# Blowout Penstemon
# *(Penstemon haydenii)*

## 5-Year Review:
## Summary and Evaluation

Photo by J. Stubbendieck; used with permission

**U.S. Fish and Wildlife Service**
**Nebraska Ecological Services Field Office**
**Grand Island, Nebraska**

**June 2012**

**5-YEAR REVIEW**
**Blowout penstemon (*Penstemon haydenii*)**

## GENERAL INFORMATION

### 1.1 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (ESA) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process that includes public review and comment.

### 1.2 Reviewers:

**Lead Regional or Headquarters Office:** Mountain-Prairie Regional Office
Michael Thabault, Assistant Regional Director for Ecological Services, 303/236-4252
Bridget Fahey, Regional Endangered Species Chief, 303/236-4258
Seth Willey, Regional Recovery Coordinator, 303/236 4257

**Lead Field Office:** Nebraska Ecological Services Field Office
Mike George, Field Supervisor, 308/382-6468, extension 12
Martha Tacha, Fish and Wildlife Biologist, 308/382-6468, extension 19
Jeanine Lackey, Fish and Wildlife Biologist, 308/382-6468, extension 14.

**Cooperating Field Office:** Wyoming Ecological Services Field Office
Mark Sattelberg, Field Supervisor, 307/772-2374, extension 231
Jan McKee, Fish and Wildlife Biologist, 307-772-2374, extension 242

### 1.3 Methodology used to complete the review:

The Service initiated a 5-year review of the blowout penstemon *(Penstemon haydenii)* on October 6, 2008 (73 FR 58261-58262). On October 17, 2008, Nebraska Ecological Services Field Office contacted numerous biologists engaged in monitoring and research projects on the blowout penstemon for recent reports and their assessment of the species' status. These biologists included Marlin French, Crescent Lake National Wildlife Refuge (NWR), Service; Bonnie Heidel, University of Wyoming; Alex Buerkle, University of Wyoming; Kay Kottas, University of

Nebraska; Frank Blomquist, U.S. Bureau of Land Management; Jan McKee, WYFO, Service; Mel Nenneman, Valentine NWR, Service; Gerry Steinauer, Nebraska Game and Parks Commission; and James Stubbendieck, University of Nebraska; Jeff Abegglen and Leslie Stewart-Phelps, Bessey and McKelvie National Forest and Grasslands. We reviewed reports and scientific papers completed since publication of the Blowout Penstemon Recovery Plan in July 1992 (Fritz et al. 1992) for new information. This review summarizes and evaluates information provided in the recovery plan and current scientific research and surveys related to the species. All pertinent literature and documents used in this review are on file at the Nebraska Ecological Services Field Office. The primary sources of information used in this 5-year review are the recovery plan, peer-reviewed literature, population demographic data, species' status reports, field notes, professional opinions of biologists, and updated information provided by researchers familiar with the species.

## 1.4 Background:

### 1.4.1 Federal Register Notice Citation Announcing Initiation of the 5-year review:

73 FR 58261, October 6, 2008

### 1.4.2 Listing history:

Original Listing
Federal Register notice: 52 FR 32926, September 1, 1987
Date listed: The final rule became effective on October 1, 1987
Entity listed: Species: *Penstemon haydenii*
Classification: Endangered rangewide

**1.4.3 Associated rulemakings:** Not applicable.

### 1.4.4 Review History:

In 1991, the Service initiated a 5-year review of all threatened and endangered species listed prior to that year (56 FR 56882, November 6, 1991). The notice initiating that review summarized the listing status of all species being reviewed, but did not further discuss species' status nor did it propose or change the status of any species, including the blowout penstemon.

We completed a recovery plan for blowout penstemon in 1992 (Fritz et al. 1992). This plan was the last status review of the species, and it did not include discussion of populations of the blowout penstemon subsequently identified in Wyoming (in 1999).

### 1.4.5 Species' Recovery Priority Number at start of 5-year review:

At the start of this review, the recovery priority number for the blowout penstemon was 11C. This ranking indicates: (1) a perceived moderate degree of threat; (2) a low recovery potential; (3) the plant's taxonomic standing as a full species; and (4) the species is in conflict with construction or other development projects or other forms of economic activity (see Table 1.).

| Degree of Threat | Recovery Potential | Taxonomy | Priority | Conflict |
|---|---|---|---|---|
| High | High | Monotypic Genus | 1 | 1C |
| | | Species | 2 | 2C |
| | | Subspecies/DPS | 3 | 3C |
| | Low | Monotypic Genus | 4 | 4C |
| | | Species | 5 | 5C |
| | | Subspecies/DPS | 6 | 6C |
| **Moderate** | High | Monotypic Genus | 7 | 7C |
| | | Species | 8 | 8C |
| | | Subspecies/DPS | 9 | 9C |
| | **Low** | Monotypic Genus | 10 | 10C |
| | | **Species** | 11 | **11C** |
| | | Subspecies/DPS | 12 | 12C |
| Low | High | Monotypic Genus | 13 | 13C |
| | | Species | 14 | 14C |
| | | Subspecies/DPS | 15 | 15C |
| | Low | Monotypic Genus | 16 | 16C |
| | | Species | 17 | 17C |
| | | Subspecies/DPS | 18 | 18C |

Table 1. Recovery Priority ranking

### 1.4.6 Recovery Plan:

**Name of plan**: Blowout Penstemon, *Penstemon haydenii* S. Watson Recovery Plan

**Date approved**: July 17, 1992

## 2.0 REVIEW ANALYSIS

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

This section of the 5-year review is not applicable to this species because the ESA precludes listing DPSs of plants. For more information, see our 1996 DPS policy (61 FR 4722, February 7, 1996).

### 2.2 Recovery Criteria

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

Yes. However the criteria are in neither realistic nor time referenced.

**2.2.2 Are the recovery criteria adequate in that they: reflect the best available and most up-to-date information on the biology of the species and its habitat; and address the five listing factors?**

**No.** The recovery plan does not reflect the best available and most up-to-date information on the biology of the species. For example, research since approval of the species' recovery plan has produced new information on germination, dispersal, and survival in the field. Distribution is also not accurately portrayed or considered in the recovery plan. The recovery plan was written in 1992 prior to the 1999 identification of populations of the blowout penstemon in Wyoming. Therefore, the species' Wyoming populations are not considered or addressed in the recovery plan. However, upon further investigation, there appear to be significant differences between the Wyoming and Nebraska populations. These differences relate to genetic composition, habitat characteristics and persistence, threats, and management strategies.

The recovery plan also falls short in that its criteria are inadequate. For example, the recovery criteria depend on a measure of population viability (i.e., minimum population size alone) that recent modeling has shown to be insufficient (Kottas 2008). Finally, the recovery criteria do not fully consider or address the five listing factors.

Given the above, we now view the recovery plan as inadequate to judge whether the species is in less danger of extinction throughout all or a significant portion of its range, and whether a change in status is warranted. Nevertheless, the species' status in relation to these criteria are discussed below so as to acknowledge progress toward recovery.

**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.**

**Abundance Recovery Criteria:** The 1992 recovery plan indicates downlisting to threatened may be considered when a minimum of 10,000 individuals in at least 5 stable populations is established with the minumun level of protection The recovery plan indicates delisting may be considered when a minimum of 15,000 individuals are established in at least 10 population groups each containing a minimum of 300 plants. A clear definition of population "group" was not provided in the recovery plan, however several botanists define a population "group" as subpopulations separated by an average of 1.5 km as pollinators for this plant move from 1 to 2 kilometers (ave. 1.5 km). Additionally, population groups of blowouts are apt to have some level of genetic exchange, are separated by stable vegetation, and hereafter will be refered to as subpopulations (Heidel, pers. comm. 2011).

**Status:** For most of the last 20 years, blowout penstemon subpopulations in Nebraska have been enhanced by transplanting greenhouse grown seedlings into previously unoccupied blowouts. This practice has increased both the overall number of plants and the number of blowout penstemon subpopulations (Stubbendieck et al. 2007). The growth rate of the entire Nebraska population,

from monitoring data of the last decade, is to a large extent, the direct result of successful planting efforts (Kottas 2008). At least five introduced subpopulations have been supplanted at an unknown interval after the initial transplant event (Kottas, pers. comm. 2011). The exact number of plant data added to these 5 introduced subpopulations is not available.

In 2008, 23,876 plants (not including seedlings) were counted during annual monitoring in Nebraska (Stubbendieck, pers. comm. 2009). The total population exceeded 10,000 plants in 2001 and from 2003 through 2007 (Stubbendieck, pers. comm. 2009). Since Dr. Stubbendieck's retirement recent comprehensive statewide surveys have not been conducted. The life achievement of Dr. James Stubbendieck's research on blowout penstemon propagation and work transplanting blowout penstemon seedlings has provided an abundance of invaluable data, has furthered the scientific communities' knowledge and understanding of the species, and will leave a lasting impact on the recovery of the blowout penstemon range-wide.

Population counts on federal land in Nebraska continue however. Additional recent census data from the U.S. Forest Service (USFS) show a substantial increase in the total number of plants on USFS land from 6246 plants counted in 2008 to 23,239 plants counted in 2011(Stuart-Phelps 2011). All subpopulations on USFS land are comprised of introduced plants and have received a total of 7639 greenhouse grown seedlings from 2000 – 2011. One large blowout (Windmill 164) contains approximately 86% of the plants located on USFS land. Number of plants on Windmill 164 increased substantially after receiving adequate moisture at a preferred time for two years in a row. Introduced subpopulations on Crescent Lake NWR have decreased from 1319 in 2008 to 312 in 2011. Native subpopulations on the refuge have also decreased in number from 396 in 2008 to 79 in 2011. Current census data for populations on private land and for other subpopulations in Nebraska is unavailable.

At least 13 subpopulations (including both native and introduced populations) in Nebraska contained a minimum of 300 blowout penstemon plants in 2008. At least one of those subpopulations dropped below 300 plants in 2011. These plants occurred in numerous isolated blowouts or blowout complexes in the Nebraska sandhills.

In Wyoming, estimates place the total Wyoming population between 5,000 and 8,000 individual plants (Heidel, pers. comm. 2009). This represents a decline from the 19,343 plants estimated in 2005 (Heidel, pers. comm. 2009). In Wyoming, there are three separate populations, and among them are five subpopulations that contain more than 300 plants which were sustained for at least two consecutive years (Heidel 2006). Based on surveys in Wyoming that took place between 2004 and 2011, a total of 19 subpopulations have been identified. Not every subpopulation was or is surveyed in every year. It should be noted that there is reason to question whether the Wyoming plants are the same species as the Nebraska plants (see section 2.3.1.3 below).

Given the best available data on hand, we consider the abundance portion of the recovery criteria satisfied. However, conservation efforts must go beyond only increasing plant numbers, or relying on one or two good years of adequate moisture, but also understanding the processes that govern their existence with or without human intervention. The measure of demographic recovery or decline should be based on the use of native and well established introduced populations as newly introduced populations are demographically imbalanced.

**Viability / Persistence Recovery Criteria**: The recovery plan indicates downlisting to threatened may be considered when 5 populations, totaling 10,000 or more individuals, have a minimum level of protection that will ensure their continued existence. The recovery plan indicates delisting may be considered when 10 populations (groups) are demonstrated to be at minimum viable population levels.

In total, these groups should represent a viable population that is demographically stable, able to maintain genetic variation, and evolve. They should be able to withstand and adapt to significant natural disturbances and environmental variations.

**Status:** At time of listing, recovery objectives indicate blowout penstemon population protection should be achieved through State, Federal, or nongovernment organization ownership. The second prong of this stipulation requires these properties have approved management plans in place and that management practices ensure these populations continued existence. However, there is little guidance on development and implementation of habitat management plans for the blowout penstemon.

The recovery plan specifies that the largest naturally occurring populations be among the populations counted above and provided with protections sufficient to ensure their continued existence. This stipulation was added to the downlisting criteria because the natural populations "…represent the total gene pool of *Penstmon haydenii*, and the protection of these populations and their habitat is crucial to the viability of the species' genetic resources" (Fritz et al. 1992, p. 18). More to the point, these naturally occurring populations may differ from captively raised and reintroduced populations making their protections especially important to the species genetic viability and, thus, its recovery.

Today, experts still agree that the measure of demographic recovery or decline should be based on the use of native and well established introduced populations. Newly introduced populations are demographically imbalanced. The population at a research site in Nebraska, for example, has been increasing, but, it is a young population. There are neither older individuals nor very small seedlings to increase mortality in these newer populations (Kottas 2008). All Wyoming subpopulations are considered naturally occurring.

In 2008, at least 13 subpopulations in Nebraska contained a minimum of 300 blowout penstemon plants. Eight of these occur on private land: seven on private ranches and one on land owned by The Nature Conservancy (TNC).

Four subpopulations occur on Federal land, including the Bessey and McKelvie Units of the Nebraska and McKelvie National Forests, on Crescent Lake NWR and on Valentine NWR (Stubbendieck 2008). The Crescent Lake NWR native population dropped from 396 plants in 2008 to 79 plants in 2011. An additional subpopulation meeting the 300 plant criteria is located on State land managed by the Nebraska Department of Roads, but this is an unusual subpopulation occurring in atypical habitat (Stubbendieck, pers. comm. 2009). Approximately 60 percent of the plants found in Nebraska occur on private land.

In Wyoming, five subpopulations, each containing more than 300 plants were sustained for at least two consecutive years (Heidel 2006). Of the places that have been surveyed in Wyoming, no subpopulations occur on private land.

**Management in Nebraska**

Currently, there is no management plan for Valentine NWR that specifically addresses practices for managing and maintaining populations of blowout penstemon. There is a goal to maintain 72 acres of blowouts as potential habitat for blowout penstemon, but no reference is made as to how this will be accomplished (Nenneman, pers. comm. 2011).

Additionally, there is no clear understanding about how to maintain existing blowouts and there appears to be limited support for creating new blowouts in Nebraska. Managing to maintain or create blowouts is generally at odds with managing for migratory bird habitat or good forage production (Nenneman, pers. comm. 2011).

A Comprehensive Conservation Plan (CCP) for was developed in 2002 for Crescent Lake NWR. The CCP outlines goals, objectives and strategies to aid in the conservation and management of the blowout penstemon. Refuge staff have been surveying for blowout penstemon since 1987. Numbers had been declining since the inception of the survey, until transplanting began in 1997 in cooperation with the University of Nebraska. Additionally, the CCP describes strategies such as:

- Continuing the transplant program; monitor population status, survival rates, colonization, and other parameters to evaluate and adjust management.

- Prepare maps showing the past, present and desired location of penstemon populations on and nearby the Refuge, and overlay information regarding numbers of plants, densities, transplants, etc.

- Protect existing penstemon subpopulations on private lands adjacent to the Refuge. Crescent Lake NWR will continue to provide habitat by utilizing grazing and prescribed fire to expose areas of the sandhills to wind erosion.

Despite having a CCP in place, in just six years from 1990-1996 Crescent Lake NWR lost about 80% of the blowout penstemon population on the Deer Lake Unit. Although there are numerous bare sand blowouts, this subpopulation is disappearing.

The Boyd Unit on Crescent Lake NWR has received transplants and fall grazing to open the landscape to blowing. Despite these efforts, natural colonization into new blowouts has not been documented.

Crescent Lake NWR change in blowouts from 1997 and 2001 Photos

| Condition | Number | Percent |
|---|---|---|
| Increasing | 15 | 21.4 |
| Maintain | 18 | 25.7 |
| Healing | 37 | 52.9 |
| Total | 70 | |

Table 2. Condition of blowouts between 1997 and 2001. (French 2008).

The changing condition of blowouts over time, based on aerial photographs, is represented in Table 2 where over half were healing, or losing habitat. During a 2008 survey, fifty percent of the blowouts checked had no plants and six blowouts contained just under 50% of the plants of the entire refuge.

The USFS and specifically the Nebraska National Forests and Grasslands (NNFG) worked with Dr. Stubbendieck to transplant blowout penstemon plants in suitable habitat on the Bessey and McKelvie Geographic Areas. Prior to 2005 no native blowout penstemon populations occurred on USFS property in Nebraska. From 2000 through 2011greenhouse-grown blowout penstemon was transplanted into subpopulations within the Bessey and McKelvie districts. The USFS NNFG staff drafted a blowout penstemon conservation plan, in cooperation with USFWS and state partners, for management and conservation of blowout penstemon on National Forest System land (Abegglan, pers. comm. 2011).

In Nebraska, the largest naturally occurring populations are currently found on TNC property (Graves Ranch) and a private ranch in Garden County (Private Ranch 04) (Figure 1). On the Nebraska Graves Ranch site (TNC), leases are structured to require grazing during the fall and winter and at relatively high stocking densities to expose sand and to reduce competition from other plants. Conservation agreements with the Nebraska Game and Parks Commission (NGPC) require considerations to be made for blowout penstemon if and when other weeds are sprayed. Other than these stipulations there are no other comprehensive management plans specifically developed to conserve and manage blowout penstemon. Neither the Graves Ranch site or Ranch 04 have approved conservation or management plans in place to specifically manage for the continued existence of the blowout penstemon. The Garden County site (Private Ranch 04) has 11 blowout subpopulations. At least 2/3 of them are doing just as poorly as other populations in Nebraska (Kottas, pers. comm. 2011). Two blowouts are quite large, however, and carry the majority of the plants. A single blowout is one of the largest and most active because it faces

northwest and is just southeast of a large lake. This ranch has also been overgrazed in the past, which has helped to keep the sand blowing as well.

If there are no natural topographic and environmental factors working in favor of moving sand and if managers have not determined the best way to actively encourage disturbance, all the while balancing management with reproductive protection, then healing of blowouts tends to occur.

**Management in Wyoming**

In Wyoming, there are three distinct populations, occuring mostly on Federal land managed by the Bureau of Land Management (BLM) (Heidel 2007). The BLM Rawlins Field office is overseeing work on a statewide programmatic Biological Assessment for blowout penstemon with the U.S. Fish & Wildlife Service. Additionally, the BLM Rawlins Field Office has designated all lands surrounding Wyoming blowout penstemon as an Area of Critical Environmental Concern (ACEC). Basic blowout penstemon ACEC management goals and objectives outlined in an ACEC Resource Management Plan (RMP) include; Manage the endangered blowout penstemon plant and its habitat, maintain, restore, and enhance the unique parabolic dune complex, and protect the area to ensure the continued existence of the plant and to allow for continued research (USDI BLM 2008). More specific ACEC management guidelines will be developed starting next year (Blomquist, pers. comm. 2011). Since 2008, three new subpopulations were discovered in Wyoming. Two of these newly discovered subpopulations are located on BLM land, however, one of these is outside an existing ACEC boundary the remaining subpopulation is located within an ACEC. The third new subpopulation is located on Bureau of Reclemation (BOR) land. The protection measures in the BLM's RMP biological opinion (BO) for blowout penstemon will still apply whether or not a subpopulation is located inside or outside an ACEC (Blomquist, pers.comm. 2011). In the meantime, the taxonomic status of Wyoming populations remains unresolved.

The largest of the nineteen blowout subpopulations in Wyoming, which contains about 25% of the Wyoming plants, is almost entirely on State Trust lands (Heidel 2006). State trust lands have their highest and best use defined as generating revenue for the state educational system; they are the "state school sections". They are effectively managed for grazing. There are no other forms of protection on non-federal lands and the ACEC designation for federal lands does not have bearing on non-federal lands such as state school lands.

According to the recovery plan, the most secure form of protection for the blowout penstemon is for a public agency to own or hold a permanent lease or easement on the property of occurrence with an approved management/ conservation plan. In addition, more research is needed to develop standardized monitoring techniques, assess impacts of various management practices and determine parameters for viable populations. Although the existence of the Wyoming populations was not known at the time the Recovery Plan was written, the data from Wyoming is used to show progress toward recovery.

That said, based on the evidence to date and the lack of approved management plans, permanent easements, and /or other tools that could provide protections and secure the continued existence of the largest naturally occurring populations, we do not consider the viability and persistence sub-criteria satisfied.

Perhaps most critical (as alluded to in section 2.2.2 above), recent population viability modeling indicates that many population groups may not be self-sustaining, and that population demographics and habitat may not be sustainable, regardless of current plant numbers (Kottas 2008). Depending on a variety or combination of factors, a population usually declines to a lower, cyclic level (Stubbendieck, pers. comm. 2009) or steadily declines to very low levels. Whichever the case, the population will eventually expire when the blowout in which it is located stops eroding and is invaded with secondary successional plants (i.e., with which blowout penstemon cannot compete).

Penstemon haydenii population demographic data suggests that any given sector of a colony is subject to decline over time, consistent for a pioneer species, so that the population is in continual flux (Heidel 2011). In short, populations are not likely to be self-sustaining unless natural processes provide juvenile plants into the population. Population modeling, which included several simplifying assumptions, indicates that seven of 11 population groups studied in Nebraska from 2005 through 2007 would persist ≤ 30 years if average population parameters remained the same (Kottas 2008).

The populations consisting of introduced plants cannot be proven to be stable since there have been additional introductions on a yearly basis and only one native population is stable and it occurs on private land. Research shows that most blowout population sites were not stable without supplemental introductions (Kottas, pers. comm. 2011). While the total number of plants surpasses the total needed for recovery, the recovery abundance criteria is likely artificially inflated because of supplemental planting of seedlings.

## 2.3 Updated Information and Current Species' Status

### 2.3.1 Biology and Habitat

#### 2.3.1.1 Information on the Species' Biology and Life History

The genus *Penstemon* is endemic to North America. Of 275 species in the *Penstemon* genus, only the blowout penstemon and one other species are fragrant (Kottas 2008). The common name of the blowout penstemon comes from the blowouts in the Sandhills of Nebraska. Blowouts are round or conical eroded areas, depressions formed in the sand when prevailing northwesterly winds scoop out the sides of the hills (Pool 1914 in Kottas 2008). These eroded areas form on the sides of dunes when vegetative cover is removed or disturbed and wind action further exposes the slopes (Stubbendieck et al. 1989). Blowout

penstmeon is a pioneer species in these blowouts, frequently found among blowout grass (*Redfieldia flexuosa*) which is often the first pioneer in a blowout (Kottas 2008). Neither blowout grass nor blowout penstemon persist after other grasses begin to invade the blowout. The amount of suitable, active blowout habitat has declined markedly since settlement of the Sandhills region in the early 20th century (See section 2.3.2.1).

In Wyoming, blowout penstemon is found primarily on the rim and lee slopes of blowouts, or the rim and steep faces of sandy slough slopes. These deposits are found at the base of mountains or ridges, which represent topographic barriers. Shifting sand dunes are prevented from becoming fully stabilized and overgrown because of wind and gravity. The dunes may be 60 to 120 feet high at elevations between 5860-7440 feet (Heidel et.al 2007). The blowout penstemon is found in the early stages of plant community development which can be composed of blowout grass, lemon scurfpea, and thickspike wheatgrass or Indian ricegrass (Heidel 2005). The Wyoming sites differ from Nebraska sandhills in that the populations occur at higher elevations, the mean annual precipitation is lower, and Wyoming has cooler minimum and maximum summer temperatures. Flowering in Wyoming occurs later than in Nebraska and usually takes place in the middle of June, extending to early July. The late flowering of blowout penstemon in Wyoming is probably because of the drier and cooler climatic conditions.

Blowout penstemon is a short-lived perennial plant, which requires actively moving sand in blowouts to thrive. It grows from a tap root, initially producing a single stem that often becomes decumbent. The stem roots readily where nodes are buried in the sand. Buds at the base of the stem break dormancy in the second spring, often producing multi-stemmed plants. These plants typically flower in the second or third year (Kottas 2008), and individual plants live for six to eight years (Stubbendieck et al. 1997). The lavender (or occasionally blue or white) flowers produce two-sided capsules (ovaries) bearing 14 to 35 discoid brown to black seeds (Fritz et al. 1992; Kottas 2008). Seeds have a thick, hard seed coat and germination in the field is typically very low. The seeds are adapted to dispersal by wind, which often distributes seed downwind across the edge of the blowout into the area of sand accumulation. Wind and animals aid in the seed dispersal (Stubbendieck, pers. comm. 2009).

Seed numbers are highly variable among years and sites (Kottas 2008). Individual plants may produce approximately 1,400 to 1,500 seeds (Kottas 2008; Fritz et al. 1992), but seed viability can reduce reproductive potential to an average of approximately 530 viable seeds per plant (Kottas 2008). The number of seeds in the seedbank is typically low, due mainly to predation by small mammals at the time of seed rain (Kottas 2008; Stubbendieck, pers. comm. 2009). Kottas

(2008) investigated the effects of floral herbivory by insects and fungal infection on seed production and viability. She reported that treatments of plants with insecticide or fungicide did not significantly affect total seed output, weight or viability (Kottas 2008). Consequently, site specific herbivore, granivore and fungal impacts may be important when seed production is low or when the surrounding vegetation invades blowout penstemon habitat, bringing additional herbivory with it (Kottas 2008).

Observations of seedlings in natural populations are rare. The sand must remain damp for a period of two weeks at the appropriate time in the spring for the seeds to germinate and for the roots of seedlings to reach a depth where moisture is available constantly. These limiting conditions are only met in one out of eight or ten years (Stubbendieck et al. 1997). The blowout penstemon has a relatively short lifespan of six to eight years due to the species adaptation to constantly moving habitat and because the plant is an early successional species. Therefore, even in blowouts where many seeds are produced, seedlings are rare (Stubbendieck et al.1997).

Based strictly on the subpopulations of 11 blowouts studied, ideal size of blowouts is likely to be greater than 600$m^2$. The subpopulations of smaller blowouts in a Nebraska study (CL83, G3, and N3) have remained low or increased slowly, while subpopulations in larger blowouts in the same vicinity have increased at a higher rate (CL 168 vs. CL 83, N3 vs. NN; Table 5.20). So long as healthy plants are present, available habitat and demographic parameters for positive growth were more important than plant abundance. The reappearance of dormant individuals suggests a demographic resilience, which has not yet been examined. More extensive data collection for modeling, following the populations over 8 to 10 years, would help determine the origin of the new adults, the dynamics and importance of dormancy to the population, and whether a cycle of increasing and decreasing growth rates exists (Kottas 2008).

#### 2.3.1.2 Distribution, Abundance, and Trends

Blowout penstemon are found in the Sandhills region of north central Nebraska and the northeastern Great Divide Basin in Carbon County, Wyoming (see Figures 1 and 2 below) (Kottas 2008, Heidel et al. 2007).

The Nebraska Sandhills is an area of stabilized sand dunes covering 5 million hectaures (approximately 12.4 million acres) in north central Nebraska. Currently 32 blowout penstemon subpopulations (i.e., 10 native sites and 22 introduced populations) occur in the Sandhills region of Nebraska (Stubbendieck 2008) (Figure 1).

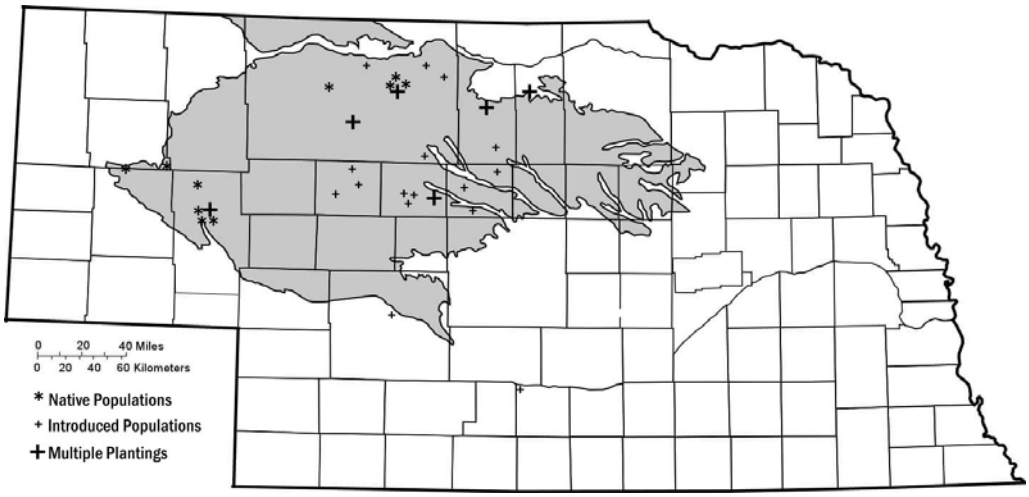


Figure 1. Location of blowout penstemon subpopulations and the Sandhills region in Nebraska. (Source: Jim Stubbendieck, 2008, used with permission).

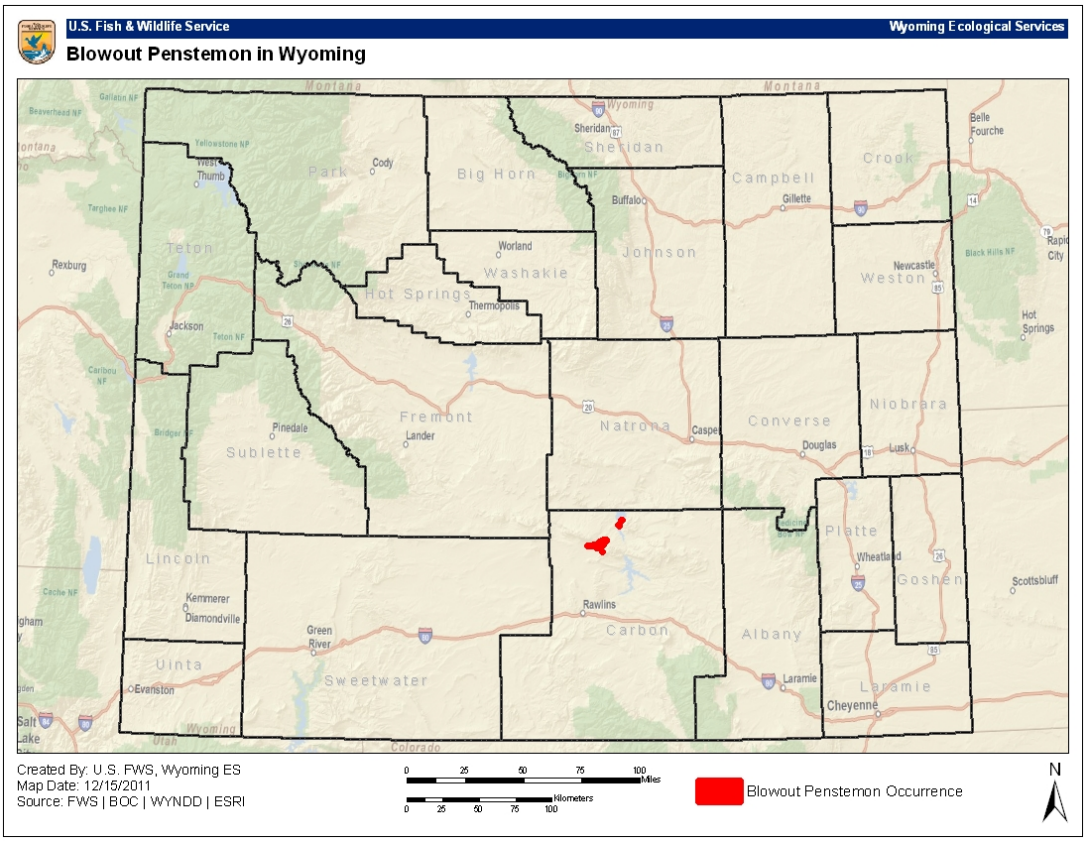


Figure 2. Distribution of blowout penstemon populations in Wyoming (from USFWS, Wyoming ES, 2011).

Annual monitoring of population demographics has been conducted for the blowout penstemon since as early as 1985 on some sites (Stubbendieck 2008). An organized site monitoring effort, primarily focused on number of plants within each population group, has been in place since 1990 and continued at least through 2008. Two native populations have not been monitored due to denial of access to privately-owned land.

In Nebraska, the total population of blowout penstemon has increased from approximately 2,788 in 1990 to 23,876 individual plants in 2008 (Stubbendieck 2008). This noteworthy increase in number of individuals and number of populations is due to extensive seedling introductions conducted by the University of Nebraska at Lincoln (UNL). For example, unoccupied blowouts received 700 five-month-old seedlings raised at the UNL in 2006 (Stubbendieck 2007). Of 20,567 blowout penstemon plants counted in 2006 (excluding the seedlings), 17,985 (87%), were established plants from greenhouse seedlings (Stubbendieck et al. 2007). Five-month-old seedlings transplanted in early May into empty suitable blowout habitat have survival rates from 10% to 70% after one year (Stebbendieck et al. 2007). Establishment of new populations has improved distribution of the species in Nebraska and made it less vulnerable to localized weather or other stochastic events. No transplanting of greenhouse plants has been done in the Wyoming populations.

Of the 22 blowout penstemon population groups introduced as seedlings in Nebraska, nine have been monitored for 10 or more years (a period exceeding the estimated life of individual plants). Of these nine, four populations were transplanted for experimental purposes meaning the sites were not selected for long-term survival (Stubbendieck 2008). All four of these populations have declined substantially (Stubbendieck 2008). The remaining five transplanted population groups have either increased substantially, or exhibited a relatively stable, cyclic population level. Usually only one transplant event per population group was made, although multiple blowouts in three of five more successful introduced populations received multiple transplantings (i.e., Valentine National Wildlife Refuge (NWR), Cresecent Lake NWR, and a private ranch in Cherry County) (Figure 3). These multi-transplant sites are primarily responsible for the substantial increase in total number of blowout penstemon plants from 1998 to 2008 in Nebraska. Since 2008, only the Valentine and Crescent Lake NWR introduced populations have been surveyed.

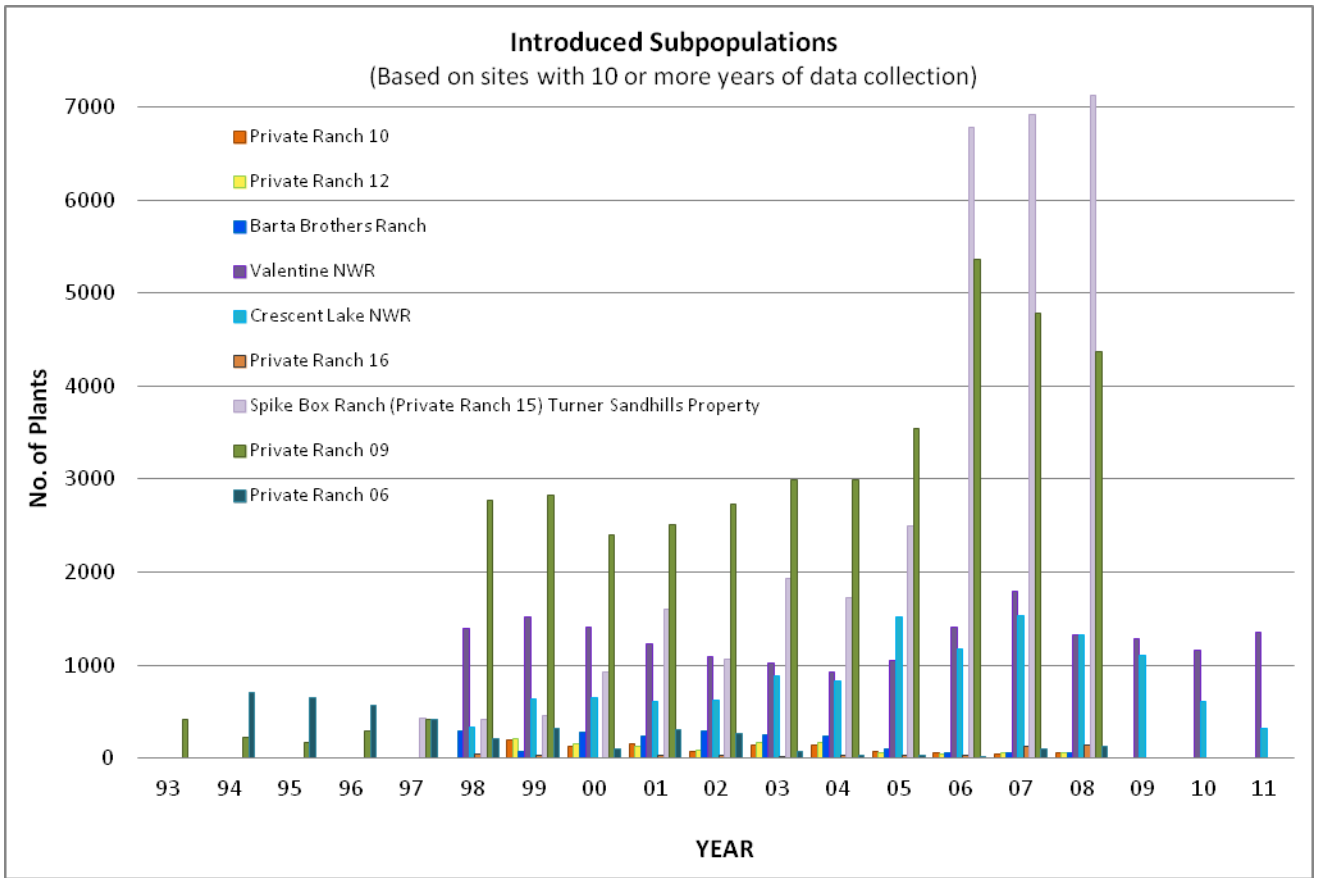


Figure 3. Number of plants in introduced subpopulations which have been monitored for ten years or more. (Source of data: Stubbendieck, (2008).

Eight native blowout penstemon subpopulations in Nebraska have been monitored for 10 or more years (Figure 4). Four of these eight exhibited substantial population decreases following stabilization of the blowout(s), two of these due to changes in range management practices to promote grassland cover (Stubbendieck 2008). A fifth native subpopulation with a relatively steady but low population level (≤40 plants for 20 years) exists in a single blowout that is not expanding (Stubbendieck 2008). Since 2008, only the Valentine NWR and the Crescent lake NWR subpopulations have monitored. The measure of demographic recovery or decline should be based on the use of native and well established introduced populations. Newly introduced populations are demographically imbalanced (Kottas, pers comm. 2011).

In Wyoming, the blowout penstemon is found in sand dune habitat in northwest Carbon County (Figure 2). Five blowout colonies have had 300 or more plants for at least two consecutive years. Of these, four are on Federal land managed by the Bureau of Land Management

(Heidel 2007). This includes the first place it was discovered (Fertig 2000). Total occupied habitat of Wyoming colonies is about 237 acres. The largest of the nineteen blowout colonies, which contains about 25% of the Wyoming plants, is almost entirely on State Trust lands (Heidel 2006).

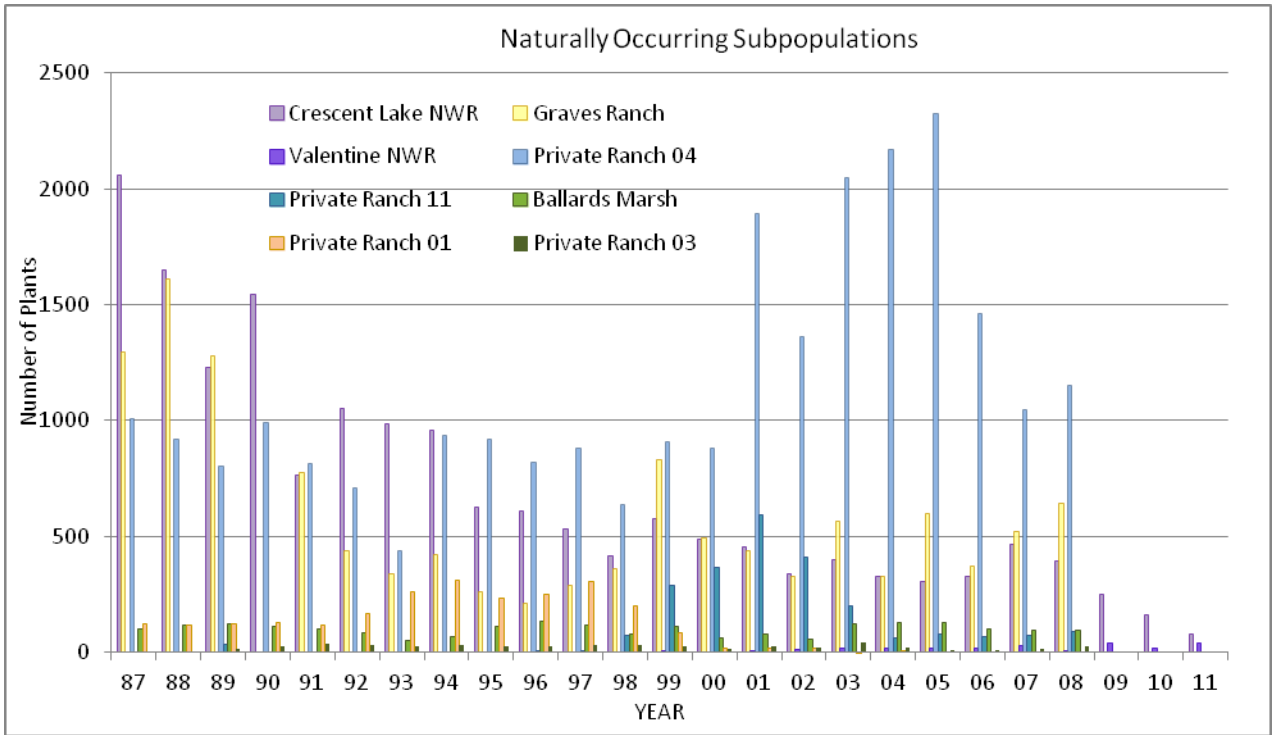


Figure 4. Native subpopulations of blowout penstemon in Nebraska that have been monitored for ten or more years. (Source of data: Stubbendieck, (2008).

In Wyoming, a mulit-year monitoring effort from 2004-2006 showed a spike in population numbers to 19,343 plants in 2005 at the middle of a prolonged drought period, (Heidel 2006, 2009; Figure 5). Subsequent decline in plant numbers may be related to significant habitat events between 2005 and 2006 (i.e., the breaching of blowout rims in most occupied habitat; Heidel 2007). Therefore, the peak census tallies of 2005 (i.e., an estimated 19,343) are not appropriate descriptions of population size, but more likely reflect a high range of variability. The 2009 estimates of from 5,000 to 8,000 total plants in Wyoming (Heidel, pers. comm. 2009) more likely reflect more stable population numbers (Heidel unpublished report, 2009). The monitoring data collected in Wyoming ( Figure 5.) represents minimum and maximum number of plants recorded in subpopulations with the number of years the subpopulation was monitored (in parenthesis). Not all subpopulations were monitored in every year and three were not discovered until 2011.

Systematic surveys have been conducted across dune landscapes in both Nebraska and Wyoming. All high potential habitats on public lands around known distribution have been surveyed. Given the extent of potential blowout penstemon habitat, and despite the long histories of botany work, there may still be undiscovered populations or extensions of known populations that remain to be documented, particularly on private land

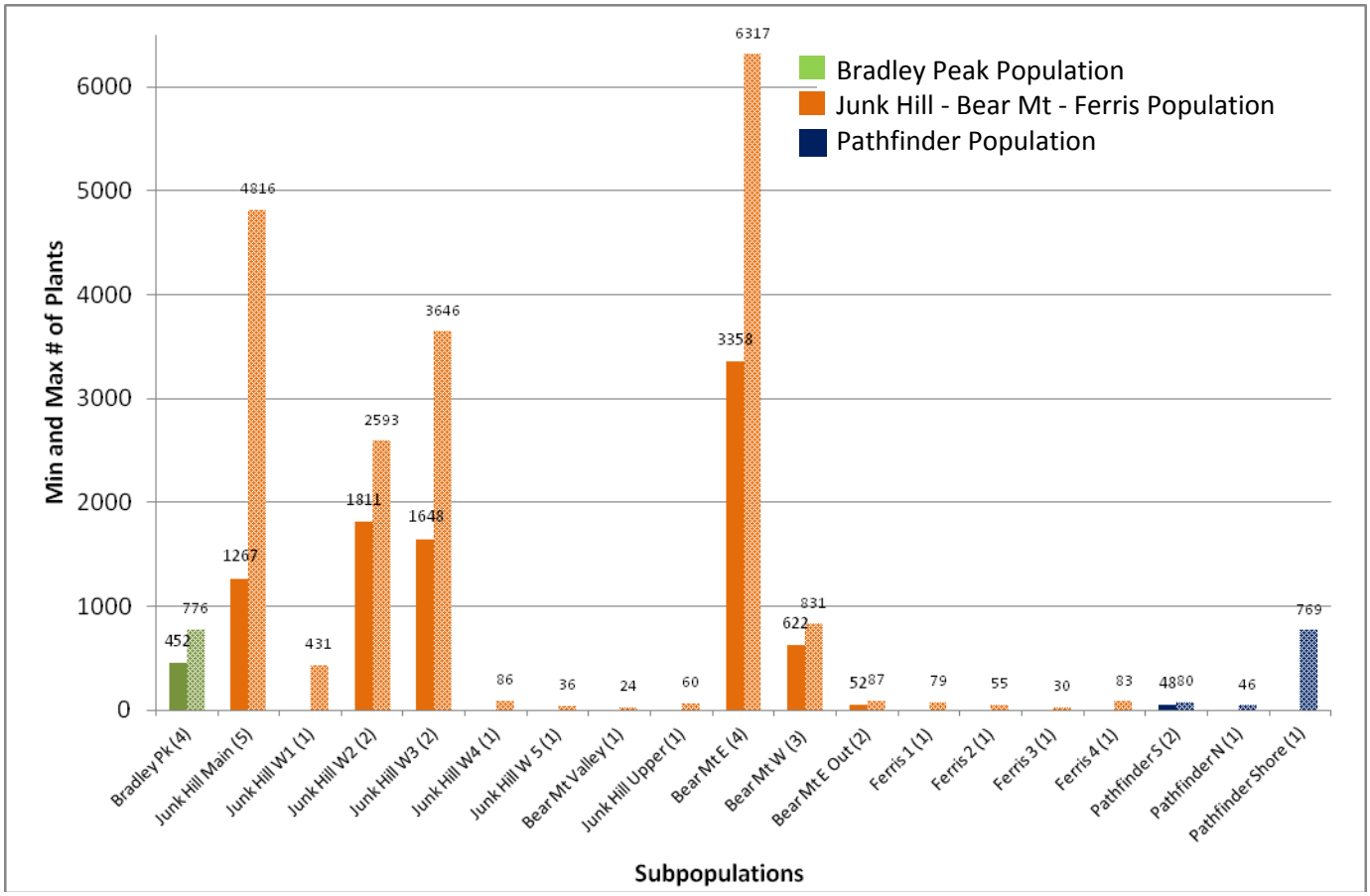


Figure 5. Census results for 19 subpopulations of blowout penstmenon in Wyoming (From: Heidel, unpublished report, 2011).

As stated above in section 2.2.3, the recovery plan specifies that the largest naturally occurring subpopulations (Graves Ranch, Private Ranch 04, and Crescent Lake NWR in Nebraska and State Trust Lands in WY) be among the populations counted towards recovery and that these populations are provided with protections sufficient to ensure their continued existence. The natural (Native) subpopulations occurring at Graves Ranch and Crescent Lake are experiencing declining trends (see Figure. 4) Private Ranch 04 is experiencing an

increasing trend. However, Private Ranch 04 site and Graves Ranch do not have management plans in place that specifically address management of the blowout penstemon.

Kottas (2008) investigated the population demography of blowout penstemon by quantifying the survival and growth of marked plants at 11 sites in the Nebraska Sandhills from 2005 through 2007. Similar in-depth studies have occurred in Wyoming, but on a much smaller scale in pilot demographic monitoring (Heidel, person. comm. 2011). Factors hypothesized to affect plant fecundity, seed viability, and seed germination rate were tested experimentally for their effect on population growth rate.

According to this study, experimental reduction in fungal infection, herbivory and granivory did not strongly affect seed output, weight, or viability (Kottas 2008). However, herbivore, granivore, and fungal impacts were significant in some sites. These interactions may be important to population persistence if surrounding vegetation invades blowout penstemon habitat, and increases habitat for potential herbivore (Kottas 2008).

Grazing can be either a benefit or a detriment to blowout penstemon, depending on timing and intensity. The results of simulated grazing experiments show no significant differences between clipped or control treatments in mean plant survival, flowering stems, flowering stem height, or number of verticillasters after either the first or second growing season (Kottas 2008). Spring clipping of flowering blowout penstemon plants was not detrimental to plant survival or reproductive capacity in the subsequent year, but all reproductive capacity was lost for those stems clipped (grazed) prior to seed set (Kottas 2008). Fall hoof action of grazing animals can benefit established plant populations by opening up blowouts to sand movement and allowing for seedling establishment, especially after seed release near the end of the growing season. Additionally, the hoof action may help bury newly released seed, protecting it from granivores that remove significant amounts of seeds (Kottas 2008).

Using a Lefkovitch stage based matrix model, the population growth rate of blowout penstemon averaged over 11 test subpopulations was found to be negative in the first transition year (0.85, 2005-2006)), positive over the second (1.01, 2006-2007), and negative over the entire study (0.94, 2005-2007) (Kottas 2008). Tests varying matrix parameters across a range of values indicated that the juvenile life stage is important for long-term survival (Kottas 2008). The initial population size made little difference in the survival potential of individual blowout subpopulations (Kottas 2008). This study result is crucial to our ability to evaluate blowout penstemon population persistence relative to the habitat criteria in the recovery plan. Rather, habitat persistence and population growth rate were important to

predicting demographic outcome for blowout penstemon (Kottas 2008). Researchers agree that bar graphs representing species' numbers as gauge of population size and trends should not include transplanted individuals (Kottas, pers. comm. 2009).

#### 2.3.1.3 Taxonomy

There is reason to question whether the Wyoming individuals should be considered *Penstemon haydenii*. Blowout penstemon individuals in Wyoming have divergent flower traits that had not been previously reported in *Penstemon haydenii* (Heidel 2007). In addition, recent research has found significant genetic differences between three blowout penstemon subpopulatios in Nebraska and two subpopulations in Wyoming (Buerkle and Jenkins, in prep.). The magnitude of these genetic differences is equal to or greater than differences between some other pairs of taxonomically recognized Penstemon species (Buerkle and Jenkins, in prep., in which 37 additional Penstemon species have been studied). Given genetic differences between Nebraska and Wyoming populations of blowout penstemon, further consultation with taxonomic experts and targeted genetic research in the genus is warranted.

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

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

At the time of listing in 1987, blowout penstemon was known to exist in only six population centers in four counties in the Nebraska sandhills. Approximately 7000 plants occurred on less than 10 hectares (25 acres). Improved range management practices which promote blowout healing, were a major cause of the species decline in Nebraska and is still the case today

Blowout penstemon is a member of early successional vegetation and requires sites that are devoid or nearly devoid of vegetation. These are usually sites of active wind erosion. As succession progresses, blowout penstemon is unable to compete with the succeeding prairie plants and gradually is eliminated.

Historically, fire and grazing would have been a major disturbance factor in maintaining and promoting blowouts. Human activities, such as fire suppression and improved range management, rather than natural processes, have greatly reduced the habitat available for blowout penstemon. Distances between populations prohibited natural movement of seed, and weather conditions allowing seed germination and seedling establishment occurred infrequently.

**Nebraska**

Since settlement, successful control of unstable sand dunes has resulted in restriction of the required blowout habitats of blowout penstemon in Nebraska (52 FR 32927). Early descriptions of the Nebraska Sandhills depict large areas of blowing sand caused by disturbance to the vegetation in the area (Stubbendieck et al. 1997). Lightning-caused prairie fires and those started by the Native Americans frequently burned extensive areas of the region, removing stabilizing vegetation (Stubbendieck et al. 1997). Because of successful dune stabilization programs that protect rangelands in the Sandhills, the species is limited by the amount of adequate habitat to colonize. In addition, active, open blowouts suitable for the pioneering blowout penstemon eventually heal naturally when they reach the downwind end of a sand dune or change in shape or orientation to prevailing winds such that sand movement stops (Steinauer, pers. comm. 2009). The decrease in extent and number of blowouts also has made dispersal to the fewer remaining natural blowouts increasingly difficult. Without intense disturbance from fire or heavy grazing, many blowouts become stabilized in a few to several years and are unsuitable for the blowout penstemon.

The efforts taken to artificially establish population groups (n=33) is commendable, but commitment to active habitat management remains minimal and there currently is little assurance that landowners will manage their blowouts in a manner that will sustain the introduced populations. Conservation groups are reluctant to conduct the intense fire and grazing management needed to create blowouts and maintain long-term habitat for the penstemon. On private lands, land managers' goals are primarily to preserve and improve grasslands for cattle forage at the expense of creating or promoting persistence of blowout habitat for the penstemon.

Active management to destabilize healing blowout habitat is necessary to ensure adequate quantity and distribution of blowout penstemon habitat and maintain the long-term existence of the species (French 2008; Steinauer, pers. comm. 2009). Population declines can be sudden in the absence of disturbance. Between 1990 and 1996, more than 80% of the native blowout penstemon population on the Crescent Lake National Wildlife Refuge (NWR) was lost on a unit that had not been disturbed by grazing or mechanical manipulation.

Further complicating management, mechanical treatments at two native population sites in Nebraska have proven unsuccessful (Stubbendieck 2008). The Crescent Lake NWR blowout penstemon population, which is distributed among numerous blowouts, has declined from 2,058 plants in 1987 to 396 plants in 2008, despite mechanical intervention to maintain blowouts in some areas (see

Figure 5). In 2008, of 223 blowouts surveyed on Crescent Lake NWR, 122 (55%) held no blowout penstemon plants, and 823 (48%) of the 1,724 plants counted were located in only 6 blowouts (French 2008, unpublished data).

Aerial photos taken of an area containing 70 blowouts at Crescent Lake NWR in 1997 and again in 2001, show that 21% blowouts were increasing in size, 26% were maintaining, and 53% were healing (i.e., losing habitat). Of 186 blowouts, 63% were rated as poor or healing, and 37 % were rated good to very good in terms of blowout penstemon habitat (French, unpublished data. See Table 2). These good and very good blowouts are generally isolated and many without blowout penstemons. Furthermore, the refuge has no data showing colonization of new blowouts. Natural colonization and establishment of a population of blowout penstemon into new habitat has not been observed from either native or introduced blowout penstemon subpopulations.

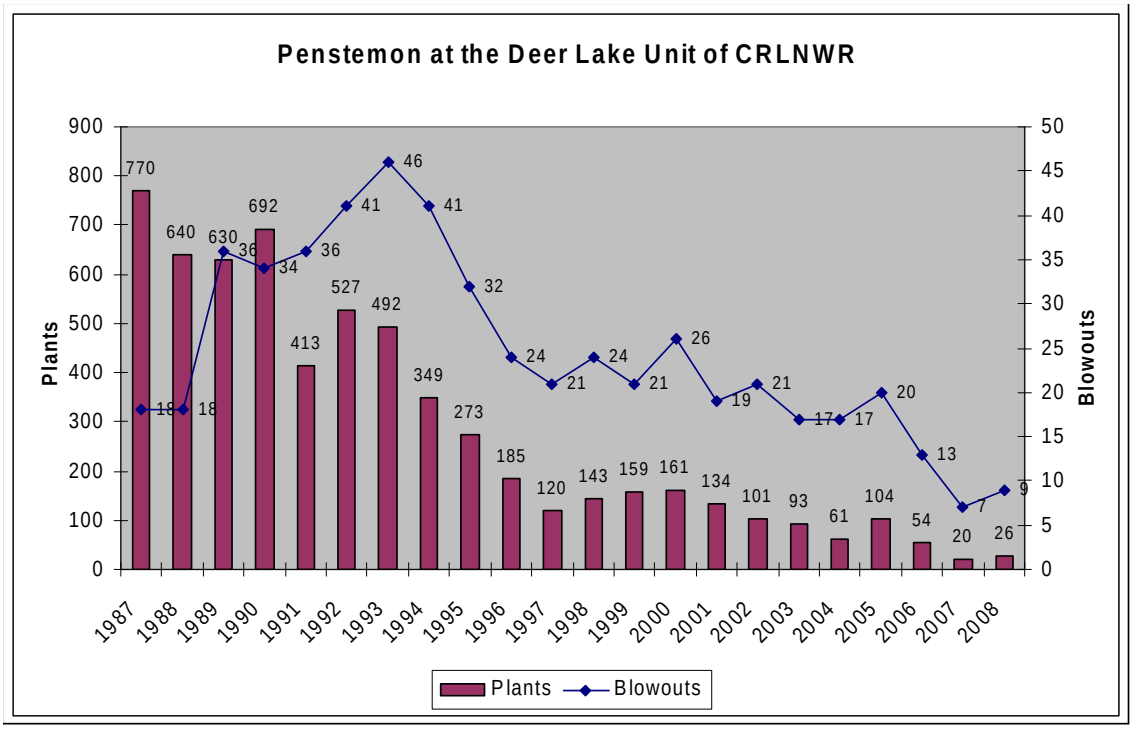


Figure 6. Annual population monitoring of the blowout penstemon at the Crescent Lake National Wildlife Refuge, showing the relationship of population to number of blowouts on the Deer Lake Unit. (Source: French 2008, unpublished data).

Despite the recovery efforts in Nebraska, two main areas of concern continue to hamper recovery of the blowout penstemon. Loss of blowout habitat due to stabilization of dunes accompanied with the lack of effective habitat management remain major threats to the recovery of the blowout penstemon. Development of management plans to guide habitat management at blowouts and initiation of written agreements to implement such plans are needed to achieve population stability and natural reproducing populations of the species.

**Wyoming**

At time of listing, Wyoming populations had not been discovered. Therefore, historical threats to the species were not identified in the Recovery Plan.

The Wyoming, populations have basically been preserved in more or less a natural state because of the isolated, currently inaccessible nature of the sites. However, we anticipate potential moderate to significant impacts from future energy development. As with other forms of development, wind energy facilities, have the potential to affect the natural dynamics of a dune system by directly or indirectly causing changes to the erosion and deposition of sand. Blowout penstemon may be negatively impacted by changes in the dynamics of the dune system (loss of key habitat attributes, competition, etc.). For example, the construction of wind energy equipment or the associated infrastructure could necessitate the stabilization of dunes in some cases (moving sand dunes may not be compatible with roads or other infrastructure). In other cases, the equipment or associated infrastructure may result in unintentional changes to dynamics of the dune system such as, changes to local microclimates that may result from decreased wind speeds behind turbines or changes in moisture deposition in winter in relation to turbines or infrastructure. The dynamics of the dune system could also be impacted by development that allows for the spread of invasive species (potentially stabilizing active dunes) as well as greater human use of area (destabilizing dunes to a rate that is detrimental to the species).

In Wyoming, threats associated with extensive interest in developing potential areas for wind farms will likely pose threats to the habitat occupied by the blowout penstemon through placement of wind turbines in and adjacent to occupied habitat and by construction of roads and other infrastructure associated with such development. This type of development could lead to expansion of ORV use or other public access issues, and introduce invasive species.

Factors threatening habitat loss and degradation vary between Nebraska and Wyoming. Immediate threats to habitat stems from energy development in Wyoming and in Nebraska the continual loss of blowout habitat due to stabilization of dunes accompanied with the lack of effective habitat management. Despite concerted efforts to increase population numbers through a transplant program, population viability and stability have not been documented in Nebraska. The threat of destruction, modification or curtailment of habitat or range is a serious and ongoing threat to the blowout penstemon especially in Nebraska where 60 percent of subpopulations occur on privately owned land.

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

The blowout penstemon is an attractive and fragrant plant. At time of listing, despite inquiries from collectors, exact locations of blowout penstemon plants were not publicized due to the potential threat of overutilization. Small subpopulations might be highly impacted if locations were made public because only a few subpopulations were know at the time and the Wyoming populations had not been discovered yet.

As long as the blowout penstemon plant is listed as endangered or threatened and the general population cannot obtain the plant there will likely be a desire for it. This coupled with the fact that there is no solid data to show that the species is maintaining itself throughout the Nebraska range and that habitat is not maintaining itself, there is a threat from collection. There are yearly requests to have the plant placed on private property (Kottas, pers. comm. 2011). While some populations are remote enough to discourage attempts at collection, especially in Wyoming, others in Nebraska are within sight of major highways.

If the blowout penstemon is downlisted to threatened, seeds from propagated plants would no longer be protected under the ESA and could be used for commercial purposes under Federal law. There is currently little propagation of blowout penstemon plants in Wyoming for scientific purposes or for reintroduction in that state. If the blowout penstemon is downlisted to threatened, seed from propagated plants in Wyoming would be available for commercial purposes. In Nebraska, the NESCA provides the same protections to threatened plants as endangered plants; propagated blowout penstemon plants or seed from such plants in Nebraska may not be possessed, sold, transported or exported from the state without a permit (§37-806[9], Nebraska Revised Statute). If the blowout penstemon was downlisted to threatened, the species would not systematically change status on the state level. However, if the state of Nebraska were to change the status of the blowout penstemon from endangered to threatened, the state could include exceptions in the downlisting proposal thereby changing or eliminating protective regulations on the seeds or other parts of the plant (Fritz pers. comm. 2011).

The scope and severity of this threat is low to moderate but the immediacy of the threat is unknown at this time.

#### 2.3.2.3 Disease or predation:

The final rule listing the blowout penstemon stated that there was little information to indicate that disease or predation were threats to the species (52 FR 32927).

Data indicates rodents have a large effect on both seed and seedling populations of blowout penstemon (Kottas 2008). For example, in May 1987, all of 300 transplanted seedlings were destroyed by rodents (Flessner and Stubbendieck 1988). Ord's kangaroo rat (*Dipodomys ordii*) and deer mice (*Peromyscus maniculatus*) were subsequently trapped on the site (Flessner and Stubbendieck 1988). The effect of exposure of seed to seed predators was relatively large, with an up to 83% decrease in seedlings and 93% decrease in remaining seed, compared to seed in cages shielded from predation (Kottas 2008). Field tested spring seedling survival with predation ranged from 3% to 30% depending on the site and the year, with and overall average of 12% (Kottas 2008). The scope and severity of this threat is relatively small in newly transplanted populations, but grows as the population ages, the plants flower and rodents discover the new source of seed (Kottas, pers. comm. 2009).

Deer mice and kangaroo rats have evolved with the blowout penstemon and may be one of the mechanisms by which these plants were spread from one blowout to another. Because of human caused habitat alteration, distance between blowouts may now exceed the exploratory range of these seed predators. The danger here then is that these predators (which tend to prefer the seed size of blowout penstemon) will stick with a population once they discover one, as it appears to be an excellent food source. (Kottas, pers. comm. 2011)

Relatively stable levels of browse were documented on steep-slope habitats in Wyoming (possibly associated with big game trails) while oscillating levels of browse were found on gentle slopes (at extremely high levels during the most severe drought years) (Heidel 2007). Browse does not appear to be a significant cause of mortality itself, but rather browsing may make the plants vulnerable to burial (Heidel 2007).

Blowout penstemon is susceptible to several types of fungal infection. Seedlings of blowout penstemon used in reintroductions are being grown in a greenhouse setting which possibly subjects a large number of individuals to mortality if a fungus, bacteria, parasite, or other disease became established. Although high standards for seedling production are used in the greenhouse and plants are not infected from outside sources, fungal disease organisms occur inside the seed coat of the blowout penstemon (Stubbendieck, pers. comm. 2009). Seed treatments, including soaking the seeds in concentrated sulfuric acid, do not eliminate the organisms. Sterile techniques have no influence on infection of seedlings from these seeds, but they do protect uninfected seedlings (Stubbendieck, pers comm. 2009). Cercospora

fungus could be brought into propagation greenhouse on the seeds of native plants where the greenhouse presents a great environment for the fungal proliferation. Naturally occurring populations that consist of older, more mature plants have been reduced, but not eliminated, due to the Cercospora fungus (Kottas, pers. comm. 2011). Since many of the introduced populations came from the same genetic material, disease may be more of a threat in these populations than in native populations.

There are challenges to drawing conclusions from the limited time that blowout penstemon has been studied both in Nebraska and Wyoming, therefore the scope and severity of the threat of predation and disease is unknown at this time.

#### 2.3.2.4 Inadequacy of existing regulatory mechanisms:

Prior to listing of the blowout penstemon as federally endangered, the species was not protected by state or Federal regulation. Once listed, some State and Federal protections became effective. Below we analyze the current situation (i.e., the situation with ESA protections in place) and, in order to gauge the adequacy of regulatory mechanism, what would happen in the absence of ESA protections.

Federal Laws and Regulations

With the listing of blowout penstemon as federally endangered, multiple protections became available.

The National Environmental Policy Act (NEPA) (42 U.S.C. 4371 et seq.) provides some protections for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, the NEPA requires an agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where the analysis reveals significant environmental effects, the Federal agency must discuss mitigation that could offset those effects (40 CFR 1502.16). These mitigations usually provide some protections for listed species. However, the NEPA does not require that adverse impacts be mitigated, only that impacts be assessed and the analysis disclosed to the public. In the absence of the ESA's protections, it is unclear what level of consideration and protection Federal agencies would provide through the NEPA process. Through the Federal Land Policy and Management Act of 1976 (FLPMA) and BLM policy 6840, BLM would have authority to manage lands for sensitive (special status) including species of concern, should the species be considered for delisting.

The ESA is the primary Federal law that has protected blowout penstemon since its listing in 1987. Section 7(a)(1) states that Federal

agencies, such as the Bureau of Land Management and the US Forest Service, in consultation with us, shall carry out programs for the conservation of endangered species. Section 7(a)(2) requires Federal agencies to consult with us to ensure any project they fund, authorize, or carry out is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Section 9(a)(2) of the ESA prohibits the following activities: 1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and 2) the malicious damage or destruction on lands under Federal jurisdiction, and 3) the removal, cutting, digging, damaging, or destruction of endangered plants on any other area in knowing violation of a state law or regulation, or in the course of any violation of a state criminal trespass law. Section 9 also makes illegal the international and interstate transport, import, export, and sale or offer for sale of endangered plants and animals.

Additionally, under provisions of 50 CFR Parts 25 through 28, the Service provides some protection for the species on refuge lands. Approximately 13% of the 2008 Nebraska population of the species in 2008 occurred on refuge land (Crescent Lake NWR and Valentine NWR). There are no Wyoming populations located on refuge lands.

During the same time, 23% of the Nebraska population was on land administered by the USFS Bessey Ranger District (on the McKelvie National Forest near Valentine, Nebraska and the Nebraska National Forest near Halsey, Nebraska). Three times between 2006 and 2009, off-road vehicle users damaged blowout penstemon plants (1-5 individual plants) on USFS land in Nebraska. Since then, a 2010 travel management plan has been approved which designates certain roads, trails and areas open to motorized vehicle travel. Although the USFS does not have an approved management plan that outlines strategies to create or manage blowout penstemon habitat specifically, there is a concerted effort underway to develop a blowout penstemon strategic habitat conservation plan in coordination with state, private and federal partners to comply with ESA Section 7(a)(1). This plan is in draft form and is expected to be finalized in 2012 (Abagglen, pers. comm. 2011). The remainder of blowout penstemon populations (~60%) in Nebraska occur on privately owned land which receive no formal protection.

Populations of blowout penstemon that occur on Federal lands in Wyoming are managed by the Bureau of Land Management (BLM) Rawlins Field Office (Heidel 2007). The BLM Rawlins Office December 2008 Resource Management Plan contains 11 conservation measures that apply to areas containing blowout penstemon. These measures include new requirements applied to grazing permit renewals in allotments with known blowout penstemon (i.e., those related to stocking levels and placement of mineral or water sources). They also establish buffers (Area of Critical Environmental Concern or ACEC's)

around known blowout penstemon subpopulations (either 0.25 mile or 1 mile) to regulate biological control of noxious plant species, herbicide and pesticide application, revegetation projects, use of off-highway vehicles, drilling of oil and gas wells, surface disturbances on new oil and gas leases, sale and removal of minerals (including sand), rights-of-way projects (power lines, pipelines, roads, etc.), and other proposed projects. Occupied habitat in Wyoming, found primarily on BLM land, may be vulnerable to impacts from adjoining non-Federal lands (as discussed in Section 2.3.2.1 above). Approximately 50 acres out of 225 occupied acres occurs on state land, which is not afforded ACEC protection.

Removal of the species from Federal protection under the ESA would remove current Federal conservation mechanisms to protect and enhance these vulnerable populations. Habitat manipulation and other conservation actions on Federal land would likely decline as funds were shifted to protection and conservation of other resources. If the species was downlisted to threatened, management and research to benefit the species would still occur, but available funding may be used for species with higher conservation priority.

State and Laws and Regulations

NESCA is regulated by the Nebraska Game and Parks Commission and requires that the state assist in the protection of species of wildlife and wild plants which are determined to be threatened or endangered elsewhere pursuant to the Endangered Species Act by prohibiting the taking, possession, transportation, exportation from this state, processing, sale or offer for sale, or shipment within this state of such endangered species and by carefully regulating such activities with regard to such threatened species. Exceptions to such prohibitions, for the purpose of enhancing the conservation of such species, may be permitted as set forth in the Nongame and Endangered Species Conservation Act

Any species of wildlife or wild plants determined to be an endangered species under the ESA shall be an endangered species under NESCA and any species of wildlife or wild plants determined to be a threatened species under ESA are considered a threatened species under the NESCA. With respect to any endangered species of wild plants, it shall be unlawful, except as provided in subsection (7) of this section, for any person subject to the jurisdiction of this state to:

(a) Export any such species from this state;

(b) Possess, process, sell or offer for sale, deliver, carry, transport, or ship, by any means whatsoever, any such species; or

(c) Violate any regulation pertaining to such species or to any threatened species of wild plants listed pursuant to this section and promulgated by the commission pursuant to the act.

In determining whether any species of wildlife or wild plants is an endangered or threatened species, the commission shall take into consideration those actions being carried out by the federal government, by other states, by other agencies of this state or political subdivisions thereof, or by any other person which may affect the species under consideration. The State of Wyoming does not have a similar state threatened and endangered species protection or conservation law.

Local or Other Laws and Regulations

Roughly 60% of the blowout penstemon subpopulations occur on privately owned land in Nebraska. The ESA offers little protection on private lands. As noted above, NESCA provides some protections against take, possession sale, and export including on private property.

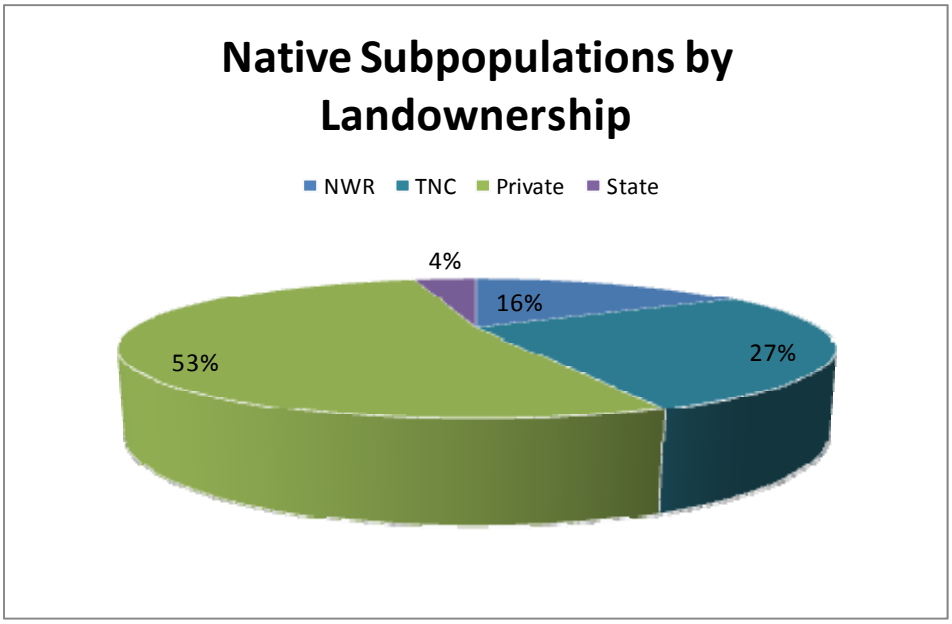


Figure 7. Native subpopulation occurrence in Nebraska based on landownership. (Source of data: Stubbendieck, (2008).

The Service is unaware of any type of legal instrument (e.g., deed restriction, wildlife extension agreement, conservation easement) with landowners that currently would promote protection or management of the subpopulations located on these privately-owned lands. In Wyoming, there are no blowout penstemon occurrences located on private land.

Existing regulatory mechanisms, secured through the ESA and

NESCA in Nebraska, have reduced some threats on Federal lands in both states. In the absence of the ESA's protective regulatory mechanisms, we believe threat level would increase dramatically.

#### 2.3.2.5 Other natural or manmade factors affecting its continued existence:

Several natural or manmade factors that affect the continued existence of the blowout penstemon were identified at the time the recovery plan was written and continue today. Human efforts to reduce fire (Bragg 1985) and implement range management practices in the sandhills (Stubbendieck et al. 1989) have reduced bare, blowing sand, confining blowout penstemon to isolated patches with little chance of dispersing to new blowout habitat (Stubbendieck and Kottas 2007, Nenneman, pers. comm. 2009). Inability to disperse to and germinate in new blowout habitat hampers genetic exchange and threatens isolated populations with extirpation. This is of particular concern in the relatively small blowouts in Nebraska.

Reintroduced blowout penstemon subpopulations in Nebraska tend to increase for several years when the plants are young and vigorous, and then decrease in numbers as the plants age and effects of rodent predation, insect herbivory or disease infections occur (Kottas, pers. comm. 2009). Depending on a variety or combination of factors, a population usually declines to a lower, cyclic level (Stubbendieck, pers. comm. 2009) or steadily declines to very low levels. Whichever the case, the subpopulation will eventually expire when the blowout in which it is located stops eroding and is invaded with secondary successional plants (i.e., with which blowout penstemon cannot compete).

The recovery plan identified the U.S. Department of Agriculture Animal and Plant Health Inspection Service's (USDA-APHIS) grasshopper suppression program as a potential threat to insect pollinators of the blowout penstemon. The suppression program has the potential to adversely affect pollinator species of blowout penstemon.

Native bees are facing unprecedented habitat loss, pesticide threats, and introduced diseases (NAS 2007). Flowers of the blowout penstemon cannot produce fruits and seeds unless they are visited by native bees carrying pollen from a flower on another plant. These native bees are species that nest both in the ground (some may be sand dune specialists) as well as others that nest in common reeds. (Tepedino 2006). Additionally pollination is limited by foraging distance of ground nesting bees.

Native bees are often more affected by pesticides than other insects, since they receive direct exposure to the nest, as well as exposure

while foraging for nectar and pollen (Delaplane and Mayer 2000). Most bee poisonings occur from contact between treated vegetation and the bee. Unlike managed honey bee hives, it is not possible to protect nest sites or prevent native bees from leaving their nests for foraging during or immediately after spraying operations.

Some potential effects of pollinator decline on rare plant species include genetic erosion, inbreeding depression, decreased reproductive success, and greater susceptibility to catastrophes and random changes in environmental conditions (Hegland et.al 2009).

In Wyoming, direct and indirect effects (e.g., the direct impact of roads built in an area and the indirect effect of those roads increasing accessibility of the area) of human activities has the potential to threaten the extant populations. These activities include but are not limited to wind energy development, oil and gas exploration and development, quarrying, and recreational use of ORVs. Occupied habitat area in Wyoming is particularly vulnerable because it has private and state-owned parcels located amidst where the blowout penstemon populations are and are not protected by provisions of the regulatory laws.

Given their localized range, endemic species like the blowout penstemon can be in peril from local catastrophes (Menges 1990). Weather conditions or prolonged drought in Wyoming in 2006 knocked off the rims of the blowouts in several areas, burying blowout penstemon plants below. This incident buried plants, and started new patterns of erosion and deposition that may account for short-term declines (Heidel, pers. comm. 2011).

**Climate Change**

Wind-deposited sand covers a large area of the Great Plains of North America, but has become stabilized by vegetation. Accounts published by early explorers, however, indicate that at least parts of dune fields in Nebraska, Colorado, Kansas, New Mexico, and Texas were active in the 19th century (Muhs and Holliday 1995). Based on an index of dune mobility and a regional tree-ring record, the probable causes for these periods of greater wind-depositied activity are droughts, accompanied by higher temperatures, which greatly lowered the precipitation-to-evapotranspiration ratio and diminished the cover of stabilizing vegetation (Muhs and Holliday 1995). Across the Northern and Central Great Plains, temperatures have risen more than 2 degrees F (1C) in the past century, with increases up to 5.5 degrees F (3C) in parts of Montana, North Dakota, and South Dakota (USGCRP 2009). Climate scenarios project that temperatures will continue to rise throughout the Great Plains Region, with the largest increases in the western parts of the Plains. The Canadian and Hadley climate models project moderate to severe increases in the Palmer Drought

Severity Index, and project increases in July heat index of 10 degrees F to 18 degrees F in areas occupied by the blowout penstemon (USGPRC 2009). Although precipitation increases are projected for parts of the Great Plains, an expected increase in evaporation rates due to rising air temperatures are projected to counteract these increases.

Outbreaks of insects (i.e.grasshoppers) could be amplified by warmer winters, because the cold temperatures associated with winter historically caused mortality sufficient to deter these eruptions. Natural systems in the Great Plains have evolved with high levels of climatic variability and have many built-in mechanisms that allow them to be somewhat resilient to climate change (USGCPR 2002). Such resiliency, however, depends on sufficient time for adaptation. If climate change occurs rapidly, natural systems may not be able to adapt at a rate that ensures their survival – leading to a loss in regional biodiversity and local extinctions (USGCPR 2002). The persistence of natural systems and population will depend on adequate time spans for recovery. If recovery spans are brief (e.g. due to increased frequency of extreme events), then the chances of local extinctions will increase.

Climate change could threaten the continued existence of the blowout penstemon in both Nebraska and Wyoming depending on various factors such as timing and duration of drought. Drought can also be associated with an increase in potential blowout penstemon habitat which initially may allow the species to inhabit new areas (Steinauer, pers. comm. 2011). A moisture event in the midst of a drought could allow germination without establishment. However, lack of precipitation at critical periods during growth would offset production (Kottas, pers. comm. 2009). Only robust blowout penstemon populations would likely disperse into expanded blowout habitats and attain viability during a long-term environmental change (drought) if all other factors remain favorable such as sufficient pollinators and invasive species control.

**Lack of education and outreach**

Another human induced threat may be from potential destruction of plants on private property where land owners may not understand their rights with regard to endangered plants. Additionally, threats on private land may occur where landowners do not have a clear concept of the blowout penstemon life cycle nor a full understanding about how to maintain it (Kottas, pers. comm. 2011). In Nebraska, range management on private land generally includes stabilizing dunes, increasing forage base for cattle, and spraying depredating insects, all of which create unfavorable conditions for the blowout penstemon.

Conclusions regarding the viability and long-term persistence of the blowout penstemon are based on the information collected from baseline census data and only 2-3 years of population dynamics research. We conclude that manmade factors currently, and

potentially affecting the blowout penstemon in the future, include rangeland vegetation stabilization, the potential of drought induced climate change, declining pollinator trends, and a potential lack of awareness on the part of private landowners.

## 2.4 Synthesis

The blowout penstemon was thought to be extinct from 1940 until it was rediscovered in 1968 in Nebraska (Stubbendieck et al. 1983). At the time of listing in 1987, blowout penstemon was known to exist in only six subpopulation centers in four counties in the Nebraska sandhills. Approximately 7000 plants occurred on less than 10 hectares (25 acres). As a primary invader and early successional plant, the blowout penstemon is not a competitive species therefore once secondary invasion of the blowout begins, the blowout penstemon disappears from the site. The species requires a substrate of eroding and shifting sand most often created and maintained by wind erosion. Historically, the use of continual summer grazing by landowners during the first half of this century caused enough disturbance to maintain many blowouts in Nebraska.

Improved range management practices, promote blowout healing, were a major cause of the species decline in Nebraska and is still the case today. Insects and periods of drought were once thought to be among the natural threats to the survival of this species. Wyoming populations were discovered in 1999, after completion of the recovery plan therefore, threats to the WY populations were not known nor addressed in the 1992 recovery plan.

For most of the last 20 years, blowout penstemon subpopulations in Nebraska have been enhanced by transplanting seedlings into previously unoccupied blowouts. This practice has increased both the overall number of plants and the number of blowout penstemon subpopulations (Stubbendieck et al. 2007). The rise in Nebraska subpopulation levels is the result of these substantial transplanting efforts, and an increased number of relatively young reintroduced subpopulations. Although the total number of plants exceeds that identified for downlisting the species to threatened, recent population modeling suggests that the criteria themselves are inadequate to project population viability of the species. The criteria of a minimum population level of 300 plants in a population group identified in the recovery plan has no effect on the projected viability of the population, whereas, habitat persistence and population growth rate do inform viability projections. It should also be noted also that most of the reintroduced plants have come from the seed of one subpopulation (Kottas, pers. comm. 2011).

Accurate, long-term data on the demographic ecology of this plant species is not extensive. Dispersal to new habitat in the Nebraska sandhills is hampered by isolation of relatively small, individual blowouts surrounded by grasslands managed for cattle forage or breeding grassland birds. There is little chance of the species migrating to new habitat (Kottas 2008, Stubbendieck and Kottas 2007). The size of individual areas of habitat have not diminished in Wyoming since 1999. Wyoming census data showed a peak in 2005 with subsequent reductions despite seemingly adequate rainfall in the inhabited areas, but the data is limited (Heidel 2009). In the Sandhills, careful range management, fire reduction, and natural succession have increased plant cover and reduced areas of

shifting sand, thereby fragmenting areas of blowing sand habitat required by the blowout penstemon (Stubbendieck et al. 1982). This fragmentation exacerbates the negative impact of disease, predation, habitat loss, potential wind development, and lack of adequate management on isolated subpopulations of endangered plants ultimately preventing the population stability required for recovery.

Whether reintroduced or native, without dispersal to new habitat, a blowout penstemon subpopulation will eventually be eliminated when the blowout in which it resides stops eroding and progresses to its secondary successional stage (i.e., heals over). Therefore, habitat management in Nebraska is needed to increase and maintain eroding blowouts, and carefully planned blowout penstemon reintroductions in the best available habitat should continue in Nebraska because the species is still not reproducing naturally at levels that will sustain it. Despite substantial increases in numbers of blowout penstemon plants in Nebraska, the species remains vulnerable to extinction due to several factors.

Genetic studies and morphologic differences between Wyoming and Nebraska populations raise questions regarding taxonomy of the Wyoming populations that need to be resolved in the near future. Regardless, Wyoming populations are threatened by direct and indirect habitat alterations from wind power development in Carbon County, as well as natural gas and mineral exploration and extraction.

Both Nebraska and Wyoming populations are threatened by ORV users because the habitat containing the species is very attractive for this form of recreation. The largest occupied habitat area in Wyoming is particularly vulnerable because it has private and state-owned parcels located throughout where the blowout penstemon population occurs and is not protected by provisions of the ESA.

Monitoring of native populations, which collectively contain the genetic diversity of the species, during the last decade has shown that sharp population declines can and do occur in native populations. In some cases, these declines occurred in response to changes in the rangeland management on private land, and in spite of several attempts at mechanical blowout habitat management on state or federal lands in other cases. In addition, populations of any endemic species can be in peril from local catastrophes (Menges 1990).

Blowout penstemon, in both Nebraska and Wyoming, may be vulnerable to long term changes in temperature and precipitation as a result from climate change. Projected higher temperatures and lower precipitation in the range of the species may impair recovery.

There are critical insufficiencies with the recovery criteria identified in the blowout penstemon recovery plan that confound our ability to evaluate the status of the species relative to extinction in all or a significant portion of its range.

Two main areas of concern continue to hamper recovery of the blowout penstemon: 1) Loss of blowout habitat due to stabilization of dunes and lack of habitat management in Nebraska; and 2) Lack of plans to guide habitat management at blowouts, and initiation of written agreements to implement such plans which can provide protections from disturbance.

## 3.0 RESULTS

**3.1** Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change is needed

**3.2 New Recovery Priority Number:** 11C

No change in recovery priority number is recommended at this time. Blowout penstemon is categorized as a species with a moderate degree of threat and a low recovery potential which is in conflict with construction or other development projects or other forms of economic activity. Our 1983 guidance describes a moderate threat level as one where the species will not face extinction if recovery is temporarily held off, although there is continual population decline or threat to its habitat. As described above, we believe this species meets this standard. The low recovery potential is related to the fact that threats extend throughout the range, are controversial, and cannot be solved by a single solution. The conflict qualifier especially for Nebraska is appropriate because of activities such as off-road vehicle use, livestock grazing, soil stabilization, and range management practices within the species' range.

## 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

**Administrative Actions**

- Revise the recovery plan for blowout penstemon to reflect the best scientific and commercial information available. The revised recovery plan should include objective, measurable criteria which address all listing factors and which, when met, will result in a determination that the species be downlisted and eventually removed from the Federal List of Endangered and Threatened Plants. Recovery criteria should include population growth rates over time (as opposed to simple minimum population levels), and documentation of populations dispersing to unoccupied habitat. The criteria should also address all threats impacting the species, and should be time referenced, as well as specific, measureable, achievable, and realistic. The recovery plans also should estimate the time required and the cost to carry out those measures needed to achieve the goal of downlisting to threatened as well as recovery and delisting. Therefore, a high priority should be placed on revising the blowout penstemon recovery plan to address its current inadequacies.

    - Pending resolution of the taxonomy of the Nebraska and Wyoming populations of the blowout penstemon (see Research subheading below), the revised recovery plan should be divided into two sub-sections that address the disparate status, habitat, threats and management strategies relevant to the Nebraska and Wyoming populations. The revised recovery plan should also define terms such as "population group" based on biological factors, and clearly discuss the role of seedling transplants in population monitoring and recovery of the species.

- Develop detailed guidance for blowout penstemon habitat management (mainly in Nebraska) for both privately owned land and Federal lands. Ensure implementation of plans to promote the long-term viability of individual populations.

- Develop improved protocols for collection of seed (i.e., for growing seedlings for transplantation) to increase genetic diversity in transplanted populations, and reduce or avoid negative impacts from pathogens and susceptibility of those pathogens in transplanted populations. Seed collection for rearing seedlings should be from a more diverse set of populations than at present to maintain increased genetic diversity.

- Develop improved protocols for reintroduction of plants, including defining measures used to identify success for reintroductions and how these measures relate to recovery.

- Establish recovery criteria that are based on population parameters that can predict population viability.

- Include criteria that are time referenced, realistic, and reflect all 5 listing factors.

**Threats Abatement**

- Investigate factors controlling longevity of blowout habitat and evaluate efficacy of different management treatments on maintenance and longevity of high-quality blowout penstemon habitat, ideally there would be a good management option to maintain existing blowouts without damaging existing plants.

- Determine the efficacy of measures implemented to reduce or eliminate human disturbance as a limiting factor to species' recovery. This includes the effects of USFS Travel Management Plan and management of ORVs on National Forests, and the efficacy of buffers established around populations on BLM land to protect the populations from disturbance.

- Investigate potential for habitat and population management easements on private land in Nebraska and state or private land in Wyoming.

**Research**

- Continue research regarding population life stage transitions for longer periods to better inform population viability analyses (in both Wyoming and Nebraska). This research should be conducted for at least a period longer than the life expectancy of individual blowout penstemon plants. Following individual plants within blowouts and sub-populations and through seed ecology research could shed light on determining the longevity and fecundity of individual plants.

- Determine mechanisms of habitat persistence i.e how long blowouts persist and the factors causing their healing and mechanisms for migration of plants to new habitat. Include an analysis of future habitat changes as a result of landuse alterations such as windfarm development and sodbusting.

- Investigate further the mechanisms of seed dispersal (wind, birds, mammals), and determine the role of insects and pathogens on population persistence (are there certain diseases or insects that move in during different stages of blowout decline or as a function of blowout size).

- Resolve questions regarding the genetic and taxonomic relationship between Wyoming and Nebraska populations of blowout penstemon. Taxonomic research and further evaluation of morphological character traits are warranted, including controlled greenhouse breeding experiments, common garden evaluations, and field documentation.

- Conduct and compile a literature review of all pertinent research for use in assessing gaps in information.

**Surveys and Monitoring**

- Identify landowners (and contacts), mainly in Nebraska, that may be interested in having blowout penstemon reintroduced on their property. These lands may be important in meeting population objectives, range-wide distribution, and to sustain populations.

- With adequate funding and support, conduct annual monitoring of both native and transplanted blowout penstemon populations across the species' range, both in Nebraska and Wyoming. Map population boundaries and delineate habitat.

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**U.S. FISH AND WILDLIFE SERVICE**
**5-YEAR REVIEW of Blowout Penstemon**

**Current Classification**: Endangered rangewide

**Recommendation resulting from the 5-Year Review**:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

**Review Conducted By**: Martha Tacha, Nebraska Ecological Services Field Office
Jeanine Lackey, Nebraska Ecological Services Field Office

**FIELD OFFICE APPROVAL**:

**Lead Field Supervisor, Fish and Wildlife Service**

Approve _____ Date 6/1/2012
Michael D. George
Field Supervisor, Nebraska Ecological Services Office