

STATUS REPORT ON
Penstemon gibbensii
IN SOUTH-CENTRAL WYOMING

Prepared for the Bureau of Land Management
Wyoming State Office and Rawlins District

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I. INTRODUCTION

In the early 1970s, Robert Gibbens, a graduate student in the Range Management Department of the University of Wyoming, collected an unusual Penstemon specimen from the badlands west of Baggs, Wyoming. Dr. Robert Dorn studied this specimen while preparing his "Manual of the Vascular Plants of Wyoming" (Dorn 1977) and tentatively assigned it to P. saxosorum. The original specimens were sent to a Penstemon specialist for identification and unfortunately were subsequently lost (Dorn 1989). Dorn resurveyed the Baggs area in 1981 and discovered additional specimens of Gibbens' unusual Penstemon. Comparative studies with related species revealed that these specimens belonged to a new, undescribed species which Dorn (1982) named P. gibbensii in honor of its discoverer.

Due to its limited range and apparently high threats, Penstemon gibbensii was designated as a Category 2 candidate for listing under the Endangered Species Act by the US Fish and Wildlife Service (USFWS) (1983). Under Bureau of Land Management (BLM) Manual 6840, the BLM is directed to manage USFWS candidate species in such a manner that these species and their habitats are conserved and to ensure that agency actions do not contribute to the need to list these species as Threatened or Endangered (Willoughby et al. 1992).

In 1995, the BLM Wyoming State Office and Rawlins District contracted on a cost-share basis with The Nature Conservancy's Wyoming Natural Diversity Database (WYNDD) to conduct field surveys for Penstemon gibbensii on public lands in south-central Wyoming. The objectives of this project were to collect information on the biology, distribution, habitat use, population size, and potential threats to this species to be used in guiding management decisions. In addition, existing monitoring transects were resurveyed and new transects were established to study demographic trends.

II. METHODS

Information on the habitat and distribution of Penstemon gibbensii was obtained from secondary sources, including WYNDD files and computer databases, Rocky Mountain Herbarium (RM) collections, the literature, and knowledgeable individuals. USGS topographic maps, geologic maps (Love and Christiansen 1985), and BLM land status maps were used to identify areas of potential habitat for ground survey.

Field surveys were conducted by the authors in mid July and mid-August 1995 (survey routes and collection sites are indicated in Appendix B). Data on biology, habitat, population size, and management needs were collected using WYNDD plant survey forms (Appendix C). Locations of occurrences were mapped on 7.5 minute

USGS topographic maps. If populations were sufficiently large, voucher specimens were collected for deposit at the RM and the Rawlins District herbarium. Color slides were taken of P. gibbensii plants and their habitats at each site. Information gathered in the field was entered into the computerized Element Occurrence database of WYNDD.

A set of three permanent monitoring transects was established at the Cherokee Basin, Wyoming site by the BLM in 1985 to study population trends and assess the response of P. gibbensii to the removal of large animal grazing (Warren 1992). An additional monitoring plot, following the protocol of Lesica (1987), was established at the Flat Top Mountain, Wyoming site in 1995 to study demographic trends. Three belt transects of 10, 20, and 25 meters were established, with each consisting of 20-50 contiguous 0.5 x 0.5 meter quadrats. Within each quadrat individual plants were mapped and assigned to one of two age classes: vegetative (non-reproductive) and reproductive (flowering or fruiting). The number of non-flowering, reproductive, and grazed stems per plant was also tallied. This technique generated quantitative data on population size, density, age distribution, and reproductive potential. Baseline data from these transects are included in Appendix D.

III. SPECIES INFORMATION

A. CLASSIFICATION

1. SCIENTIFIC NAME: Penstemon gibbensii Dorn (Dorn 1982).
2. SYNONYMS: None.
3. COMMON NAMES: Gibbens' beardtongue; Gibbens' penstemon.
4. FAMILY: Scrophulariaceae (Figwort family).
5. SIZE OF GENUS: The genus Penstemon contains approximately 250 species primarily restricted to western North America from Alaska to Guatemala (Cronquist et al. 1984). Thirty-seven species and five varieties occur in Wyoming (Dorn 1992).
6. PHYLOGENETIC RELATIONSHIPS: Dorn (1982) placed Penstemon gibbensii in section Glabri and noted its strong resemblance to P. cyananthus, P. fremontii, and P. saxosorum. P. gibbensii may be at least partly derived from P. fremontii, which grows in adjacent sagebrush habitats (Dorn 1989). O'Kane (1988) also has suggested a possible affinity between P. gibbensii and P. penlandii, a

Colorado endemic. Each known population of P. gibbensii exhibits slight morphological and habitat differences from other populations, suggesting that this species has been in existence for a long period of time (Dorn 1989).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. NATIONAL:

- a. LEGAL STATUS: Penstemon gibbensii has been listed as a USFWS Category 2 (C2) candidate since 1983 (US Fish and Wildlife Service 1983; 1993). Category 2 includes taxa for which there is current evidence of vulnerability, but for which USFWS lacks sufficient biological data to support a listing proposal. On 19 July 1995, USFWS revised its policy on candidate species and replaced the C2 designation with a new category "Species at Risk" (Davis 1995). Species in this new category are no longer considered formal candidates for listing. At present, no official Species at Risk list has been developed for Wyoming.

P. gibbensii has been recommended for state BLM Sensitive status by WYNDD (Fertig 1994).

- b. HERITAGE RANK: Ranked G1 in The Nature Conservancy's Natural Heritage Network system. Penstemon gibbensii is considered critically imperiled because of extreme rarity or other factors of its life history making it especially vulnerable to extinction range-wide.

2. STATE:

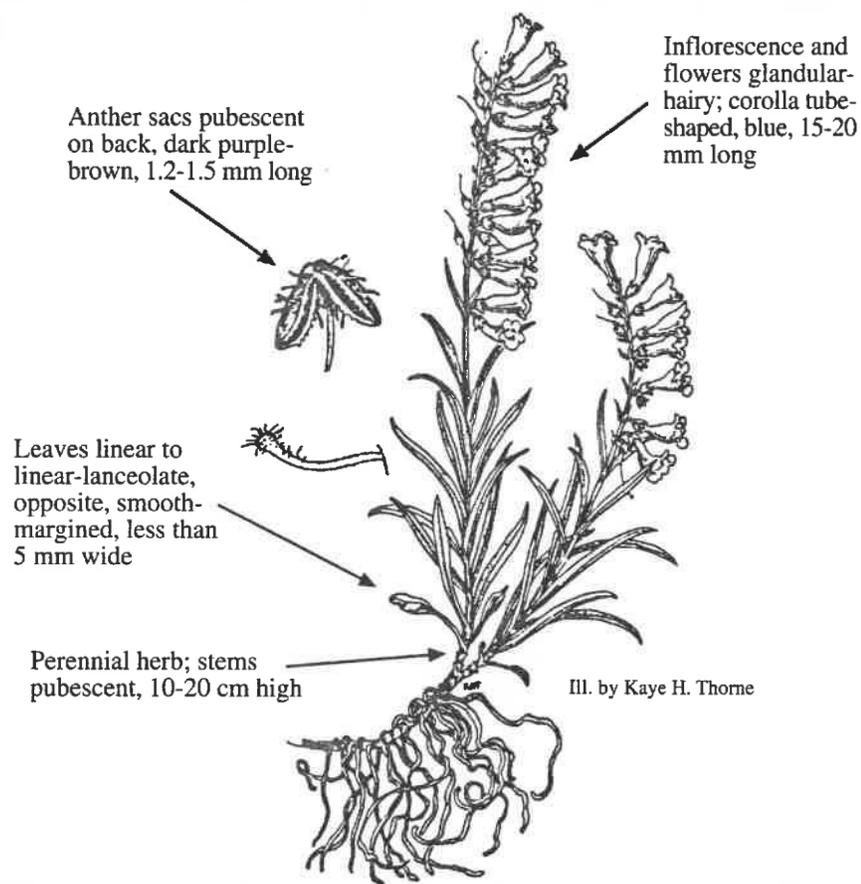
- a. LEGAL STATUS: This species is not protected by state government statutes in any of the states within its range.
- b. HERITAGE RANK: Penstemon gibbensii is ranked S1 in Wyoming and is considered critically imperiled because of extreme rarity (Fertig 1996). It is also ranked S1 in Colorado (Colorado Natural Heritage Program 1995) and Utah (Atwood et al. 1991).

C. DESCRIPTION

1. GENERAL NON-TECHNICAL DESCRIPTION: Penstemon gibbensii is a perennial herb with several to many erect, pubescent (rarely glabrous) stems 4-14 inches (10-35 cm) tall (Figures 1-2). The leaves are linear to linear-lanceolate and often folded down the length of the midrib, opposite, smooth-margined, pubescent to glabrate, and mostly less than 3/16 inches (5 mm) wide. The inflorescence and flowers (including the sepals) are glandular-hairy. The corolla is tube-shaped, bright blue, and 1/2-3/4 inches (15-20 mm) long. Anther sacs are short pubescent on the back, dark purple-brown and 1/16 inches (1.2-1.5 mm) long. Fruits are oval, tawny-brownish capsules (Dorn 1982, 1989, 1992; Atwood et al. 1991; Welsh et al. 1993; Fertig et al. 1994).
2. TECHNICAL DESCRIPTION: Perennial herb with stems several to many from root crown, 1-2 dm high, hairy usually to near base, rarely glabrous below inflorescence. Leaves opposite, entire, linear to linear-lanceolate or lance-linear, to 9 cm long, mostly 5 (8) mm or less wide, at least the lower mostly glabrous. Inflorescence glandular-hairy, sepals lanceolate, 4-8 mm long, corolla blue, 15-20 mm long, hairy inside and out, the inner hairs long and broad, the outer smaller and mostly glandular. Anthers hairy, dehiscent not quite to the base, staminode sparsely bearded at tip. Seeds 2-3 mm long (adapted from Dorn 1982, 1989).
3. LOCAL FIELD CHARACTERS: Penstemon gibbensii can be recognized by its pubescent stems, narrow and often folded leaves, glandular inflorescence, and hairy anthers.

Three distinctive and geographically restricted morphs of P. gibbensii can be recognized, based on differences in leaf width and degree of pubescence (Dorn 1989). Plants from Flat Top Mountain, Wyoming, tend to have wider and more glabrous leaves than individuals from other sites. Specimens from the Cherokee Basin and Sand Creek, Wyoming, typically have narrow, sparsely pubescent leaves, while Colorado-Utah plants have very narrow and extremely hairy leaves. The amount of morphological variability exhibited by P. gibbensii suggests that these populations have been reproductively isolated for a long period of time.

Figure 1. Line drawing of Penstemon gibbensii from Fertig et al. 1994. Illustration by Kaye H. Thorne.



4. SIMILAR SPECIES: Penstemon saxosorum has leaves over 5 mm wide and glabrous stems and sepals. P. fremontii and P. cyananthus have non-glandular inflorescences and wider leaves (Dorn 1982; Fertig et al. 1994). P. scariosus (an endemic of Utah and Colorado) has glabrous lower stems and leaves and typically has wider leaves and larger flowers (Dorn and Lichvar 1990).

D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: Penstemon gibbensii is a regional endemic of south-central Wyoming (Carbon and Sweetwater counties), northwest Colorado (Moffat County), and northeastern Utah (Daggett County) (Dorn 1989). In Wyoming, this species is restricted to the southern Washakie Basin north and west of Baggs. An additional population is found along the Colorado-Utah border in the Brown's Park area (Figure 3).
2. EXTANT SITES: Three populations of Penstemon gibbensii are currently known in Wyoming (Dorn 1989). The type locality, rediscovered by Dorn in 1981, is on a ridge on the north side of Cherokee Basin, approximately 2 miles north of the Wyoming-Colorado state line (Dorn 1982). The two other Wyoming occurrences on Sand Creek and Flat Top Mountain were discovered by Dorn in 1987 (Dorn 1989). All three of these populations were relocated and surveyed in 1995. A fourth, disjunct population was first located in the Brown's Park area of Colorado in 1978, but was not determined as P. gibbensii until after 1982 (Dorn 1989). This occurrence was found to extend into Utah in 1989 (Utah Natural Heritage Program records).

Previous reports of P. gibbensii from the Piceance Basin of Rio Blanco County, Colorado (O'Kane 1988) are based on misidentified specimens of P. fremontii var. glabrescens (Dorn and Lichvar 1990).

Figure 2 (page 7). Penstemon gibbensii in flower on sandy roadbank at east end of Cherokee Rim, Carbon County, Wyoming (EO # 002). WYNDD photograph by Walter Fertig, 11 July 1995.



Table 1. Location Information for Known Populations of Penstemon gibbensii.

A. Wyoming

Occurrence # 001

County: Sweetwater.

Legal Description: T12N R94W S10 (N2 of NW4 & NW4 of NW4 of NE4).

Latitude: 41° 01' 56" N (centrum).

Longitude: 107° 58' 04" W (centrum).

Elevation: 6500 ft (1980 m).

USGS 7.5' Quad: McPherson Springs.

Location: East-west trending ridge at northeast end of Cherokee Basin, ca 2.2 air miles north of the Colorado-Wyoming state line, ca 17 miles west of Baggs.

Occurrence # 002

County: Carbon.

Legal Description: T12N R93W S3 (E4 of SW4 & W2 of SE4), 4 (S2 of SW4, NE4 of SW4, & NW4 of SE4), 8 (NE4 of NE4 of NE4), and 9 (N2 of NW4).

Latitude: 41° 02' 10" N (centrum).

Longitude: 107° 51' 47" W (centrum).

Elevation: 6200-6260 ft (1890-1910 m).

USGS 7.5' Quads: McPherson Springs and Poison Basin.

Location: East end of Cherokee Rim on both sides of Sand Creek, ca 0.75 miles north of the Little Snake River, ca 2 miles north of the Colorado-Wyoming state line, ca 14 air miles west of Baggs.

Occurrence # 003

County: Carbon.

Legal Description: T14N R93W S3 (SE4 of SE4 of SW4) and 10 (NW4 of NE4).

Latitude: 41° 12' 20" N (centrum).

Longitude: 107° 50' 52" W (centrum).

Elevation: 7500-7700 ft (2285-2350 m).

USGS 7.5' Quad: Flat Top Mountain.

Location: West slope of Flat Top Mountain, ca 1 mile southwest of North Flat Top, ca 0.5 miles northwest of head of Robber's Gulch, ca 15 air miles north-northwest of Baggs.

B. Colorado/Utah

Occurrence # 004

County: Moffat (Colorado) and Daggett (Utah).

Legal Description: Colorado: T10N R102W S20 (SE4 of SW4), 8 (S2 of NE4), 9 (S2 of NW4), 10 (E4), and 11 (NW4 of NW4). Utah: T1N R25E S2 (NE4 of SW4 of SE4 & N2 of SE4 of SE4).

Latitude: 40° 50' 27" N (centrum).

Longitude: 108° 57' 23" W (centrum).

Elevation: 5500-5560 ft (1675-1695 m).

USGS 7.5' Quads: Lodore School (Colorado) and Swallow Canyon (Utah-Colorado).

Location: Brown's Park on the Utah-Colorado state line.

Exact locations of P. gibbensii populations are listed in Table 1. Element Occurrence Records and maps for Wyoming populations are provided in Appendix A.

3. HISTORICAL SITES: None known.
4. SITES WHERE PRESENT STATUS NOT KNOWN: None.
5. UNVERIFIED/UNDOCUMENTED REPORTS: None known.
6. AREAS SURVEYED BUT SPECIES NOT LOCATED: Surveys in 1995 focused on higher elevation, sparsely vegetated slopes in and around the badlands of the Washakie Basin. Unsuccessful surveys were conducted on the western flank of the Sierra Madre north of Baggs, the Powder Rim near Cherokee Basin, East and West Flat Top Mountains, The Haystacks, the Overland Trail corridor to Bitter Creek, the vicinity of Cooper Ridge south of Rock Springs, and Vermillion Creek on the Wyoming/Colorado border south of Rock Springs. Survey routes are shown in Appendix B.

E. HABITAT

1. ASSOCIATED VEGETATION: Penstemon gibbensii is found on barren shale or sandstone slopes and low ridges (Figure 4). Populations may be found in sparsely vegetated grasslands dominated by bluebunch wheatgrass (Elymus spicatus), Indian ricegrass (Oryzopsis hymenoides), and needle-and-thread (Stipa comata) with widely-scattered desert shrubs, including big sagebrush (Artemisia tridentata), shadscale saltbush (Atriplex confertifolia), and Utah juniper (Juniperus osteosperma) or in fringed sagebrush (Artemisia frigida)-thickspike wheatgrass (Elymus dasystachyum) communities. Total vegetative cover in P. gibbensii habitat ranges from 1-25%, but averages 5-10%.

Figure 4 (page 11). Habitat of Penstemon gibbensii on white shale-sandstone slopes of butte on north side of Cherokee Basin, Sweetwater County, Wyoming (EO # 001). This butte is the site of an 8 foot tall BLM monitoring enclosure, established in 1985. WYNDD photograph by Walter Fertig, 10 July 1995.



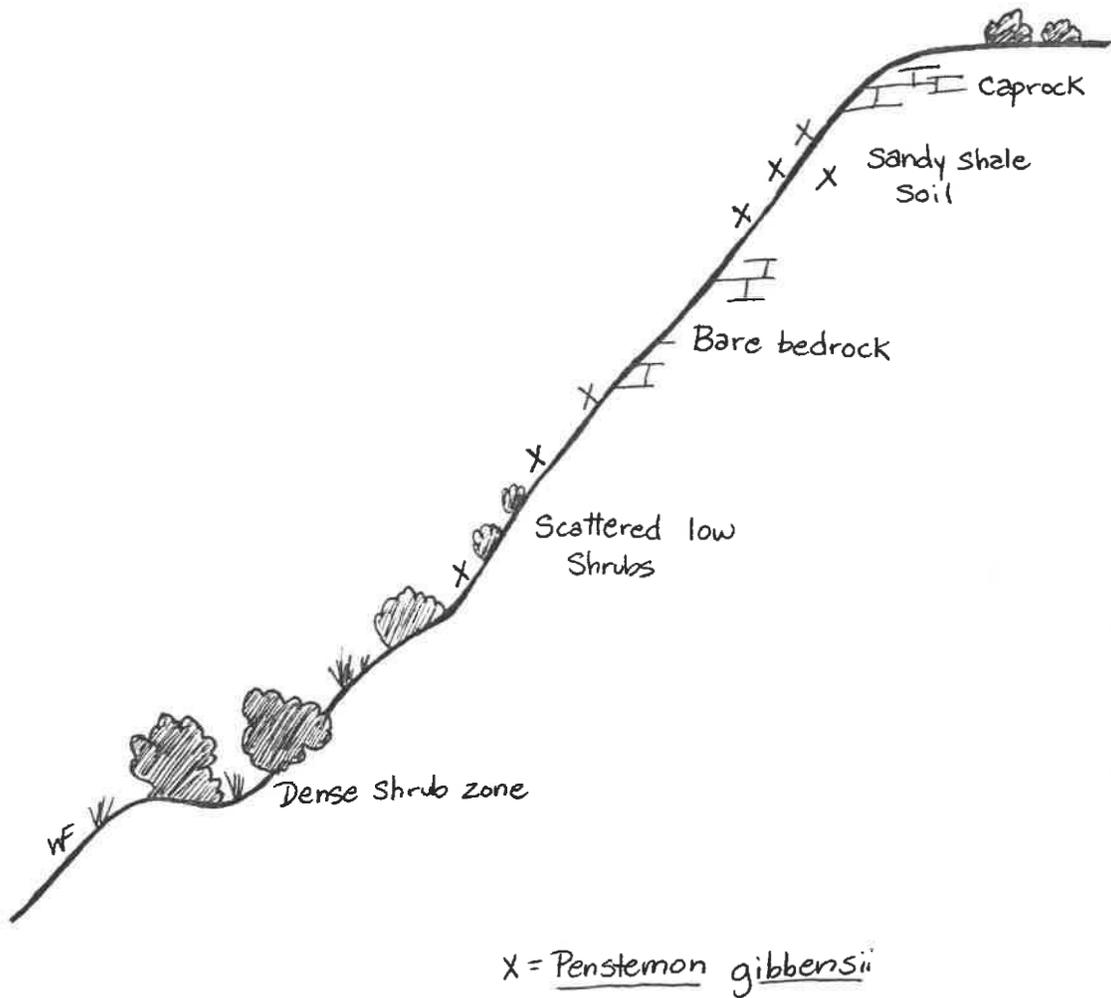
P. gibbensii is absent from red clay slopes and draws with high cover of saltbush (Atriplex sp.), rabbitbrush (Chrysothamnus sp.), and greasewood (Sarcobatus vermiculatus). It is also absent from desert grasslands in valley bottoms, gravelly ridgetops, and playa habitats.

2. FREQUENTLY ASSOCIATED SPECIES:

Arenaria eastwoodiae (Eastwood's sandwort)
Arenaria hookeri (Hooker's sandwort)
Artemisia frigida (Fringed sagebrush)
Artemisia tridentata var. wyomingensis (Wyoming big sagebrush)
Astragalus jejunus var. jejunus (Starveling milkvetch)
Astragalus spatulatus (Spoonleaf milkvetch)
Astragalus vexilliflexus (Bent-flowered milkvetch)
Chaenactis douglasii (Hoary chaenactis)
Chrysothamnus nauseosus (Rubber rabbitbrush)
Comandra umbellata (Bastard toadflax)
Cryptantha caespitosa (Caespitose cat's-eye)
Cryptantha flava (Yellow miner's candle)
Cymopterus terebinthinus (Turpentine cymopterus)
Elymus elymoides [Sitanion hystrix] (Squirreltail)
Elymus lanceolatus [Agropyron dasystachyum] (Thickspike wheatgrass)
Elymus spicatus [Agropyron spicatum] (Bluebunch wheatgrass)
Erigeron pulcherrimus (Basin daisy)
Eriogonum brevicaulis (Shortstem wild-buckwheat)
Gutierrezia sarothrae (Broom snakeweed)
Haplopappus nuttallii (Nuttall's goldenweed)
Leptodactylon pungens (Prickly-phlox)
Lupinus argenteus (Silvery lupine)
Oryzopsis hymenoides (Indian ricegrass)
Phacelia glandulosa (Glandular phacelia)
Purshia tridentata (Bitterbrush)
Stanleya pinnata (Bushy prince's-plume)
Stephanomeria runcinata (Runcinate-leaved skeletonweed)
Stipa comata (Needle-and-thread)
Thermopsis rhombifolia (Round-leaved golden-pea)
Zuckia brandegei (Western hop-sage)

3. TOPOGRAPHY: Penstemon gibbensii populations typically occur on south and west-facing slopes and gullies of 20-30 degrees (Figure 5). Plants may also be found on low ridges and roadsides of less than 5 degrees on all aspects. Known

Figure 5. Topographic Position of Penstemon gibbensii on the landscape. South-facing slope of Flat Top Mountain, Wyoming (EO # 003). Illustration by W. Fertig.



occurrences range in elevation from 6200-7700 feet (1890-2350 m) in Wyoming and 5500-5560 ft (1675-1700 m) in Colorado and Utah.

4. SOIL RELATIONSHIPS: Known occurrences of Penstemon gibbensii are restricted to exposed outcrops of shale or sandstone with thin, weakly developed soils. Populations from the type locality, Sand Creek, and Brown's Park are found on soils derived from the Miocene Brown's Park Formation (Dorn 1989). Soils from the type location and Sand Creek are primarily loose, yellowish sandy-clays formed from sandstones. These soils also appear to contain low to moderate quantities of selenium. At Brown's Park, soils are developed from white shales with a high clay content (Dorn 1989). The population on Flat Top Mountain is found on yellowish sandy-shale soils believed to be derived from the Laney Shale Member of the Eocene Green River Formation (Dorn 1989).

Colonies of P. gibbensii appear to be restricted to sites where a specific substrate is exposed and are usually absent from adjacent areas where surface soils differ in color, texture, or appearance. The high substrate specificity of this species may reflect adaptations to specific soil nutrient or drainage conditions.

5. REGIONAL CLIMATE: Average annual precipitation in the southern Washakie Basin of Wyoming is approximately 10 inches (254 mm) with peak levels in May and June (Martner 1986). Mean annual temperature is 40° F (4.4° C), with mean maximum and minimum temperatures in January of 31° and 4° F (- 0.5° and - 15.5°) and mean maximum and minimum temperatures in July of 84° and 48° F (28.8° and 8.8° C) (Martner 1986).

In the Brown's Park area of Colorado and Utah, average annual precipitation is about 16 inches (406 mm). Annual, January, and July temperatures are slightly higher than in Wyoming (Dorn 1989).

6. LOCAL MICROCLIMATE: Penstemon gibbensii usually occurs on south and west-facing upper slopes, facing the prevailing wind. Evaporation from reflected solar radiation and wind may make these sites drier than regional climate data would indicate. Warren (1992) reports 10 years of rain gauge measurements from the vicinity of Cherokee Basin (near WY EOs 001 and 002) and found average

annual precipitation to be 8.3-8.9 inches (210-226 mm), slightly lower than the long-term regional average.

F. POPULATION BIOLOGY AND DEMOGRAPHY

1. PHENOLOGY: Flowering typically occurs from early June to late July, depending on summer moisture conditions. In 1995, some flowers were still present on Flat Top Mountain in late August. Dorn (1989) observed flowering as late as 23 September following late season rains. Fruits are produced several weeks after flowering, from June to September.
2. POPULATION SIZE AND CONDITION: There are currently three known populations of Penstemon gibbensii in Wyoming and a fourth along the Colorado-Utah state line. These occurrences range in area from 12-35 acres. The entire known range of this species covers approximately 100 acres (Dorn 1989).

Dorn (1989) surveyed the three known Wyoming occurrences in 1989 and estimated the entire state population to consist of approximately 2800 individuals. Each of these populations was resurveyed in 1995 and found to be stable or to have increased. Based on 1995 results, the total Wyoming population is currently estimated to be 3900-4200 individuals. Range-wide, the population is estimated to be 8600-8900 plants.

Preliminary trend data suggest that Wyoming populations of P. gibbensii are stable to increasing. The population from Cherokee Basin (EO # 001) has increased from an estimated 500 plants in 1982 (Whiskey Basin Consultants 1982) to over 1000 in 1995. Studies by Warren (1992) indicate that this population may even be larger, approaching 2800 individuals. The Sand Creek population (EO # 002) appears to have remained stable since 1989. Surveys in 1995 suggest that the Flat Top Mountain population (EO # 003) has increased from approximately 300 individuals in 1989 to well over 1000 (Dorn 1989). Trend data are not available from the Colorado-Utah population.

Surveys in 1995 found that 30-40% of all mature plants produced flowers or fruit. Previous studies have shown that seedling individuals can account for 21-50% of all plants (Warren 1992).

Seedlings were not observed to be abundant in 1995, possibly as a result of drought conditions in 1994 and dry summer conditions in 1995. Uneven seedling establishment and survival may account for short-term population fluctuations in this species.

P. gibbensii populations exhibit a random distribution characterized by widely scattered clumps of 1-6 individual plants. Based on 1995 demographic studies, densities may range from 3.2-5.6 plants per square meter in favorable upper slope sites with well developed soils. More often, individuals may be more than a meter apart and large areas of habitat may be devoid of any vegetation (Dorn 1989).

Demographic data collected in 1995 are summarized in Table 2 and Appendix D.

3. REPRODUCTIVE BIOLOGY

- a. TYPE OF REPRODUCTION: Penstemon gibbensii is a perennial that reproduces by seed (Dorn 1989). Flowering appears to be influenced strongly by summer moisture availability and plant size. At the Flat Top Mountain site, flowering individuals often possessed as many as 10 stems per plant, compared with 2-3 stems for vegetative plants. There is no evidence of vegetative reproduction in this species.
- b. POLLINATION BIOLOGY: Based on flower color and shape, P. gibbensii is probably insect pollinated, but the specific pollinator is not known.
- c. SEED DISPERSAL AND BIOLOGY: Seeds are probably dispersed primarily by gravity or wind and deposited near the parent plant. Depending on topography, seeds may also be dispersed downslope and downwind of existing plants. Germination requirements are poorly understood, but scarification of the seed coat may be necessary for germination (Carol Dawson, Denver Botanical Garden, personal communication). Seedling establishment is probably episodic and dependent on rare years of adequate summer moisture. Mature plants

Table 2. Demographic Information for Wyoming Populations of Penstemon gibbensii.

Note: For additional information, see Appendix B.

Occurrence # 001

Area: 15 acres.

Number and Age of Plants: 257 reproductive and vegetative plants were observed during a walk-through survey of the BLM enclosure and adjacent area in 1995. Only ca 25% of the area was sampled due to concerns about trampling the plants. The total population was estimated at 1000 individuals.

Density: Not measured in 1995. Previous studies by Warren (1992) have recorded densities ranging from 0.013-0.030 mature plants per square foot within the BLM enclosure. Plants exhibit a clumped to dispersed distribution pattern.

Evidence of Reproduction: Mature plants observed in flower and fruit in 1995, but relatively few seedlings noted in surveys in early July.

Population Trends: When first surveyed in 1982, this population was estimated to contain 500 individuals (Whiskey Basin Consultants 1982). Follow-up surveys in 1985 and 1989 found approximately the same number (Dorn 1989; Warren 1992). Studies by Warren (1992) in 1988 and 1991 found the population to contain an estimated 1400-2766 plants (including seedlings). Lower numbers in 1995 may be the result of a small decline since 1991 or reflect the low number of seedlings established in the past few years.

Occurrence # 002

Area: 35 acres.

Number and Age of Plants: Total population estimated at 1900-2000 plants in 1995 in four large subpopulations. 30-40% of all mature plants observed in flower or fruit.

Density: Plants widely scattered and distributed in a semi-clumped, non-random pattern.

Evidence of Reproduction: Mature plants observed in flower and fruit in 1995. Very few seedlings observed in early July.

Population Trends: This population has been known since 1987. When surveyed in 1989, it was found to consist of 5 main subpopulations (a total of 8 colonies) with a total population estimated at 2000 plants (Dorn 1989). One of these subpopulations could not be relocated in 1995, but was observed in 1994. Total population size appears to be stable from 1989-1995.

Occurrence # 003

Area: 12 acres.

Number and Age of Plants: Population estimated at 1000-1200 plants in 1995. Approximately 50% of all plants were in flower or fruit in early July, while only 10-15% were in flower or fruit in mid-August.

Density: Density ranged from 3.2-5.6 plants per square meter in favorable habitats. Plants non-randomly distributed, often in clumps of 2-6 plants.

Evidence of Reproduction: Plants observed in flower and fruit in 1995. Very few seedlings observed.

Population Trends: This occurrence has been known since 1987. Dorn (1989) estimated the population to contain 300 individuals in 1989. Based on 1995 estimates, this population has tripled in size since then.

are often found at the edge of small shrubs at the Cherokee Basin site, suggesting that seedling establishment may be enhanced by "nurse plants."

G. POPULATION ECOLOGY

1. GENERAL SUMMARY: Penstemon gibbensii is restricted to bare, sandy-shale slopes and sparsely vegetated ridgetops with poorly developed soils. At several sites on the west side of Sand Creek (EO # 002) it appears to be capable of colonizing disturbed, bare ground along roadsides, although only in areas where a suitable substrate has been exposed. Populations tend to be relatively small and composed of widely scattered clumps of 1-6 plants. Flowering appears to be dependent on adequate moisture conditions (Dorn 1989). Population expansion may be restricted by the availability of specific soil types, episodic climatic conditions favoring seedling establishment, and the degree of herbivory.
2. COMPETITION: This species is restricted to sparsely vegetated sites with large areas of bare soil where competition with other plant species is minimal. It is almost always absent from adjacent areas with high graminoid or shrub cover.
3. HERBIVORY: Penstemon gibbensii is relatively succulent and appears to be grazed by mule deer, pronghorn, cattle, and other herbivores during late summer when other green vegetation is sparse (Whiskey Basin Consultants 1982; Dorn 1989; Warren 1992). Based on observations in 1995, this herbivory appears to be restricted almost entirely to inflorescences.
4. HYBRIDIZATION: No direct evidence of hybridization has been observed in the field. The closely related Penstemon fremontii occurs in the vicinity of P. gibbensii at the Cherokee Basin and Sand Creek sites, but appears to be reproductively isolated by ecological and temporal barriers.

H. LAND OWNERSHIP

1. BUREAU OF LAND MANAGEMENT: All known Wyoming occurrences are found partly or entirely on lands managed by the BLM Rawlins District, Great Divide Resource Area. A portion of the Brown's Park population is found on lands managed by the BLM

Craig District, Little Snake Resource Area
(Colorado Natural Heritage Program records).

2. US FISH AND WILDLIFE SERVICE: A portion of the Brown's Park occurrence in Colorado is within the Brown's Park National Wildlife Refuge (Dorn 1989).
3. STATE: A small portion of the Sand Creek, Wyoming, population is found on state lands (T12N R93W S9 NE4 of NW4 and NW4 of NE4). Although originally reported from private lands (Dorn 1989), the Utah portion of the Brown's Park population is found on state owned lands (Utah Natural Heritage Program records).

IV. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

- A. POTENTIAL THREATS TO CURRENTLY KNOWN POPULATIONS: The restricted and specialized habitat of Penstemon gibbensii makes this species vulnerable to habitat degradation and loss. The following potential threats were identified during field surveys in 1995 or have been reported in the literature:

1. GRAZING: Summer grazing by livestock and large native ungulates (mostly mule deer) has been cited as the primary threat to Penstemon gibbensii (Whiskey Basin Consultants 1982). Surveys in 1995 found that most herbivory was restricted to flowering stems. This reduction in reproductive output could have a significant negative impact on seed production, seed bank replenishment, and long-term viability of this species.

Livestock use of P. gibbensii habitat may be less than previously reported, however, due to the low amount of available forage and absence of water at known occurrences. Steep slopes and loose footing may also protect these plants from high levels of cattle grazing. Winter use by sheep does not appear to be a concern at the Cherokee Basin site (Warren 1992).

Exclosure studies have documented an increase in P. gibbensii numbers in the past decade since livestock grazing has been removed and deer numbers have been low at the Cherokee Basin population (EO # 001) (Warren 1992).

2. MINERAL DEVELOPMENT: Dorn (1989) listed oil and gas exploration as a potential threat to P. gibbensii populations, but noted that activity was

"minimal" at that time. Since 1989, exploration activity has increased greatly throughout the Washakie Basin of Wyoming. Most sites occupied by P. gibbensii are on technically unstable slopes that are unlikely to be developed for access roads, pipeline routes, or well pad sites. Flatter terrain, such as that in the Sand Creek area (EO # 002), however, has already been extensively developed as a gas field, with additional exploration proposed by Meridian Oil Company of Colorado in 1995. Further development of this field should be carefully planned to minimize additional, unnecessary disturbance to this occurrence. Seismic exploration utilizing explosives or trampling by vehicles transporting testing equipment should be excluded from occupied or high-potential P. gibbensii habitat.

3. RECREATION: Trampling by off-road vehicles may result in direct mortality of plants and lead to soil erosion. Although plants may colonize disturbed areas on road margins, they are not able to become established within roadbeds that receive active vehicle use. Construction of additional roads (planned or unplanned) should be discouraged within P. gibbensii habitat. Some existing roads (such as those on Flat Top Mountain) should be closed or re-routed (when possible) to minimize trampling impacts.

Trampling by botanists and others studying P. gibbensii is also a potential threat, especially in areas with steep, loose soils. Visitation of occupied habitat should be kept to a minimum to prevent excessive erosion.

- B. MANAGEMENT PRACTICES AND RESPONSE: An 8 foot high wire mesh enclosure was established by the BLM in 1985 to enclose 80% of the occupied habitat of Penstemon gibbensii at the Cherokee Basin site (EO # 001). A smaller, 3-strand barbed wire enclosure covering 15% of the habitat and an unfenced area covering the remaining 5% of the site were also constructed. Studies since 1985 have documented an upward trend in P. gibbensii populations within all three study plots, with the greatest numerical increase coming in the fenced sites (Warren 1992). This increase may be attributed to the reduction in grazing by native ungulates and livestock. It remains to be determined, however, if this decrease in grazing intensity is the result of exclusion of grazers or due to lower stocking rates, elimination of water sources for livestock and native ungulates, or

naturally low deer populations over the last decade (Warren 1992).

C. CONSERVATION RECOMMENDATIONS

1. RECOMMENDATIONS REGARDING PRESENT OR ANTICIPATED ACTIVITIES: Whiskey Basin Consultants (1982) recommended fencing the Cherokee Basin population to protect Penstemon gibbensii from the impacts of grazing. Based on the upward trend of this species since this enclosure was built, this fence should remain in place (Warren 1992). Additional fencing may be desirable for the Flat Top Mountain population if mule deer herbivory becomes too great of a threat. All populations should be protected from unnecessary disturbance associated with oil and gas exploration and development. Roads through occupied habitat should be closed or re-routed if use by recreational vehicles becomes too great of a threat through trampling or accelerated erosion.
2. NOTIFICATION OF BLM PERSONNEL OF LOCATIONS ON BLM LANDS: To prevent inadvertent impacts to known populations, all appropriate BLM personnel involved in planning and on-the-ground land management activities should be provided with location data for Penstemon gibbensii. It is especially important that BLM minerals, engineering, and range staff know precise locations so that disturbances can be avoided.
3. AREAS RECOMMENDED FOR PROTECTION: Ten acres of habitat encompassing the Cherokee Basin population (EO # 001) was proposed for designation as an Area of Critical Environmental Concern (ACEC) in the draft Great Divide Resource Area Resource Management Plan (RMP) (USDI Bureau of Land Management 1988). This ACEC was not designated, however, in the final Record of Decision for the RMP (USDI Bureau of Land Management 1990). ACEC designation is still desirable for this site and for Penstemon gibbensii habitat on Flat Top Mountain to formalize existing management actions on behalf of this species.

- D. STATUS RECOMMENDATIONS: Penstemon gibbensii should continue to be recognized as a "Species at Risk" by the USFWS throughout its range. Although not threatened at present, the small population size and limited global distribution of this species make it highly vulnerable to extinction if major changes were to take place in

current management practices. The BLM Wyoming State Office should list P. gibbensii as a state Sensitive species and develop appropriate strategies to ensure that agency actions do not contribute to the further endangerment of the species and the subsequent need for listing under the Endangered Species Act.

- E. SUMMARY: Penstemon gibbensii is a regional endemic of the southern Washakie Basin of Wyoming and the Brown's Park area along the Colorado-Utah border. It is currently known from only four locations range-wide, three of which are within the BLM Rawlins District in Wyoming. The Wyoming occurrences occupy a total area of less than 70 acres. P. gibbensii is restricted to steep, barren slopes and ridgetops of loose, sandy-shale derived from Brown's Park and Green River formations. Vegetative cover is typically less than 10% and consists primarily of scattered bunchgrasses and low desert shrubs. Populations consist of widely scattered, sparse clusters of 2-6 plants. The total Wyoming population was estimated at 3900-4200 individuals in 1995, an increase from approximately 2800 plants in 1989. Despite the increase, this species remains threatened by grazing (mostly from mule deer), disturbances associated with oil and gas development, and trampling by recreational vehicles. ACEC designation is recommended for two of the three known sites. Protection within fenced exclosures is also recommended for these sites. P. gibbensii should continue to be recognized by USFWS as a Species at Risk and should be designated as Sensitive by the BLM Wyoming State Office.

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