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APPENDIX N RECOVERY STRATEGY FOR THE WESTERN PRAIRIE FRINGED ORCHID ON THE SHEYENNE NATIONAL GRASSLAND

This strategy represents the best identified approach for managing the Western Prairie Fringed Orchid in a multiple use setting and reflects the commitment of the Sheyenne National Grassland and Dakota Prairie Grasslands to meet the intent of the Threatened and Endangered Species Act, as amended. This strategy is tiered to the Recovery Plan for the Western Prairie Fringed Orchid (USFWS 1996), and is specific to the Sheyenne National Grassland metapopulation. It is not intended to be a research or recovery plan for the orchid.

INTRODUCTION

SIGNIFICANCE OF THE SHEYENNE PRAIRIE FRINGED ORCHID POPULATION

The Western Prairie Fringed Orchid *(Platanthera praeclara)* was listed as a threatened species by the U.S. Fish and Wildlife Service on September 28, 1989. The orchid is primarily associated with wetlands in tallgrass prairie communities, most of which have been converted to intensively farmed cropland. The Sheyenne National Grassland (SNG) is comprised of native tallgrass prairie and associated plant communities, and supports one of the largest remaining metapopulations of the orchid. The Sheyenne population is one of three metapopulations of the orchid remaining in North America. Small relict orchid populations considered non-viable occur sporadically across the remainder of the remnant tallgrass prairie, west of the Mississippi River.

Purpose of the Recovery Strategy

This strategy is considered an important step in the recovery of the orchid for several reasons. It will:

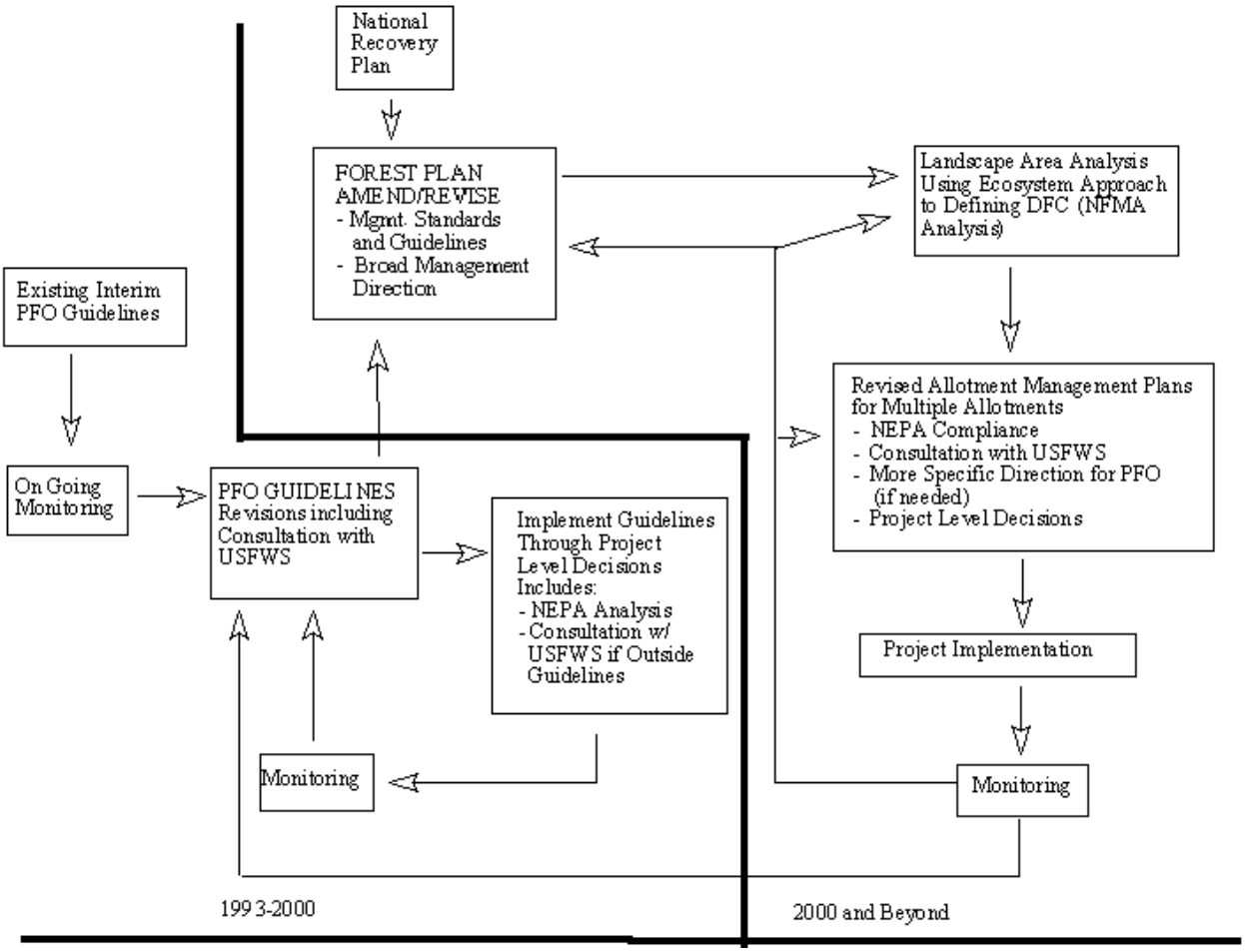
- Implement management direction found in the Dakota Prairie Grasslands Land and Resources Management Plan and the Western Prairie Fringed Orchid Recovery Plan (USFWS 1996).
- Provide a broad umbrella under which management activities will occur that will not adversely impact the orchid.
- Provide the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

Scope and Applicability of the Recovery Strategy

Figure 1 displays how this strategy relates to national recovery efforts, Forest Plan direction, landscape level analysis, project implementation and monitoring.

The strategy will be implemented through project level decisions and will be modified on the basis of monitoring and consultation with the U.S. Fish and Wildlife Service. The Western Prairie Fringed Orchid Recovery Plan (USFWS 1996), coupled with this strategy, will be used to amend or revise the Forest Plan. Forest Plan direction is used to provide broad management direction at the landscape level. An ecosystem management approach will be used to define landscape variables and to define specific Desired Future Condition objectives at a landscape level. Allotment management plans will be revised under NEPA to implement desired future condition objectives. Proposals made in allotment management plan revisions that are outside of the scope of this strategy will require additional consultation with the U.S. Fish and Wildlife Service. Minor adjustments to this strategy may be allowed after consultation with the District Ranger (or designee) and Grassland Botanist. Monitoring will be an important step in assessing the effectiveness of management changes and strategy implementation. Results of monitoring will be used to amend the strategy, Forest Plan, and allotment management plans.

Figure 1. Prairie Fringed Orchid Guideline Development and Revision Process



SPECIES BIOLOGY

This section summarizes information regarding the autecology, life history, and synecological relationships of the western prairie fringed orchid. Several important studies, especially relating to the life history, synecology and demographics of the orchid on the Sheyenne National Grassland have been completed (Wolken 1995, Sieg and King 1995,) since the original management guidelines were amended in 1993. In addition, the recovery plan for the western prairie fringed orchid has since been completed and approved (USFWS 1996).

Autecology and Life History Characteristics

The western prairie fringed orchid *(Platanthera praeclara)* is an herbaceous perennial orchid. The orchid was once thought to be a long-lived species, with erratic flowering patterns and periods of dormancy (Bowles 1983). However, recent demographic data collected on the SNG during a period that included drought and episodic flooding suggest that most plants live three years or less, and once absent the odds of them remaining absent are 80% or better (Sieg and King 1995). The root system consists of a fleshy tuber that regenerates during the growing season by forming a new tuber and perennating bud, which then gives rise to a new shoot the following season. Infrequently, plants may form multiple buds, giving rise to twin or triplet plants (Sieg and King 1995, Wolken 1995). The shoots emerge from the soil in the late spring after a period of soil warming, generally about late April and early May on the Sheyenne National Grassland (Wolken 1995).

Sexual reproduction is the principal means of recruitment of new individuals into populations. Plants bloom between late June and mid-July on the SNG (Wolken 1995). Individual flowers last as long as ten days and inflorescences produce flowers for up to three weeks (USFWS 1996). It is also common for the western prairie fringed orchid to remain vegetative throughout the entire growing season (Sieg and King 1995, Sather and Smith 1994). Vegetative plants are shorter and usually have one to three leaves (Sieg and King 1995). Vegetative orchids may result when physiological requirements are not met (e.g., hormonal imbalance or inadequate carbohydrate reserves to support shoot and inflorescence primordia), or when microhabitat conditions are not conducive to flower production (Goh et al. 1982).

Seeds mature in capsules, and are released in early fall upon dehiscence of the capsules at the onset of plant senescence (Bowles and Duxbury 1986). Seed dispersal occurs in mid- September on the Sheyenne National Grassland (Wolken 1995). Orchid seeds are extremely small and bear a minute, morphologically undifferentiated embryo that often consists of a few cells (Cronquist 1981). Such seeds contain very limited food reserves and exhibit limited development (Harley and Smith 1983). The minute size and inflated air-filled testa make orchid seeds well-equipped for wind dispersal, but the water-repellent lipoid layer, buoyancy and rough surface also enable them to float on the surface of water (Rasmussen 1995). Germination and continued growth of seedlings may require an association with compatible soil-inhabiting mycorrhizal fungi (Cronquist 1981, Bowles and Duxbury 1986, Currah et al. 1990). This symbiotic relationship is believed to continue as the plants mature (Bowles and Duxbury 1986). On the SNG *Rhizoctonia* sp. was associated with orchid roots (Bjugstad- Porter 1993).

The flowers of the western prairie fringed orchid are characterized by a long narrow nectar spur, pale color, and fragrance which is activated in the evening, indicating adaptation for pollination by night-flying long-tongued moths (Sheviak and Bowles 1986). The plants are self-compatible, but pollination is required for fruit set and seed production (USFWS 1996). Cuthrell and Rider (1993) identified two species of hawkmoths as pollen vectors for the orchid on the Sheyenne National Grassland. At present, little is known about the abundance of pollinators on the Sheyenne National Grassland. And, although adult hawkmoths can apparently feed from a number of non-orchid nectar sources, little is known about these alternate sources (USFWS 1996).

Many orchid species have erratic flowering habits (Curtis and Green 1953, Wells 1967), and for the prairie fringed orchids, flowering may be related both to precipitation and to the acquisition of adequate photosynthates in the previous growing season for the formation of a new tuber and shoot (Bowles 1983, Wolken 1995). Bowles et al. (1992) reported that flowering eastern prairie fringed orchids were present 89% of the time in wet sites, but less than 40% of the time in relatively dry sites. Numbers of flowering western prairie fringed orchids on the Sheyenne National Grassland were lowest in years with low precipitation, and increased in wet years (Sieg and King 1995). In addition, densities of western prairie fringed orchids on the Sheyenne National Grassland were positively correlated with surface soil moisture in some years (Sieg and King 1995).

Environmental and Synecological Characteristics

In North America, the tallgrass prairie biome occupies a climatic zone located at the eastern edge of the rain shadow of the Rocky Mountains, and extends eastward as the "Prairie Peninsula" (Transeau 1935). This region is characterized by unpredictable and often relatively low summer and winter precipitation, and occasional severe summer droughts (Weaver 1954). The region also is characterized by occasional severe flooding, particularly early in the spring. Minimum rainfall limits the western distribution of the tallgrass prairie (Weaver 1954), and probably also controls the westward distributional limit of the western prairie fringed orchid (Bowles 1983). Across its range, the orchid is generally found in fire- and grazing-adapted communities dominated by graminoid species, most often on unplowed, calcareous prairies and sedge meadows; it has also been observed in disturbed sites in successional plant communities (i.e., roadside ditches, borrow pits, and old fields) (USFWS 1996).

The SNG occurs on a deltaic sand plain deposit where glacial meltwater of the Sheyenne River once entered into glacial Lake Agassiz near the end of the Wisconsin Glaciation (Baker and Paulson 1967). These deposits have been reworked into sand dunes, and a layer of nearly impervious lake sediments lies beneath the delta formation. This layer is responsible for the relatively high water table of the area. The western prairie fringed orchid occurs primarily in and adjacent to graminoid wetlands in these sandy prairies. Specifically, it has been found in several habitat types within the Hummocky Sandhills and Deltaic Plain habitat associations as described by Manske (1980), including mesic toe slopes and wetlands as classified as the Lowland Grassland habitat type, and adjacent tallgrass prairie classified as the Midland Grassland habitat type.

The Lowland Grassland habitat type occupies wet-mesic, ephemerally inundated settings having a shallow water table, and is confined to the basins of shallow wetlands, the margins of deeper wetlands, and waterway margins. This habitat type is dominated by wooly sedge *(Carex*

lanuginosa), northern reedgrass *(Calamagrostis stricta),* and baltic rush (*Juncus balticus)* (Bjugstad and Fortune 1989, Manske 1980, Sieg and King 1995), but in many cases Kentucky bluegrass *(Poa pratensis)* and willows *(Salix* spp.) are common species in wetlands supporting the western prairie fringed orchid (Sieg and Bjugstad 1994, Sieg and King 1995). The Midland Grassland habitat type exists adjacent to the Lowland types on the sides of hummocks, on loamy fine sand soils with low to moderate available soil water, and is dominated by big bluestem (*Andropogon gerardi*), little bluestem *(A. scoparius),* switchgrass *(Panicum virgatum)* and Kentucky bluegrass (Manske 1980).

Historically, fire played an important role in the ecology of the tallgrass prairie. These grasslands tend to have high fire frequencies and increased post-fire productivity (Steuter and McPherson 1995). Although quantitative data on fire frequency in this region are limited, Collins and Gibson (1990) postulated that the combination of droughts, high temperatures, strong winds and ample fuels allowed these prairies to burn every one to five years on the average. Historically, the major ignition sources for prairie fires were lightning and American Indians (Higgins 1984, 1986). In western North Dakota, lightning-set fires most commonly occur in July and August in this region; fewer occur in April, May, June and September. Higgins' (1986) review of historical accounts written between 1673 and 1920 revealed that American Indians set fires in nearly every month of the year, but April, September and October were their peak fire-setting times. Fires that occurred after fuels were cured in the fall or in the early spring before green-up may have been more extensive than summer fires (Steuter 1988).

Frequent fires in this region functioned to favor the growth of herbaceous species over shrubs and trees (Bragg and Hulbert 1976). Fire exclusion policies have likely contributed to the expansion of woody plants such as willow and aspen *(Populus tremuloides)* on the SNG in recent years (e.g., Kobriger, et al. 1987, McCarthy et al. 1997). Although little is known about the historical role of fire in the life history of the orchid, it is likely that this plant did evolve with burning, but wetlands burned less frequently than uplands, and only when wetland vegetation and soils were dry and no standing water was present. Vogl (1969) described a "quasi-equilibrium" of a Wisconsin wetland maintained by floods during wet periods and fires during droughts.

It has been hypothesized that disturbances are required to remove competing shrubs and provide open microsites (e.g., regeneration niches) for the orchid (Bowles 1983). Such disturbances might include fire and grazing; however, intense disturbances that remove seed heads are detrimental to long-term recruitment (Bowles 1983). Further, increased light and decreased competition have been suggested to stimulate the growth and flowering of terrestrial orchids (Stoutamire 1974). Burning may also be beneficial to orchid mycorrhizal fungi and plant growth rates by increasing fungal food resources and creating warmer soil conditions (Bowles 1983).

The natural disturbance regime of the SNG included periodic fires, flooding, and grazing by bison. These disturbances controlled litter accumulation and woody plant invasion. The fires also returned nutrients tied up in organic matter to the soil for plant uptake (Seastedt and Ramundo 1990). Under relatively stable natural conditions both the eastern and western prairie fringed orchids appear to prefer late-successional communities (Bowles et al. 1992). However, under disturbance conditions similar to those described above, these orchids can colonize early-successional communities, reproduce in sites undergoing disturbance, and withstand ecological disturbances as adults (Bowles 1983). Curtis (1959) emphasized that reproduction of prairie plants in an apparently stable environment occurs through colonization of micro-patches created by disturbances or death of mature plants. Recruitment of orchids under natural conditions may

require these micro-disturbances for seedling establishment and proper fungal activity (Bowles 1983). In addition, seedling maturation may be a very slow process, with the disturbance and fungal activity related to orchid seedling establishment having not occurred the same year as the appearance of the flowering plants (Curtis 1946, Stoutamire 1974).

In summary, maintenance of functional, dynamic tallgrass prairie systems is key to the survival of the western prairie fringed orchid. Disturbances such as fire, flooding and grazing occurred historically and may be important for creating regeneration niches for the orchid.

Influence of Habitat Management

Habitat management, such as burning, grazing or mowing, could have a positive or negative effect on western prairie fringed orchid populations, depending on its frequency, timing and intensity (USFWS 1996). Controlled studies of the effects of management activities are logistically difficult and require collection of data over a number of years. Preliminary studies have been restricted to particular populations, using methods that are far from comparable. The results to date are less conclusive than might be desired by land managers (USFWS 1996).

Burning may directly impact orchids through mortality of individual plants, and indirectly through effects on the orchid's habitat. It has been suggested that flowering may be suppressed by litter accumulation and stimulated by fire (Bowles 1983, Bowles and Duxbury 1986). The effect of fire on the orchid and its habitat is influenced by intensity and timing of the burn and climatic conditions both at the time of the burn and in subsequent growing seasons. In Nebraska, the orchid flowered for the first time in 40 years following a spring burn, deferred grazing, and high precipitation levels. This was in a pasture historically grazed season-long (Currier 1982). However, flowering probability did not differ between burned and unburned orchids following spring burning in Iowa (Pleasants 1995). On the Sheyenne National Grassland, prescribed burning in the fall did not significantly affect orchid numbers, heights, number of leaves, phenology, nor condition the following year, compared to paired plots that were not burned in the fall (Bjugstad-Porter 1993). Data collected the second growing season following burning suggesting that burning did not reduce orchid numbers, and may have enhanced populations in some swales (Sieg et al. 1994).

Cattle may directly impact orchids through both grazing and trampling, and indirectly through effects on orchid habitat. The influence of cattle grazing on orchid populations is related to when and how many times the grazing occurs, how long the cattle are left in the pasture, and the stocking rates, and is interconnected with other management activities (such as burning and mowing), and with climatic conditions. Grazing systems that encourage heavy repeated grazing throughout the growing season are more likely to be detrimental to individual orchids, both in terms of reducing carbohydrate reserves, and in preventing plants from completing their life cycle and setting seed. Grazing systems that are timed correctly, and spatially managed, can help create seral conditions that are advantageous to orchid establishment. Monitoring data collected between 1987 and 1994 on 16 transects that encompassed five management regimes on the Sheyenne National Grassland have not documented consistent, significant differences in orchid densities among the five sites (Sieg and King 1995). These management regimes included: 1) season-long livestock grazing, 2) twice-over rotational grazing with spring burning, 3) twice-over rotational grazing without spring burning, 4) no grazing with spring burning and 5) no grazing without spring burning. However, the wide variation in orchid densities between years made the effects assessment of management regimes difficult particularly since flowering and above-ground growth are highly influenced by environmental factors such as precipitation

and flooding (Sieg and King 1995). Preliminary analyses of seed set data collected between 1995 and 1998 indicate that the number of plants with viable pods and the number of viable pods per flowering orchid, were significantly lower on grazed sites when compared with ungrazed sites in most years (Sieg and King in prep.).

Quantitative information regarding the effects of mowing on the orchid is lacking. Mowing is detrimental to the orchids, both in terms of failure to complete their life cycles and in reduction of carbohydrate reserves. Mowing when the orchid has completed its life cycle (in late September) would allow orchids to set seed and to accumulate additional carbohydrates needed to form bud tissue for the next season's plant.

Management activities designed to suppress the expansion of noxious weeds have the potential of impacting the orchid metapopulation on the SNG. Leafy spurge *(Euphorbia esula)* is the most severe threat on the SNG (USFWS 1996). Leafy spurge is a highly invasive, deeply rooted, persistent weed known from orchid sites on the SNG (Sieg and Bjugstad 1994), and potentially out competes native vegetation. The direct effect of competition with this weed species is exacerbated by the potential threat of control measures. Although few data are available on the effects of herbicides used to control leafy spurge on the orchid, application of herbicides when the orchid is actively growing is likely to damage or kill individual plants. Angora goats, and a variety of insects, are other methods that are used to suppress leafy spurge on the SNG. Concentrated goat grazing on the SNG reduced leafy spurge cover, height and biomass (Hanson 1994), but may have a detrimental effect on individual orchids (Wolken 1994). Published data on the effects of sheep or any of the insect species on leafy spurge and the orchid are not available. In spite of the concerns about treatment impacts on individual orchids, unless drastic measures are taken to suppress this invasive species the viability of the orchid metapopulation and its habitat may be seriously jeopardized.

Management activities that influence the amount and quality of groundwater that feeds the wetlands supporting the orchid may influence the persistence of the orchid metapopulation on the SNG. Given that data from throughout the range of the western prairie fringed orchid indicate a decrease in flowering and an increase in mortality during the extreme drought of the late 1980s, it is more certain that hydrologic alterations that draw down the local water table near the root zone of the orchid have the potential of serious adverse impacts (USFWS 1996). Although data are lacking, it is likely that severe draw down of the aquifer or high levels of pesticides or other chemicals are impacts that may result from activities on or adjacent to the SNG. Center pivot irrigation and pesticide/herbicide spraying resulting in contamination of the aquifer are two threats occurring on and adjacent to the SNG that have the potential to impact the hydrological regime.

In summary, land management practices may influence both individual plants and the habitat of the western prairie fringed orchid. The effects depend on the type, timing, intensity and duration of land uses. Activities that prevent the orchid from completing its life cycle are detrimental because: 1) they do not allow the production of seeds, 2) they do not allow for the production of adequate photosynthates necessary for formation of a perennating bud that is the critical to the development of next year's plant. However, disturbances that enhance recruitment and maintain habitat characteristics favorable for the persistence of the orchid metapopulation are needed. Seedling establishment may be linked to edaphic factors controlling soil moisture, mycorrhizae, the availability of suitable microhabitats, and interspecific competition. As a result, habitat management such as mowing, grazing, or burning could have varying effects on recruitment and survivorship, depending on the frequency, intensity and timing of these

activities. Invasive species such as leafy spurge present additional challenges, in that the methods used to control these species may be detrimental to the persistence of the orchid metapopulation. Yet without control efforts, the quality of the orchid's habitat may be seriously compromised. In addition, hydrologic alterations that draw down the local water table near the root zone of the orchid have the potential of serious adverse impacts on maintaining the SNG metapopulation. Optimal management for the orchid is likely to be that which best maintains quality wetland habitats within the tallgrass prairie (USFWS 1996).

Field Inventory Results.

Field inventories summarized by North Dakota Natural Heritage Program (Lenz 1997) provided information on orchid numbers between 1984 and 1997. Data from different years are not directly comparable because the areas sampled, and sampling intensity and design, varied between years. However, these data do provide a minimum known number of flowering orchids for some allotments, and were used as a basis for establishing core and satellite populations for purposes of the strategy.

MANAGEMENT GOALS

Management Direction from the Forest Plan and Recovery Plan

This Recovery Strategy revises the previous Western Prairie Fringed Orchid Management Guidelines that were developed in 1993. The primary reasons for revising the Recovery Strategy are: 1) to update the Recovery Strategy based on the best available scientific findings and use this information in the Dakota Prairie Land and Resource Management Plan, 2) to make necessary changes to those aspects of the Recovery Strategy that are known to be inadequate based on the new scientific information, 3) to demonstrate compliance with the Endangered Species Act, as amended, 4) to provide a basis for consultation with the USFWS relative to management actions potentially affecting the orchid, and 5) to carry out programs for the conservation and restoration of listed species.

This strategy is also viewed as a means of implementing the *Recovery Plan for Western Prairie Fringed Orchid* (USFWS 1996) for that portion of the orchid's habitat found on the SNG. The Recovery Plan provides a step-down procedure for research, management and monitoring relative to the orchid on a range-wide basis. The main activities in the Recovery Plan germane to the SNG are:

- Maintain protective management of all sites in public ownership.
- Develop or maintain appropriate burning regimes.
- Develop or maintain appropriate grazing regimes.
- Develop or maintain appropriate mowing regimes.
- Develop and maintain appropriate noxious weed treatment practices.
- Develop and implement hydrologic guidelines.
- Conduct research relative to management practices, physical limiting factors, reproductive biology of the orchid, and synecology of the species.
- Monitor populations and identify and search potential habitat.

Desired Future Condition (DFC) and Recovery Goals

The Recovery Plan (USFWS 1996) states that the orchid will be considered for delisting when sites that include occupied habitat harboring 90 percent of plants in each ecoregion are protected at protection codes 4 through 9 (public ownership or higher level of protection), 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. General conditions necessary for the maintenance of the orchid on the SNG include the following:

DFC 1: Manage western prairie fringed orchid populations consistent with metapopulation concepts.

The primary objective of this strategy is to maintain the long term viability of the SNG metapopulation. The variability of precipitation and flooding events on the SNG appear to influence reestablishment and extinctions of local orchid populations. In high precipitation years it is important that a high proportion of orchids be allowed to set and disperse seed. These years may be critical in the maintenance of a seed bank for the orchid. Management that allows the replenishment of the seed bank is considered essential for the perpetuation of the SNG metapopulation.

DFC 2: Manage toward sustainable native tallgrass prairie ecosystems.

Perhaps the single most significant effect on the orchid has been the loss of native tallgrass prairie ecosystems. Most of this will never be reclaimed. The SNG includes some of the last remaining portions of the original tallgrass prairie ecosystem.

DFC 3: Manage the SNG to promote the ecological processes that provide the structural and floristic diversity characteristic of the tallgrass prairie ecosystem. This management approach will provide the best opportunity for long-term maintenance of a viable orchid metapopulation on the SNG.

The orchid exists within a complex framework of tallgrass prairie ecosystem processes and functions. In order to successfully maintain viable populations of the orchid, it is imperative to maintain the integrity of this ecosystem. Some important considerations include climate, physical site characteristics (including soil type and texture, water table influences), seral status of associated plant communities, and biotic interactions (including herbivory, pollinators and mycorrhizal relationships).

DFC 4: Management activities should favor practices that 1) reduce woody and exotic plant species such as leafy spurge and Kentucky bluegrass, 2) provide a mosaic of structural classes, seral stages and plant communities characteristic of tallgrass prairies, using fire, grazing, and other suitable practices, and 3) maintain the hydrological regime that supplies ground water to the wetlands supporting the orchid.

Exotic plant species, including noxious weeds, potentially compete directly with the orchid. Leafy spurge, in particular, is a serious threat to the orchid. Aggressive action must be taken to limit the expansion of such species. However, management practices designed to reduce leafy spurge and other exotic species must also recognize the needs of the orchid. This strategy is designed to protect the orchid by dealing with these aggressive species, to provide a diversity of native plant communities, and to maintain the hydrologic regime necessary for sustaining the SNG orchid metapopulation.

Management from a Metapopulation Perspective

Western prairie fringed orchid populations on the SNG make up one of three remaining, large "metapopulations" for the species. The other two metapopulations occur in Minnesota and Manitoba, Canada. A metapopulation consists of a shifting mosaic of interacting populations that are subject to periodic local extinctions, and are linked by subsequent recolonization (Menges 1990, Murphy et al. 1990). The component populations occupy patches of suitable habitat in a heterogeneous environment, and thus are spatially and temporally separated. Colonization or recolonization of unoccupied habitat patches is via dispersal from nearby populations (wind and/or water dispersal of seeds, in the case of the western prairie fringed orchid).

A typical metapopulation consists of one or more large core populations with fairly stable numbers, and satellite areas with smaller, fluctuating populations (Primack 1993). In the case of species such as the western prairie fringed orchid, the core populations provide a substantial, reliable seed source for establishment and reestablishment of the species in adjacent suitable habitats (= the "rescue effect" of the core populations). As such, these core populations need to be carefully managed in order to insure long-term viability of the metapopulation as a whole. Smaller (satellite) populations, especially those near core populations, may not need to be as carefully managed, since they are less stable than the core populations, and can be reestablished by seed dispersal from the core population. These satellite populations may also allow for expansion of the orchid metapopulation in favorable years, and provide experimental opportunities for habitat enhancement or recovery purposes.

The orchid has a patchy distribution that is related to the pattern of wetlands on the landscape, the species dispersal ability, and water table fluctuations in response to climatic conditions (Hof et al. 1999). Excessive drought or flooding can cause local population declines and extinctions (Sieg and King 1995). Available data suggest that the presence of seeds at sites with adequate moisture allows the reestablishment of those local populations. In this manner, the metapopulation shifts in time and space in response to the dynamics of the water table.

Based on the principles of metapopulation dynamics, population categories are generally defined by size and geographic distribution of the population. Thus, the largest number of flowering orchids ever observed in a given allotment is a primary factor used in delineating core populations. Core areas are considered critical because of their large populations in favorable (wet) years. They form the basis of the metapopulation seed reservoir. The other factor is the

geographic distribution of orchid populations across the SNG landscape, and the importance of these populations in recolonizing suitable habitats that undergo periodic extinctions.

For the purposes of the recovery strategy on the SNG, we categorized allotments as core or satellite. In addition, additional allotments have populations of orchids which were not considered either core or satellite. These allotment categories will not be changed until future revisions of the recovery strategy. Criteria used in making these designations include:

- Highest number of flowering plants observed in allotments (USFWS 1996, Sieg and King 1995 and NDNHP unpublished data).
- Presence of orchids in both wet and dry years.
- Importance in maintaining the geographic distribution of the metapopulation.
- Presence of geographic barriers impede population expansion.

In order to maintain metapopulation viability on the SNG, recovery strategies specific to allotments containing core, and satellite populations will be developed. These pasture-specific recovery strategies are most efficiently proposed and implemented in upcoming revisions of management plans for blocks of allotments. Based on the presence of core and satellite populations within them, the allotments are assigned the following priorities for allotment management plan revision:

Allotments Containing Core Orchid Populations Allotment (Block)*	**Allotments Containing Satellite Orchid Populations: Allotment (Block)**	**Other Allotments with Orchids Allotment (Block)**
1. A-Annex (A Block)	1. Bjugstad (Owego Block)	1. Ekre (Owego Block)
2. Olerud (McLeod Block)	2. Berg (McLeod Block)	2. Froemke-Hoy (Venlo Block)
3. Sagvold (McLeod Block)	3. Hanson (N Block)	3. Griggs (N Block)
4. McLeod (McLeod Block)	4. Milton Sr. (N Block)	4. Jordheim (R Block)
5. Venlo (Venlo Block)	5. Northrup (N Block)	5. King (King Block)
6. Milton Jr. (Sheyenne Block)	6. Brown (N Block)	6. Hakanson (McLeod Block)
7. LX (N Block)	7. R (R Block)	
8. Penberthy (Venlo Block)	8. South S (S Block)	
9. North S (S Block)	9. J (Sheyenne Block)	
10. Wall (Owego Block)	10. Braaten (King Block)	
11. North Durler (Durler Block)	11. Owego Annex (Owego Block)	
	12. South Durler (Durler Block)	
	13. Leibbrand (McLeod Block)	

***** Only pastures containing orchids within these allotments will be managed as core areas.

Of particular concern for core populations will be the allowance of seed production on a regular basis as a source for the establishment of new, or reestablishment of extirpated, populations throughout the SNG and on adjacent lands of other ownership.

Modeling Viability of the SNG Metapopulation

Data collected on the SNG between 1990 and 1998 were used to model the viability of the SNG metapopulation. Demographic data were collected between 1990 and 1994 (Sieg and King 1995) and seed set data were collected between 1995 and 1998 (Sieg and King In Prep). Population growth rates (lambda) were calculated for the Sheyenne metapopulation using RAMAS (stage model) (see Armstrong et al. 1997: 35-50). This modeling exercise was also useful in identifying those variables with high elasticity values. Elasticity is basically a measure of the contribution of life stage transitions to the magnitude of lambda (Armstrong et al. 1997). Variables that contributed to high elasticity values were the number of flowering plants, the number of viable seeds produced, and the proportion of seeds that remain viable in the seedbank.

The RAMAS stage model was run using a management scenario that protected a portion of orchid core populations from livestock grazing, while allowing the grazing of other orchid habitats, to determine if a positive growth rate (λ>1.0) could be achieved. The assumptions used in the model were:

- 80 % of the maximum number of flowering orchids historically documented occur in allotments designated as core.
- One-third of the historical core areas would be protected on an annual basis when the plant is susceptible to livestock grazing (June 1 - September 15).
- One-tenth of the historical satellite areas would be protected on an annual basis when the plant is susceptible to livestock grazing (June 1 - September 15).

When incorporated into the model, these assumptions resulted in a population growth rate of λ=1.12 (i.e. an increasing population). It should be noted that seed set data are based on years that were climatically favorable (wet) for orchids and demographic data that spans both favorable and unfavorable conditions. Longer term data are required to more accurately assess the population growth rate. Bessinger and Westphal (1998) recommend that population modeling data be viewed cautiously, and applied only to short (<10 year) time periods. However, these types of models are helpful in identifying demographic stages important to orchid viability.

The importance of the aforementioned life stages in sustaining orchid populations suggests that management be focused on the establishment of core areas that contain high numbers of orchids, and that these areas be given sufficient protection to allow them to complete their life cycle (roughly late April to mid-September). The orchid is considered particularly susceptible to grazing between June 1st and September 15th. Grazing prior to, or after, these dates will have minimal impacts on the orchid life cycle. Management of orchid habitat should also account for shifts in the geographic distribution of populations, and the metapopulation as a whole, between wet and dry years (Hof et al. 1999).

MANAGEMENT RECOVERY STRATEGIES

History of Management Practices

The area including the SNG was settled by Europeans in the late 1800s. With settlement the principal uses of the land were grazing, farming and haying. The collapse of the economy in the late 1920s and early 1930s combined with the great drought during the mid-1930s and the farming practices of the time resulted in severe erosion on the submarginal farm land and hardships on the landowners. Some of these lands were purchased by the Federal government and were assigned to the Soil Conservation Service. The immediate objective was to reestablish vegetative cover. During this period many of the old fields and blowouts were reseeded, but many of these fields and blowouts also reseeded naturally. In some areas, trees were planted to stabilize the soil. By 1954, when the Forest Service acquired the land, vegetative cover had generally been restored to the big fields and blowouts. Since this time, livestock grazing, wetland mowing, noxious weed treatment, blowout stabilization and burning have constituted the major land management activities on the SNG.

1. Cattle Grazing

Grazing by cattle on the SNG was primarily of a season long nature until the 1960s. Some rotation grazing systems were implemented in the early to mid 1960s as allotment management plans were developed. Allotment division and pasture rotation have been occurring ever since, with only a few allotments today being grazed on a season long basis. The most common grazing regime currently being used on the SNG is a multi-pasture twice over rotational system.

2. Mowing

Mowing is used to increase utilization of wetlands, reduce shrub encroachment and reduce heavy livestock utilization on upland areas of the SNG. From the 1940s until the mid 1970s many wetlands were mowed every year. From approximately 1984 to 1993, mowing was curtailed in wetlands with orchid concentrations, and delayed until July 15. Since 1993, mowing has been permitted in wetlands known to support orchids only after seed dispersal, or after July 15 when inventory confirms the absence of flowering orchids.

3. Noxious Weed Treatment

Leafy spurge was first observed in the SNG in the 1940s. Treatment efforts began in the 1950s, but were discontinued in 1967. Without control efforts the infestation spread quickly and in the early 1970s, treatments resumed. By 1973, the area of leafy spurge infestation on the SNG was estimated at approximately 3770 acres. Inventories of leafy spurge on the SNG (1985) indicated approximately 5,163 acres of spurge on the Grassland and 10,000 to 12,000 acres by 1995 (SNG unpublished records).

The principal means of control of leafy spurge on the SNG is by a mixture of 2,4-D and Tordon. Beginning in 1990, angora goats were introduced on the SNG for control of leafy spurge. Goat grazing reduced height, cover and biomass of leafy spurge compared to ungrazed plots (Hanson 1994); however, the long-term effect of goat grazing on spurge density remains to be evaluated. Four species of flea beetles (*Apthona* spp.) have been released on the SNG since 1990. Data on establishment and effect of these flea beetles on leafy spurge are not available. However, extensive colonies of flea beetles on the SNG have not been documented as a result of introduction efforts. The highly variable topography,

sandy soils, and flooding in recent years has likely impeded the establishment and expansion of biocontrol agents on the SNG.

The Custer National Forest developed a Noxious Weed Environmental Impact Statement (EIS) in 1986 (USDA Forest Service, 1986). This document outlined the effects, constraints and procedures of noxious weed treatment on the Forest, including the SNG. Any noxious weed treatment program will meet the constraints developed in this EIS.

4. Blowout Stabilization

The SNG area is characterized by sandy soils that were originally deposited as a delta of an ancient river as it emptied into glacial Lake Agassiz. Many acres of these "Dakota Sandhills" were farmed under the Homestead Entry Act. Conversion to croplands resulted in severe erosion on submarginal lands. Once these lands were acquired by the Federal government, a major program of revegetation was initiated which effectively treated the major erosion (blowout) areas. Beginning in 1954, smaller areas of blowouts have been treated. This includes fencing the areas to exclude cattle, eventual reshaping of the area with heavy equipment, and seeding. Occasionally, trees were planted in these blowout areas.

5. Prescribed Burning

Since the SNG passed into federal ownership, prescribed fire has occurred with varying intensity. The Sheyenne Valley Grazing Association (SVGA) accomplished much of the burning on the SNG up until 1980. Prior to the 1960s, uncontrolled wildfires were responsible for approximately half of the acres burned on the SNG, though exact acreages are not known.

In the early 1960s, the SVGA was actively burning areas on the SNG but a burning ban was imposed in the mid 1960s by the Forest Service for approximately l0 years until 1973. Burning on a regular basis was again implemented from 1974 until 1980 when the Forest Service rescinded the SVGA burning authority. From this time on, only a few hundred acres per year, on the average, have been burned. Most prescribed burning on the SNG occurs during spring (late March - early May), or in the fall (late Sept. - Oct.). A few mid-summer burns have been ignited in recent years to set back woody plant invasion. From 1990 to 1998 approximately 1800 acres per year have been prescribe burned.

6. Vehicles, Roads, Trails, and Earth-Disturbing Activities

Construction of roads, trails and other earth-disturbing activities has the potential to eliminate or seriously affect populations of the orchid either directly through the activity itself or indirectly through possible establishment of blowouts.

7. Special Use Permits

Generally, a permit is required for all activities which may have an impact on National Forest System lands (including National Grasslands). Through the Special Use Permit System, various activities such as large (75 or more individuals) group camping, Boy Scout jamborees etc., could occur on the SNG that could have an effect on the orchid.

8. Water Management

Artesian flow wells were developed between the early 1900s through the 1960s. No new wells have been developed since then. Recent management has been to plug these wells and discourage the development of new flow wells on the SNG. Ditching, water management in existing ditches, water developments, and aquifer depletion are other activities that could potentially affect habitats important to the western prairie fringed orchid.

9. Pesticide Uses

In the 1930s, arsenic trioxides were used to control grasshopper outbreaks in the approximate area of the SNG. Roberts et al. (1985) document levels of arsenic groundwater contamination in areas southeast of the SNG. The extent of contamination on groundwater within the SNG, and the effects of on the orchid, or pollinators important to the orchid, are unknown.

On private lands adjacent to the Sheyenne National Grassland, fumigants and insecticides are commonly used to control agricultural pests. The degree of drift into orchid habitats is unknown. However, fumigants can potentially affect mycorrhizal fungi important to the orchid. Pesticides can affect the abundance and distribution of pollinators in orchid habitats.

Specific Management Practices and Strategies

The original Interim Management Guidelines were developed in 1990 with a provision that they would be reviewed and updated based on new information gathered through the monitoring process. The Guidelines were first amended in 1993. To better reflect their intent and follow USDA Forest Service Manual direction, this document has been retitled the *Western Prairie Fringed Orchid Recovery Strategy on the Sheyenne National Grassland*. This strategy reflects a better understanding of orchid biology and population trends as related to management on the SNG. Implicit in this version is the significance of periodic high precipitation years relative to providing orchids the opportunity to replenish the seed bank. Thus, these strategies focus on management in wet years that contribute to the maintenance of the seed bank, and allow more flexibility in drier years when seed production may be less crucial. Strategies were developed for:

- Core allotments, or those areas considered critical in the management of the SNG metapopulation because of their large populations (in wet years) and geographical locations, and their role in providing a reservoir for re-establishing populations in favorable years.
- Satellite allotments, or those areas considered important in maintaining the overall geographic pattern of orchid populations on the SNG.
- Other allotments with orchids, or those areas that are considered less important in maintaining the SNG metapopulation because of their low population numbers, even in wet years.

This strategy applies to the management practices contained in this document. Exceptions to these strategies may occur for purposes of research on the orchid. These exceptions would undergo consultation with the U.S. Fish and Wildlife Service on a case-by-case basis. A research plan must be developed and then reviewed by the Forest Service and the U.S. Fish and Wildlife Service prior to granting exceptions.

These strategies were based on analyses of current information and were designed conservatively to insure the protection of this metapopulation. This is warranted because: 1) the orchid is federally listed as a threatened species and the communities it resides in are rare, 2) the SNG population is only one of three remaining viable metapopulations, and 3) of the importance of insuring seed production for replenishing the seed bank.

Core Allotment Recovery Strategies:

Cattle Grazing

1. Each year, 1/3 of the acres historically occupied by orchids in core allotments will not be grazed 6/1-9/15. Areas that are rested during this time period will encompass a topographic gradient to allow for the local population shifts, and will be adjusted spatially to account for future metapopulation shifts.

2. Stocking rates in other orchid habitats within core allotments will not be increased to offset the areas rested.

3. Where rotation grazing systems are used, each pasture containing orchids in core allotments will be grazed no more than twice during a given growing season.

4. New fence corners, water developments, salting areas, and creep feeders will be located at least 200 feet from wetlands known to support orchids.

5. Experimental grazing management (grazing management under an authorized research project) may be used to evaluate the response of the orchid to different grazing systems and timing of grazing on a limited scale provided a monitoring system is established to evaluate the response of the orchid to grazing management.

6. Allotments designated as core areas should be the highest priorities for AMP revision.

7. When revising allotment management plans, incorporate grazing systems and stocking rates that will result in a diversity of native plant communities, seral stages, and vegetation structure across the landscape of the SNG.

Mowing

1. Wetlands will be surveyed before mowing to determine if flowering orchids are present.

2. If flowering orchids are present, wetlands will be mowed only after seed dispersal, approximately September 15. In wetlands where inventory confirms the absence of the flowering orchids, mowing **may** be allowed prior to this date, but not before July 15.

3. Where the objective is to reduce woody plant encroachment, wetlands may be mowed in successive years, as long as the above conditions are followed.

4. Experimental mowing (mowing conducted under an authorized and permitted research project) may be conducted at any time provided a monitoring system is established to evaluate response of the orchid to mowing.

Noxious Weed Treatment

1. Wetlands supporting orchids in core allotments will be priority areas for spraying leafy spurge with herbicides approved for use in wetlands, and leaving no soil residual, using fall treatments after the orchid has dispersed seeds, approximately September 15th.

2. The Forest Service will provide 1:24,000 scale maps detailing wetlands likely to support orchids to all chemical applicators, and applicators will return maps to the Forest Service that detail locations actually sprayed.

3. If sheep or goats are used to control leafy spurge or other noxious weeds in wetlands that currently support flowering orchids, their use will be limited to before 6/1 or after 9/15.

4. Sheep or goats may graze allotments that currently support flowering orchids between 6/1 and 9/15 if agronomy cages are placed around orchids, explicit herding instructions are followed, or electric fences used to protect orchids.

5. Experimental noxious weed treatment (noxious weed treatment conducted under an authorized and permitted research project) may be conducted provided a monitoring system is established to evaluate the response of the orchid to noxious weed treatment.

Restoration of Blowouts

1. Heavy equipment will not be allowed across areas known to support orchids.

2. Soil deposition will not be allowed in areas known to support orchids.

3. Woody species will not be planted in orchid habitats.

4. Exotic plant species will not be used for restoration seeding in orchid areas.

Burning

1. Core allotments will be given a high priority for prescribed burning.

2. Fall or spring burns are allowed as long as field surveys verify that orchids are not actively growing.

3. Burns after May 22 may be conducted in dry years (i.e. years in which there is relatively little risk to orchids). In dry years, areas suitable for burning after May 22 would typically have less than 50 flowering orchids per pasture. Determination of an area's suitability for burning after May 22 will be based on the best information available at the time. Areas with high shrub/tree encroachment are priority areas for summer burns.

5. Burns after May 22 are allowed in no more than 1/3 of the core allotments per year.

6. Existing prescribed burn plans for all allotments containing wetlands known to support orchids will be amended to reflect the above conditions.

7. Experimental prescribed burns (burns conducted under an authorized and permitted research project) may be conducted at any time, including the summer months, provided a monitoring system is established to evaluate the response of the orchid to burning.

Vehicles, Roads, Trails, and Earth-Disturbing Activities

1. New roads and/or trails will not be allowed through wetlands known to support orchids.

2. Survey for orchid presence or absence before earth-disturbing activities take place anywhere within potential orchid habitat.

3. Establish a monitoring system to evaluate response of the orchid to changes in patterns of use due to people or nearby earth disturbance (construction of trails and/or roads).

4. In future transportation planning, move roads and trails out of wetlands known to support orchids, where feasible.

Special Use Permits

1. The Forest Service will review all applications for Special Use Permits. Any activity permitted will meet the intent of the strategy for the orchid.

2. Permits will not be issued that concentrate people in wetlands known to support orchids.

3. Habitat-altering activities, such as campsites and campfires, will not be allowed in wetlands known to support orchids.

4. Requests for permits to collect orchids, including orchid fruits and seeds will be referred to the U.S. Fish and Wildlife Service in Bismarck, which is the only agency authorized to issue such permits.

Water Management

1. Plug abandoned flow (artesian) wells.

2. Do not permit the development of dugouts and new flow (artesian) wells.

3. No new ditches will be permitted in core allotments.

4. Manage existing ditches to ensure maintenance of water regimes.

5. Where feasible, restore wetlands that have been compromised by ditching or other activities.

Satellite Allotment Recovery Strategies

Cattle Grazing

1. Each year, 1/10 of the acres historically occupied by orchids in satellite allotments will not be grazed 6/1-9/15. Areas that are rested during this time period will encompass a topographic gradient to allow for the local population shifts, and will be adjusted spatially to account for future metapopulation shifts.

2. Stocking rates in other orchid habitats within satellite allotments will not be increased to offset the areas rested.

3. New fences, water developments, salting areas, creep feeders, and big game feeders will be located at least 100 feet from wetlands known to support orchids.

4. Experimental grazing management (grazing management under an authorized and permitted research project) may be used to evaluate the response of the orchid to different grazing systems and timing of grazing on a limited scale provided a monitoring system is established to evaluate the response of the orchid to grazing management.

Mowing

1. Wetlands will be surveyed before mowing to determine if flowering orchids are present.

2. Wetlands may be mowed every year if wetlands with ten or more flowering plants are avoided, however no more than 1/3 of the orchid wetlands in a satellite allotment may be mowed annually.

3. If 10 or more flowering orchids are present in a given wetland, mowing will be postponed until after seed dispersal, approximately September 15. In wetlands where inventory confirms the presence of <10 flowering orchids, mowing may be allowed prior to this date, but not before July 15.

4. Annual mowing permits will be amended to reflect the above conditions.

5. Experimental mowing (mowing conducted under an authorized research project and permitted) may be conducted at any time provided a monitoring system is established to evaluate response of the orchid to mowing.

Noxious Weed Treatment

1. Wetlands may be sprayed with herbicides approved for use in wetlands, and leaving no soil residual, at any time of the year, providing that groups of 10 or more flowering orchid plants are avoided.

2. If sheep or goats are used to control leafy spurge or other noxious weeds in wetlands that support flowering orchids, their use will be limited to that period before 6/1 or after 9/15.

3. Sheep or goats may graze allotments with wetlands that currently support flowering orchids between 6/1 and 9/15 if agronomy cages are placed around orchids, explicit herding instructions are followed, or electric fences used to protect orchids.

4. Sheep or goats may graze wetlands currently supporting less than 10 flowering orchids throughout the growing season.

5. Experimental noxious weed treatment (noxious weed treatment conducted under an authorized research project and permitted) may be conducted provided a monitoring system is established to evaluate the response of the orchid to the treatment.

Restoration of Blowouts

1. Heavy equipment will not be allowed across wetlands known to support orchids.

2. Soil deposition will not be allowed in wetlands known to support orchids.

3. Woody species will not be planted in orchid habitats, or in areas where they would impede management for the orchid.

4. Exotic plant species will not be used for restoration seeding.

Burning

1. Burning at any time of the year is permitted as long as no more than one third of the satellite allotments are burned in a given year.

2. Existing prescribed burn plans for all allotments containing wetlands known to support orchids will be amended to reflect the above conditions.

3. Experimental prescribed burns (burns conducted under an authorized and permitted research project) may be conducted at any time, including the summer months, provided a monitoring system is established to evaluate the response of the orchid to burning.

Vehicles, Roads, Trails, and Earth-Disturbing Activities

1. New roads and/or trails will not be allowed through wetlands.

2. Survey for orchid presence or absence before earth-disturbing activities take place anywhere within potential orchid habitat.

3. Establish a monitoring system to evaluate response of the orchid to changes in patterns of use due to people or nearby earth disturbance (construction of trails and/or roads).

Special Use Permits

1. The Forest Service will review all applications for Special Use Permits. Any activity permitted will meet the intent of the strategy for the orchid.

2. Permits will not be issued that concentrate people in wetlands supporting orchid concentrations.

3. Habitat-altering activities, such as campsites and campfires, will not be allowed in wetlands supporting orchid concentrations.

4. Requests for permits to collect orchids will be referred to the U.S. Fish and Wildlife Service in Bismarck, which is the only agency authorized to issue such permits.

Water Management

1. Plug abandoned flow (artesian) wells.

2. Do not permit the development of dugouts and new flow (artesian) wells.

3. No new ditches will be permitted in satellite allotments.

4. Manage existing ditches to ensure maintenance of water regimes.

5. Where feasible, restore wetlands that have been compromised by ditching or other activities.

Other Allotments With Orchids

While these allotments are not deemed critical to metapopulation viability, they do provide opportunities for orchid management. Efforts will be made to protect flowering orchids in these habitats.

MONITORING AND RESEARCH

Monitoring Needs

Monitoring of orchid populations relative to various management practices will be continued. In addition, research should continue to quantify population dynamics and habitat requirements of the orchid, and identify specific management practices to maintain and enhance orchid populations.

Three types of monitoring are considered important in assessing this strategy: implementation, effectiveness and validation monitoring. Implementation monitoring assesses whether or not the orchid recovery strategy was implemented in the various management activities. An annual implementation monitoring report will be prepared by the SNG that describes how the orchid recovery strategy was incorporated into various management activities. This report will include:

- A summary of areas rested between 6/1-9/15 within each core allotment.
- Areas treated for leafy spurge within core and satellite areas.
- Pastures and allotments surveyed for flowering orchids.
- Vegetation treatments (e.g. Burning, mowing) done in core and satellite areas, including rested areas.
- A summary describing whether management was in compliance with the recovery strategy.

Effectiveness monitoring addresses the issue of whether or not the orchid recovery strategy is meeting the objectives for orchid conservation and maintenance of metapopulation viability. As stated earlier, the viability analysis indicated that the key life history variables for insuring viability of the metapopulation were: 1) the number of flowering plants, 2) the number of pods that set seed per flowering plant, and 3) the number of viable seeds incorporated into the seedbank This information can be summarized by comparing the number of plants with viable seed pods, and the number of viable seed pods per plant, between grazed and ungrazed areas. As a long-term data set is further developed, we can better ascertain the effects of management activities on the orchid through a variety of climatic conditions. The Rocky Mountain Research Station (RMRS) will provide guidance in sampling design.

Validation monitoring addresses the issue of whether assumptions made in the orchid recovery strategy are, or will continue to be, valid. This type of monitoring will also help determine the validity of assumptions used in assessing orchid viability. Validation monitoring would continue to focus on demographic characteristics of the metapopulation, and would be used to further enhance knowledge of the life history requisites of the orchid. As such, validation monitoring would require site- specific transects or plots in a variety of environmental settings subjected to various management activities, and followed over long (10 year) time periods. This work can be characterized as research that would be conducted by RMRS. Although this research is considered outside of the purview of this recovery strategy, it is essential in obtaining a better understanding of the Sheyenne orchid metapopulation. New information emanating from research will be incorporated into future revisions of the orchid recovery strategy.

Monitoring Tasks and Responsibilities

Task/Objective	Responsibility	Cost/year
Prepare annual implementation monitoring report documenting how the strategy was applied.	SNG/DPG	$3,000
Continue survey of potential and existing SNG habitat on SNG to determine population locations. Output: Annual Progress Report	SNG/DPG/NDNHI	$15,000
Census of existing orchid populations under various management strategies. Output: Annual Progress Report	SNG/DPG/RMRS	$5,000
Update maps and data bases	SNG/DPG/NDNHI	$2,000
Long term monitoring of orchid seed set in selected wetlands in core allotments.	RMRS	$20,000

Research Tasks and Responsibilities

Task/Objective	Responsibility	Cost/year
Influence of prescribed burning on orchid seed germination and seedling development	RMRS	$35,000
Long term demography of the orchid on the SNG	RMRS	$30,000
Impacts of fall-applied herbicides in treating leafy spurge in orchid habitats	RMRS/USFW, NDSU	$25,000
Assessment of SNG metapopulation viability	RMRS/DPG	$10,000
Develop monitoring methods and protocol for tracking drought and flood locations of orchid populations	DPG/RMRS/R1	$5,000
Assessment of pollinator viability on the SNG	DPG	$20,000
Field testing protocol	NDNHI/RMRS	$30,000

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