitor different areas of the same population. In these instances, each subpopulation has been ranked as if it is a separate population generating a separate PVI. In cases such as this, where each sub-population is ranked individually, an average PVI is generated for all subpopulations of the same site resulting in one PVI for that site.