Western Prairie Fringed Orchid
(Platanthera praeclara)

5-Year Review:
Summary and Evaluation

February 2009

Photo: J. Challey

U.S. Fish and Wildlife Service
Twin Cities Field Office
Bloomington, Minnesota

5-YEAR REVIEW
Western Prairie Fringed Orchid (*Platanthera praeclara*)

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1.0 GENERAL INFORMATION

1.1 Reviewers

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Mel Nenneman – Valentine National Wildlife Refuge
Gary Willson (RT)[1] – National Park Service
Tom Nagel (RT) – Missouri Department of Conservation
Tim Smith – Missouri Department of Conservation
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1.2 Methodology used to complete the review:

The review was conducted by Phil Delphey in the Twin Cities Field Office in coordination with other field offices in the Mountain-Prairie and Southwest Regions. The Service solicited information from the public through a *Federal Register* notice (71 FR 16177) and also reviewed reports and scientific papers that had been completed since the November 1991 5-year review (which includes the species' 1996 approved recovery plan). We reviewed each document for significant information, beginning with the earliest document not cited in the recovery plan (i.e., Fauske and Rider 1996 – see References). In addition, we relied extensively on a database containing information on each occurrence of western prairie fringed orchid, which the Service maintains at its Twin Cities Ecological Services Field Office.

[1] "RT" indicates that this person is a member of U.S. Fish and Wildlife Service's Western Prairie Fringed Orchid Recovery Team.

1.3 Background:

1.3.1 Federal Register Notice citation announcing initiation of this review:

71 FR 16176, March 30, 2006.

1.3.2 Listing history

Original Listing
FR notice: 54: 39857-39863
Date listed: September 28, 1989
Entity listed: *Platanthera praeclara*
Classification: Threatened

1.3.3 Associated rulemakings: None

1.3.4 Review History: Western prairie fringed orchid was included in a five-year review of all species listed before January 1, 1991 (56 FR 56882). The five-year review resulted in no change to the listing classification of threatened.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 8C. A recovery priority of 8C denotes that the degree of threat is moderate, the recovery potential is high, the listed taxon is a species (e.g., as opposed to a subspecies), and that the species may be in conflict with construction, other developmental projects, or other forms of economic activity.

1.3.6 Recovery Plan

Name of plan: Western Prairie Fringed Orchid (*Platanthera praeclara*) Recovery Plan
Date issued: September 30, 1996
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? *No*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? *Yes*

2.2.2 Adequacy of recovery criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? *No*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The recovery criteria in the 1996 recovery plan (U.S. Fish and Wildlife Service 1996) are:

Platanthera praeclara will be considered for delisting when sites that include occupied habitat harboring 90 % of plants in each ecoregion are protected at protection levels 4 through 9 (The Nature Conservancy 1996) and managed in accordance with a Service-approved management plan or guidelines. This plan must assure implementation of management practices that provide the range and spatial distribution of successional and hydrologic regimes required to maintain the species and its pollinators in self-sustaining, naturally occurring populations, and must remain in effect following delisting. Implementation of these criteria is further clarified in the strategy of recovery section above and in the recovery narrative below.

The recovery criteria may be divided into two distinct components – ensuring that (1) a minimum proportion of plants within each inhabited ecological region occur on lands that are protected from habitat destruction and (2) management of these protected habitats is conducive to the conservation of western prairie fringed orchid. Below we refer to these as the protection and management criteria, respectively.

Protection Criterion:
...sites that include occupied habitat harboring 90 % of plants in each ecoregion are protected at protection levels 4 through 9 (The Nature Conservancy 1996)...

Under this criterion, plants are protected only if they are on sites that are "permanently safe from conversion from grassland into any other use" (see Strategy of Recovery section in the recovery plan - U.S. Fish and Wildlife Service 1996:17). Levels 4 through 9 ensure protection in different ways, as listed below. The Nature Conservancy's 10 levels of protection are (The Nature Conservancy 1996):

0 No protection
1 Notification – Landowner or site manager notified of the species' presence

2 Voluntary protection provided by landowner or site manager
3 Bequest – Will, right of first refusal, or other landowner/agency commitment
4 Lease, license, or management agreement
5 Undivided or remainder interest conveyed to a conservation entity
6 Public land designation
7 Conservation easement
8 Fee title or beneficial interest with management control
9 Dedication

This criterion addresses the following threats:

- Conversion of habitat to cropland
- Inter-seeding of non-native species, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail), into wet prairie in Nebraska. Inter-seeding of non-native species is only likely to occur on sites managed primarily for agriculture.

The recovery criteria do not specifically address the viability of protected populations. For example, an ecoregion could meet this criterion even if none of the protected populations are viable. Actions 421-423 in the recovery plan's step-down outline (U.S. Fish and Wildlife Service 1996:19-22) describe research needed to provide a basis for a population viability analysis (PVA) and action 424 calls for the development of a PVA for the species. The results of these actions could be used to revise the recovery criteria to address the viability of protected populations; a PVA based on demographic monitoring in Minnesota may be nearing completion (Nancy Sather, Minnesota Department of Natural Resources, pers. comm., 4/9/07).

We used data provided by the states and others to assess progress towards meeting the protection criterion.[2] Consistent with the recovery plan, we considered a population to be extant if one or more plants were recorded within the last 25 years – i.e., in 1983 or later – unless the population was known to be extirpated (e.g., Elkins Prairie in Kansas, which was plowed up in 1990). In addition, we used the highest counts for each population to determine the number of plants protected at each site. The plan does not state how plants are to be counted to assess progress towards the recovery, but the maximum number of flowering plants in any given year has been used by others to describe sizes of western prairie fringed orchid populations (e.g., Seifert-Spilde 2001) and Sather (1997) used the highest number of plants reported for sites to measure progress towards meeting the protection criterion for one ecological section.

[2] This data is maintained in a Microsoft Access database at the Service's Twin Cities Ecological Services Field Office in Bloomington, Minnesota.

Alternatively, some authors have proposed using *mean* counts as a basis for assessing the conservation status of threatened plants (Bowles et al. 1999). The use of maximum counts of flowering plants (non-flowering plants are too difficult to find to include in censuses) may overestimate actual population sizes, but it is sufficient for determining the proportion of plants protected from conversion.

We counted *as protected* only those populations whose protection level was known to meet or exceed level 4, as defined in the recovery plan (U.S. Fish and Wildlife Service 1996:68) and assumed that populations whose protection level is unknown were unprotected. This is likely valid because our data sources, typically state conservation agencies, are usually aware of the status of populations that are under some type of protective ownership or agreement, but are often uncertain of the exact protective status of populations that are in private ownership. There are 75 populations with unknown protection levels in Nebraska and 7 in Minnesota.

The Western Prairie Fringed Orchid Recovery Plan (U.S. Fish and Wildlife Service 1996) based recovery on the status of populations within each ecoregional section occupied by the species (Bailey et al. 1994). Bailey's ecoregions are mapped at successively finer levels of detail. From coarse to fine they are: domain, division, province, section, and subsection. The Western Prairie Fringed Orchid Recovery Plan based recovery on the status of populations among the ecoregional *sections* occupied by the species. Since 1996, the boundaries of these sections have been revised to improve correspondence between finer-scale map boundaries and important ecological features such as glacial lines and landforms (ECOMAP 2007; McNab et al. 2007). These changes included modifications to the section boundaries that were used by the Service to guide western prairie fringed orchid recovery (U.S. Fish and Wildlife Service 1996:87). Therefore, we will describe progress toward meeting the recovery criterion in the context of revised ecoregional sections map (Figure 1, Table 1).

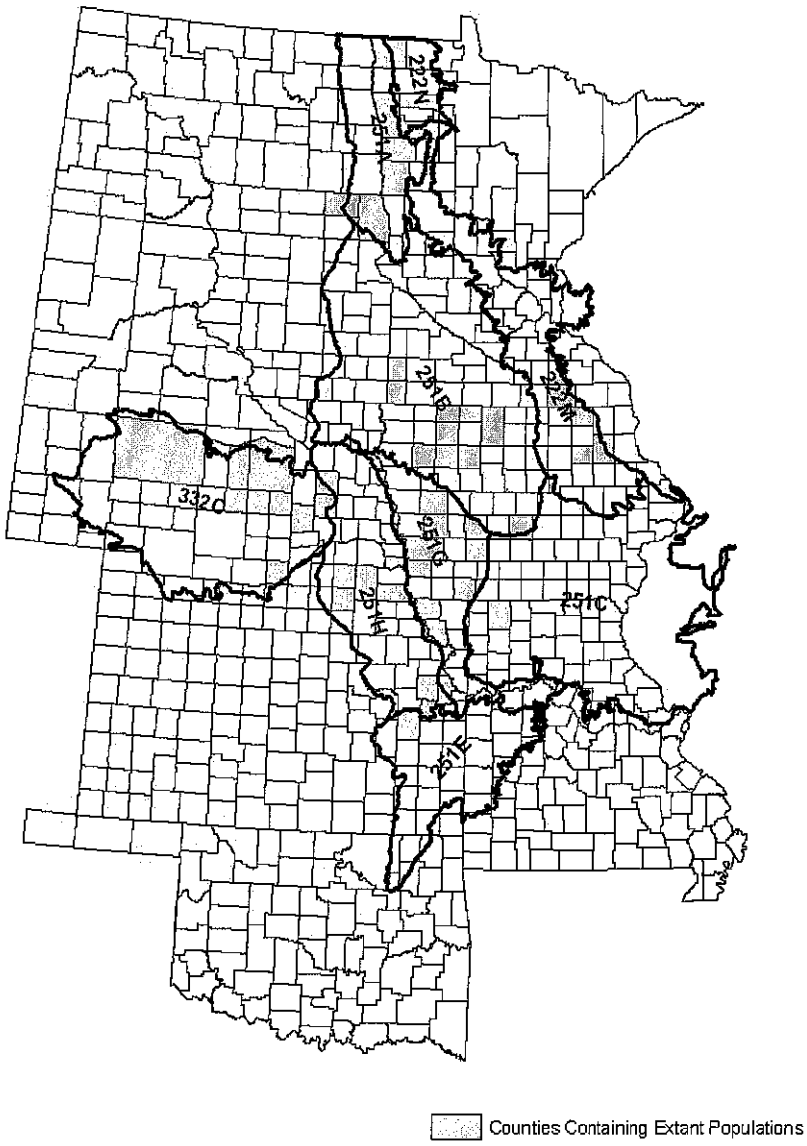

Figure 1. Revised ecological sections (McNab et al. 2007) that contain extant populations of western prairie fringed orchid.

Table 1. Abundance of western prairie fringed orchid plants in each revised ecological section (Figure 1) and on sites with protections levels 4-9 (USFWS 1996:68). Numbers are based on high counts of flowering plants for sites known or presumed to be extant (at least one plant observed after 1982 and not otherwise known to have been extirpated) and were calculated based on data in the Service's files on September 23, 2008. Note that further investigation may be necessary to determine if sites are also protected from hydrologic alterations and from impacts of pesticides and herbicides.

Section Name	Section	Total Plants	Total Plants on Sites with Protection Levels 4-9	% Plants on Sites with Protection Levels 4-9
Minnesota and Northeast Iowa Morainal-Oak Savannah	222M	125	123	98
Lake Agassiz-Aspen Parklands	222N	11,788	10,064	85
Red River Valley	251A	12,768	11,770	92
North Central Glaciated Plains	251B	1,127	714	63
Central Dissected Till Plains	251C	51	51	100
Osage Plains	251E	14	0	0
Missouri Loess Hills	251G	938	515	55
Nebraska Rolling Hills	251H	158	71	45
Nebraska Sand Hills	332C	2,171	769	35
Total		29,140	24,077	83

Due to the revision of the section boundaries, there are two sections (McNab et al. 2007) that now contain *P. praeclara* that were not addressed in the recovery plan – 222N and 251H. In addition, the name of section 251G was changed from the Central Loess Section to the Missouri Loess Hills Section. Finally, sections 332D and 332E no longer contain any *P. praeclara* populations due to the relocation of the boundaries for these sections.

Based on this analysis, 90% or more of the plants in sections 222M, 251A, and 251C have been protected and the protection criterion has nearly been met in section 222N with 85% of plants under protective ownership. Protection actions are still needed to meet the recovery criteria, however, in the remaining five sections. Two sections, 251C and 251E, each contain only one recorded extant population.

Management Criterion:
... and managed in accordance with a Service-approved management plan or guidelines. This plan must assure implementation of management practices that provide the range and spatial distribution of successional and hydrologic regimes required to maintain the

species and its pollinators in self-sustaining, naturally occurring populations, and must remain in effect following delisting.

This criterion addresses the following identified threats:

- Overgrazing
- Intensive hay mowing that may reduce primary productivity and seed dispersal and facilitate invasion of exotic cool season grasses
- Lack of management (woody plant invasion)
- Invasive species, including some cool season grass species
- Actions to control invasive species
- Herbicide use

The Service has not approved any management plans with clear reference to this recovery criterion or developed general management guidelines for the species. The recovery plan provides the following guidance, however, for evaluating management plans:

1. Populations must be protected from hydrologic alterations and pesticide impacts (p. 17);
2. Appropriate management must be implemented for at least three management cycles (e.g., if guidelines call for prescribed fire at a specified interval or range of intervals, the guidelines would not be fully implemented until the third prescribed burn has taken place at the appropriate intervals);
3. "Where sites are too small to permit natural succession to occur, manage communities to maintain the species' specific microhabitat requirements" (pp. 22-23);
4. "(F)ocus on maintaining or restoring the composition, function, and structure of the ecosystem on which *western prairie fringed orchid* depends, even though specific autecological and synecological information is lacking for the species" (p. 24);
5. Management practices should "duplicate the natural processes of the tallgrass prairie ecosystem" (p. 24);
6. Regularly review management practices and refine them as relevant research becomes available (p. 24).

Although this criterion has not been achieved, these six guiding principles for evaluating management plans may serve as interim guidelines to assess the adequacy of management of sites where western prairie fringed orchid is under protective ownership levels 4-9.

Sheyenne National Grasslands Management Plan

The Forest Service's "Recovery Strategy for the Western Prairie Fringed Orchid on the Sheyenne National Grassland" (USDA Forest

Service 2001) may be the most explicit management plan focused on the conservation of specific western prairie fringed orchid populations. Therefore, we will use it here as an example of how the Service might evaluate management plans in light of the recovery plan's management criterion.

This strategy is intended to:

1. Implement management direction found in the Dakota Prairie Grasslands Land and Resources Management Plan and the Western Prairie Fringed Orchid Recovery Plan (USFWS 1996).
2. Provide a broad umbrella under which management activities will occur that will not adversely impact western prairie fringed orchid.
3. Provide the framework for implementing a realistic western prairie fringed orchid monitoring program specific to Sheyenne National Grasslands (SNG).
4. Provide the impetus to guide changes in allotment management plan revisions relative to management of western prairie fringed orchid and its habitat.

Threats Not Adequately Addressed by Recovery Criteria

Recovery criteria should address all threats to the species that are contributing to its status as threatened or endangered and should be objective and measurable to be effective in measuring progress toward recovery. The recovery criteria do not adequately address the following threats that were identified in the listing rule, recovery plan, or after the approval of the recovery plan:

- Off-site drainage that would directly or indirectly lower water levels in the *P. praeclara* rooting zone
- Pesticide and herbicide impacts
- Low seed set in small and isolated populations

The recovery plan clearly acknowledges the need for sites to be protected from "the plow", pesticide impacts, and hydrologic alterations (U.S. Fish and Wildlife Service 1996:17), but the *recovery criteria* do not appear to adequately address the latter two threats. Even if protective ownership and appropriate management guard against drainage within the protected site, drainage on neighboring properties or projects with broad effects could still affect otherwise protected populations. Likewise, inadequate protection from the effects of herbicide and pesticide use carried out on or adjacent to occupied sites may also threaten some populations. Therefore, our summary of protection at levels 4-9 (Table 1) may adequately address the potential threat of "the plow" and collection of plants from small populations,

but may not adequately account for the level of threat posed by hydrologic alterations and pesticides.

Development of a population viability criterion may address the threat of small and isolated populations with low seed set if populations facing this threat would have to reach viable levels to be counted toward recovery.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Pollination Biology

Although Western prairie fringed orchid forms tubers and vegetative shoots from existing plants, pollination is required for seed production (U.S. Fish and Wildlife Service 1996:7). Western prairie fringed orchid is pollinated by a few species of sphinx moths (Sphingidae, Table 2) (Vik in prep.; Westwood and Borkowsky 2004:17). Vik (in prep.) found that 96% of flowers with signs of moth visits ('pollinia missing', 'pollen deposited', or 'scales deposited') produced seed pods, whereas only 23% of flowers with none of these signs produced seed. Several studies have identified or reconfirmed various sphinx moths as pollen vectors (i.e., species observed with attached pollinia of *Platanthera praeclara*, Table 3) since 1996. Western prairie fringed orchid pollinia typically attach to the center of the moths' eyes (Vik in prep.; Westwood and Borkowsky 2004:18) and Sheviak and Bowles (1986) concluded that potential pollinators have a distance of 5.8-6.4 mm between the outer eye margins and probosces that are "sufficient to reach common nectar levels" (34-43 mm long). Westwood and Borkowsky (2004), however, concluded that in Manitoba a slightly shorter proboscis length of 30-35 mm may be sufficient to obtain nectar, based on a mean distance to nectar of 32.83 mm (n = 1016, SE = 0.2). They also found that distance to nectar decreased during the flowering period due to increasing volumes of nectar. Therefore, a proboscis as short as approximately 28 mm may be sufficient to reach nectar late in the flowering period (Borkowsky 2006:88). This was supported by Vik (in prep.), who captured 20 *Hyles euphorbiae* with attached pollinia in North Dakota between 2004 and 2007 – this species may have a proboscis as short as 28 mm (Table 2).

Table 2. Documented pollen vectors for *Platanthera praeclara*. Except for *Hyles euphorbiae*, minimum proboscis lengths shown in table are based on measurements reported by Fauske and Rider (1996), representing extremes of material available at the North Dakota State Insect Reference Collection. For *Hyles euphorbiae* Jordan et al. (2006) reported simply "Proboscis length", not minimum proboscis length.

Species (Source)	Min. Length of Proboscis (mm)
Sphinx drupiferarum (Cuthrell 1994; Westwood and Borkowsky 2004)	31.6
Lintneria eremitus (Harris et al. 2004; Vik in prep.)	
Eumorpha achemon (Cuthrell 1994; Westwood and Borkowsky 2004)	32.2
Hyles euphorbiae (Jordan et al. 2006)	28
H. gallii (Westwood & Borkowsky 2004)	31.7
H. lineata (Vik in prep.)	32.5
Paratraea plebeja (Ashley 2001)	

Pollinator abundance and pollination rates may vary among geographic areas. Westwood and Borkowsky (2004:18) described the period of overlap between western prairie fringed orchid flowering and pollinators' flight periods as "restricted" at the Tallgrass Prairie Preserve (TPP) in southern Manitoba and suggested that low populations of pollinators may restrict seed production in southern Manitoba in some years. In 2001 and 2002, for example, about 1 of every 31 flowers produced seed 0.032 (seed capsules/flower, Borkowsky 2006:93). Of the 15 species of sphinx moths they captured at TPP, they confirmed only two species as pollen vectors (Table 3) and concluded that two other species, *Sphinx chersis* and *S. kalmiae*, may also be able to transfer pollen (Westwood & Borkowsky 2004:18). One of the confirmed pollen vectors, *S. drupiferarum* is "uncommon" near the TPP and populations of the other, *Hyles gallii*, fluctuate greatly in southern Manitoba (Westwood & Borkowsky 2004:19). Fauske and Rider (1996) speculated that cool and wet springs delay blooming in western prairie fringed orchid and may contribute to asynchrony with peaks in pollinator abundance in some situations. Cool and wet weather during the growing season may also depress local populations of pollinators, increasing reliance on sphinx moths emigrating from other areas (Fauske and Rider 1996:7).

Ultraviolet light may be used to artificially increase seed production, although it is not clear if and when this may be appropriate. Borkowsky (2006) lighted western prairie fringed orchid plants with ultraviolet light in Manitoba in 2001 and 2002 to determine its effects on pollination. In 2002, the mean percentage of pollinaria removed was significantly higher

among plants in the ultra-violet (UV) light treatment than among controls and a greater proportion of the flowers in the UV treatment produced seed capsules (Borkowsky 2006:50).

It may be necessary to use a variety of techniques when attempting to identify *P. praeclara* pollen vectors at a site. Vik (in prep.), for example, captured 23 *Lintneria eremitus* (seven with attached pollinia) in net traps and only one in a standard light trap. About ten years earlier, Cuthrell (1994) had captured no *L. eremitus* in the same geographic area using only light traps.

The apparent importance of *Hyles euphorbiae* as a *P. praeclara* pollen vector at SNG is especially interesting. *Hyles euphorbiae*, the leafy spurge hawk moth, was released as a potential biological control of leafy spurge (*Euphorbia esula*) from 1960 to 1985, but an adult was not recorded in North Dakota until 2000 (Vik in prep.). Vik (in prep.) found it to be the predominant hawk moth at SNG during her study of potential *P. praeclara* pollinators from 2004 to 2007, comprising 69% of all moths captured with net traps over flowers and standard light traps. Collection dates ranged from June 14 to August 16.

Some observations suggest that non-sphingid moths may cause pollination in *P. praeclara*. *Catocala* spp. (Noctuidae) moths have been observed pulling western prairie fringed orchid pollinia down onto female flower parts at SNG in North Dakota. At least one plant caged with a *Catocala* spp. moth before and throughout its flowering period produced swollen pods, which is typically indicative of successful reproduction (Marion Harris, North Dakota State University, pers. comm., 3/24/07).

Habitat - Effects of Soil Moisture and Flooding

Soil moisture is a critical determinant of growth, flowering, and distribution of western prairie fringed orchid. At Sheyenne National Grassland soil moisture in the top 10 cm was higher in swales with western prairie fringed orchid than in swales without western prairie fringed orchid (Wolken et al. 2001) and 60% percent of orchids had their root systems entirely within 10 cm of the soil surface – maximum and mean rooting distances were 16 and 12 cm, respectively (Wolken 1995; Wolken et al. 2001). At Pipestone National Monument in southwest Minnesota, two variables – late August precipitation and October-March precipitation – explained 77% of the variation in numbers of flowering western prairie fringed orchid in the subsequent growing season (Willson et al. 2006:39). The late August period corresponds with plant senescence and development of a perennating bud, whereas the latter period encompasses the period of winter dormancy (Willson et al. 2006:39). Precipitation during late August was positively related to the number of

flowering western prairie fringed orchid, whereas the relationship between flowering and October-March precipitation was the inverse (Willson et al. 2006:40). A preliminary analysis based on demographic monitoring, however, indicates that spring precipitation may have a greater impact on population growth than fall precipitation (N. Sather, pers. comm., 4/2/07). Therefore, precipitation may have effects on flowering and survival during different periods of the year.

Drought depresses the number of western prairie fringed orchid plants appearing aboveground, increases the proportion of vegetative plants, or both (Ashley 2001:9; Sather 2000:6). Viable seeds that persist from previous years (i.e., the seed bank) may be important for post-drought recovery of western prairie fringed orchid populations (Hof et al. 2002).

Although moist soil near the ground surface is critical to maintain western prairie fringed orchid populations, standing water may adversely affect populations depending on the depth and duration of flooding. Flooding decreases survival of all affected western prairie fringed orchid plants (Sieg and Wolken 1999), but flowering plants are more likely than vegetative plants to survive (Sieg and Wolken 1999). The hollow stems of flowering plants may conduct oxygen to roots and their greater height increases the odds that at least part of the plant remains above water and is able to photosynthesize. Plants are more likely to persist if they continue at least some photosynthesis during floods, as opposed to relying entirely on energy reserves (Sieg and Wolken 1999:199). Even among flowering plants, taller plants are more likely to survive flooding (Sieg and Wolken 1999).

Water may also disperse western prairie fringed orchid seeds (Sieg and Wolken 1999). From (2002) described western prairie fringed orchid seeds as "highly water resistant" due to hydrophobic and impermeable structures surrounding the embryo and found that the testa (seed coat) contained "considerable air space" that could "keep seeds afloat in water for long periods of time." Flooding at SNG resulted in a shift in the population from low swales to higher landscape positions where soil moisture was still suitable (Sieg and Wolken 1999). At sites with little topographic variation, the development of flowering plants may be reduced or eliminated during flood years or in subsequent years (see Sather 2002).

Wolken et al. (2001) developed a logistic regression model based on the percent cover of two associated plant species (*Juncus balticus* and *Stachys palustris*), the concentration of soluble magnesium, and August soil moisture between 0-2 cm below the surface that correctly classified 84% of swales that did or did not contain western prairie fringed orchid at SNG. The coverage of *Juncus balticus* alone allowed for the correct

classification of 66% of the swales containing western prairie fringed orchid and soil moisture in the top 10 cm was greater in swales that contained western prairie fringed orchid than in swales where the species was absent (Wolken et al. 2001).

Mycorrhizal Associations, Seed Biology, and Artificial Propagation

Western prairie fringed orchid is dependent on mycorrhizal fungi, especially for seed germination and for nutritional support before plants are capable of photosynthesis (Sharma 2002). Orchids "face almost certain extinction in the wild if their mycorrhizal symbionts (mycobionts) were to disappear" and survival of the mycorrhizal species depends on the conservation of orchid habitats (Zettler et al. 2003). Western prairie fringed orchid is likely dependent on certain fungal species that are typical of its tallgrass prairie and wet meadow habitats (Sharma 2002:26) – that is, there may be a stronger association between the fungal species and the habitats of western prairie fringed orchid than there is specifically between the fungi and the species (Zettler et al. 2003:212).

Sharma et al. (2003a) isolated both *Ceratorhiza* and *Epulorhiza* spp. from a protocorm and adult plants in Minnesota, although adult plants and field-incubated seeds in Missouri yielded only *Epulorhiza* isolates. Western prairie fringed orchid may preferentially associate with *Ceratorhiza* species (Sharma et al. 2003a), which "appear to be the dominant orchid mycobionts in Midwestern prairies" (Sharma 2002). Sharma et al. (2003) found that fungus derived from mature western prairie fringed orchid plants "failed to promote seedling development to advanced growth stages." Therefore, fungal associates likely vary among life stages.

Inoculation with appropriate fungal isolates facilitates western prairie fringed orchid seed germination and enhances *in vitro* plant development (Sharma 2002; Sharma et al. 2003b). *In vitro* germination rates were higher for seeds inoculated with mycorrhizal fungi (31%) than for uninoculated seeds (13%). From et al. (2005) successfully propagated western prairie fringed orchid without symbiotic fungi (asymbiotically), but mean germination percentages of cold-stratified seed placed on asymbiotic media were only 2-4%. Protocorms that developed from seeds sown in association with symbiotic fungi (i.e., symbiotically germinated) developed a shoot when inoculated with an *Epulorhiza* sp. mycobiont, but only developed leaves and "mycotrophic ability" when cultured with a *Ceratorhiza* sp. (Sharma 2002:74). Protocorms were more likely to develop to later stages when inoculated with an isolate derived from a seedling (Sharma 2002; Sharma et al. 2003b). Therefore, Sharma et al. (2003b:114) recommended inoculating seeds with fungal isolates from both seedlings and "naturally-occurring protocorms" to produce plants for conservation projects.

Studies of western prairie fringed orchid development suggest that seeds sown in actual prairie habitats of the species may be unlikely to develop into above-ground plants until at least one to two years after being sown (Alexander 2006; Sharma 2002; Sharma et al. 2003b, Figure 2). Western prairie fringed orchid seeds field-sown in nylon mesh bags at sites in Minnesota and Missouri yielded only protocorms with a few rhizoids and no visible leaf primordium after 20 months (Sharma 2002; Sharma et al. 2003b). At Sheyenne National Grassland, Alexander (2006:128) divided 18,717 seeds among 30 packets and planted them in western prairie fringed orchid habitat. After one year, she dug up the seed packets and divided the seeds into five groups (Figure 2). Plants may develop more quickly from seeds inoculated with a mycorrhizal symbiont and germinated *in vitro* (e.g., in a Petri dish) - some seeds sown in this way by Sharma (2002:138), for example, produced leaf-bearing seedlings within six to nine months.

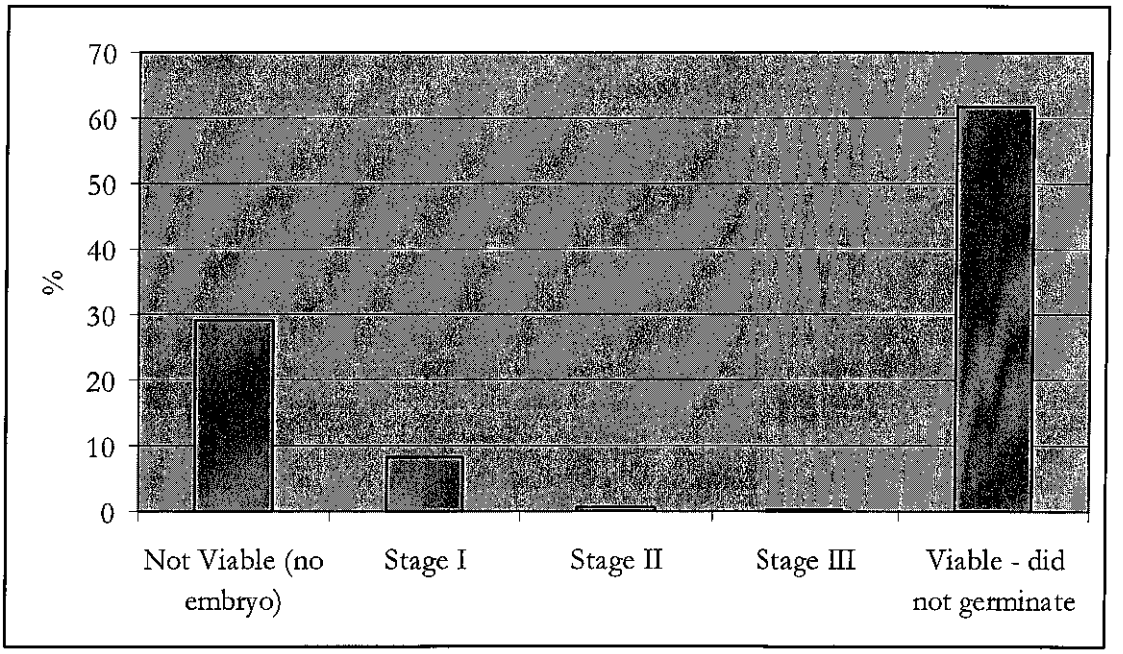

Figure 2. Developmental state of seeds recovered from seed packets twelve months after being sown in western prairie fringed orchid habitat at Sheyenne National Grasslands in 2004 (Alexander 2006). Stage I seeds (n = 1706) had doubled in size and showed signs of rupturing the seed coat one year later; Stage II seeds (n = 94) had developed to the protocorm stage; Stage III seeds (n = 51) had developed at least the tip of the first leaf and 5427 seeds lacked viable embryos (i.e., were non-viable). 11,584 seeds that were evidently viable had not germinated after one year *in situ*.

Cold stratification of seeds for at least six months combined with the addition of fungal mycobionts may maximize production of plants *in vitro*. For example, protocorms that developed from seeds stratified for six months developed *in vitro* to later stages than protocorms grown from

seeds stratified for only four months (Sharma et al. 2003b); non-stratified seeds did not germinate (Sharma 2002). Western prairie fringed orchid seeds consist of a testa (seed coat) surrounding a carapace-like structure that contains a "rudimentary" embryo consisting of approximately 32 cells and containing nutrient bodies consisting primarily of calcium and potassium (From 2002). The testa is easily removed "by gently rubbing," but it and the carapace appear to function as separate layers that are each highly hydrophobic and impermeable to water (From 2002). Western prairie fringed orchid seeds delay germination even after removal of the testa, suggesting that chemical inhibitors are present in other structures (From 2002).

Sharma et al. (2003b:110) found that seed viability varied from 9-37% among five populations and was highest in the small populations sampled. Related propagation studies yielded advanced stage protocorms only from the small populations studied (Sharma 2002:98). In North Dakota, Alexander (2006, see above) found that only 5% of seeds sown in packets in North Dakota germinated after one year.

Dormancy and Mortality

In a preliminary analysis of 408 plants in four Minnesota populations, 4-12 % of monitored plants were dormant each year from 1986 to 1994 – approximately one-third of the plants experienced one or more periods of dormancy lasting one to three years (Sather 1997). Dormancy may last as long as eight years, but more than half of all dormancy episodes may be as short as one year (Quintana-Ascencio et al. 2004:17). Annual mortality rates of monitored plants were as low as 1.2 % and, in a drought year, as high as 13.5 % (Sather 1997).

2.3.1.2 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, etc.), or demographic trends:

Drought has significant and, in some cases, widespread effects on western prairie fringed orchid flowering and survival. Some Nebraska populations, for example, were depressed by a drought in 1999 (Steinauer 2000), although populations at Valentine National Wildlife Refuge (VNWR) in the Nebraska Sandhills mostly recovered to near high levels in 2005. In 2006, some VNWR populations remained at high levels, whereas others declined (M. Nenneman, unpubl. data, 2007). Drought conditions also affected western Iowa beginning in 1999 and continuing into 2000 when Watson (2001a:9-10) found flowering plants at only two of six western Iowa populations monitored and only in especially wet portions of the habitats. In contrast, northeast Iowa received high levels of

precipitation in 1999 and Watson (2000:10) observed a record high number of flowering plants at Hayden Prairie in 2000.

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

In 2002, Sharma completed a protein electrophoresis study that included eight Minnesota populations. She looked at variation in allozymes among 13 loci, 10 of which were polymorphic. She found that the number of alleles was higher in larger populations and that heterozygosity was positively correlated to population size (Sharma 2002:112). The high incidence of monomorphism among small populations indicated that genetic drift, not inbreeding, has caused low genetic variation and a loss of heterozygosity in these populations (Sharma 2002:119; Sharma 2005).

2.3.1.4 Taxonomic classification or changes in nomenclature:

No new information has come to light since the 1991 5-year review.

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

Some background is warranted for this section. Published accounts and herbarium records suggest *P. praeclara* was widespread and perhaps locally common prior to European settlement (Bowles and Duxbury 1986). Historically, Brownell (1984) and Lobeck (1957) suggest western prairie fringed orchid was distributed throughout much of the western Central Lowlands and eastern Great Plains physiographic provinces of the central United States and Interior Plains in extreme south-central Canada. There are no recent records from South Dakota and Oklahoma, although surveys in potential habitat may be warranted in South Dakota and there is a current proposal to reintroduce the species in Oklahoma. In Iowa, southeastern Kansas, Missouri, and eastern Nebraska the species is now extirpated from a significant number of counties where it occurred historically. A single collection reported from Wyoming (Bowles 1983, Sheviak and Bowles 1986) is of dubious origin (Bjugstad and Fortune 1989).

In 2000, the Nebraska Game and Parks Commission conducted surveys to document new populations of western prairie fringed orchid along the Cedar Creek drainage of Garfield and southwestern Holt Counties in the central and eastern Sandhills region. This region had maintained "soil moisture levels favorable for the orchid development" during the prevailing severe drought when orchid numbers were depressed elsewhere

in the state (Steinauer 2000:2-3). Of the 16 newly recorded populations discovered, all but 3 consisted of fewer than 15 plants at the time of the survey. Additional surveys in the Nebraska Sandhills may identify additional populations of western prairie fringed orchid (Steinauer 2000:4).

In Kansas, a survey of 249 native prairie remnants contained within a five-county area in the range of western prairie fringed orchid found no new western prairie fringed orchid populations and confirmed the extirpation of one population, which was plowed under by the landowner (Kindscher et al. 2005).

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

Reed canary grass was described as a species associated with western prairie fringed orchid in the recovery plan, but was not described as a threat. Watson (2001a:11) described it as a threat, however, to one Iowa population.

2.3.1.7 Other Information:

Habitat Management

The persistence of western prairie fringed orchid is dependent on periodic disturbance by fire, mowing, or grazing, but these practices may also cause adverse effects and must be carefully implemented. Late May fires in Kittson County, Minnesota, for example, destroyed above-ground parts of western prairie fringed orchid plants for the entire growing season (Minnesota Department of Natural Resources 2000) and were implicated in the complete absence of plants at Blue Mounds State Park and Burnham Wildlife Management Area in Minnesota in 1986 and 1999, respectively. As with the conservation of other rare prairie species that exist in fragments of a once vast ecosystem, successful management consists of careful application of practices that are essential for conserving the habitat, while ensuring that associated adverse effects are avoided or minimized.

Adverse effects of fires in late May in Minnesota could last for two growing seasons, but minimal effects observed at some sites suggest that their impacts may vary due to differences in soil moisture and fuel loads (Sather 2000:6-7). Sather (2000:7) recommended avoiding burns in Minnesota after May 1 unless site inspections indicate that orchids are not yet aboveground. She later (Sather 2004) indicated, however, that western prairie fringed orchid may emerge as early as mid-April in southwest Minnesota. In 2002, a small fire experiment at Pipestone National

Monument showed no effects of fire on flowering of the orchid when the locations of plants were burned on May 2 (Willson et. al 2006). Therefore, the timing of prescribed burns is best adjusted annually to western prairie fringed orchid phenology.

A study to assess the impacts of fall burning, spring burning, haying, and no management on western prairie fringed orchid was initiated at Pembina Trail Preserve Scientific and Natural Area in northwestern Minnesota in 1999. Each of the four treatments is replicated 21 times on the preserve within a series of 30 x 30 meter cells (Minnesota Department of Natural Resources 2002). The study is intended to assess the effects of typical management practices used on sites inhabited by western prairie fringed orchid in northwestern Minnesota, including four-year fire rotations, annual haying, and no treatment (idle). Baseline data on western prairie fringed orchid and associated species were collected annually from 1995 to 1999 and used to optimally assign management cells among treatments before experimental treatments were initiated (Minnesota Department of Natural Resources 2002) Since then, all management treatments have been conducted as scheduled and data have been collected annually, including number of flowering and vegetative western prairie fringed orchid plants per cell and number of flowers and seed pods per cell. A mid-project data summary and analysis are pending.

Sheyenne National Grassland contains several large populations of western prairie fringed orchid, all or most of which are subject to grazing. The Forest Service (USDA Forest Service 2001) ran a RAMAS stage model to predict the effects of grazing management there on the viability of the impacted western prairie fringed orchid populations. Populations were divided into "core" (n = 11), "satellite" (n = 13), and "other" (n = 6) populations. Core populations contained the highest numbers of flowering plants, were recognized for their importance in maintaining the geographical distribution of the species at SNG, and supported above ground plants in both wet and dry years. The RAMAS stage model was run under the assumption that one-third of the eleven core populations and one-tenth of the thirteen satellite populations, respectively, would be protected from grazing during the period when western prairie fringed orchid is particularly susceptible to the effects of livestock grazing (June 1 to September 15, USDA Forest Service 2001) – delaying grazing until after September 15 may be crucial for maximizing seed production because seed number and embryo size may still be increasing as late as September 9 at SNG (Alexander 2006). The resulting model predicted a population growth rate of 1.12. Continued monitoring is necessary to validate the model's predictions.

Disease

No diseases that affect western prairie fringed orchid were noted in either the final listing rule (USFWS 1989) or the recovery plan. Carlson et al. (2001) noted that anthracnose leaf blight, which may have been exacerbated by insect herbivory, adversely affected orchid growth and flowering in Nebraska in 2000.

Effects of Invasive Species Control

Application of herbicides to control invasive plant species may also harm or kill western prairie fringed orchid, but effects vary among herbicides and with the timing of application. Herbicide damage to western prairie fringed orchid has been documented at Sheyenne National Grassland, with damage as high as 85% of plants within an allotment in at least one case (USDA Forest Service 2003:5). Erickson et al. (2006:464-465) found that imazapic applied at rates typically used for control of leafy spurge (140 g/ha), tended to cause western prairie fringed orchid to remain in a vegetative state ten months after treatment, be shorter, have fewer and deformed flowers, and produce less seed. In plots where the herbicide quinclorac was applied, however, they detected no effects on growth, persistence, or reproduction of western prairie fringed orchid. Kirby et al. (2003) evaluated the effects of three herbicides used to control leafy spurge and found no significant effects on the reemergence or density of western prairie fringed orchid in plots at SNG that were sprayed with three herbicides in mid-September when above ground orchid parts were senescent. Studies longer than two years, however, may be necessary to completely assess herbicide effects on reemergence, flowering, and seed production, especially if herbicide applications will be repeated in future years. Biological controls (*Aphthona* spp. - flea beetles) may also reduce leafy spurge, but may not be as effective as herbicides (Erickson and Lym 2004).

Arrested Floral Development

Sather (2000) documented arrested floral development in populations in extreme northwest Minnesota in 1998 and in southeast Minnesota in 2000. Plants developed buds that failed to develop into flowers. Among plants that developed buds in 1998 at demographic monitoring plots in northwest Minnesota, 95% aborted floral development in the bud stage (Sather 2000:4). Watson (2001b) recorded similar "arrested development" of flowers at Hayden Prairie in northeast Iowa in 2001 and suggested that it was caused by an "intense dry spell" that began in mid-June.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

For each category of threat we provide a list of threats identified in the 1989 listing rule, the recovery plan, or since the approval of the recovery plan. We then discuss any information that we have obtained since 1996 regarding the magnitude (scope and severity) and imminence of new or previously identified threats. We also discuss measures that may be taken to alleviate these threats.

Threats Described at the Time of Listing

The Service described the following threats to western prairie fringed orchid at the time of listing [54 FR 39857 (28 September 1989)]:

- Conversion of suitable habitat to cropland
- Overgrazing
- Intensive hay mowing that may reduce primary productivity and reduce seed dispersal
- Drainage
- Lack of management (succession)
- Small, isolated populations with low seed set
- Herbicide use
- Collection of plants from small populations

Threats Described in the 1996 Recovery Plan

In its recovery plan (U.S. Fish and Wildlife Service 1996) the Service mostly reiterated the threats it described in the final listing rule, but emphasized that conversion of habitat to cropland was the greatest remaining threat to southern populations. It also emphasized that little was known about how to ensure that burning, grazing, and mowing are conducted in a manner not adverse to western prairie fringed orchid populations and pointed out that actions that directly or indirectly lower water levels in the rooting zone of plants "have the potential of serious adverse impacts." In addition, it implied that potential impacts of pesticides to western prairie fringed orchid and its pollinators were also a threat (U.S. Fish and Wildlife Service 1996:17). The listing rule included herbicides as a threat, but not pesticides.

In the recovery plan, the Service also clarified that invasion by exotic species is a threat not specifically addressed in the 1989 final listing rule. The recovery plan mentions leafy spurge (*Euphorbia esula*) and musk thistle (*Carduus nutans*) as the most severe threats in the northern and southern portion of the species range, respectively. It also mentions that

actions to control these species may also threaten western prairie fringed orchid.

The recovery plan discusses potential threats posed by native and non-native herbivores, including mammals and insects. Although herbivore impacts may be significant locally in some years (Borkowsky 2006:62), it is not clear whether native herbivores threaten any populations. The recovery plan (p. 13) mentions several herbivores that have fed on western prairie fringed orchids. Since completion of the recovery plan, at least one additional taxon, rose chaffer beetles (assumed to be *Macrodactylus subspinosus*, Scarabaeidae), was found feeding on western prairie fringed orchid. Rose chaffer beetles fed on a significant number of western prairie fringed orchid plants in Nebraska's Pierce and Madison counties in 2002 and the affected plants later exhibited fungal infections. Levels of this herbivory decreased after 2002, but persisted at least until 2005 (Gerry Steinauer, Nebraska Game and Parks Commission, pers. comm., 2005). Watson (2001b) found predated seed capsules that contained unidentified insect pupae at Kalsow Prairie in Iowa in 2001.

Threats Described Since 1996

Inter-seeding of non-native species, especially Garrison creeping foxtail (a cultivated variety of *Alopecurus arundinaceus* Poir), into wet prairie or wet meadows to increase livestock forage is now promoted in Nebraska (G. Steinauer, pers. comm., 2005; Volesky et al. 2003). This grass may pose a previously unrecognized threat if it is introduced into sites inhabited by western prairie fringed orchid (G. Steinauer, pers., comm. 2005). Morse et al. (2004:37) list nine reproductive characteristics typical of invasive plant species, including:

- Has quickly spreading rhizomes or stolons that may root at nodes
- Resprouts readily when broken, cut, grazed, or burned
- Reproduces readily both vegetatively and by seed or spores

According to a plant guide produced by U.S. Department of Agriculture, *Alopecurus arundinaceus* "produces numerous aggressive underground rhizomes" and is able to "recover quickly from grazing" (USDA NRCS 2004). The following excerpt from this guide strongly suggests that it could become a threat if planted near or into habitats occupied by western prairie fringed orchid:

"In addition to aggressive rhizomes, creeping foxtail proliferates by windborne and waterborne seeds. Rapid reproduction can be useful in repairing damaged sites; however, creeping foxtail's ability to spread quickly may create management problems in canals, irrigation ditches, and other waterways."

Staff at Valentine National Wildlife Refuge in Nebraska have been finding "small patches" of Garrison creeping foxtail on the refuge and are spraying each one with herbicide (Mel Nenneman, Valentine National Wildlife Refuge, Valentine, NE, pers. comm., 7/18/07). Exotic, cool-season grasses also are invading and increasing in western prairie fringed orchid habitats in Nebraska – a long-term trend that may be exacerbated by annual mid-summer haying (G. Steinauer, pers. comm., 2005).

Comprehensive List of Identified Threats

In summary, the following have been identified as threats in the 1989 listing rule, the 1996 recovery plan, or since the recovery plan:

- Conversion of habitat to cropland
- Overgrazing
- Intensive hay mowing that may reduce primary productivity and seed dispersal and facilitate invasion of exotic cool season grasses
- Drainage
- Lack of management (succession)
- Actions that directly or indirectly lower water levels in the rooting zone of plants
- Invasive species, including some cool season grass species
- Inter-seeding of non-native species, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail), into wet prairie in Nebraska
- Collection of plants from small populations
- Actions to control invasive species
- Small, isolated populations with low seed set
- Herbicide and pesticide impacts on western prairie fringed orchid and its pollinators

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

The following identified threats (see list above) are included in this category:

- Conversion of habitat to cropland
- Overgrazing
- Intensive hay mowing that may reduce primary productivity and seed dispersal and facilitate invasion of exotic cool season grasses
- Drainage
- Lack of management (succession)

- Actions that directly or indirectly lower water levels in the rooting zone of plants
- Invasive species, including some cool season grass species
- Inter-seeding of non-native species, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail), into wet prairie in Nebraska

The U.S. Forest Service is currently implementing a grazing management plan at Sheyenne National Grassland that is intended, in part, to conserve western prairie fringed orchid populations. Effective monitoring and evaluation of grazing and its effects on western prairie fringed orchid populations at SNG may be important for designing grazing strategies elsewhere in the species' range. Most importantly, however, it will be crucial for determining whether grazing management is effective in conserving the important populations at SNG – 91% of the protected plants in the Red River Valley ecological section (251A, Table 1) are on SNG.

The Service identified intensive hay mowing that may reduce primary productivity and reduce seed dispersal as a threat at the time of listing in 1989. Steinauer (pers. comm., 2005) reconfirmed the importance of this threat in Nebraska, pointing specifically to annual mid-summer haying as a practice that is facilitating the long-term invasion of western prairie fringed orchid habitats by exotic cool season grasses. The research project at Pembina Trail Preserve Scientific and Natural Area described above (section 2.3.1.7, Habitat Management) includes an assessment of annual late summer (August/September) haying on western prairie fringed orchid survival and reproduction in northwest Minnesota. This study may shed some light on the relative impacts of this management practice, at least in the northern part of the species' range.

Although the Service has not compiled a complete list of threats to western prairie fringed orchid for each site, invasive species are noted as a current threat to about 20% of extant sites. Leafy spurge and reed canary grass are the two most frequently reported threats (Table 4). The Service should improve its tracking of invasive species threats for each site, in cooperation with the states and others, to determine the relative importance range wide of each invasive species. Invasive species should be identified as a threat to an extant population if they are present at the site and if current or anticipated management is unlikely to be sufficient to control them to the extent that they would no longer pose a threat to western prairie fringed orchid at the site. The latter may be primarily a function of management resources and, for private lands, landowner cooperation.

Table 3. Invasive species reported as threats from sites inhabited by western prairie fringed orchid.

Species	No. Sites Reported as Threat
Leafy spurge (*Euphorbia esula*)	12
Reed canary grass (*Phalaris arundinacea*)	11
Smooth brome (*Bromus inermis*)	5
Redtop (*Agrostis gigantea*)	4
Canada thistle (*Cirsium arvense*)	2
White sweet clover (*Melilotus alba*)	2
Sericea lespedeza (*Lespedeza cuneata*)	2
Crown vetch (*Securigera varia*)	2
Timothy (*Phleum pratense*)	1
Clover (*Trifolium sp.*)	1
Bird's-foot trefoil (*Lotus corniculatus*)	1

The recovery plan recognized the potential threat of lowering groundwater levels (U.S. Fish and Wildlife Service 1996:12), but did not discuss any specific population that may be threatened in this way. The Forest Service (USDA Forest Service 2001), however, recognized this as a potential threat to populations at SNG in North Dakota. Since 1996, we have a better understanding of the extent of the rooting zone (see "Habitat - Effects of Soil Moisture and Flooding", above) and have also seen that soil moisture during late summer (late August in southwest Minnesota, Willson et al. 2006) affects abundance of flowering plants in the following growing season. Effects on soil moisture levels in the top 10 cm seem especially critical (Wolken et al. 2001).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Only one identified threat may be included under this category - collection of plants from small populations (54 FR 39857 [September 28, 1989]). We are aware of only one report that mentioned this as a potential threat to a western prairie fringed orchid population. Watson (2001b) reported that trails made by humans wound through Sheeder Prairie in Iowa and seemed to 'converge on areas where flowering orchids were located' and coincided with observations of missing flowers.

2.3.2.3 Disease or predation:

The recovery plan describes instances of herbivory by native and non-native species, but does not clearly recognize herbivory by wildlife as a threat to the species. Although wildlife herbivory by a variety of vertebrates and invertebrates likely occurs in all populations, it may have significant effects only on small populations and in years when drought or

other factors may depress numbers of flowering plants and increase populations of insect herbivores (Fauske and Rider 1996). Watson (2001a:11) suggested that small western prairie fringed orchid habitats in predominantly agricultural landscapes may be vulnerable to white-tailed deer herbivory. In 2000, for example, white-tailed deer (*Odocoileus virginianus*) apparently damaged approximately one-third (9 of 32) of the inflorescences at Hayden Prairie. In those situations, buffers around occupied sites (e.g., restored habitats on lands currently used for agriculture) may reduce the vulnerability of western prairie fringed orchid if they would disperse deer foraging. Fauske and Rider (1996) found that insect herbivory had no significant effect on flowering at SNG in 1995 after four years of above average precipitation. Previous studies (Cuthrell 1994) had found significant effects of insect herbivores, suggesting that this type of herbivory fluctuates in inverse proportion to precipitation.

Above (in section 2.3.2, "Threats Described in the 1996 Recovery Plan"), we discuss the observations of significant damage during at least one year by rose chaffer beetles in Nebraska. Rose chaffer beetles predated a significant number of western prairie fringed orchid plants in Nebraska's Pierce and Madison counties in 2002 and the predated plants later exhibited fungal infections. Levels of this herbivory decreased after 2002, but persisted at least until 2005 (G. Steinauer, pers. comm., 2005).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Regulatory Protection in Canada

In 1996, western prairie fringed orchid was listed as endangered under the Manitoba Endangered Species Act, which specifically prohibits acts that destroy, disturb, or interfere with the habitat of an endangered species (Environment Canada 2006:6). In June 2003, the species was also listed as Endangered under the Canadian Species at Risk Act (Environment Canada 2006:6).

State Regulatory Protections

Among the six states in which the species occurs, it is listed as endangered in one, threatened in three, and is not listed under any endangered species statute in the remaining two states (Table 4).

Table 4. Summary of listing status and protections afforded under state endangered species statutes.

State	Status	Summary of Protections
IA	T	"(A) person shall not take, possess, transport, import, export, process, sell or offer for sale, buy or offer to buy, nor shall a common or contract carrier transport or receive for shipment" the species without a permit. (Iowa Code chapter 481B)
KS	None	The Kansas state endangered species statute provides no authority to list plants as endangered or threatened.
MN	T	"Minnesota's Endangered Species Statute and the associated Rules impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. A person may not take, import, transport, or sell any portion of an endangered or threatened species. However, these acts may be allowed by permit issued by the DNR; plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices are exempt; and the accidental, unknowing destruction of designated plants is exempt." (Minnesota Department of Natural Resources. 2008. Endangered, threatened and special concern species. <http://files.dnr.state.mn.us/natural_resources/ets/endlist.pdf>. Accessed 2008 June 20.
MO	E	State regulations (3 CSR 10-4.111) prohibit the "exportation, transportation or sale of any endangered species of plant or parts thereof, or the sale of or possession with intent to sell any product made in whole or in part from any parts of any endangered species of plant."
NE	T	Under Nebraska Code, Section 37-806, it is unlawful to export, possess, process, sell or offer for sale, deliver, carry, transport, or ship, by any means whatsoever, any listed species.
ND	None	n/a

The protection afforded by state statutes and associated regulations seems to focus primarily on protecting western prairie fringed orchid from unauthorized commercial use and, in Minnesota and Iowa, "take" of the species. Commercial use of western prairie fringed orchid is not one of the twelve identified threats to the species (see section 2.3.2, "Comprehensive List of Identified Threats") and direct take of plants would address only one of these threats (collection of plants from small populations). Moreover, two of the six states (Kansas and North Dakota) that together contain about 42% of all western prairie fringed orchid plants have no direct legal or regulatory protection for western prairie fringed orchid.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Three identified threats fall under this category:

- Actions to control invasive species
- Small, isolated populations with low seed set
- Herbicide and pesticide impacts to western prairie fringed orchid and its pollinators

Fauske and Rider (1996) observed fewer pollinators at a site in North Dakota where herbicides apparently reduced the density of nectar sources and western prairie fringed orchid, suggesting that the impacts on other nectar species should be considered when using herbicides to control invasive species. Erickson et al. (2006:464-465) found that imazapic applied at rates typically used for control of leafy spurge (140 g/ha), tended to cause western prairie fringed orchid to remain in a vegetative state ten months after treatment, to be shorter, to have fewer and deformed flowers, and to produce less seed. In plots where the herbicide quinclorac was applied, they detected no effects on growth, persistence, or reproduction of western prairie fringed orchid. (Also see "Effects of Invasive Species Control" in section 2.3.1.7, above.)

In some cases, drift of herbicides from adjacent properties or roadsides may pose a threat. For example, herbicide applied to control roadside weeds drifted into Powell Prairie in Iowa in 2001 – only one orchid may have been damaged, although damage would have likely been worse if some shrubs along the road had not blocked much of the drift (Watson 2001b:12). In this case, the county was contacted to make them aware of the threat posed by roadside spraying. Similar incidents in Polk County, Minnesota, have been addressed with annual pre-season coordination between the Minnesota Department of Natural Resources and the county highway department.

2.4 Synthesis

Significant progress has been made to protect western prairie fringed orchid populations in some portions of its range (see above – Table 1), where approximately 83% of the plants are on sites with protection, but substantial protective actions are still necessary in some ecological sections, especially 332C (Nebraska Sand Hills), 251H (Nebraska Rolling Hills), 251G (Missouri Loess Hills), and 251B (North Central Glaciated Plains). These sections are concentrated in the central and southern portions of the species' range. Populations under protective ownership must also be appropriately managed and not subject to threats from hydrologic alteration or impacts of pesticides and herbicides to be considered contributing to recovery.

As noted above, the Sheyenne National Grassland has prepared and begun implementing a comprehensive grazing management plan with a stated intention of conserving western prairie fringed orchid populations. Effective and comprehensive monitoring will be necessary to confirm that grazing will be implemented in a manner appropriate to the

conservation of western prairie fringed orchid. The outcome of implementing the grazing plan will have a major impact on the recovery of the species in the Red River Valley ecological section (251A).

At present, the recovery criteria may not adequately address all current threats to the species. The Service will work with the recovery team to determine how the recovery criteria may be revised to address all current threats and the recent changes in ecoregional mapping and to ensure that criteria are objective and measurable. Issues that have arisen since the approval of the recovery plan that need to be addressed include: 1) drainage and other actions that directly or indirectly lower water levels in the rooting zone of plants; 2) collection of plants from small populations; 3) small, isolated populations with low seed set; and 4) herbicide and pesticide impacts to western prairie fringed orchid and its pollinators. It is unclear whether collection of plants from small populations is still a threat that is significantly affecting the likelihood that *P. praeclara* will become endangered in the foreseeable future. If the Service determines that it is a threat to the species, then the recovery criteria should be revised to address it. Development of a population viability criterion may address the threat of small and isolated populations with low seed set because populations facing this threat would have to reach viable levels to be counted toward recovery.

Previously recognized and new threats affect the existence of the western prairie fringed orchid to the extent that it may become endangered in the foreseeable future throughout all or a significant portion of its range. Therefore, this species continues to meet the definition of threatened. The listing classification of the western prairie fringed orchid should remain as threatened under the Endangered Species Act.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
__X_ No change is needed

3.2 New Recovery Priority Number

We do not propose a change in the recovery priority number for western prairie fringed orchid.

Brief Rationale:

Although numerous threats to western prairie fringed orchid have been identified, a significant proportion of populations in some ecological regions have been protected from direct habitat destruction (e.g., plowing). Substantial actions to protect populations from habitat destruction, however, are still needed in some ecological sections. Therefore, it is still appropriate to describe the level of threats as "moderate." Significant questions remain as to how to best manage western prairie fringed orchid, but a fair amount of new information to guide management planning has been obtained since the approval of the recovery plan in 1996. The ongoing study in northwestern Minnesota and implementation of the grazing management plan at SNG, for example, will likely provide managers with useful information to conserve this species. Although many populations are small, especially in some ecoregions, we think that the recovery potential for the species is still "high", primarily due to the large proportion of populations that occur on areas protected from habitat destruction in some ecological sections (Table 1).

3.3 Listing and Reclassification Priority Number: N/A.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Revise the recovery criteria to include clear and measurable standards to determine whether western prairie fringed orchid plants are part of a viable population. The recovery criteria require that plants be under protective ownership or control and appropriately managed to count towards recovery in each ecoregion. There are no standards within the criteria, however, to assess whether these plants are part of populations that are viable. Although not addressed by the recovery criteria, actions 42 (Determine parameters required to maintain viable self-sustaining populations) and 424 (Conduct a population viability analysis for the species) do address this issue and a preliminary population viability analysis has been completed based on demographic monitoring.

- Ensure that any revised recovery criteria are objective and measurable and address the following threats, as appropriate:

    - Drainage and other actions that directly or indirectly lower water levels in the rooting zone of plants
    - Isolation and low reproduction of small populations
    - Herbicide and pesticide impacts to western prairie fringed orchid and its pollinators
    - Collection of plants from small populations
    - Effects of invading exotic species and actions to control those species
    - Inter-seeding of non-native species into wet prairie in Nebraska, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail)

- Describe a process by which the Service will evaluate management plans for the purposes of measuring progress towards recovery. This should include a description of the Service's review process (e.g., who will conduct and approve these reviews for the Service) and the basis for evaluating the adequacy of each plan. The following excerpts from the recovery plan may be useful for evaluating management plans until more specific guidance is developed:

    - Populations must be protected from hydrologic alterations and pesticide impacts (p. 17).
    - Appropriate management must be implemented for at least three management cycles (e.g., if guidelines call for prescribed fire at a specified interval or range of intervals, the guidelines would not be fully implemented until the third prescribed burn has taken place at the appropriate intervals, p. 17).
    - "Where sites are too small to permit natural succession to occur, manage communities to maintain the species' specific microhabitat requirements" (pp. 22-23).
    - Plans should focus "on maintaining or restoring the composition, function, and structure of the ecosystem on which western prairie fringed orchid depends" (p. 24).

- Management practices should "duplicate the natural processes of the tallgrass prairie ecosystem" (p. 24).
- The plan should include a process for regular review and refinement of the management practices as relevant research becomes available (p. 24).

- Compile existing management plans for sites where western prairie fringed orchid is extant and protected from conversion and determine whether they are adequate to ensure the conservation of the respective western prairie fringed orchid populations.

- Implement recovery action 33 – Develop or maintain appropriate mowing regimes (U.S. Fish and Wildlife Service 1996:20). Steinauer (2000:4) briefly summarized the importance of the Nebraska's eastern Sandhills region for the conservation of western prairie fringed orchid and suggested that significant progress towards the species' conservation could be made by modifying haying practices at some sites.

- Conduct additional surveys in the Nebraska Sandhills when soil moisture levels may be suitable for significant levels of flowering. Additional surveys in this region may identify additional populations of western prairie fringed orchid (Steinauer 2000:4), but significant surveys have not been conducted since 2000 (recovery action 52 – Identify and search potential new sites [U.S. Fish and Wildlife Service 1996:22]).

- Improve tracking of invasive species threats for each site, in cooperation with the states and others, to determine the relative range-wide harm of each invasive species. Invasive species should be identified as a threat at a site if they are present and if current or anticipated management is unlikely to be sufficient to control invasives to the extent that the invasive(s) will no longer pose a threat to western prairie fringed orchid.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Platanthera praeclara*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review
___ Downlist to Threatened
___ Uplist to Endangered
___ Delist
X No change is needed

Appropriate Recovery Priority Number: 8C
Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Phil Delphey

FIELD OFFICE/REFUGE APPROVAL:
Lead Field Supervisor/Refuge Manager, Fish and Wildlife Service

Approve _____ Date 12/5/08

REGIONAL OFFICE APPROVAL:
Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Midwest Region

Approve Lynn M Lewis Date 2/5/09

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. Written concurrence from other regions is required.

ACTING
Cooperating Regional Director, Fish and Wildlife Service, Southwest Region
Signature _____ Date 4/27/09 X Concur ___ Do Not Concur

ACTING
Cooperating Regional Director, Fish and Wildlife Service, Mountain-Prairie Region
Signature Mike Stempel Date 2/18/09 X Concur ___ Do Not Concur