Status of Cary Beardtongue (*Penstemon caryi*) in Wyoming

Penstemon caryi by Linda Shoemaker (from Fertig et al. 1994)

Prepared for the
Bureau of Land Management Wyoming State Office
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University of Wyoming

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Abstract

Cary beardtongue (*Penstemon caryi*) is a regional endemic restricted to the Bighorn and Pryor mountains of north-central Wyoming and adjacent south-central Montana. This species is found primarily in sparsely vegetated openings within Big sagebrush, Utah Juniper, Rocky Mountain juniper, or Ponderosa pine meadows on outcrops of calcareous bedrock or on semi-disturbed limey-clay or talus slopes on soils derived from the Bighorn Dolomite, Madison Limestone, Tensleep Sandstone or Amsden formations. Cary beardtongue is currently known from 22 occurrences in Wyoming, of which 10 have been discovered since 1999. These populations consist of at least 63 discrete subpopulations that are isolated by barriers to pollen or seed dispersal. Individual subpopulations are typically small, consisting of 20-1000 plants. Based on surveys of 17 occurrences from 1999-2001, the total state population is currently estimated at 19,600-22,300. An additional 21 extant populations (consisting of 35 subpopulations) are known from Montana and contain a minimum of 2000-4550 individuals. Although trend data are lacking for most occurrences, populations are probably stable to slightly increasing in both states. Density may be as high as 4.5-6.6 plants per square meter, but individual clumps are usually widely scattered and limited to small patches of suitable habitat. Over 90% of Wyoming populations occur on public lands and at least 5 occurrences are protected in the Shell Canyon RNA, Little Mountain ACEC, Spanish Point Karst ACEC, TNC Tensleep Preserve, and Renner Wildlife Habitat Management Unit. This species is potentially threatened by loss of habitat to road construction, quarrying, and livestock grazing and trampling, or by over-collection for garden use, although these threats are probably less significant at most sites than once thought. *P. caryi* is currently listed as Sensitive by the US Forest Service and BLM and was formerly a Category 2 candidate for potential listing under the Endangered Species Act. The results of recent studies in Wyoming and Montana suggest that this species is more widespread and less imminently threatened by human activities than once suspected, and probably does not warrant significant attention under present management conditions. Due to its limited range, however, *P. caryi* remains vulnerable to large-scale changes in habitat quality and periodic monitoring will still be needed to detect significant downward trends.

Acknowledgements

I would like to thank the following individuals for their contributions to this project: Laura Welp of WYNDD assisted with field surveys and conducted monitoring in 2000; Andrew Lutz, a graduate student from Ohio State University, shared information from 4 Wyoming populations he visited in 2000 as part of an on-going population genetics study; Ann Humphrey and Phil Shephard of The Nature Conservancy's Ten Sleep Preserve provided survey and monitoring data from colonies at the preserve; Margaret Beer and Bonnie Heidel provided occurrence information from Montana; Rob Thurston of WYNDD assisted with development of a predictive model for this species (Appendix D); Scott Laursen of WYNDD assisted with digitizing distribution maps; Bernie Bornong of Bighorn National Forest shared information from field surveys conducted by Forest Service personnel (Kevin O'Dea, Tucker Galloway, and Nathan Gross) in 1999-2000, Claire Leon and Jean Daly shared information from their visit to Occurrence #027 in June 2001 following the annual field trip of the Wyoming Native Plant Society, and Jeff Carroll of the Wyoming BLM State Office provided funding for the project.

Table of Contents

Figures, Tables, and Appendices

INTRODUCTION

Cary beardtongue was first recognized as a distinct species by Francis Pennell in 1920, based on a specimen collected ten years earlier by naturalist Merritt Cary on the west slope of the Bighorn Range in Big Horn County, Wyoming (Pennell 1920). During the next 55 years, *Penstemon caryi* was collected only 5 additional times in Wyoming, prompting the Smithsonian Institution to recommend this species for listing as Threatened under the Endangered Species Act in 1975 (Ayensu and DeFilipps 1978). Although not listed at that time, Cary beardtongue remained a Category 2 candidate for listing from 1980-1996 and was designated as Sensitive by the US Forest Service and the Bureau of Land Management (BLM) Wyoming State Office.

Since 1976, Cary beardtongue has been documented at over twenty new localities in the Bighorn and Pryor Mountains of Wyoming and Montana (Fertig 1999 a). Information from recent Wyoming surveys has not been formally summarized since Clark and Dorn (1979). To better assess the status and potential management needs of this species, the BLM Wyoming State Office contracted with the University of Wyoming and Wyoming Natural Diversity Database (WYNDD) in 2000 to conduct field surveys for Cary beardtongue on public lands in the Bighorn Range and adjacent foothills. The following report summarizes the results of this study and contains information on the biology, distribution, habitat, population size, potential threats, and management needs of *P. caryi* in Wyoming.

METHODS

Information on the taxonomy, distribution, habitat, and life history of Cary beardtongue was obtained from scientific literature, unpublished reports, specimens from the Rocky Mountain Herbarium (RM), knowledgeable individuals, and field surveys conducted by WYNDD staff in 2000-2001. 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 Laura Welp and Walter Fertig of WYNDD in June-July 1999, June-July 2000 and June-July 2001 (survey routes are shown in Appendix B). Data on habitat, reproduction, phenology, and associated species were collected using WYNDD plant survey forms. Locations of occurrences were mapped on 7.5 minute USGS topographic maps and digitized as an Arc-View theme. Voucher specimens were collected for deposit at the RM. Information gathered in the field was entered into the computerized Element Occurrence database of WYNDD.

Three permanent demographic monitoring plots were established following the protocol of Lesica (1987). These transects consisted of a single belt 0.5 meters x 30-50 meters long, subdivided into 0.5 x 1 meter plots. Within each plot, individual plants were counted and assigned to one of four age classes: seedling, vegetative (non-reproductive), reproductive, and dead. This technique was designed to gauge population density and assess population change over time. Data from these transects are included in Appendix C.

Rob Thurston of WYNDD and I developed a potential habitat model for *Penstemon caryi* (Appendix D) using Classification Tree Analysis and GIS (Fertig 1999 b, 2002 in ed.). Based on location information from WYNDD, the Montana Natural Heritage Program, and RM, we used 27 known locations of *P. caryi* in Montana and Wyoming to construct the model and 8 known

locations from Wyoming for independent validation. An additional 865 "absent points" (locations where this species has not been documented despite recent, intensive field sampling) were selected from the RM's database of Wyoming collection sites for model building and 182 absent points were selected for validating the final model. Environmental attributes for each present and absent point were derived from digital coverages in ArcView version 3.1. Selected environmental variables included elevation, mean January, April, July, and October precipitation and temperature (Daly et al. 1994), average maximum June, July, and August temperature, average minimum April, May, and June temperature (Daly et al. 1997), Gap land cover (Driese et al. 1997), bedrock geology (Love and Christiansen 1985), and STATSCO soil order and suborder (US Department of Agriculture 1994). Using presence/absence as the response variable and a pruning algorithm to eliminate terminal nodes capturing fewer than 4% of possible points, we created a simple classification tree model in S-Plus version 1.1 that identified two possible combinations of variables leading to predicted presence of this species. In Arc-View, we then intersected the predicted variables to create a map of potential habitat in Wyoming (Appendix D). The validation data set was compared to this final map to determine the classification success rate.

SPECIES INFORMATION

Classification:

Scientific Name: *Penstemon caryi* Pennell (Pennell 1920). Holotype: USA: Wyoming, Big Horn County, "Big Horn Mountains, alt. 8000 ft.", 4 June 1910, *Cary 504* (US). Based on Cary's original field notes in the Bureau of Biological Survey archives, the type locality is located somewhere between Cary's camp "... at a Sulphur Spring 8 miles north of Hyattville" on 3 June 1910 and his "permanent camp on Trapper's Creek ... reached the night of June 4." (Payson 1924).

Common Name: Cary beardtongue, Cary penstemon.

Family: Scrophulariaceae (Figwort family).

Synonyms: None.

Phylogenetic Relationships: The genus *Penstemon* contains nearly 250 species centered primarily in western North America (Cronquist et al. 1984). Cary beardtongue belongs to section *Glabri* (Pennell 1920), a group characterized by blue to violet corollas and glabrous to pubescent anther sacs that dehisce from their outer tips towards the connective (Cronquist et al. 1984). Wyoming taxa in Section *Glabri* include *Penstemon cyananthus, P. cyaneus P. fremontii, P. gibbensii, P. paysoniorum, P. saxosorum, P. scariosus,* and *P. strictus.* Payson (1924) noted the similarity of *P. caryi* with specimens from Lincoln and Uinta counties, Wyoming, which were later named as *P. paysoniorum* by Keck (1947). The evolutionary relationships of *P. caryi* and other taxa within Section *Glabri* is currently being investigated using modern genetic techniques by Dr. Andrea Wolfe and her students (particularly Andrew Lutz) at Ohio State University.

Legal Status: Cary's beardtongue was formerly a Category 2 (C2) Candidate for listing under the Endangered Species Act (US Fish and Wildlife Service 1993). The C2 list included species that might have warranted listing as Threatened or Endangered, but for which the USFWS lacked

sufficient biological data to support a listing proposal. The C2 program was eliminated by the USFWS in 1996 (US Fish and Wildlife Service 1996). *Penstemon caryi* was listed as Sensitive by US Forest Service Region 2 in 1993 and by the BLM Wyoming State Office in April 2001.

Natural Heritage Rank: NatureServe (formerly the heritage division of The Nature Conservancy) and the network of natural heritage programs gives *Penstemon caryi* a rank of G3, indicating that the species is "rare or local throughout its range or found locally in a restricted range" and usually known from 21-100 extant occurrences. In Wyoming, this species is ranked S2 and considered "imperiled because of rarity or because of other factors demonstrably making [it] vulnerable to extinction" (Fertig and Beauvais 1999). Montana ranks this species as S3, indicating that it is "rare or local" within its limited range in the state and considers it a "species of potential concern" (Montana Natural Heritage Program 2001). In light of recent surveys, the rank of *P. caryi* in Wyoming should probably be changed to S3.

Description: Cary beardtongue is a glabrous perennial herb with flowering stems 10-40 cm tall (Figures 1-2). Leaf blades are narrowly linear to lance-shaped, entire, opposite, and 2-12 cm long (with the longest leaves at the base of the stem). Flowers have long-tipped sepals 6-11 mm long and a blue (rarely pink), tubular corolla 20-38 mm long. The flowers and inflorescence are usually glabrous, although occasional specimens have sparsely glandular pubescence. Anthers are straw-colored with numerous long, tangled white hairs on the back. The sterile stamen (staminode) is glabrous or bearded at the tip. Fruits are dry capsules (Clark and Dorn 1979; Dorn 2001; Fertig et al. 1994; Marriott and Jones 1989; Pennell 1920).

Figure 1 (right). Line drawing of Penstemon caryi *by Linda Shoemaker (Fertig et al. 1994).*

Figure 2 (right). Close-up of flowers of Penstemon caryi. *Photograph by Jennifer Whipple.*

Robert Dorn (personal communication) has observed a "small form" of *P. caryi* from the western foothills of the Bighorn Range near Hyattville that differs in having shorter stems (17-22 cm tall), narrower leaves, and corollas 16-19 mm long. These populations (Element Occurrence # 005) are probably not worthy of taxonomic recognition as a new variety or species, but could represent a distinct and localized genotype.

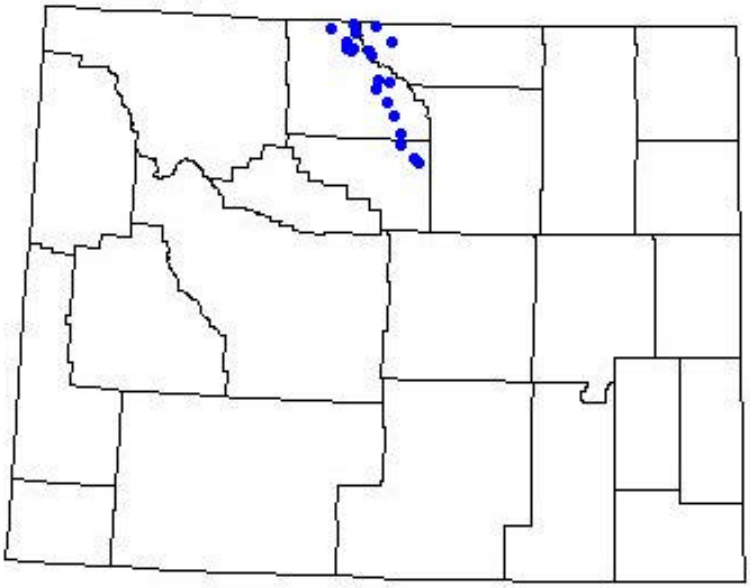
Similar Species: *Penstemon aridus* and *P. attenuatus* have glandular flowers and inflorescences and glabrous anthers. *P. rydbergii* has smaller, more densely clustered flowers and glabrous anthers. *P. paysoniorum* has dark brown or purplish anthers with short, sparse pubescence, corollas 15-22 mm long, and occurs primarily in desert habitats. *P. strictus* has sepals that are rounded or short-acute at the tip (Dorn 2001; Fertig et al. 1994).

Geographic Range: Cary beardtongue is a regional endemic restricted to the Bighorn Mountains of north-central Wyoming (Big Horn, Sheridan, and Washakie counties) (Figure 3) and Pryor Mountains of south-central Montana (Fertig et al. 1994). The location of Wyoming populations is summarized in Table 1 and more detailed population data and maps are provided in Appendix A.

Extent of Surveys in Wyoming: Cary beardtongue was apparently first collected on 7 July 1896 by F.L. and C.E. Moore in the "Big Horn Mountains" of Wyoming, but went unrecognized until 1938 when Francis Pennell annotated the specimen from the Rocky Mountain Herbarium (it was originally identified as *Penstemon strictus*). Merritt Cary collected the type specimen near Trapper and Medicine Lodge canyons in Big Horn County, Wyoming on 4 June 1910. James Thorp collected the species at an unknown site on the "west slope of the Big Horn Mountains" in June 1928 and again along Shell Creek on 4 July 1932. Marion Ownbey discovered a new population near Five Springs Falls in July 1935. Louis and Terua Williams collected *P. caryi* twice near Medicine Mountain in June and July 1936. Cary beardtongue was not collected again until 1976, when Robert Dorn discovered this species for the first time in Montana in the Pryor Mountains of Carbon County (Dorn 1978). In 1977, Dorn relocated Ownbey's Five Springs Falls population, marking the first documentation of *P. caryi* in Wyoming in 41 years. From 1978-1981, Dorn,

Barry Johnston, Robert Lichvar, B. Ernie Nelson, Ron Hartman, and Erwin Evert discovered 5 new populations in Wyoming and relocated one additional site. In 1989 and 1990, Hollis Marriott and Mary Neighbours of WYNDD discovered 2 new populations and relocated one known occurrence in the Bighorn Range. Michele Girard, Stephanie Mills, and Kathy Zacherkevics of Bighorn National Forest located two new sites and relocated one known population during surveys from 1993-1995. Ann Humphrey, Phil Shephard, and Walter Fertig relocated 2 populations on The Nature Conservancy's Tensleep Preserve in 1992 and initiated a yearly monitoring program. Since 1999, Laura Welp and Walter Fertig of WYNDD, Robert Dorn, Andrew Lutz of Ohio State University, and Bernie Bornong, Kevin O'Dea, Tucker Galloway, and Nathan Gross of Bighorn National Forest have discovered 10 new occurrences and relocated 7 additional known populations in Wyoming's Bighorn Range.

Figure 3. Wyoming Distribution of Penstemon caryi *(from Fertig 2000).*



Potential Distribution in Wyoming: Based on modeling, over 11,100 square kilometers of potential habitat occurs for *Penstemon caryi* in Wyoming (ca 4.4% of the state's area) (Appendix D). Most of this potential habitat is restricted to the northern, western, and southern slopes of the Bighorn Range, but large areas of suitable environments also occur in the Bridger-Owl Creek mountains, the east slope of the Wind River Range, the east slope of the Absarokas, the Gros Ventre Range, southern Tetons, Wyoming-Salt River ranges, and scattered locations in the Laramie Range. To date, no populations have been located outside of the Bighorns, despite extensive floristic surveys of most of Wyoming (Hartman 1992). The absence of *P. caryi* in these areas may be due to poor dispersal, absence of pollinators, competition from closely related taxa, or recent extirpation, or may be an artifact of the environmental attributes used to create the model.

Table 1. Locations of Penstemon caryi *in Wyoming*

Occurrence # 001
County: Big Horn
USGS Quad: Medicine Wheel
Latitude: 44° 48' 20" N (centrum)
South Latitude: 44° 48' 00" N
North Latitude: 44° 48' 22" N
Longitude: 107° 58' 55" W (centrum)
East Longitude: 107° 58' 10" W
West Longitude: 107° 59' 10" W
Town/Range/Section: T56N R92W S30 (SW4 of NE4 & NW4 of SE4 of NW4); T56N R93W S25 (SE4)
Location: Bighorn Mountains, along old highway 14 from first switchback north of current US Highway 14A northeast to vicinity of BLM Five Springs Campground.

Occurrence # 002
County: Big Horn
USGS Quad Name: Medicine Wheel
Latitude: 44° 48' 09" N (centrum)
South Latitude: 44° 47' 26" N
North Latitude: 44° 48' 40" N
Longitude: 107° 55' 30" W (centrum)
East Long: 107° 54' 30" W
West Long: 107° 56' 17" W
Town/Range/Section: T56N R92W S22 (S1/2 of SE4), S28 (NE4 of SE4 & N2 of NW4); S33 (SW4 of NW4).
Location: Bighorn Range, south slopes of Medicine Mountain and vicinity of old highway 14 and current US Highway 14A (near first runaway truck ramp and scenic pullout).

Occurrence # 004
County: Big Horn
USGS Quad: Black Mountain
Latitude: 44° 35' 10" N (centrum)
Longitude: 107° 38' 43" W (centrum)
Town/Range/Section: T53N R90W S11 (TRS approximate, taken from quad)
Location: West slope Bighorn Range, "along Shell Creek".

Occurrence # 005
County: Big Horn
USGS Quad Name: Bush Butte
Latitude: 44° 25' 55" N (centrum)
South Latitude: 44° 23' 57" N
North Latitude: 44° 27' 50" N
Longitude: 107° 33' 20" W (centrum)
East Longitude: 107° 31' 27" W
West Longitude: 107° 35' 52" W
Town/Range/Section: T51N R89W S4 (NE4NE4), S7 (N2 of SE4 & SW4), S8 (NE4 OF SW4), S17 (NE4); T52N R89W S19 (SE4SE4); S29 (NE4 of SE4), S30 (NE4NE4), S34 (SE4); T51N R90W S12 (NW4 of SE4).
Location: Bighorn Range, ridge system between Trapper Creek and Dry Medicine Lodge Creek, including slopes above Webber Canyon and south rim of Trapper Canyon southeast of Bush Butte. Occurrence consists of 6 main subpopulations: (1) along Alkali Road near head of Webber Canyon and Sheep springs Canyon near old tar sands mine, ca 2.5 air miles south of Trapper Canyon [Sec 4], (2) 5 small colonies along north and south side of road on divide between Webber Canyon and Alkali Creek beginning ca 0.9 miles west of junction with Alkali Road and extending 1.75 miles to west [Secs 7, 8, & 12], (3) near head of Alkali Creek on north side of two-track ca 0.4 miles west of Alkali Road [Sec 17], (4) south side of Alkali Road on divide between upper end of Sheep Springs Canyon and head of southern tributary of Trapper Creek, ca 2 miles SSW of confluence of Jack Creek and Trapper Creek [Sec 34], (5) southwest rim of Trapper Canyon, ca 2 air miles southeast of Bush Butte on north side of

Table 1. Continued

two-track [Sec 19/30], and (6) upper reach of first major tributary of Trapper Creek, ca 1 mile south of the main stem of Trapper Canyon [Sec 29].

Occurrence # 008
County: Big Horn
USGS Quad Names: Natural Trap Cave and Simmons Canyon
Latitude: 44° 56' 27" N (centrum)
South Latitude: 44° 56' 08" N
North Latitude: 44° 56' 51" N
Longitude: 108° 08' 35" W (centrum)
East Longitude: 108° 05' 40" W
West Longitude: 108° 09' 13" W
Town/Range/Section: T57N R94W S2 (NW4 of SE4); S11 (NE4NE4NE4); T57N R93W S8
Location: Bighorn Range, Little Mountain, ca 2 air miles east of Bighorn Lake and 5.5-6 miles northeast of US Highway Alt 14. 3 subpopulations: (1) west slope of Little Mountain near Kane BM (Sec 12), ca 14.5 air miles northeast of Lovell. (2) northeast side of Little Mountain near Godes Spring, ca 1 mile south of Devil Canyon (Sec 8). (3) northwest flank of Little Mountain near the John Blue Canyon Road (sec 2).

Occurrence # 012
County: Sheridan
USGS Quad Name: Burgess Junction
Latitude: 44° 52' 15" N (centrum)
Longitude: 107° 31' 30" W (centrum)
Town/Range/Section: T57N R88W S31
Location: Bighorn Range, SE half of Dry Fork Ridge, ca 7 air miles north of Burgess Junction and ca 13.5 air miles west of Dayton.

Occurrence # 013
County: Sheridan
USGS Quad Name: Bull Elk Park
Latitude: 44° 58' 15" N (centrum)
Longitude: 107° 41' 20" W (centrum)
Town/Range/Section: T58N R90W S26 (SE4)
Location: Bighorn Range, summit and upper slopes of Fisher Mountain west of the Little Bighorn River.

Occurrence # 014
County: Washakie
USGS Quad Names: Big Trails NE, Monument Hill, Old Maid Gulch, and Onion Gulch.
Latitude: 43° 59' 45" N (centrum)
South Latitude: 43° 59' 30" N
North Latitude: 44° 00' 35" N
Longitude: 107° 13' 36" W (centrum)
East Longitude: 107° 12' 12" W
West Longitude: 107° 15' 20" W
Town/Range/Section: T47N R87W S26 (NW4 of SE4); S36 (NE4 of SW4); T47N R86W S31 (N2 of NE4); S32 (S2 of SE4, NW4NW4 of SE4, NW4NW4 of SW4, & SE4 of NW4); S33 (SW4 of NW4).
Location: West slope Bighorn Range, 9 subpopulations located on Cooks Vee on south rim of Canyon Creek Canyon and east side of Cooks Canyon, 1-2 miles north of Rome Hill Road.

Occurrence # 018
County: Big Horn
USGS Quad Name: Allen Draw
Latitude: 44°19' 55" N (centrum)
South Latitude: 44° 19' 40" N
North Latitude: 44° 19' 55" N
Longitude: 107° 28' 50" W (centrum)
East Longitude: 107° 28' 45" W
West Longitude: 107° 28' 45" W
Town/Range/Section: T50N R89W S1 (E2 of SE4); T50N R88W S5 (SW4SW4)
Location: Bighorn Range, south rim of Medicine Lodge Canyon below confluence with Captain Jack Creek, just north of Cold

Table 1. Continued

Springs Road, ca 8.5 air miles northeast of Hyattville.

Occurrence # 020
County: Washakie
USGS Quad Names: Old Maid Gulch and Onion Gulch.
Latitude: * Sensitive Data
Longitude: * Sensitive Data
Town/Range: T47N R87W
Location: Bighorn Range, ca 10 miles east of Tensleep.

Occurrence # 022
County: Big Horn
USGS Quad Name: Medicine Wheel
Latitude: 44° 51' 35" N (centrum)
Longitude: 107° 58' 50" W (centrum)
Town/Range/Section: T56N R92W S6 (SW4 of NW4).
Location: Bighorn Range, road to Cottonwood Cow Camp.

Occurrence # 023
County: Big Horn
USGS Quad Name: Shell Falls
Latitude: 44° 34' 45" N (centrum)
South Latitude: 44° 34' 33" N
North Latitude: 44° 34' 45" N
Longitude: 107° 32' 28" W (centrum)
East Longitude: 107° 32' 28" W
West Longitude: 109° 32' 40" W
Town/Range/Section: T53N R89W S10, S14 (N1/4), S15
Location: West slope Bighorn Mountains, north slope Shell Canyon, ca 3-4 air miles SSE of Cedar Mountain, ca 0.1-0.3 air miles east-northeast of Granite Creek campground.

Occurrence # 024
County: Sheridan
USGS Quad Name: Ice Creek
Latitude: 44° 45' 30" N (centrum)
Longitude: 107° 43' 05" W (centrum)
Town/Range/Section: T55N R90W S7 (SE4 of NW4)
Location: Bighorn Range, adjacent to the north side of US Highway 14A on talus road cut, ca 1 mile west of Ice Creek.

Occurrence # 025
County: Big Horn
USGS Quad Name: Mexican Hill
Latitude: 44° 59' 00" N (centrum)
Longitude: 107° 55' 35" W (centrum)
Town/Range/Section: T58N R92W S27 (NE4NE4)
Location: Bighorn Range: below the rock wall that constitutes the northwest edge of Cookstove Basin, ca 0.5 miles north of Forest Service road 103.

Occurrence # 026
County: Big Horn
USGS Quad Names: Pierce Draw and Ten Sleep
Latitude: 44° 07' 28" N (centrum)
South Latitude: 44° 06' 19" N
North Latitude: 44° 09' 20" N
Longitude: 107° 24' 12" W
East Longitude: 107° 21' 39" W
West Longitude: 107° 24' 12" W
Town/Range/Section: T48N R88W S14 (E2 of SW4); S25.
Location: West slope Bighorn Range, two subpopulations: 1) ridgetop between Brokenback Creek and the South Fork of Brokenback Creek, ca 5.5 airmiles north-northeast of Tensleep and ca 2 air miles southwest of Sand Springs Draw; and 2) Fertig Draw, ca 5 air miles northwest of Tensleep and ca 4 airmiles west-northwest of the mouth of Leigh Creek.

Occurrence # 027
County: Big Horn
USGS Quad Name: Brokenback Narrows and Pierce Draw

Table 1. Continued

Latitude: 44° 12' 25" N (centrum)
South Latitude: 44° 11' 37" N
North Latitude: 44° 12' 41" N
Longitude: 107° 24' 09" W (centrum)
East Longitude: 107° 22' 14" W
West Longitude: 107° 25' 13" W
Town/Range/Section: T49N R87W S19 (S2 of NE4 & SW4SW4); T49N R88W S14 (SW4SW4 of SE4); S23 (N4 OF SW4); S24 (NW4NW4 & SE4SE4).
Location: Bighorn Basin, along BLM route 1117, extending from 9-11 air miles east of Hyattville and from 2-5 air miles west of the Bighorn Forest boundary.

Occurrence # 028
County: Big Horn
USGS Quad Name: Black Mountain
Latitude: 44° 31' 24" N (centrum)
South Latitude: 44° 31' 13" N
North Latitude: 44° 31' 24" N
Longitude: 107° 39' 34" W (centrum)
East Longitude: 107° 39' 34" W
West Longitude: 107° 39' 58" W
Town/Range/Section: T53N R90W S35 (SW4SW4); T52N R90W S4 (NE4NE4)
Location: East edge of the Bighorn Basin, near top of Black Mountain, ca 6 air miles east of Shell and ca 4 air miles southwest of Shell Falls.

Occurrence # 029
County: Big Horn
USGS Quad Name: Mexican Hill
Latitude: 44° 55' 42" N (centrum)
South Latitude: 44° 55' 07" N
North Latitude: 44° 55' 49" N
Longitude: 107° 53' 08" W (centrum)
East Longitude: 107° 52' 52" W
West Longitude: 107° 54' 10" W
Town/Range/Section: T57N R92W S12 (SE4); S13 (SW4 of NW4); T57N R91W S17 (NW4NW4).
Location: Bighorn Range, ca 1-2 miles southwest of Sheep Mountain, near the head of Bucking Mule Creek. 3 main subpopulations: (1) ca 0.25 miles south of USFS Road 105 and 1 mile east of junction of 105 and Road 032218, (2) just north of USFS Road 105 at the north headwaters fork of Bucking Mule Creek at the base of a calcareous rock slide, (3) south of USFS Road 105 on south slopes of Point 9438.

Occurrence # 030
County: Sheridan
USGS Quad Name: Bald Mountain
Latitude: 44° 48' 05" N (centrum)
South Latitude: 44° 48' 02" N
North Latitude: 44° 48' 08" N
Longitude: 107° 45' 15" W (centrum)
East Longitude: 107° 45' 04" W
West Longitude: 107° 45' 23" W
Town/Range/Section: T56N R91W S25 (NE4 of SW4)
Location: Bighorn Range, 1.5 miles east-southeast of Bald Mountain City, east of the junction of USFS Road 15 and the Little Bighorn River [2 miles north-northeast of the summit of Little Bald Mountain].

Occurrence # 031
County: Big Horn
USGS Quad Name: Bald Mountain
Latitude: 44° 51' 36" N (centrum)
Longitude: 107° 50' 52" W (centrum)
Town/Range/Section: T56N R91W S6 (NE4 of SW4 of NE4)
Location: Bighorn Range, west slope of Duncum Mountain, east of USFS Road 11, ca 3.75 miles north of US Highway Alt 14 and 10 miles south of the Montana state line.

Occurrence # 032
County: Big Horn
USGS Quad Name: Brokenback Narrows
Latitude: 44° 09' 20" N (centrum)
South Latitude: 44° 09' 17" N

Table 1. Continued

North Latitude: 44° 09' 23" N
Longitude: 107° 21' 38" W (centrum)
East Longitude: 107° 21' 36" W
West Longitude: 107° 21' 40" W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T48N R87W S6 (NE4 of SW4)
Location: Bighorn Range, base of buttes ca 1.5 air miles southwest of Brokenback Narrows and ca 1 air mile north-northeast of Sand Springs.

Occurrence # 033
County: Washakie
USGS Quad Name: Old Maid Gulch
Latitude: 44° 03' 09" N (centrum)
South Latitude: 44° 03' 07" N
North Latitude: 44° 03' 12" N
Longitude: 107° 19' 20" W (centrum)
East Longitude: 107° 19' 10" W
West Longitude: 107° 19' 30" W
Town/Range/Section: T47N R87W S9 (NE4 of SW4)
Location: Bighorn Range, west of Canyon Ridge on south side of Sand Draw Road (FS Road 43601), ca 0.5 miles east of Sand Spring and 2 miles south of Leigh Creek Campground on Tensleep Creek.

Habitat: *Penstemon caryi* is most frequently found on sparsely vegetated outcrops of limestone or dolomite in small openings within Mountain big sagebrush, Utah juniper, Rocky Mountain juniper, Douglas-fir, or Limber pine grasslands (Figures 4-5) or on semi-barren roadcuts, slumping clay

Figure 4. Habitat of Penstemon caryi *in shallow pockets of thin, limey-clay soil on outcrops of dolomitic bedrock within Utah juniper-mountain mahogany grasslands at south end of Black Mountain, SW of Shell Falls (Occurrence # 028). WYNDD photo by Laura Welp, 30 June 2000.*

banks, or gravelly slopes. At all of these sites vegetative cover is well under 20%. Common associated species include Hooker's sandwort, Alpine mousetail, and Larch-leaved beardtongue (Table 2). Cary beardtongue is usually found on thin, limey or alkaline soils that have weathered directly above shallow bedrock or been exposed by natural or human-induced erosion (entisols or inceptisols). Most of these soils are derived from Bighorn Dolomite, Madison Limestone, Tensleep Sandstone or the Amsden Formation (Love and Christensen 1985). Less commonly, *P. caryi* can be found on sites with deeper, cryic mollisols or on soils with a dense layer of moss or lichens. Populations mostly occur on level terrain or slopes of 10-25% and with a southern or southeastern aspect. One high elevation population in the Bighorn Range occurs on a west-facing dolomite talus and rubble slope on pockets of whitish-gray limey clay soil in a community dominated by *Phlox multiflora, Cirsium hookerianum, Festuca idahoensis,* and *Potentilla ovina* (Occurrence # 031). Wyoming populations range in elevation from 5200-9650 feet (1585-2940 meters).

Average annual precipitation within the Wyoming range of *P. caryi* varies from 304-508 mm (12-20 inches), with peaks during April-June. Mean annual temperature ranges from 2.2 to 5.5? C (36-42? F). Average maximum and minimum temperatures for January are - 0.5? and - 14.4? C (31? and 6? F). Mean maximum and minimum temperatures in July are 26.7-30? and 6.7-11? C (80-86? and 44-52? F) (Martner 1986).

Population Size and Trends: In Wyoming, Cary beardtongue is currently known from 22 primary occurrences (Tables 1, 3). Most surveyed populations consist of 2 or more subpopulations that are separated by breaks in continuous habitat of 0.1-1.5 miles. Wyoming populations consist of at least 63 discrete subpopulations that occupy a total area of approximately 115 acres (Table 3). Individual colonies range in size from 0.1 to 10 acres and contain 20-1500 plants. Based on surveys

Figure 5 (right). Habitat of Penstemon caryi *on sand-limey soil with thick biotic crust within sparsely vegetated Ponderosa pine-Rocky Mountain Juniper woods on the divide between Brokenback and South Fork Brokenback creeks (Occurrence # 026). WYNDD photo by Laura Welp, 27 June 2000.*

Table 2. Species commonly associated with Penstemon caryi.

Scientific Name	Common Name	Growth Form
Achillea millefolium	Common yarrow	Perennial forb
Achnatherum [*Oryzopsis*] *hymenoides*	Indian ricegrass	Perennial graminoid
Agoseris glauca	Pale goat-chicory	Perennial forb
Artemisia tridentata var. *vaseyana*	Mountain big sagebrush	Shrub
Astragalus miser	Timber milkvetch	Perennial forb
Astragalus spatulatus	Tufted milkvetch	Perennial forb
Bromus tectorum	Cheatgrass	Annual graminoid
Cercocarpus ledifolius var. *ledifolius*	Curl-leaf mountain mahogany	Shrub
Elymus lanceolatus	Thickspike wheatgrass	Perennial graminoid
Eremogene [*Arenaria*] *congesta*	Ball-head sandwort	Perennial forb
Eremogene[*Arenaria*] *hookeri*	Hooker's sandwort	Perennial forb
Erigeron allocotus	Big Horn fleabane	Perennial forb
Festuca idahoensis	Bluebunch [Idaho] fescue	Perennial graminoid
Geranium viscosissimum	Sticky purple crane's-bill	Perennial forb
Heterotheca fulcrata	Rocky-scree false golden-aster	Perennial forb
Ipomopsis spicata	Spiked skyrocket	Perennial forb
Ivesia gordonii	Alpine mousetail	Perennial forb
Juniperus osteosperma	Utah juniper	Shrub/Tree
Juniperus scopulorum	Rocky Mountain juniper	Shrub/Tree
Koeleria macrantha	Prairie Koeler's grass	Perennial graminoid
Lupinus argenteus	Silver-stem lupine	Perennial forb
Mahonia repens	Creeping Oregon-grape	Shrub
Opuntia polyacantha	Hair-spine prickly-pear	Perennial forb
Packera cana [*Senecio canus*}	Silver-woolly groundsel	Perennial forb
Penstemon aridus	Stiff-leaf beardtongue	Perennial forb
Penstemon laricifolius	Larch-leaf beardtongue	Perennial forb
Penstemon nitidus	Waxy-leaf beardtongue	Perennial forb
Petrophyton caespitosum	Rocky Mountain rockmat	Perennial forb
Phacelia hastata	Silver-leaf scorpion-weed	Perennial forb
Phlox hoodii	Carpet phlox	Perennial forb
Pinus ponderosa	Ponderosa pine	Tree
Sedum lanceolatum	Lance-leaf stonecrop	Perennial forb
Stenotus armerioides [*Haplopappus armerioides*]	Thrift mock goldenweed	Perennial forb

of 40 subpopulations at 17 occurrences from 1999-2001, the total population in Wyoming contains at least 11,935-13,585 individuals. Extrapolating from these samples, the population of *P. caryi* in the state may be as high as 19,600-22,300 plants.

One Wyoming population (Occurrence # 004) has not been relocated since 1932 and may be extirpated (Andrew Lutz, personal communication). Three other populations first located from 1979-1993 have not been resurveyed since their initial discovery and their current status is unknown (Occurrences 012, 013, and 022).

Since 1976, at least 21 populations (consisting of 35 subpopulations) have been documented in the Pryor Mountains of Montana by Robert Dorn, Robert Lichvar, Steve Shelly, and Peter Lesica (Montana Natural Heritage Program records). These occurrences contain a minimum of 2000-4550 individuals in an area of approximately 110 acres.

Long-term trend data are unavailable for most populations of *P. caryi* in Montana or Wyoming. One exception is The Nature Conservancy's Tensleep Preserve along Canyon Creek Canyon on the west slope of the Bighorn Range (Occurrence # 014), where monitoring studies have been conducted since 1993 (Humphrey 2001). Although the monitoring plots at Tensleep were selected non-randomly (and thus may not be indicative of trends throughout the preserve), results suggest that the number of plants has remained stable or increased over the last 9 years (with some inter-annual variability in response to climatic conditions). Short-term population increases have also been detected at two other populations in the Bighorns surveyed in 1999 and 2000 (Table 3). New monitoring plots were established at three sites in 2000 (Appendix C), but additional follow-up studies are necessary to detect any changes in trend.

Population Biology and Ecology: Depending on elevation, Cary beardtongue flowers from late May to late July (Fertig et al. 1994). Fruits are produced from mid June into mid August. Flowers are probably pollinated by small bees and wasps, but the specific pollinators have yet to be identified. *Penstemon caryi* reproduces exclusively by seed, although individual plants may expand by branching of the root crown. The number of flowering and fruiting **(continued on page 21)**

Table 3. Demographic data from Wyoming occurrences of Penstemon caryi *on public lands*. (data not included for one occurrence on private lands)

Occurrence # 001 (3 subpopulations)
Area: ca 5 acres
Number of Plants: 45 plants observed at one subpopulation (Sec 30 NW4) in 2000 (population estimated at 70 plants).
Density: Not reported.
Evidence of Reproduction: 80% of plants in flower or fruit in July 2000.
Trends: Population first documented in 1935 and relocated in 1977. Subpopulation in Sec 25 has not been relocated since 1981. Other subpopulations probably stable.

Occurrence # 002 (4 subpopulations)
Area: ca 5 acres
Number of Plants: Largest subpopulations contained an estimated 1000 individuals in

Table 3. Continued

1999 (Sec 28 & 33 colonies). Other subpopulations much smaller, with 20-100 plants.
Density: Reported as scattered and patchy.
Evidence of Reproduction: 10% of plants in bud on 3 July 2000.
Trends: Population first discovered in 1936 and relocated in 1978.

Occurrence # 004
Area: Not known.
Number of Plants: Not known, population may be extirpated.
Density: Not known.
Evidence of Reproduction: None.
Trends: Population has not been relocated since 1932. Andrew Lutz surveyed this area unsuccessfully in June 2000 and suspects that road expansion may have eliminated the occurrence.

Occurrence # 005 (10 subpopulations)
Area: 10 acres.
Number of Plants: 580 reproductive and vegetative plants observed at 4 subpopulations by L. Welp in June 2000 (total estimated at 835). 450 plants estimated at 3 subpopulations by H. Marriott in 1989 (Marriott and Jones 1989). Total population probably exceeds 1200 individuals.
Density: Reported as locally dense, but individual colonies are widely scattered across patchy habitat.
Evidence of Reproduction: 30-70% of plants in flowering or fruiting condition at 4 subpopulations surveyed by Welp in 2000.
Trends: Population was first discovered in 1979. Sec 8 colony showed small increase in numbers from 1999 to 2000. Other populations are probably stable to slightly increasing.

Occurrence # 008 (3 subpopulations)
Area: 4-5 acres.
Number of Plants: 425 plants counted in S2 colony by L. Welp in 2000 (estimated at 500).
Density: Populations patchy.
Evidence of Reproduction: 75% of plants observed in fruit in June 2000.
Trends: Sec 2 colony was discovered in 1979 and relocated in 1999 and 2000. Sec 8 and 12 colonies have not been relocated since 1980.

Occurrence # 012
Area: Not reported.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Observed in flower by B.E. Nelson in July 1979.
Trends: Population has not been relocated since first being documented in 1979.

Occurrence # 013
Area: Not reported.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Observed in flower by Hartman and Odasz in June 1979.
Trends: Population has not been relocated since 1979.

Occurrence # 014 (13 subpopulations)
Area: 40 acres.
Number of Plants: Total population on TNC Tensleep Preserve estimated at 3400 individuals by Humphrey (2001).
Density: Density varies from 1.0-1.9 plants per square meter, depending on seasonal moisture conditions and past recruitment success.
Evidence of Reproduction: Observed in flower and fruit every year since 1992.
Trends: Population first discovered in 1989 and resurveyed every 1-3 years since. Overall population trend is increasing at Billy Creek and Cooks Vee monitoring plots, although numbers fluctuate annually (Humphrey 2001).

Table 3 Continued

Occurrence # 018 (2 subpopulations)
Area: 3 acres.
Number of Plants: 251 reproductive and vegetative plants counted at 2 sites by Welp in June 2000 (population estimated at 300). Same population estimated at 350 individuals by Andrew Lutz in June 2000.
Density: Plants clumped, but individual patches widely scattered.
Evidence of Reproduction: 40-50% of plants in flowering or fruiting condition in late June 2000.
Trends: Population has increased from an estimated 50 plants in 1989 (Marriott and Jones 1989) to over 300 in 2000. This population may represent the type locality of Cary (Payson 1924).

Occurrence # 022
Area: 1-2 acres.
Number of Plants: ca 100 plants observed by Michele Girard.
Density: Distribution patchy.
Evidence of Reproduction: Observed in flower and fruit in July 1993.
Trends: Not relocated since first being reported in 1993.

Occurrence # 023 (4 subpopulations)
Area: 5 acres.
Number of Plants: 17 plants observed at one colony by L. Welp in July 2000 (estimated at 30 plants). Approximately 130 plants observed at 2 sites by Kathy Zacharkevics in 1995. Total population size not known, but probably 150-200.
Density: Plants randomly distributed.
Evidence of Reproduction: ca 45% of plants in flower or fruit in early July 2000.
Trends: Population discovered in 1995 and relocated in 2000. Trends stable to decreasing.

Occurrence # 024
Area: Not reported.
Number of Plants: Population estimated at 80-100 individuals by K. O'Dea in August 1999.
Density: Not reported.
Evidence of Reproduction: Only 2% of plants observed in fruit in August 1999.
Trends: Population was relocated (but not surveyed) by A. Lutz in June 2000. Long-term trends are not known.

Occurrence # 025
Area: 1 acre.
Number of Plants: Population estimated at 25-50 plants by K. O'Dea in August 1999.
Density: Plants widely scattered, often in groups of 2-5.
Evidence of Reproduction: 67% of population in flower and 33% in fruit in 1999.
Trends: Not known (population has been known only since 1999).

Occurrence # 026 (2 subpopulations)
Area: 2 acres.
Number of Plants: 103 plants observed in one population by L. Welp in June 2000.
Density: Not reported.
Evidence of Reproduction: Plants all in fruit in June 2000.
Trends: Not known (population only discovered in 2000).

Occurrence # 027 (5 subpopulations)
Area: 10 acres
Number of Plants: 332 reproductive and vegetative plants counted at 5 subpopulations by L. Welp in June 2000 (population estimated at 500 plants).
Density: Plants were more clustered at this site than in other populations surveyed in 2000.
Evidence of Reproduction: 10-50% of plants in flower or fruit in late June 2000.

Table 3 Continued

Trends: Population first discovered in 2000 (relocated in 2001). No long-term trend data available.

Occurrence # 028 (2 subpopulations)
Area: 3 acres.
Number of Plants: 17 plants observed in 2 small populations by L. Welp in June 2000 (population estimated at 50 individuals).
Density: Plants widely scattered within large area of seemingly suitable habitat.
Evidence of Reproduction: 70% of plants in flower or fruit on 30 June 2000.
Trends: Not known (population first discovered in 2000).

Occurrence # 029 (4 subpopulations)
Area: 6-10 acres.
Number of Plants: Total population estimated at 2200 plants in July 2000.
Density: Not reported.
Evidence of Reproduction: At least 10% of plants in flower or fruit in 2000.
Trends: Not known (population just discovered in 2000 by T. Galloway and N. Gross of Bighorn National Forest).

Occurrence # 030
Area: 5 acres.
Number of Plants: Population estimated at ca 1000 individuals by Galloway and Gross in July 2000.
Density: Not reported.
Evidence of Reproduction: 70% of plants in flower or fruit in July 2000.
Trends: Not known (population just discovered in 2000).

Occurrence # 031
Area: 1 acre.
Number of Plants: Population estimated at 500-1000 individuals by W. Fertig in late July 2001.
Density: Locally dense, with as many as 70 individuals in areas of 10 x 20 meters. Clumps may be widely scattered.
Evidence of Reproduction: Less than 5% had remnant flowers in late July 2001 (remainder mostly in fruit).
Trends: Not known (population just discovered in 2001).

Occurrence # 032
Area: 1 acre.
Number of Plants: 129 plants observed by L. Welp in June 2000 (population estimated at 200).
Density: Population restricted to area of 75 x 50 meters.
Evidence of Reproduction: 60% of plants in flower and 30% in fruit on 27 June 2000.
Trends: Not known (population just discovered in 2000).

Occurrence # 033
Area: 5 acres.
Number of Plants: 1482 plants observed in survey by B. Bornong, T. Galloway, and N. Gross on 6 June 2000.
Density: Locally dense, but clumps of plants widely scattered.
Evidence of Reproduction: 80% of plants in flower in early June 2000.
Trends: Population first discovered in 1999 and initially estimated at 550-750 plants.

(continued from page 17) stalks ranges from 1-10 or more, with higher production during moister years (Humphrey 2001). Dozens of seeds are produced in each capsule and are released passively through slits in the outer walls of the fruit. These seeds are dispersed by gravity or strong winds and probably do not travel long distances from the parent plant under ordinary conditions (thus helping to account for the clustered nature of most subpopulations). Germination requirements and seedling biology is not known for this species, but establishment is probably episodic and limited to suitable microsites with low cover or adequate moisture. No seedling plants were encountered in 3 demographic plots established by Laura Welp in June 2000.

Penstemon caryi populations in Wyoming and Montana are typically small and consist of widely scattered clumps of 2-5 individuals that are often restricted to small patches of exposed soil or bedrock within a matrix of more dense sagebrush or meadow vegetation. Not all patches of suitable habitat are occupied, suggesting that population increase and spread may be limited by dispersal. Populations are capable of colonizing or persisting in disturbed roadside areas, especially if competing vegetation is unable to become reestablished. Steve Shelly (personal communication) has noted that Montana populations may actually prefer habitats that receive light, periodic disturbance. Population density may vary widely depending on habitat quality and moisture availability. Humphrey (2001) measured average densities of 1-1.9 plants per square meter at the Tensleep Preserve from 1995-2001, while Laura Welp detected densities of 4.5-6.6 plants per square meter at sites near Trapper Canyon in June 2000 (Appendix C).

Cary beardtongue is frequently browsed by a variety of herbivores, including deer, elk, rodents, rabbits, insects, and domestic livestock (especially cattle and horses). In most cases, herbivory is restricted to inflorescences, upper stems, or fruiting pods.

No evidence of hybridization has been detected in the field.

Current Management: Over 90% of the populations of *Penstemon caryi* in Wyoming are found on public lands managed by the US Forest Service or BLM. Twelve occurrences are known from Bighorn National Forest, including one presumably extirpated population from the Shell Canyon Research Natural Area (RNA) or potential Elephant Head RNA (Welp et al. 1998). One other occurrence on USFS lands is within the potential Mann Creek RNA (Jones and Fertig 1998). All or portions of 8 occurrences are found on lands managed by the BLM Cody and Worland field offices. At least two of these populations are currently protected within the Little Mountain and Spanish Point Karst Areas of Critical Environmental Concern (ACECs) and portions of two occurrences are within the Trapper Creek and Medicine Lodge Wilderness Study Areas (WSAs) (Fertig 1999 a; Marriott and Jones 1989; Welp et al. 2000). One additional BLM population may be located in the Five Springs Falls ACEC. Unless located within a designated RNA or ACEC, all Cary beardtongue populations on public lands are in areas managed for multiple use.

The largest occurrence of *P. caryi* in Wyoming (consisting of 13 subpopulations) is fully protected within The Nature Conservancy's Tensleep Preserve (Fertig 1999 a; Humphrey 2001; Humphrey and Shepherd 1994). A portion of one occurrence is protected within the Wyoming Game and Fish Department's Renner Wildlife Habitat Management Unit. One other population in the state is found on private lands.
In Montana, most *P. caryi* populations occur on Custer National Forest and the BLM Miles City

District (Montana Natural Heritage Program data).

Existing and Potential Threats: Cary beardtongue is threatened primarily by loss of habitat from road construction, limestone quarrying, and other development. In some areas, however, small colonies have been able to persist or become established on roadcuts that expose suitable substrates and restrict competition from other vegetation. Livestock may have impacts on some populations, either through direct herbivory on flowering stems or by trampling. Long-term studies of grazed and ungrazed plots on the Tensleep Preserve suggest that cattle grazing may be less significant than previously assumed and that much herbivory is the result of smaller animals, especially rodents and rabbits (Humphrey 2001). Observational evidence from other populations, however, suggests that grazing by cattle, horses, or sheep may be important in reducing flower and fruit production. Impacts from deer and elk herbivory are poorly understood, but could be significant in certain areas. Several populations surveyed from 1999-2001 may be impacted by competition from exotic plants, especially sweet-clover (*Melilotus*), mullein (*Verbascum thapsus*), and timothy (*Phleum pratense*). Some of the more accessible populations could be negatively impacted through over-collection by gardeners and *Penstemon*-fanciers. Overall, threats to *P. caryi* from human activities are probably less imminent or of lower impact than previously suspected, although the plant's limited range and high habitat specificity makes it vulnerable to large scale habitat modification in the future and monitoring should continue in order to detect potential downward trends.

SUMMARY

Cary beardtongue (*Penstemon caryi*) is a regional endemic restricted to the Bighorn and Pryor mountains of north-central Wyoming and adjacent south-central Montana. This species is found primarily in sparsely vegetated openings within Big sagebrush, Utah Juniper, Rocky Mountain juniper, or Ponderosa pine meadows on outcrops of calcareous bedrock or on semi-disturbed limey-clay or talus slopes on soils derived from the Bighorn Dolomite, Madison Limestone, Tensleep Sandstone or Amsden formations. Cary beardtongue is currently known from 22 occurrences in Wyoming, of which 10 have been discovered since 1999. These populations consist of at least 63 discrete subpopulations that are isolated by barriers to pollen or seed dispersal. Individual subpopulations are typically small, consisting of 20-1000 plants. Based on surveys of 17 occurrences from 1999-2001, the total state population is currently estimated at 19,600-22,300. An additional 21 extant populations (consisting of 35 subpopulations) are known from Montana and contain a minimum of 2000-4550 individuals. Although trend data are lacking for most occurrences, populations are probably stable to slightly increasing in both states. Density may be as high as 4.5-6.6 plants per square meter, but individual clumps are usually widely scattered and limited to small patches of suitable habitat. Over 90% of Wyoming populations occur on public lands and at least 5 occurrences are protected in the Shell Canyon RNA, Little Mountain ACEC, Spanish Point Karst ACEC, TNC Tensleep Preserve, and Renner Wildlife Habitat Management Unit. This species is potentially threatened by loss of habitat to road construction, quarrying, and livestock grazing and trampling, or by over-collection for garden use, although these threats are probably less significant at most sites than once thought. *P. caryi* is currently listed as Sensitive by the US Forest Service and BLM and was formerly a Category 2 candidate for potential listing under the Endangered Species Act. The results of recent studies in Wyoming and Montana suggest that this species is more widespread and less imminently threatened by human activities than once suspected, and probably does not warrant significant management attention under present

conditions. Due to its limited range, however, *P. caryi* remains vulnerable to large-scale changes in habitat quality and periodic monitoring will still be needed to detect significant downward trends.

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Appendix A.
Element Occurrence Records and Population Maps for *Penstemon caryi* on Public Lands in Wyoming

EO # 020 from private lands in the Bighorn Range is not included.

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 001

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Medicine Wheel
Latitude: 444820N (centrum)
South Latitude: 444800N
North Latitude: 444822N
Longitude: 1075855W (centrum)
East Longitude: 1075810W
West Longitude: 1075910W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T56N R92W S30 (SW4 of NE4 & NW4 of SE4 of NW4); T56N R93W S25 (SE4)
Location: Bighorn Mountains, along old highway 14 from first switchback north of current US Highway 14A northeast to vicinity of BLM Five Springs Campground.

Population Data
Last Observed: 2000-07-03
First Observed: 1935-07-05
Occurrence consists of 3 subpopulations in an area of 0.3 x 0.5 miles.

2000-07-03: Sec 30 NW4 colony - 45 plants observed by Laura Welp (population estimated at 70). 20% of plants in fruit, 60% in flower, 20% vegetative. Population in Sec 25 could not be re-located.

2000-06-15: Sec 30 NE4 colony - observed in flower by Andrew Lutz. Some individuals with pink flowers.

1981-06-26: Sec 25 colony - observed in flower by Erwin Evert.

1980-06-12: Sec 25 colony - observed in flower and early fruit by B.E. Nelson.

1979-07-06: Sec 30 NW4 colony - reported as
"frequent" by Lichvar. In flower and fruit. Occurs with *Hordeum* and *Chaenactis*.

1977-06-23: Sec 30 NW4 colony - observed in flower by R. Dorn. Occurs with *Lupinus* and *Artemisia*.

1935-07-05: observed in flower and fruit by Marion Ownbey from "near Five Springs Falls".

Habitat: Along roadside on shaley bank and on rocky juniper-sagebrush slopes. Substrate derived from Bighorn Dolomite

Elevation: 5800-6800 feet
Size: 5 acres

Comments: EO includes former EOS 010 (from same general vicinity) and EO 019 (probably mis-labeled as R93W on original label, as written description places it in R92W).

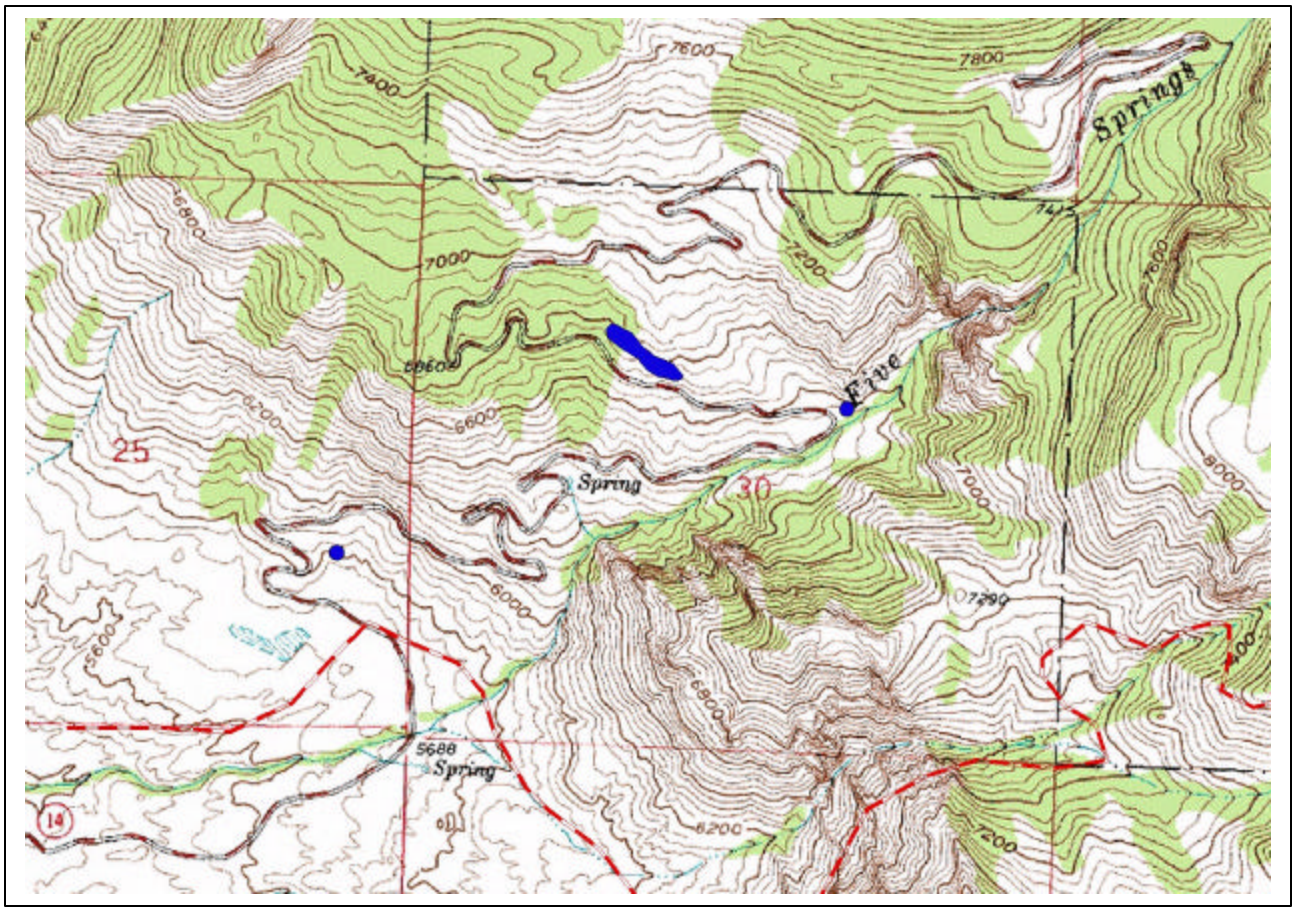
Managed Area: BLM Cody Field Office, Five Springs Falls ACEC?
Management Comments: Colony near Five Springs Campground may be within the Five Springs Falls ACEC. Virtually all plants on lower half of cutbank have been browsed to the basal rosette by cattle. Exotic species are prevalent.

Specimens: Dorn, R.D. (2948). 1977. RM.
Lichvar, R.W. (1963). 1979. RM.
Ownbey, M. (832). 1935. RM.
Nelson, B.E. (5476). 1980. RM.
Evert, E.F. (2892). 1981. RM.

Author: Walter Fertig
Edition Date: 97-03-10

Penstemon caryi Occurrence # 001
Medicine Wheel Quad

T56N R92W S30 (SW4 of NE4 & NW4 of SE4 of NW4); T56N R93W S25 (SE4)
Bighorn Mountains, along old highway 14 from first switchback north of current US Highway 14A northeast to vicinity of BLM Five Springs Campground.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 002

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Medicine Wheel
Latitude: 444809N (centrum)
South Latitude: 444726N
North Latitude: 444840N
Longitude: 1075530 W (centrum)
East Long: 1075430W
West Long: 1075617W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T56N R92W S22 (S1/2 of SE4), S28 (NE4 of SE4 & N2 of NW4); S33 (SW4 of NW4).
Location: Bighorn Range, south slopes of Medicine Mountain and vicinity of old highway 14 and current US Highway 14A (near first runaway truck ramp and scenic pullout). Occurrence consists of 5 main subpopulations: (1) 2 colonies ca 0.5 miles south of the summit of Medicine Mountain, (2) west end of ridge extending 2 miles southwest of main summit of Medicine Mountain, (3) north side of old highway 14 near head of Crystal Creek, and (4) along US
Highway 14 near first runaway truck ramp and scenic pullout.

Population Data
Last Observed: 2000-07-03
First Observed: 1936-06-19

2000-07-03: Sec 22 SE4 colonies: two small patches with ca 20 plants observed by Laura Welp (each occupies an area of ca 15 x 25 meters). 10% of plants in bud and 90% vegetative. Associated species: *Oxytropis, Arenaria hookeri*, and *Phlox hoodii*.

1999-08-04: Sec 28 & 33 colonies - ca 1000 fruiting and vegetative plants observed by Kevin O'Dea and Bernie Bornong. Occurs with *Lupinus argenteus, Agoseris glauca, Taraxacum officinale*, and *Geranium viscosissimum*. Plants scattered and patchy.

1993-08-03: Sec 28 NW4 colony - ca 100 plants observed by Stephanie Mills. Plants scattered, patchy.

1978-07-19 Sec 33 colony - observed in flower and fruit by Johnston, Lucas, Garland, and Gillam.

1936-07-06: observed in flower and fruit by Williams and Williams on south slope of Medicine Mountain.

1936-06-19: Observed in flower and early fruit by Williams and Williams from "10-15 miles east of Kane", which is thought to be the same general locality as Medicine Mountain.

Habitat: Sec 22 colonies: small scattered openings with rocky clay soils within densely vegetated meadows. Sec 33 colony - on road banks, landslides, and rocky hillsides on shallow, limestone-derived soils. Sec 28 colony - on a dry, south slope.
Elevation: 8000-9520 feet
Size: 5 acres

Managed Area: Bighorn National Forest

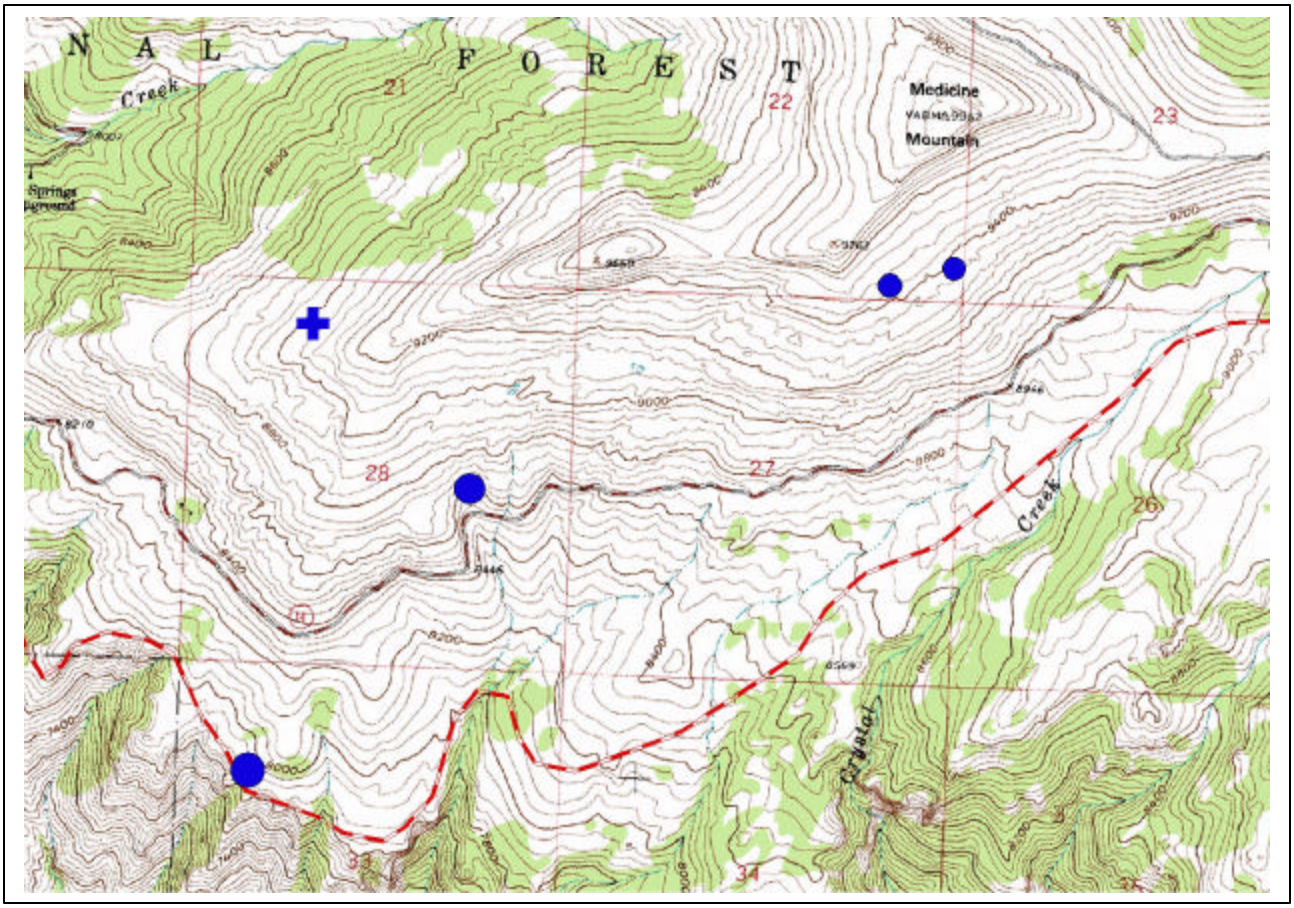
Comments: Includes former EO # 007 from the same vicinity.

Specimens: Johnston, Lucas, Garland, and Gillam (1837) 1978 (COLO, USFS).
O'Dea, K. and B. Bornong (028, 029, 030)
Bighorn National Forest Herbarium.
Williams, L.O. and R. Williams (3011, 3258). 1936. RM.

Author: Walter Fertig
Edition Date: 01-10-02

Penstemon caryi Occurrence # 002
Medicine Wheel Quad

T56N R92W S22 (S1/2 of SE4), S28 (NE4 of SE4 & N2 of NW4); S33 (SW4 of NW4). Bighorn Mountains, south slopes of Medicine Mountain and vicinity of old highway 14 and current US Highway 14A (near first runaway truck ramp and scenic pullout). Exact location of subpopulation in S28 NW4 (indicated by "+") is not known.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 004

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Black Mountain
Latitude: 443510N (centrum)
Longitude: 1073843W (centrum)
Map Accuracy: General; location is within 5 mi of point on USGS topo map.
Town/Range/Section: T53N R90W S11 (TRS approximate, taken from quad)
Location: West slope Bighorn Range, "along Shell Creek".

Population Data
Last Observed: 1932-07-04
First Observed: 1932-07-04
Data: 2000-06: Andrew Lutz attempted but failed to locate this population. He suspects it may have been destroyed by road construction.

1932-07-04: in flower and fruit.

Habitat: Soil alkaline, derived from pale sandstone.
Elevation: 5500-6000 feet
Size: Not known.

Managed Area: Shell Canyon Research Natural Area
Bighorn National Forest

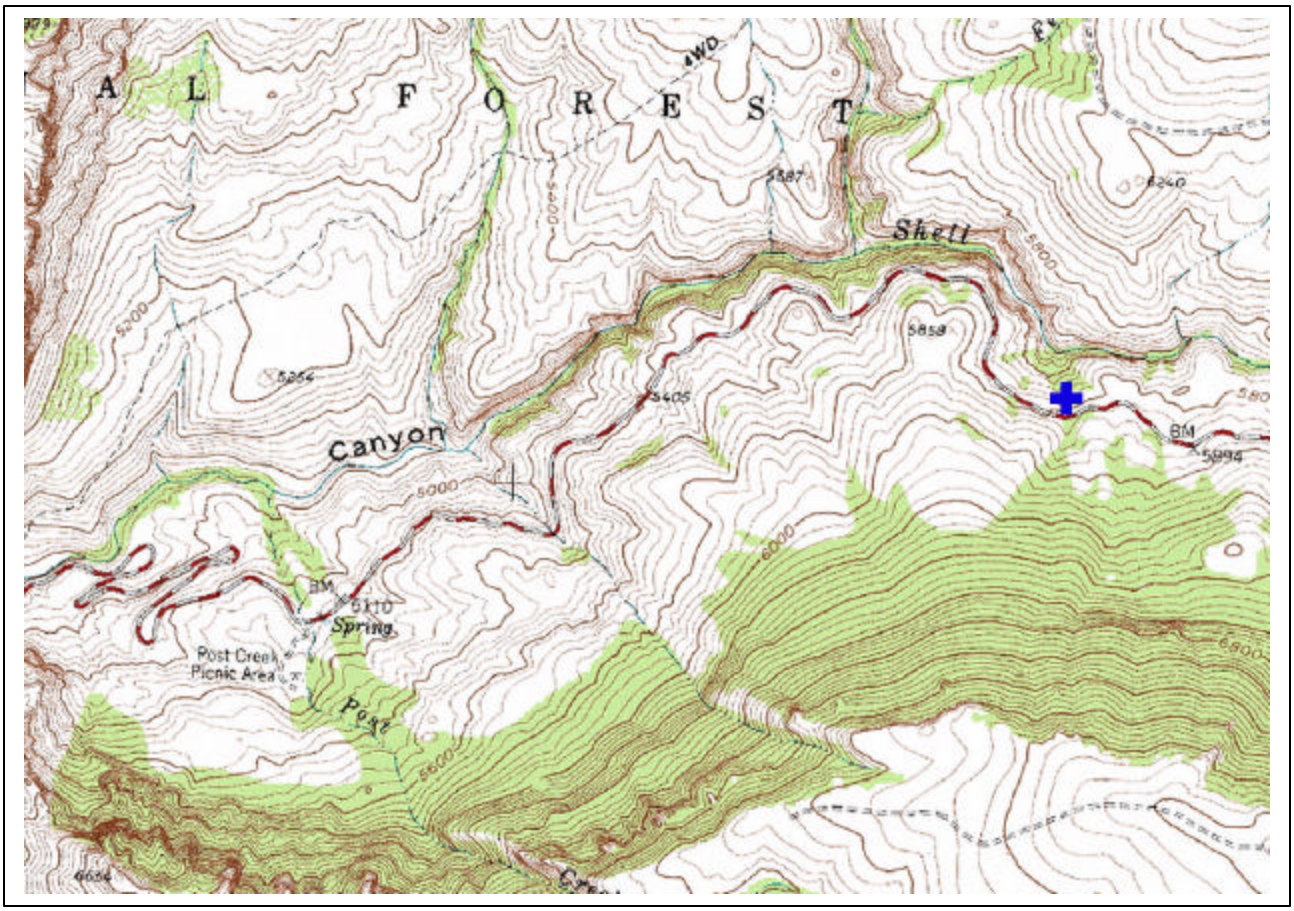
Specimens: Thorp, J. (s.n.). 1932. RM.

Sources:
Welp, L., W. Fertig, and G. Jones. 1998. Ecological Evaluation of the Potential Elephant Head Research Natural Area Within the Bighorn National Forest, Big Horn County, Wyoming. Unpublished report prepared by the Wyoming Natural Diversity Database, Laramie, WY.

Author: Walter Fertig
Edition Date: 94-03-08

Penstemon caryi Occurrence # 004
Black Mountain Quad

T53N R90W S11 (TRS approximate, taken from quad)
Bighorn Range, "along Shell Creek".



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 005

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Bush Butte
Latitude: 442555N (centrum)
South Latitude: 442357N
North Latitude: 442750N
Longitude: 1073320W (centrum)
East Longitude: 1073127W
West Longitude: 1073552W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T51N R89W S4 (NE4NE4), S7 (N2 of SE4 & SW4), S8 (NE4 OF SW4), S17 (NE4); T52N R89W S19 (SE4SE4); S29 (NE4 of SE4), S30 (NE4NE4), S34 (SE4); T51N R90W S12 (NW4 of SE4).
Location: Bighorn Range, ridge system between Trapper Creek and Dry Medicine Lodge Creek, including slopes above Webber Canyon and south rim of Trapper Canyon southeast of Bush Butte. Occurrence consists of 6 main subpopulations: (1) along Alkali Road near head of Webber Canyon and Sheep springs Canyon near old tar sands mine, ca 2.5 air miles south of Trapper Canyon [Sec 4], (2) 5 small colonies along north and south side of road on divide between Webber Canyon and Alkali Creek beginning ca 0.9 miles west of junction with Alkali Road and extending 1.75 miles to west [Secs 7, 8, & 12], (3) near head of Alkali Creek on north side of two-track ca 0.4 miles west of Alkali Road [Sec 17], (4) south side of Alkali Road on divide between upper end of Sheep Springs Canyon and head of southern tributary of Trapper Creek, ca 2 miles SSW of confluence of Jack Creek and Trapper Creek [Sec 34], (5) southwest rim of Trapper Canyon, ca 2 air miles southeast of Bush Butte on north side of two-track [Sec 19/30], and (6) upper reach of first major tributary of Trapper Creek, ca 1 mile south of the main stem of Trapper Canyon [Sec 29].

Population Data
Last Observed: 2000-06-30
First Observed: 1979-06-22
Data: Known from 10 subpopulations in a V-shaped area ca 4.5 x 4 miles wide.

2000-06-30: T52 R89 S19/30 - 38 plants counted, 60 estimated in survey by Laura Welp. 30% in fruit/flower, 70% vegetative. T52 R89 S34 - 50 plants counted, 75 estimated by Welp. 75% in flower, 25% vegetative. T51 R89 S8 - 379 plants counted, 500 estimated. 40% in fruit, 30% in flower, 30% vegetative. T51 R89 S7 - 113 plants counted, 200 estimated. 20% in flower, 60% in fruit, 20% vegetative.

2000-06-29: 3 monitoring plots established by L. Welp in Sec 4 NE4NE4 (plots 1-2) and Sec 8 W2 (plot 3). 43.6-57.1% of plants in flower or fruit in these plots. Density ranges from 4.5-6.6 plants per square meter, with 1.9-3.7 vegetative and 2.6-2.9 reproductive.

2000-06-08: 2 small colonies observed by R. Dorn in Sec 7-8 line and Sec 12. Plants in flower. Populations both consist of “small plants” averaging 15-18 mm tall.
Occurs with *Phacelia hastata, Heterotheca,*

Penstemon laricifolius, & Petrophyton.

1999-06-26: Sec 8 colony: Observed in flower and fruit by L. Welp. 227 counted, 500-700 estimated in 5m x 50m area. 40% in fruit and flower, 50% in flower, 10% vegetative. Associated with *Lupinus, Oenothera,* and *Phacelia.*

1989-06-24: Sec 4 NE4: observed in flower by Hollis Marriott. Population estimated at 50 plants (not all suitable habitat investigated). Sec 29: ca 200 plants observed by Marriott.

1989-06-23: Sec 19/30 colony: ca 200 plants in flower and fruit observed by H. Marriott.

1979-07-09: observed in flower and fruit by B.E. Nelson.

1979-06-22: Sec 7 SE4: observed in flower and fruit by R. Dorn. Occurs with *Artemisia, Erigeron, Sedum, Juniperus,* and *Pinus flexilis.*

Habitat: Sec 19/30: Sparsely vegetated sandy soil among small calcareous sandstone outcrops in sagebrush grassland with *Oryzopsis hymenoides, Bromus tectorum,* and *Elymus lanceolatus*. Substrate derived from Tensleep Sandstone and the Amsden Formation. Sec 7/8: sandy soil on limestone outcrop. Sec 12: sandy pockets on limestone-sandstone outcrop. Sec 4: disturbed sandy soil near outcrops with juniper and sagebrush. Sec 19/30: sparsely vegetated sandy soil among outcrops.
Elevation: 6400-8000 feet
Size: 10 acres

Comments: Includes former EOs 006, 011, 015, 016, and 017 included in Marriott and Jones' 1989 report. These occurrences are all in the same general vicinity and their patchiness reflects the patchy distribution pattern of suitable habitat.

Managed Area: BLM Worland Field Office, Trapper Creek Wilderness Study Area.

Specimens: Dorn, R.D. (3252, 3253). 1979. RM; (8272, 8273). 2000. RM.
Nelson, B.E. (3404). 1979. RM.
Marriott, H. (11023). 1989. RM.
Welp, L. (7982). 1999. (RM).

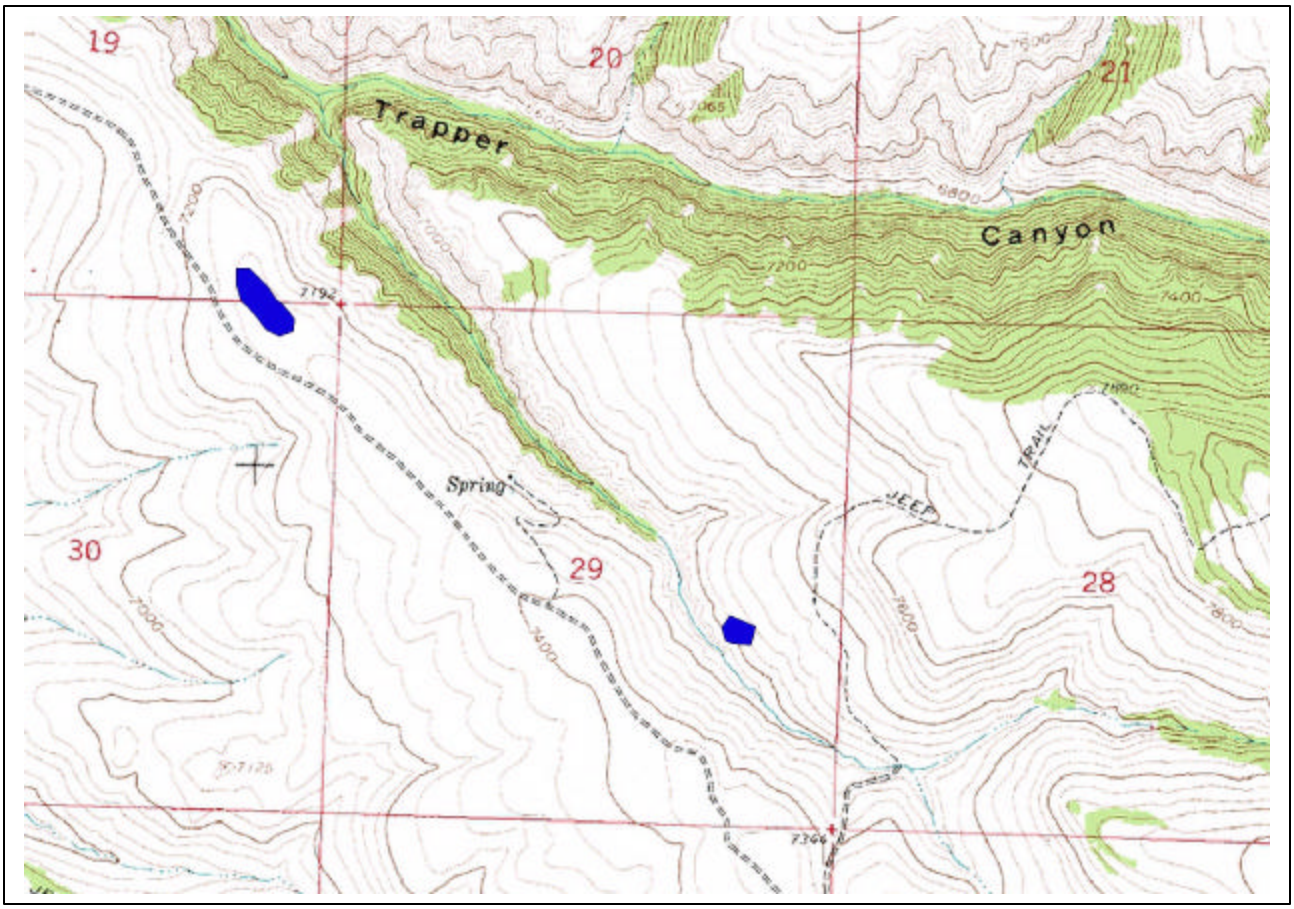
Sources:
Marriott, H. and G.P. Jones. 1989. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Prepared for the Worland District Office of the Bureau of Land Management by the Wyoming Natural Diversity Database.

Author: Walter Fertig
Edition Date: 01-10-03

Penstemon caryi Occurrence # 005 (north end)
Bush Butte Quad

T52N R89W S19 (SE4SE4); S29 (NE4 of SE4), S30 (NE4NE4)

Bighorn Range, ridge system between Trapper Creek and Dry Medicine Lodge Creek, including slopes above Webber Canyon and south rim of Trapper Canyon southeast of Bush Butte.
Two of six subpopulations: (#5) southwest rim of Trapper Canyon, ca 2 air miles southeast of Bush Butte on north side of two-track [Sec 19/30], and (#6) upper reach of first major tributary of Trapper Creek, ca 1 mile south of the main stem of Trapper Canyon [Sec 29].

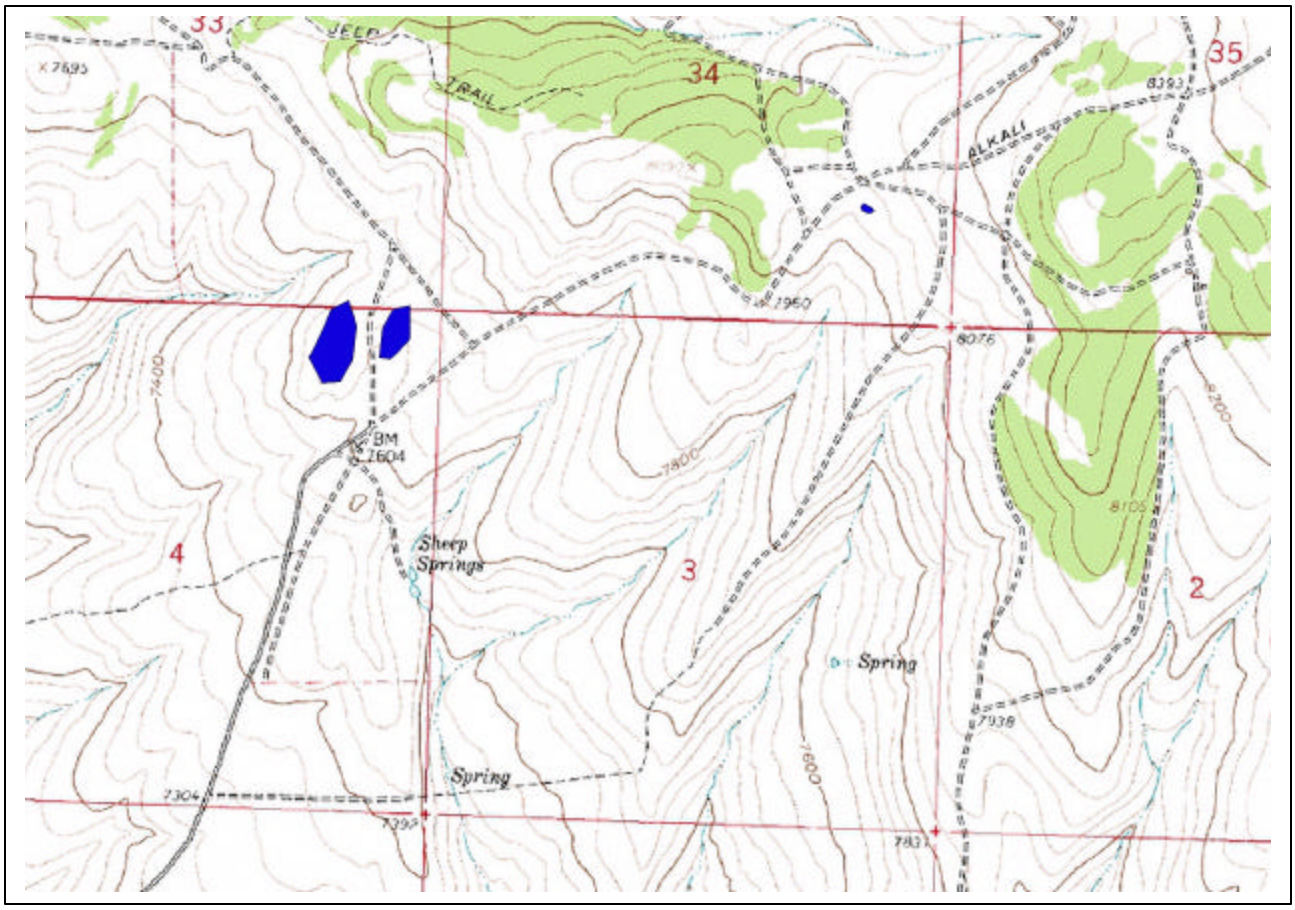


Penstemon caryi Occurrence # 005 (middle)
Bush Butte Quad

T51N R89W S4 (NE4NE4); T52N R89W S34 (SE4)

Bighorn Range, ridge system between Trapper Creek and Dry Medicine Lodge Creek, including slopes above Webber Canyon and south rim of Trapper Canyon southeast of Bush Butte.
Two of six subpopulations: (#1) along Alkali Road near head of Webber Canyon and Sheep springs Canyon near old tar sands mine, ca 2.5 air miles south of Trapper Canyon [Sec 4], (#4) south side of Alkali Road on divide between upper end of Sheep Springs Canyon and head of southern tributary of Trapper Creek, ca 2 miles SSW of confluence of Jack Creek and Trapper Creek [Sec 34],

Demographic monitoring plots 1 & 2 are located in Sec 4 NE4NE4 (see Appendix C).

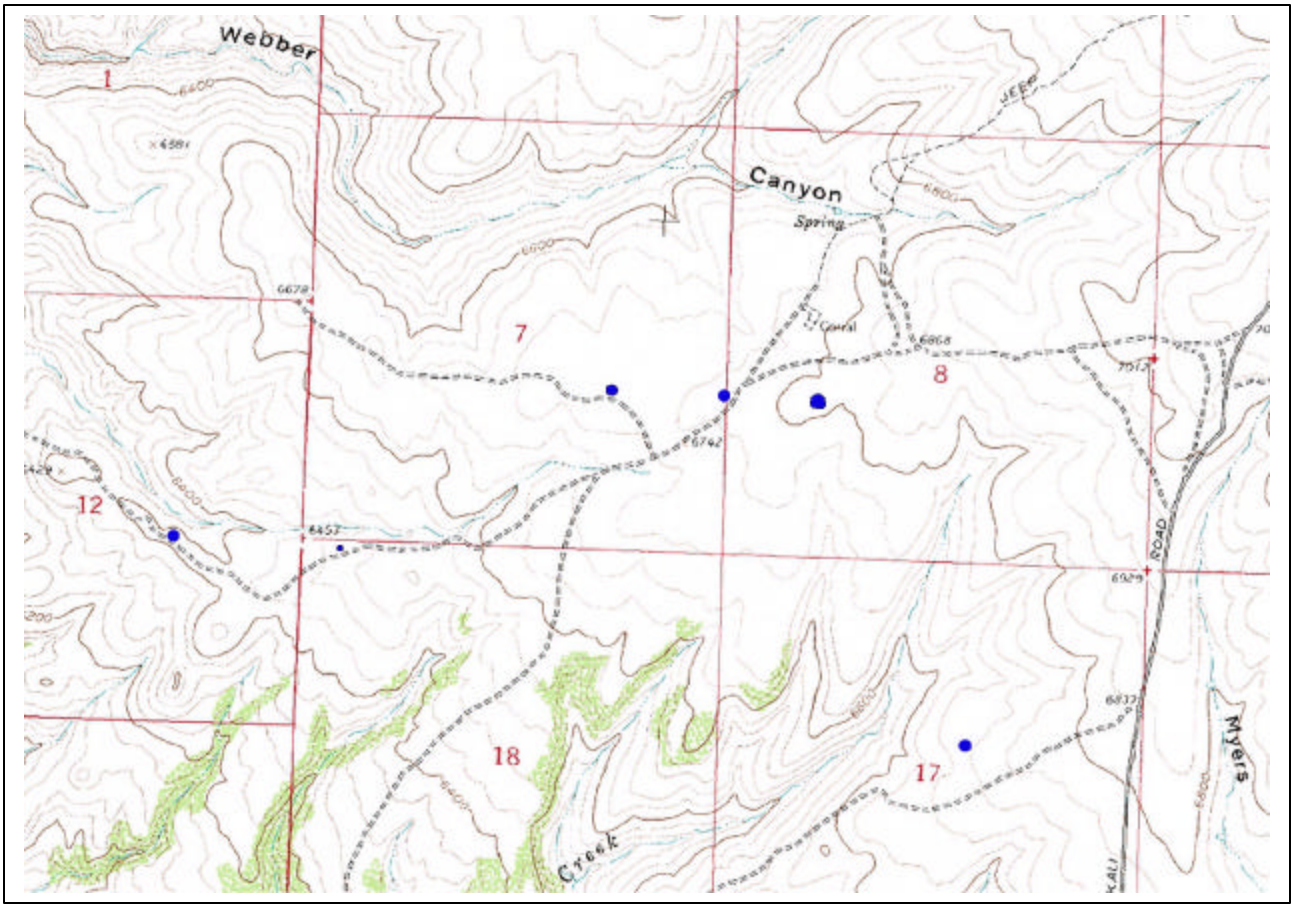


Penstemon caryi Occurrence # 005 (south end)
Bush Butte Quad

T51N R89W S7 (N2 of SE4 & SW4), S8 (NE4 OF SW4), S17 (NE4);
T51N R90W S12 (NW4 of SE4).

Bighorn Range, ridge system between Trapper Creek and Dry Medicine Lodge Creek, including slopes above Webber Canyon and south rim of Trapper Canyon southeast of Bush Butte. Two of six subpopulations: (#2) 5 small colonies along north and south side of road on divide between Webber Canyon and Alkali Creek beginning ca 0.9 miles west of junction with Alkali Road and extending 1.75 miles to west [Secs 7, 8, & 12], (#3) near head of Alkali Creek on north side of two-track ca 0.4 miles west of Alkali Road [Sec 17].

Demographic monitoring plot # 3 located in Sec 8 W2 (see Appendix C).



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 008

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Names: Natural Trap Cave and Simmons Canyon
Latitude: 445627N (centrum)
South Latitude: 445608N
North Latitude: 445651N
Longitude: 1080835W (centrum)
East Longitude: 1080540W
West Longitude: 1080913W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T57N R94W S2 (NW4 of SE4); S11 (NE4NE4NE4); T57N R93W S8
Location: Bighorn Range, Little Mountain, ca 2 air miles east of Bighorn Lake and 5.5-6 miles northeast of US Highway Alt 14. 3 main subpopulations: (1) west slope of Little Mountain near Kane BM (Sec 12), ca 14.5 air miles northeast of Lovell. (2) northeast side of Little Mountain near Godes Spring, ca 1 mile south of Devil Canyon (Sec 8). (3) northwest flank of Little Mountain near the John Blue Canyon Road (Sec 2 & 11).

Population Data
Last Observed: 2000-07-01
First Observed: 1979-06-23
Data: 2000-07-01: Population in T57 R94 S2 - 425 plants counted, 500 estimated. 75% in fruit, 25% vegetative (L. Welp).

2000-06-16: 200 plants observed in population by Andrew Lutz. Population was nearly finished blooming. Most plants were on the border of Section 11 and 2. Sections 8 and 12 were not visited.

1999-06-23: Sec 2 colony: Population scattered along roadside in areas of suitable habitat. Total population estimated at 300 plants by L. Welp. 80% in flower, 10% in fruit, and 10% vegetative. Occurs with *Hordeum, Arenaria hookeri*, and *Elymus lanceolatus*.

1980-06-11: Observed in flower and fruit at 2 sites (sec 8 and 12) by B.E. Nelson.

1979-06-23: Sec 2 colony: Observed in flower and fruit by R. Dorn. Occurs with *Hymenoxys* and *Juniperus*.

Habitat: Known from 3 main habitats: (1) disturbed roadside at edge of burn on dry, rocky limey-sandstone in open juniper woodlands, (2) stony, grassy slopes. (3) rocky calcareous banks. Substrates derived from the Tensleep and Amsden formations.
Elevation: 5400-6100 feet
Size: 4-5 acres

Comments: Includes former EO # 009.

Managed Area: BLM Cody Field Office (Little Mountain ACEC)

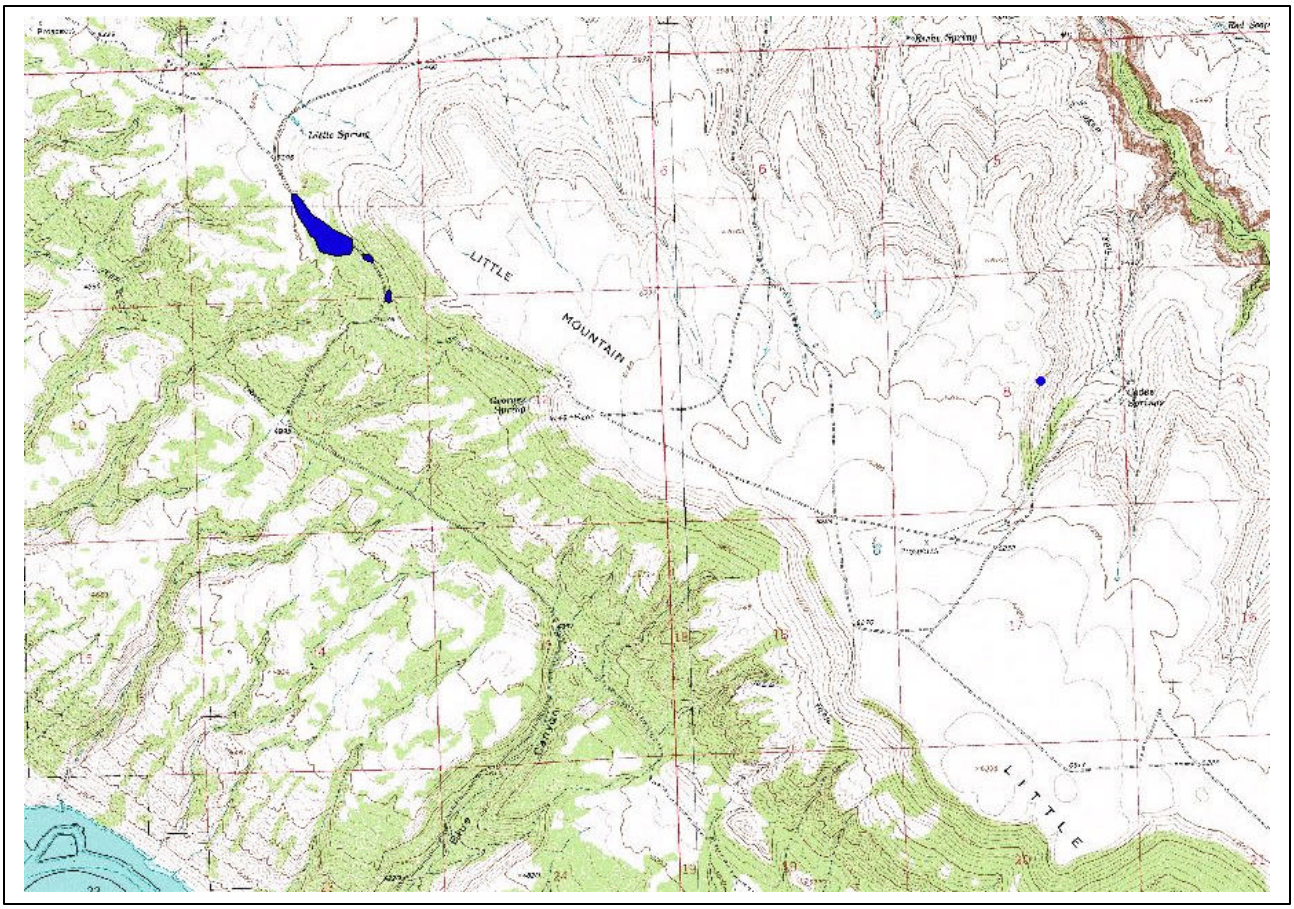
Specimens: Nelson, B.E. (5392, 5418). 1980. RM.
Dorn, R.D. (3262). 1979. RM.

Author: Walter Fertig Edition Date: 00-06-04

Natural Trap Cave and Simmons Canyon quads

T57N R94W S2 (NW4 of SE4); S11 (NE4NE4NE4); T57N R93W S8

Bighorn Range, Little Mountain, ca 2 air miles east of Bighorn Lake and 5.5-6 miles northeast of US Highway Alt 14. 3 main subpopulations: (1) west slope of Little Mountain near Kane BM (Sec 12), ca 14.5 air miles northeast of Lovell. (2) northeast side of Little Mountain near Godes Spring, ca 1 mile south of Devil Canyon (Sec 8). (3) northwest flank of Little Mountain near the John Blue Canyon Road (Sec 2 & 11).



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 012

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Sheridan
USGS Quad Name: Burgess Junction
Latitude: 445215N (centrum)
Longitude: 1073130W (centrum)
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T57N R88W S31
Location: Bighorn Range, southeastern half of Dry Fork Ridge, ca 7 air miles north of Burgess Junction and ca 13.5 air miles west of Dayton.

Population Data
Last Observed: 1979-07-15
First Observed: 1979-07-15
1979-07-15: observed in flower by B.E. Nelson.

Habitat: Rocky slope. Substrate derived from Bighorn Dolomite or Madison Limestone.
Elevation: 8400 feet
Size: Not reported

Managed Area: Bighorn National Forest

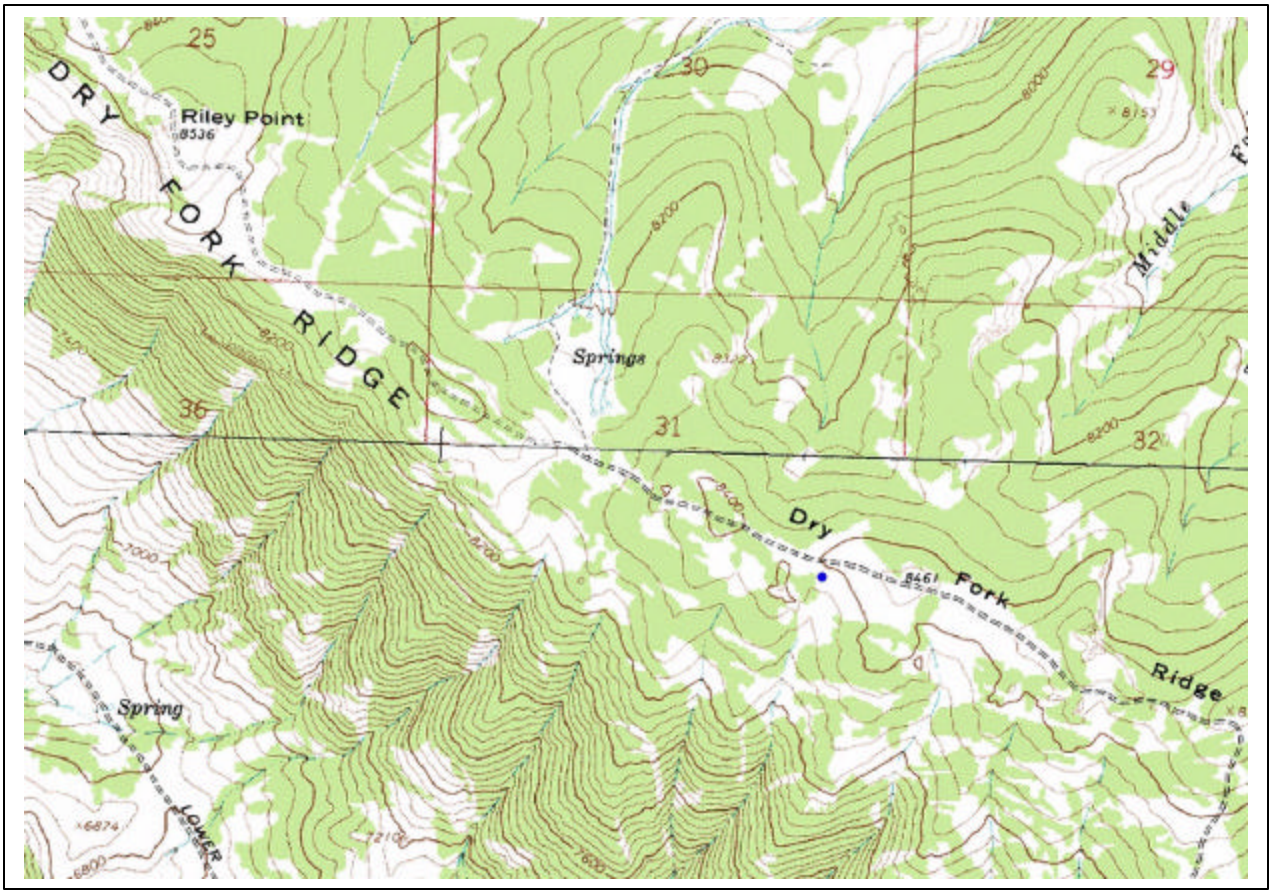
Specimens: Nelson, B.E. (3744). 1979. RM.

Author: Walter Fertig
Edition Date: 97-03-10

Penstemon caryi Occurrence # 012
Burgess Junction Quad

T57N R88W S31

Bighorn Range, southeastern half of Dry Fork Ridge, ca 7 air miles north of Burgess Junction and ca 13.5 air miles west of Dayton.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 013

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Sheridan
USGS Quad Name: Bull Elk Park
Latitude: 445815N (centrum)
Longitude: 1074120W (centrum)
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T58N R90W S26 (SE4)
Location: Bighorn Range, summit and upper slopes of Fisher Mountain west of the Little Bighorn River.

Population Data
Last Observed: 1979-06-25
First Observed: 1979-06-25
1979-06-25: Observed in flower by Hartman and Odasz.

Habitat: Limestone outcrops [probably Madison Limestone].
Elevation: 7390 feet
Size: Not recorded

Managed Area: Bighorn National Forest (may occur in the potential Mann Creek Research Natural Area).

Specimens: Hartman, R.L. and A. Odasz (9418). 1979. RM.

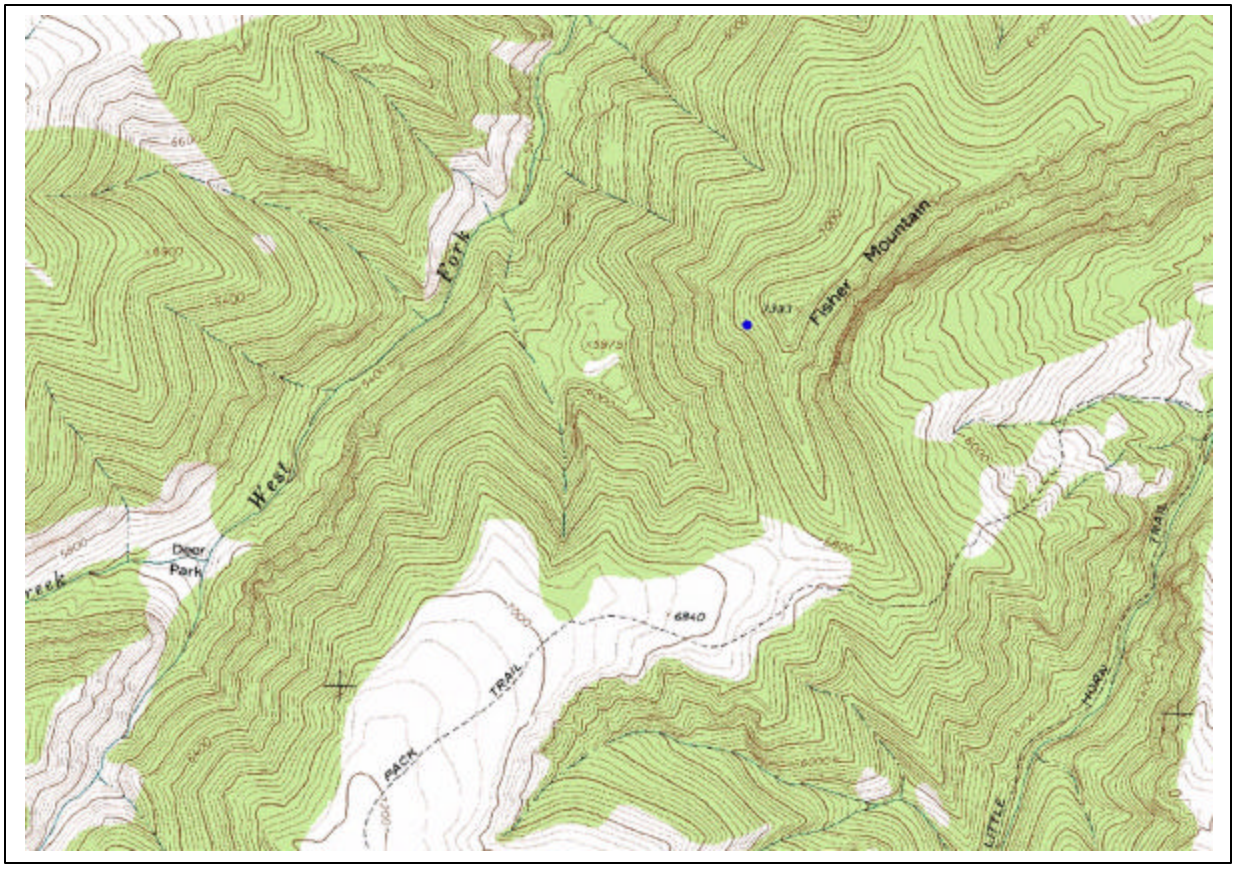
Sources:
Jones, G.P. and W. Fertig. 1998. Ecological evaluation of the Mann Creek potential research natural area within the Bighorn National Forest, Sheridan County, Wyoming. Unpublished report prepared for the Bighorn National Forest, USDA Forest Service by the Wyoming Natural Diversity Database. Laramie WY.

Author: Walter Fertig
Edition Date: 97-03-10

Penstemon caryi Occurrence # 013
Bull Elk Park Quad

T58N R90W S26 (SE4)

Bighorn Range, summit and upper slopes of Fisher Mountain west of the Little Bighorn River.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 014

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Washakie
USGS Quad Names: Big Trails NE, Monument Hill, Old Maid Gulch, and Onion Gulch.
Latitude: 435945N (centrum)
South Latitude: 435930N
North Latitude: 440035N
Longitude: 1071336W (centrum)
East Longitude: 1071212W
West Longitude: 1071520W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T47N R87W S26 (NE4 of SE4 & SE4SE4); S36 (SW4 of NE4); T47N R86W S31 (N2 of SE4 & W2 of SW4 of NE4); S32 (N2 of SE4 of NW4, NW4NW4 of SE4, E2 of SE4SE4); S33 (NE4 of SW4SW4).
Location: West slope Bighorn Range, 13 subpopulations located on Cooks Vee on south rim of Canyon Creek Canyon and east side of Cooks Canyon, 1-2 miles north of Rome Hill Road.

Population Data
Last Observed: 2001-06-24
First Observed: 1989-06-21
2001-06-24: Sec 32 SE4 - small colony of 10-20 plants observed in flower and fruit near trailhead of Top of the World Trail by W. Fertig and members of the WY Native Plant Society.

2001-summer: 53 reproductive plants and 57 vegetative plants observed at Billy Creek monitoring plot. 19 reproductive plants observed in 11 transects on Cooks Vee (density of 1.9/square meter). Total population estimated at 3400 individuals by Ann Humphrey, based on an observed 36% increase in numbers in sample plots since last rough estimate in 1994.

1998-summer: 17 reproductive plants observed in 11 monitoring transects on Cooks Vee (density averages 1.7/square meter). 20% of the sampled population produced only one flower stalk, while 24% produced 5 or more flower stalks per plant.

1997-summer: 47 reproductive plants and 28 vegetative plants observed at Billy Creek monitoring plot. 15 reproductive plants observed in 11 transects on Cooks Vee (density of 1.5/square meter).

1996-summer: 29 reproductive plants and 21 vegetative plants observed in Billy Creek plot. 10 reproductive plants observed at 11 monitoring transects on Cooks Vee (average 1 plant/square meter). 33% of all individuals produced one flowering stalk, and 12% produced 5 or more flower stalks per plant.

1995-summer: 92 reproductive and 4 vegetative plants observed in Billy Creek monitoring plot. 14 reproductive plants observed in 11 monitoring transects on Cooks Vee (1.4/square meter).

1994-06: population estimated at 2500 individuals by Humphrey and Shephard based on 11 sampling transects established to estimate population densities on Cooks Vee.

47 reproductive and 23 vegetative plants observed in 2.5 m radius Billy Creek permanent plot (Sec 33 SW4).

1993-summer: 2080 reproductive plants counted in census by A. Humphrey, P. Shephard, and Preserve staff. Total of 19 patches observed, 13 of which were ranked as abundant or common. This species appears to occupy about 10% of the available potential habitat surveyed on the preserve. Common associated species include *Senecio canus, Festuca idahoensis, Ivesia gordonii, Ipomopsis spicata, Arenaria congesta, Juniperus osteosperma,* and *Koeleria macrantha*.

1992-05: ca. 300 flowering plants observed by Fertig, Humphrey, and Shephard in cursory survey of 9 subpopulations. Individual populations often small, numbering 10-100 plants. Occurs with *Petrophyton caespitosum, Ivesia gordonii, Heterotheca fulcrata, Erigeron ochroleucus, E. divergens, Astragalus spatulatus, Penstemon nitidus, Mahonia repens,* and *Sedum lanceolatum*.

1989-06-21: Sec 26 NW4SE4: ca 50 plants observed near the old Cadette corrals by Hollis Marriott. Occurs with *Petrophyton* and *Juniperus*.

Habitat: Found in 2 main vegetation types: (1) thin soils on flat, exposed limestone bedrock with shallow erosion pockets and low vegetative cover surrounded by Juniper/sagebrush grasslands. (2) large limestone boulders with shallow pockets of soil within limber pine/ponderosa pine woods. Substrates derived from the Tensleep and Amsden formations.
Elevation: 5750-6600 feet
Size: 40 acres

Managed Area: TNC Tensleep Preserve.
Management Comments: Grazing in the area could be potentially damaging, mostly from trampling if animal activity is congregated in one area of habitat. Monitoring studies using exclosures were established in 1994 to determine the impacts of grazing and trampling on this species. Results as of 2001 indicate that direct grazing by cattle is very low on *Penstemon caryi*, but that trampling can be a problem where animals congregate. Most herbivory appears to be from small-mouthed animals, most likely rabbits (Humphrey 2001).

Specimens: Fertig, W., A. Humphrey and P. Shephard (12568, 12607). 1992. RM.
Fertig, W. (12581, 12584). 1992. RM.
Marriott, H. (11015). 1989. RM.

Sources:
Humphrey, A. and P. Shephard. 1994. Status report: longterm monitoring of *Penstemon caryi* on The Nature Conservancy's Tensleep Preserve, Ten Sleep, Wyoming. Unpublished report prepared for the TNC Wyoming State Office.

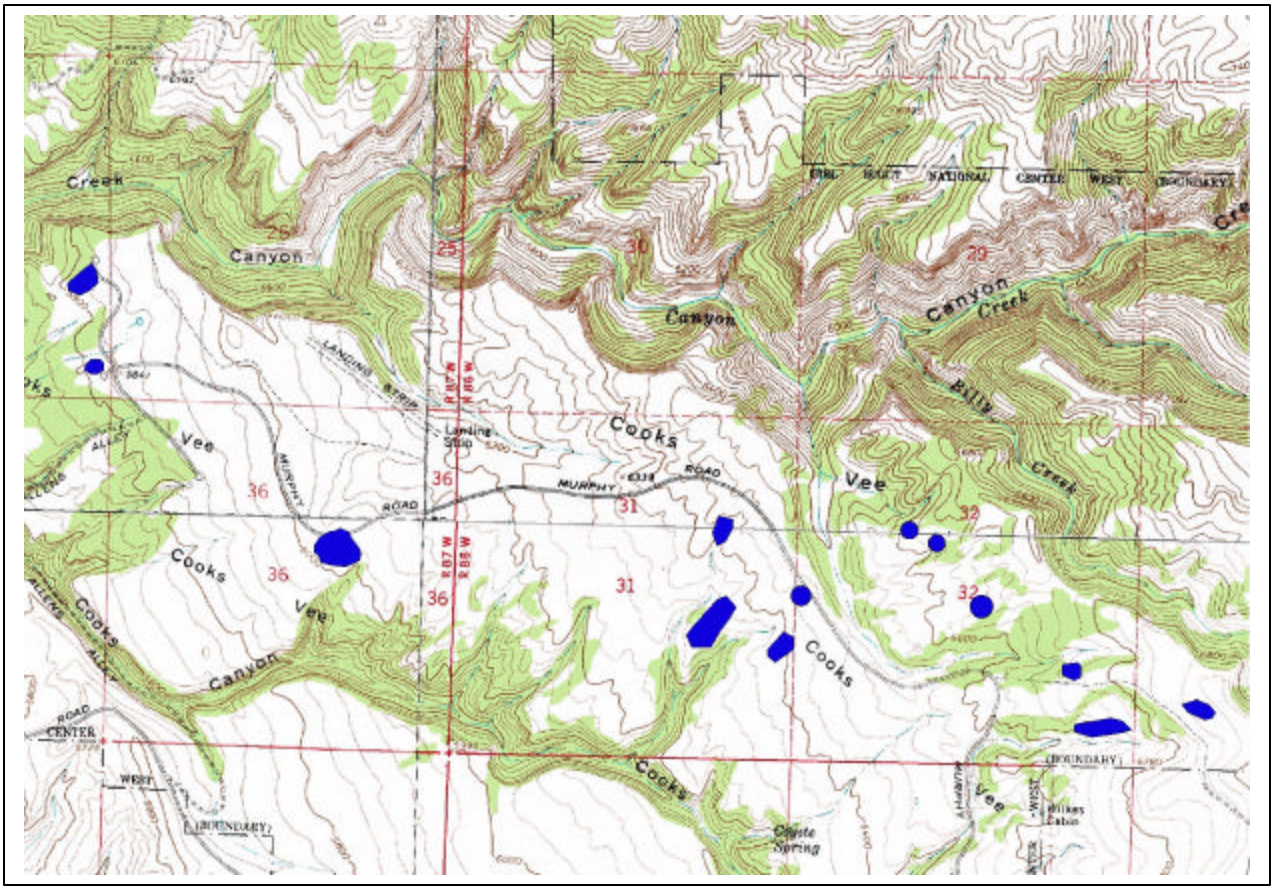
Humphrey, A. 2001. Status report of *Penstemon caryi* monitoring on the Tensleep Preserve. Report prepared for the Nature Conservancy Wyoming Field Office.

Author: Walter Fertig
Edition Date: 01-10-03

Penstemon caryi Occurrence # 014
Big Trails NE, Monument Hill, Old Maid Gulch, and Onion Gulch quads

T47N R87W S26 (NE4 of SE4 & SE4SE4); S36 (SW4 of NE4); T47N R86W S31 (N2 of SE4 & W2 of SW4 of NE4); S32 (N2 of SE4 of NW4, NW4NW4 of SE4, E2 of SE4SE4); S33 (NE4 of SW4SW4).

Bighorn Range, 13 subpopulations located on Cooks Vee on south rim of Canyon Creek Canyon and east side of Cooks Canyon, 1-2 miles north of Rome Hill Road.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 018

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Allen Draw
Latitude: 441955N (centrum)
South Latitude: 441940N
North Latitude: 441955N
Longitude: 1072845W (centrum)
East Longitude: 1072843W
West Longitude: 1072847W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T50N R89W S1 (E2 of SE4); T50N R88W S5 (SW4SW4)
Location: Bighorn Range, south rim of Medicine Lodge Canyon below confluence with Captain Jack Creek, just north of Cold Springs Road, ca 8.5 air miles northeast of Hyattville.

Population Data
Last Observed: 1989-06-30
First Observed: 1910-06-04
2000-06-28: Population on north side of road has 142 plants in 150m x 100m area based on survey by Laura Welp. 1% in flower, 60% vegetative, 40% in fruit. Plants concentrated in small area. Population on south side of road contained 109 plants (150 estimated). 30% of the plants were in flower, 20% in fruit, 50% vegetative. Associated species include *Koeleria macrantha, Elymus* spp., *Gilia* sp., *Penstemon laricifolius*, and *Senecio canus*.

2000-06-14: Population size estimated at 350 by Andrew Lutz.

1989-06-30: Ca 50 plants observed in flower by Hollis Marriott.

1910-06-04: observed in flower by Merritt Cary.

Habitat: Sandy, sparsely vegetated soil among small calcareous sandstone outcrops in sagebrush grassland on ridgecrest. Also on open knoll with exposed calcareous outcrops and blowouts among rolling sagebrush plains with scattered juniper. Aspect is flat and soil is sandy with coarse gravel and rocks. Substrate is derived from Madison Limestone.
Elevation: 6700-6900 feet
Size: 3 acres

Comments: This EO may be very near the type location of Cary based on Payson's interpretation of Cary's field notes and itinerary (Payson 1924).

Managed Area: BLM Worland Field Office (Spanish Point Karst ACEC; Medicine Lodge WSA).
Management Comments: Populations are near road and campsite.

Specimens: Marriott, H.J. (11027). 1989. RM.
Cary, M. (504). 1910. US holotype.

Sources:
Marriott, H. and G.P. Jones. 1989. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the

Spanish Point Karst ACEC. Prepared for the Worland District Office of the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, WY.

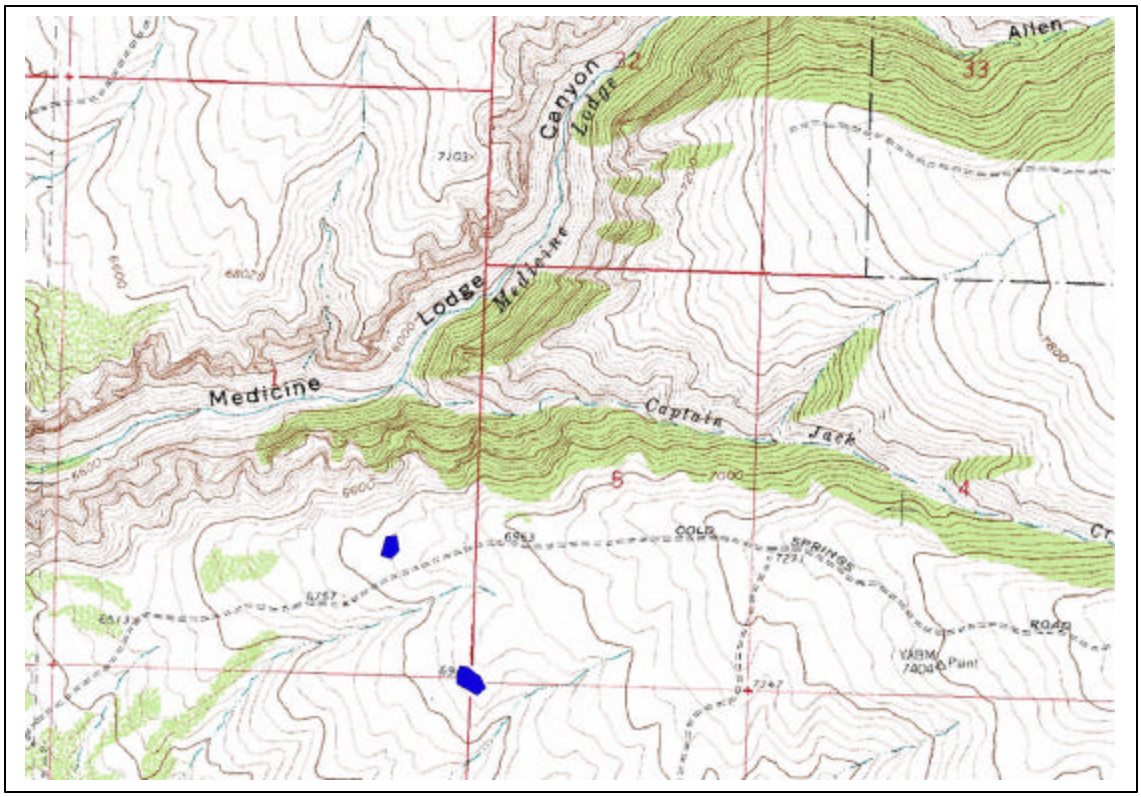
Payson, E.B. 1924. The Species of *Penstemon* native of Wyoming. Univ. of Wyoming Publ. Science 4:88-103.

Author: Walter Fertig
Edition Date: 97-03-10

Penstemon caryi Occurrence # 018
Allen Draw Quad

T50N R89W S1 (E2 of SE4); T50N R88W S5 (SW4SW4)

Bighorn Range, south rim of Medicine Lodge Canyon below confluence with Captain Jack Creek, just north of Cold Springs Road, ca 8.5 air miles northeast of Hyattville.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 022

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Medicine Wheel
Latitude: 445135N (centrum)
Longitude: 1075850W (centrum)
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T56N R92W S6 (SW4 of NW4).
Location: Bighorn Range, road to Cottonwood Cow Camp [the road past the Medicine Wheel may no longer be open to traffic].

Population Data
Last Observed: 1993-07-14
First Observed: 1993-07-14
1993-07-14: ca 100 plants observed in area of 1-2 acres. Occurs with *Stipa, Festuca idahoensis, Lupinus, Achillea, Erigeron*. Distribution patchy.

Habitat: South-facing, dry slope on shallow, limestone soils. May be in an old burn site. Substrate derived from Madison Dolomite.
Elevation: 8040 feet
Size: 1-2 acres

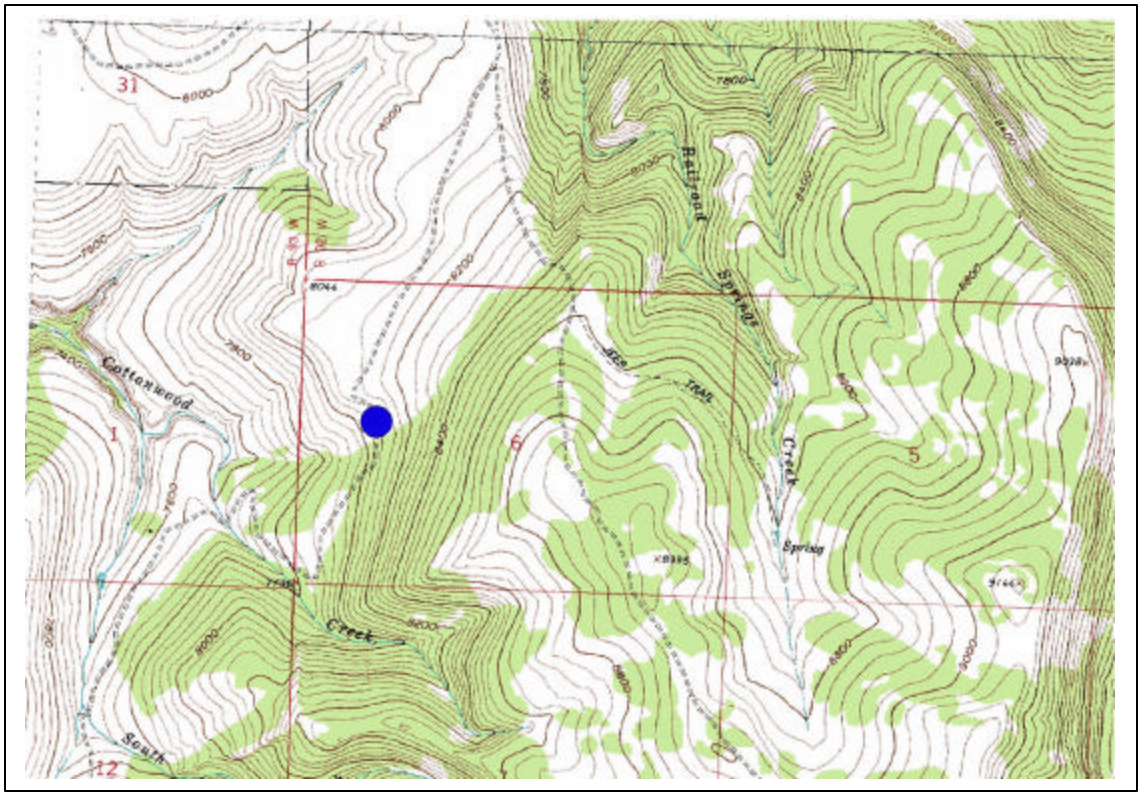
Managed Area: Bighorn National Forest.

Specimens: Girard, M. (s.n.). 1993. RM.

Author: Walter Fertig
Edition Date: 94-03-08

Penstemon caryi Occurrence # 022
Medicine Wheel Quad

T56N R92W S6 (SW4 of NW4).
Bighorn Range, road to Cottonwood Cow Camp.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 023

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Shell Falls
Latitude: 443445N (centrum)
South Latitude: 443433N
North Latitude: 443445N
Longitude: 1073228W (centrum)
East Longitude: 1073228W
West Longitude: 1093240W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T53N R89W S10, S14 (N1/4), S15
Location: West slope Bighorn Mountains, north slope Shell Canyon, ca 3-4 air miles south-southeast of Cedar Mountain, ca 0.1-0.3 air miles east-northeast of Granite Creek campground.

Last Observed: 2000-07-01
First Observed: 1995-07-04
2000-07-01: One subpopulation discovered in T53 R89 S14 by Laura Welp. 17 individuals counted, 30 estimated in an area ca 100 x 400 meters. 5% in flower, 40% in fruit, 55% vegetative. Associated species include *Erigeron allocotus, Astragalus miser*, and *Penstemon laricifolius.*

2000-06-15: 2 plants found in section nearest to highway 14, and 75 individuals in section further away from the road (Andrew Lutz). Plants in bud and flower.

1999-07-13: Sec 23 colony- Observed in flower by R. Dorn.

1995-07-04: Two subpopulations discovered by K. Zacharkevics. Sec 10 colony: ca 40+ randomly spaced flowering plants observed with *Artemisia tridentata, Juniperus, Taraxacum officinale, Achillea millefolium, Cirsium* spp., *Linum*, and *Poa.* Sec 15: ca 90+ randomly spaced individuals, associated with *Artemisia tridentata, Balsamorhiza sagittata,* and *Castilleja.*

Habitat: In "grassy" sagebrush or sagebrush/juniper communities on a northwest-facing hillside with a slope between 20% and 25%. Occurs on limestone outcrops or gravelly limestone soil. Population in Section 14 occurs on artificially disturbed, steep, rocky, calcareous slope with *Elymus, Artemisia tridentata* var. *vaseyana*, and scattered juniper. Substrate derived from Bighorn Dolomite.
Elevation: 7360-7640 feet
Size: 5 acres

Managed Area: Bighorn National Forest
Management Comments: Occurrence is in a cattle allotment. High density of exotics (*Melilotus, Verbascum, Phleum pratense*) in Section 14 population.

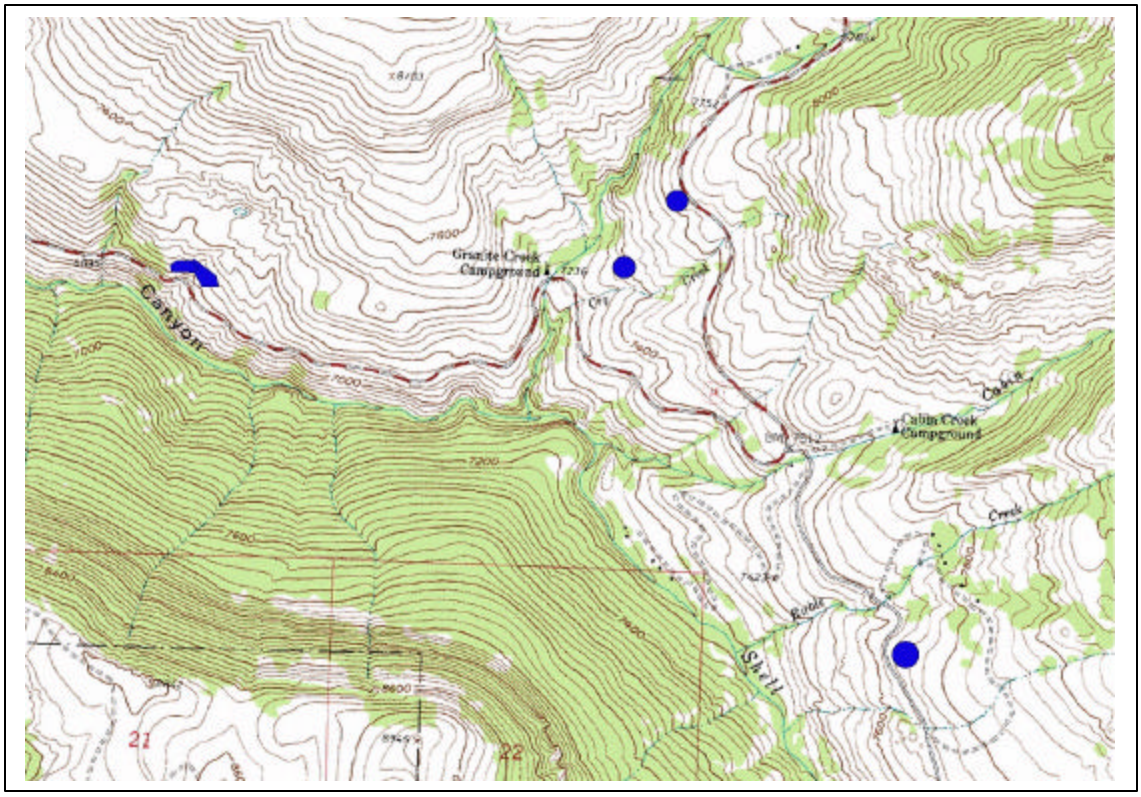
Specimens: Dorn, R. (8031). 1999. RM.
Welp, L. (8017). 2000. RM.

Author: Walter Fertig
Edition Date: 01-09-29

Shell Falls Quad

T53N R89W S10, S14 (N1/4), S15

Bighorn Range, north slope Shell Canyon, ca 3-4 air miles south-southeast of Cedar Mountain, ca 0.1-0.3 air miles east-northeast of Granite Creek campground.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 024

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Sheridan
USGS Quad Name: Ice Creek
Latitude: 444530N (centrum)
Longitude: 1074305W (centrum)
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T55N R90W S7 (SE4 of NW4)
Location: Bighorn Range, adjacent to the north side of US Highway 14A on talus road cut, ca 1 mile west of Ice Creek.

Last Observed: 2000-06
First Observed: 1999-08-16
2000-06: Observed in bud by Andrew Lutz.

1999-08-16: 80-100 individuals observed mostly (98%) in vegetative state by K. O'Dea. Occurs with *Geranium viscosissimum, Cirsium*, and *Campanula*.

Habitat: Talus road cut composed of light brown clay with a high content of slab-like rocks. Area is actively slumping and eroding with very little vegetative cover and a low soil moisture content. Substrate derived from Bighorn Dolomite.
Elevation: 9320 feet
Size: Not reported.

Managed Area: Bighorn National Forest

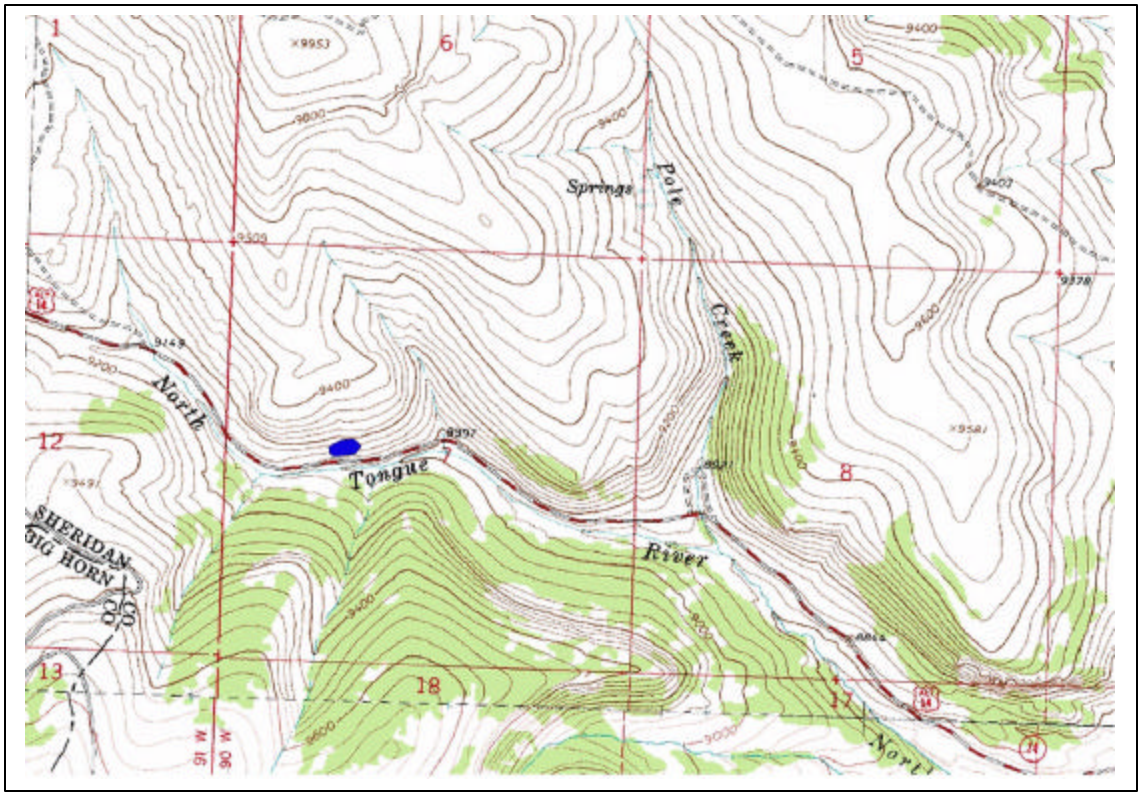
Specimens: O'Dea, K. (035). 1999. Bighorn NF Herbarium.

Author: Kevin O'Dea
Edition Date: 99-12-07

Penstemon caryi Occurrence # 024
Ice Creek Quad

T55N R90W S7 (SE4 of NW4)

Bighorn Range, adjacent to the north side of US Highway 14A on talus road cut, ca 1 mile west of Ice Creek.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 025

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Mexican Hill
Latitude: 445900N (centrum)
Longitude: 1075535W (centrum)
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T58N R92W S27 (NE4NE4)
Location: Bighorn Range: below the rock wall that constitutes the northwest edge of Cookstove Basin, ca 0.5 miles north of Forest Service road 103.

Population Data
Last Observed: 1999-08-17
First Observed: 1999-08-17
1999-08-17: 25-50 individuals, 67% in flower 33% in fruit observed by K. O'Dea. Plants widely scattered over area, sometimes in groups of 2-5. Occurs with *Festuca idahoensis, Artemisia tridentata, Taraxacum officinale, Lupinus polyphyllus, Geranium viscosissimum,* and *Erigeron*.

Habitat: Actively eroding clay hillside dominated by *Lupinus* and bare soil.
Elevation: 7680 feet
Size: 1 acres

Managed Area: Bighorn National Forest.

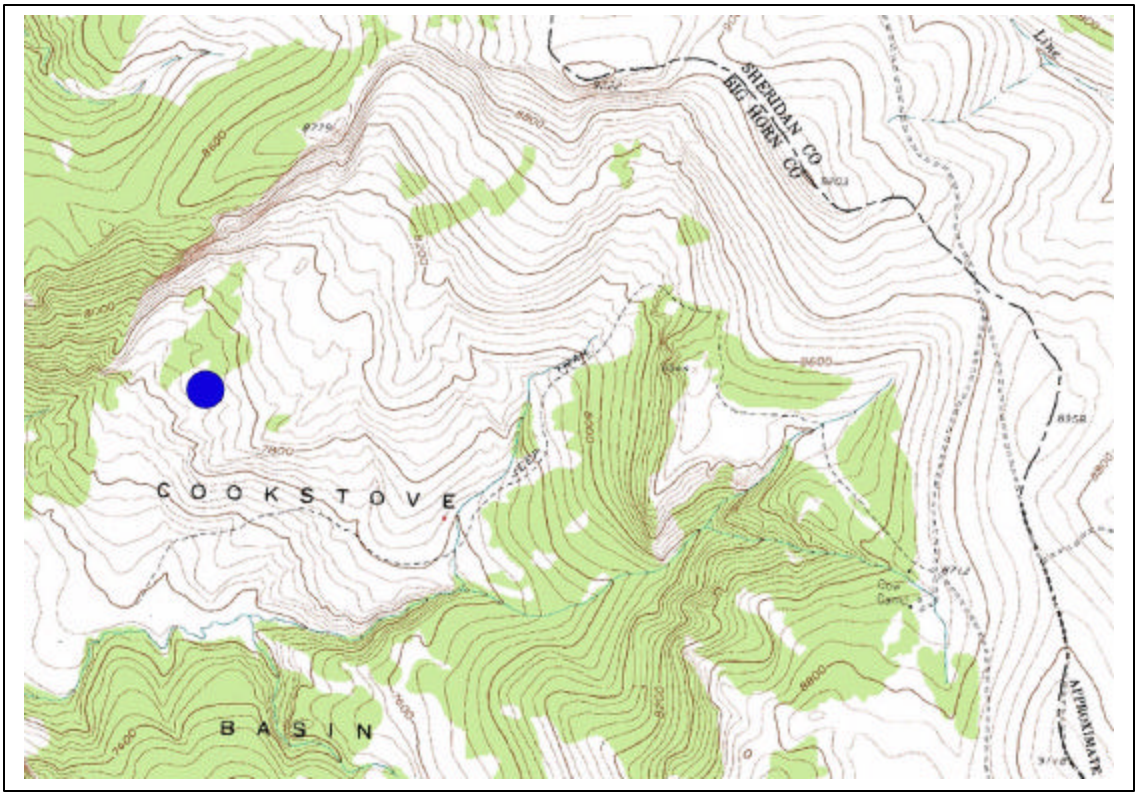
Specimens: O'Dea, K. (042). 1999. Bighorn NF Herbarium.

Author: Kevin O'Dea
Edition Date: 99-12-07

Penstemon caryi Occurrence # 025
Mexican Hill Quad

T58N R92W S27 (NE4NE4)

Bighorn Range: below the rock wall that constitutes the northwest edge of Cookstove Basin, ca 0.5 miles north of Forest Service road 103.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 026

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Names: Pierce Draw and Ten Sleep
Latitude: 440728N (centrum)
South Latitude: 440619N
North Latitude: 440920N
Longitude: 1072412W
East Longitude: 1072139W
West Longitude: 1072412W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T48N R88W S14 (E2 of SW4); S25.
Location: West slope Bighorn Range, two subpopulations: 1) ridgetop between Brokenback Creek and the South Fork of Brokenback Creek, ca 5.5 air miles north-northeast of Tensleep and ca 2 air miles southwest of Sand Springs Draw; and 2) Fertig Draw, ca 5 air miles northwest of Tensleep and ca 4 airmiles west-northwest of the mouth of Leigh Creek.

Population Data
Last Observed: 2000-06-27
First Observed: 2000-06-27
2000-06-27: Sec 14 colony - at least 103 plants observed by L. Welp (estimate may be conservative since plants are multi-branched and often clumped). All plants in fruit. Most plants are small relative to other populations, although a few plants in washes or near trees are larger. Associated species include *Haplopappus nuttallii, H. armerioides, Senecio cana, Opuntia polyacantha, Cryptantha* sp., *Erigeron allocotus and Penstemon laricifolius.*

2000-06: Phil Shephard of the Tensleep Preserve reports that he has observed *P. caryi* in Fertig Draw (exact location not known).

Habitat: Plants are in a relatively restricted area at the base of low dolomite cliffs between two larger canyons. Most are on flat aspects. The dolomite substrate is weathered and soft. Soil is sandy with a thick biotic crust. Vegetation is open, low, and sparse, dominated by *Pinus ponderosa* and *Juniperus* with *Elymus spicatus* and *Koeleria macrantha* with scattered *Cercocarpus ledifolius.* Substrate derived from the Tensleep and Amsden formations.
Elevation: 5500-5600 feet
Size: 2 acres

Comments: Population is in the vicinity of EO # 032.

Managed Area: BLM Worland Field Office

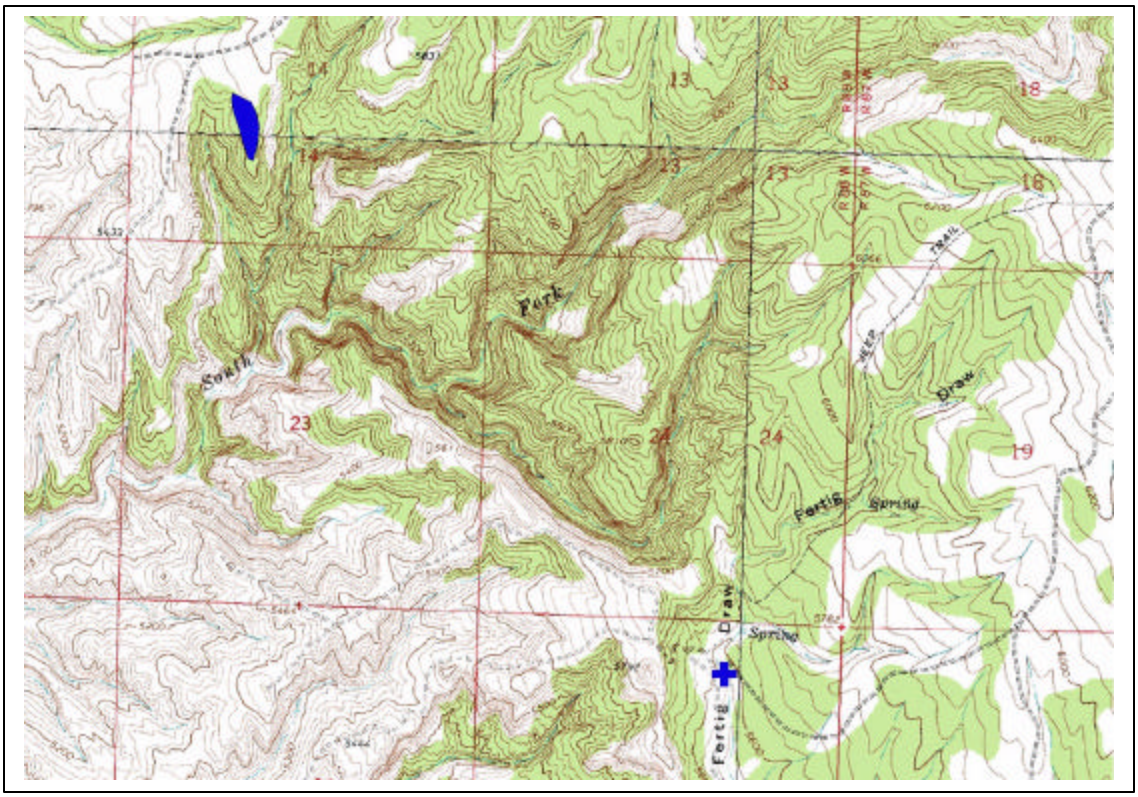
Specimens: Welp, L. (8007). RM.

Author: Walter Fertig
Edition Date: 01-09-28

Penstemon caryi Occurrence # 026
Pierce Draw, Ten Sleep, Brokenback Narrows, and Old Maid Gulch quads

T48N R88W S14 (E2 of SW4); S25.

Bighorn Range, two subpopulations: 1) ridgetop between Brokenback Creek and the South Fork of Brokenback Creek, ca 5.5 air miles north-northeast of Tensleep and ca 2 air miles southwest of Sand Springs Draw; and 2) Fertig Draw, ca 5 air miles northwest of Tensleep and ca 4 airmiles west-northwest of the mouth of Leigh Creek.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 027

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Brokenback Narrows and Pierce Draw
Latitude: 441225N (centrum)
South Latitude: 441137N
North Latitude: 441241N
Longitude: 1072409W (centrum)
East Longitude: 1072214W
West Longitude: 1072513W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T49N R87W S19 (S2 of NE4 & SW4SW4); T49N R88W S14 (SW4SW4 of SE4); S23 (N4 OF SW4); S24 (NW4NW4 & SE4SE4).
Location: Bighorn Basin, along BLM route 1117, extending from 9-11 air miles east of Hyattville and from 2-5 air miles west of the Bighorn Forest boundary.

Population Data
Last Observed: 2001-06-24
First Observed: 2000-06-28

2001-06-24: Sec 19 NE4 colony: Observed in flower and fruit by Claire Leon and Jean Daly on WY Native Plant Society field trip.
2000-06-28: Plants are widely scattered throughout suitable habitat. Five populations: Population in T49 R88 S14 - 8 plants counted. 90% vegetative and 10% in fruit. At least 2 plants showed signs of herbivory. Population in S23 - 30 plants counted and 50 estimated in a 150 x 30 meter area (L. Welp). 40% fruiting, 60% vegetative. Associated species include *Petrophyton caespitosum, Achillea millefolium, Koeleria macrantha, Gutierrezia sarothrae, Bromus tectorum,* and *Erodium cicutarium*. Sec 24 NW4 colony - 19 plants in 5 x 3 meter area. 5% in flower, 45% in fruit, and 50% vegetative. Associated species include *Penstemon aridus, Festuca idahoensis, Erigeron* sp., and *Senecio* sp. Population in Sec 24 SW4 - 15 plants counted, 30 estimated. 25% in flower, 25% in fruit, and 50% vegetative. T49 R87 Sec 19 NE4 colony - Plants scattered in a linear strip ca 12 x 300 meters along the road. 260 plants counted, 400 estimated. Plants here were more clustered than other populations, so the count may be low. A cluster of leaves was counted as a single plant. Associated species include *Senecio* sp., *Castilleja* sp., *Sedum lanceolatum*, *Arenaria hookeri*, *Penstemon laricifolius* var. *exilifolius,* and *P. aridus.*

Habitat: T49 R88 S14, 23-24 colonies – Small flat dolomite outcrops within rolling grassland with scattered juniper and *Cercocarpus ledifolius* or among open stands of Ponderosa and Limber pine. T49 R87 S19 colony- Sparsely vegetated, steep cutbanks along road in loose calcareous soil in stand of mixed Ponderosa pine and Subalpine fir. T49 R88 S24 SE4 colony- somewhat atypical habitat with higher vegetative cover of grasses, *Haplopappus*, and *Gutierrezia sarothrae*. Substrates for these populations derived from Tensleep Sandstone and the Amsden Formation.
Elevation: 6360-7600 feet
Size: 10 acres

Managed Area: BLM Worland Field Office and Renner Wildlife Habitat Management Unit (WY Game and Fish Dept.).

Specimens: Welp, L. (8010, 8011, 8012).

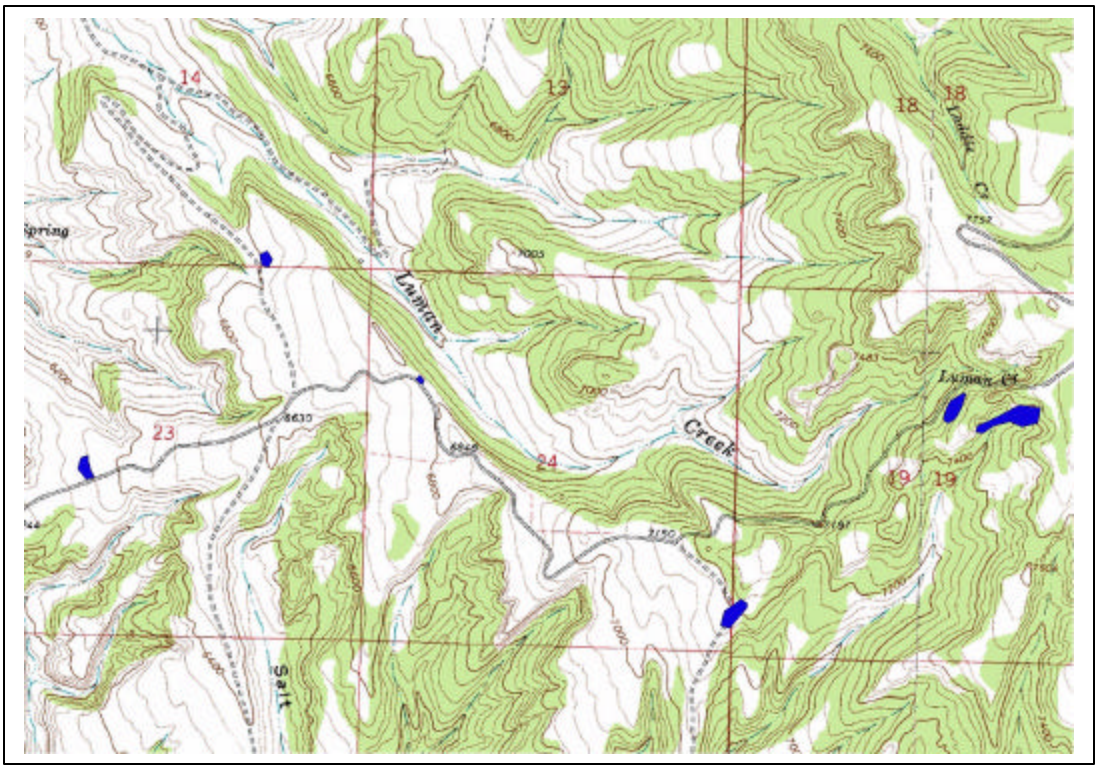
2000. RM.

Author: Laura Welp
Edition Date: 00-12-31

Penstemon caryi Occurrence # 027
Brokenback Narrows, and Pierce Draw quads

T49N R87W S19 (S2 of NE4 & SW4SW4); T49N R88W S14 (SW4SW4 of SE4); S23 (N4 OF SW4); & S24 (NW4NW4 & SE4SE4).

Bighorn Basin, along BLM route 1117, extending from 9-11 air miles east of Hyattville and from 2-5 air miles west of the Bighorn Forest boundary.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 028

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Black Mountain
Latitude: 443124N (centrum)
South Latitude: 443113N
North Latitude: 443124N
Longitude: 1073934W (centrum)
East Longitude: 1073934W
West Longitude: 1073958W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T53N R90W S35 (SW4SW4); T52N R90W S4 (NE4NE4)
Location: Bighorn Range, near top of south end of Black Mountain, ca 6 air miles east of Shell and ca 4 air miles southwest of Shell Falls.

Population Data
Last Observed: 2000-06-30
First Observed: 2000-06-30
2000-06-30: Very small populations despite the apparently large amount of habitat. 17 plants counted, 50 estimated. 5% in fruit/flower, 65% fruit, 30% vegetative (L. Welp). Associated species include *Petrophyton caespitosum, Koeleria macrantha, Festuca idahoensis*, and *Erigeron allocotus*.

Habitat: South and south-east facing slopes with calcareous outcrops on dry rocky soil. Dominant vegetation is *Artemisia tridentata* var. *vaseyana* with scattered juniper. Substrate derived from Madison Limestone.
Elevation: 6600-6840 feet
Size: 3 acres

Managed Area: BLM Worland Field Office

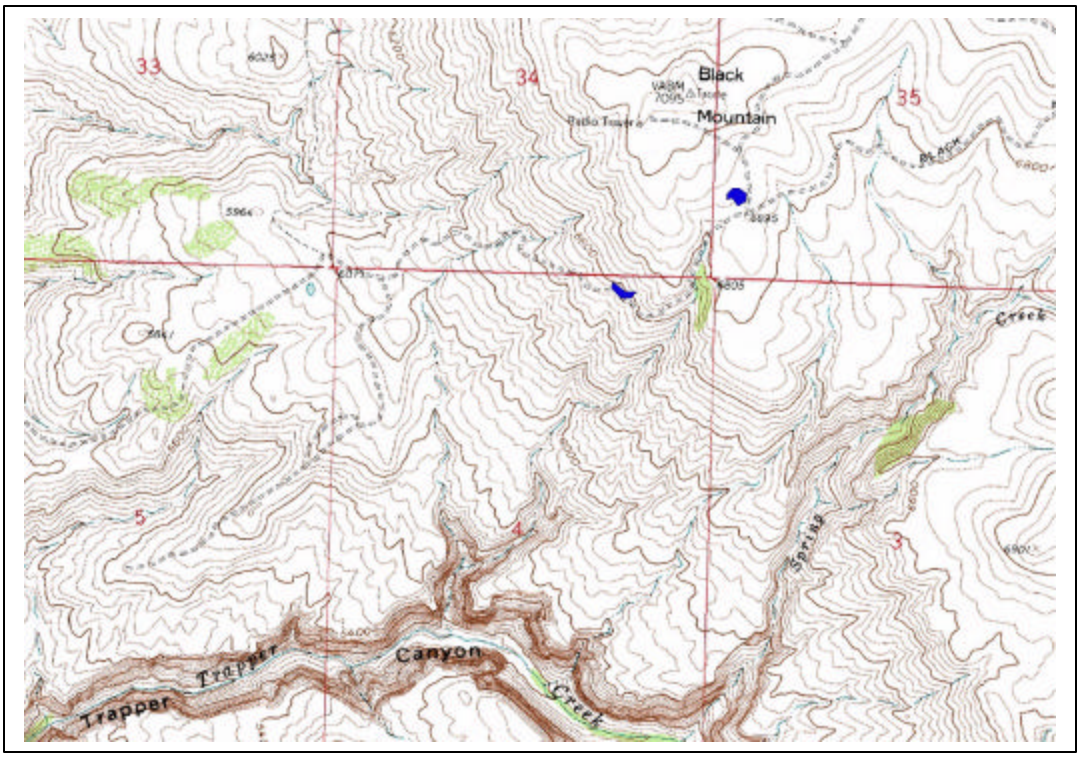
Specimens: Welp, L. (8015). 2000. RM.

Author: Laura Welp
Edition Date: 01-01-01

Penstemon caryi Occurrence # 028
Black Mountain Quad

T53N R90W S35 (SW4SW4); T52N R90W S4 (NE4NE4)

Bighorn Range, near top of south end of Black Mountain, ca 6 air miles east of Shell and ca 4 air miles southwest of Shell Falls.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 029

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Mexican Hill
Latitude: 445542N (centrum)
South Latitude: 445507N
North Latitude: 445549N
Longitude: 1075308W (centrum)
East Longitude: 1075252W
West Longitude: 1075410W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T57N R92W S12 (SE4); S13 (SW4 of NW4); T57N R91W S17 (NW4NW4).
Location: Bighorn Range, ca 1-2 miles southwest of Sheep Mountain, near the head of Bucking Mule Creek. 3 main subpopulations: (1) ca 0.25 miles south of USFS Road 105 and 1 mile east of junction of 105 and Road 032218, (2) just north of USFS Road 105 at the north headwaters fork of Bucking Mule Creek at the base of a calcareous rock slide, (3) south of USFS Road 105 on south slopes of Point 9438.

Population Data
Last Observed: 2000-07-11
First Observed: 2000-07-06
Population consists of 4 subpopulations in area of 0.5 x 1 mile. Total numbers estimated at 2200 plants.

2000-07-11: Sec 12 colony: Population estimated at ca 1000 plants by Galloway and Gross. Plants in flower. Occurs with Mountain sagebrush, Idaho fescue, alpine lupine, and *Penstemon procerus*. Sec 17 colony: Population estimated at ca 200 plants. Occurs with Mountain sagebrush, Idaho fescue, and alpine lupine.

2000-07-06: Sec 13 colonies (2): Population estimated at ca 1000 plants, with 10% in flower and 90% vegetative. Occurs with alpine lupine, larkspur, bistort, and dandelion.

Habitat: Sagebrush grassland at base of calcareous cliffs and rockslides that are slumping and eroding. Slopes range from 10-70% and are east to south-facing. Soils dry (Owen Creek-Waybe Association).
Elevation: 8600-9275 feet
Size: 6-10 acres

Managed Area: Bighorn National Forest.
Management Comments: Area managed for livestock grazing.

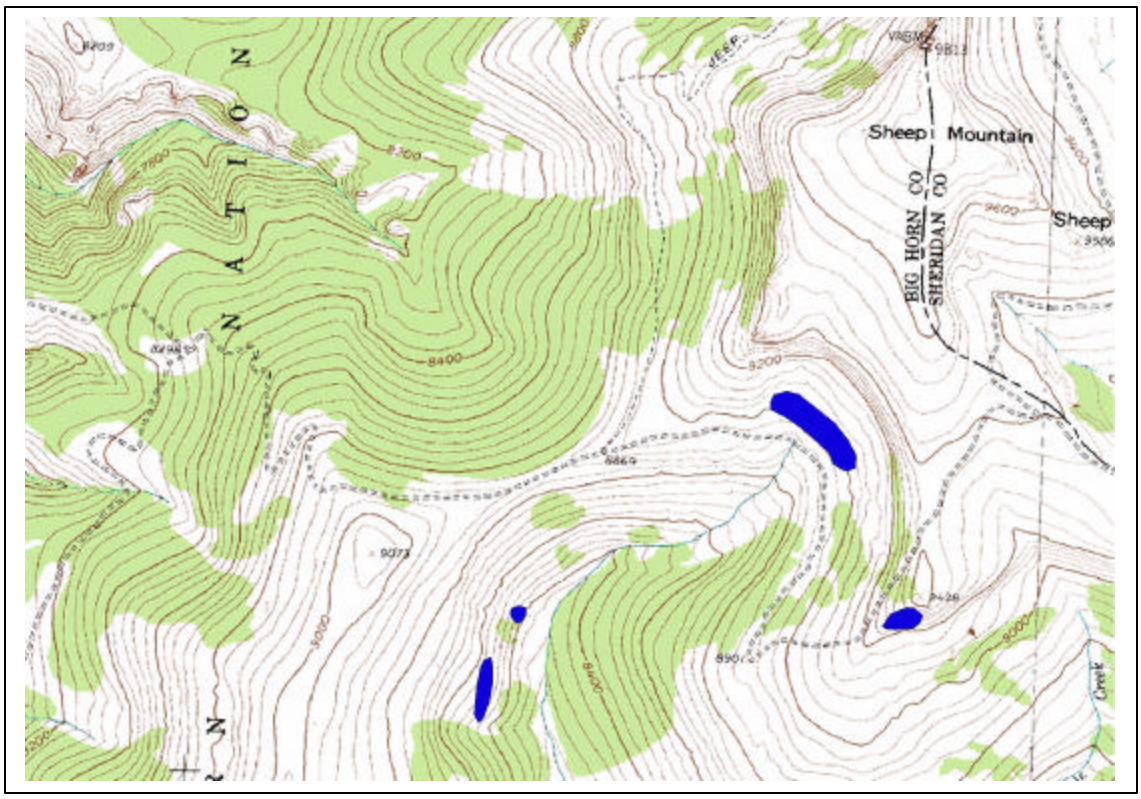
Specimens: Galloway, T. and N. Gross (001, 003). 2000. RM & Bighorn NF Herbarium

Author: Walter Fertig
Edition Date: 00-01-10

Penstemon caryi Occurrence # 029
Mexican Hill Quad

T57N R92W S12 (SE4); S13 (SW4 of NW4); T57N R91W S17 (NW4NW4)

Bighorn Range, ca 1-2 miles southwest of Sheep Mountain, near the head of Bucking Mule Creek. 3 main subpopulations: (1) ca 0.25 miles south of USFS Road 105 and 1 mile east of junction of 105 and Road 032218, (2) just north of USFS Road 105 at the north headwaters fork of Bucking Mule Creek at the base of a calcareous rock slide, (3) south of USFS Road 105 on south slopes of Point 9438.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 030

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Sheridan
USGS Quad Name: Bald Mountain
Latitude: 444805N (centrum)
South Latitude: 444802N
North Latitude: 444808N
Longitude: 1074515W (centrum)
East Longitude: 1074504W
West Longitude: 1074523W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T56N R91W S25 (NE4 of SW4)
Location: Bighorn Range, 1.5 miles east-southeast of Bald Mountain City, east of the junction of USFS Road 15 and the Little Bighorn River [2 miles north-northeast of the summit of Little Bald Mountain].

Population Data
Last Observed: 2000-07-09
First Observed: 2000-07-09
2000-07-09: ca 1000 individuals observed by Galloway and Gross. 70% of plants in flower, 30% vegetative. Occurs with Mountain sagebrush, Idaho fescue, larkspur, and alpine lupine.

Habitat: Sagebrush grassland on slightly barren, south-facing hillside of ca 45 degrees
that is actually slumping and eroding. Soils dry (Owen Creek-Waybe association).
Elevation: 9250-9425 feet
Size: 5 acres

Managed Area: Bighorn National Forest.
Management Comments: Site managed for livestock grazing.

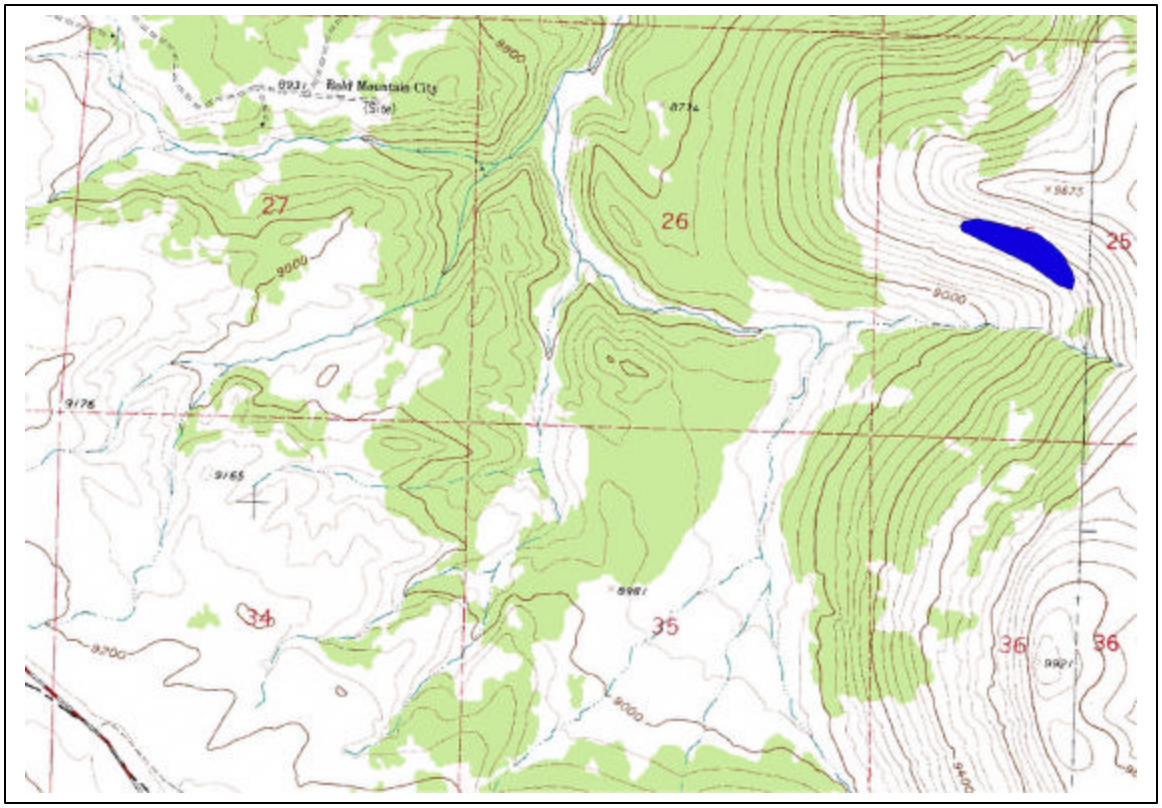
Specimens: Galloway, T. and N. Gross (002). 2000. RM & Bighorn NF Herbarium.

Author: Walter Fertig
Edition Date: 01-01-10

Penstemon caryi Occurrence # 030
Bald Mountain Quad

T56N R91W S25 (NE4 of SW4)

Bighorn Range, 1.5 miles east-southeast of Bald Mountain City, east of the junction of USFS Road 15 and the Little Bighorn River [2 miles north-northeast of the summit of Little Bald Mountain].



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 031

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Bald Mountain
Latitude: 445136N (centrum)
Longitude: 1075052W (centrum)
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T56N R91W S6 (NE4 of SW4 of NE4)
Location: Bighorn Range, west slope of Duncum Mountain, east of USFS Road 11, ca 3.75 miles north of US Highway Alt 14 and 10 miles south of the Montana state line.

Population Data
Last Observed: 2001-07-28
First Observed: 2001-07-28
2001-07-28: plants observed in fruit by W. Fertig. Less than 5% had remnant flowers with prominently lanate-pubescent anthers. Plants limited to a narrow band at the toe of the talus slope. Locally dense, with as many as 70 individuals in areas of 10 x 20 meters. Total population estimated at 500-1000. Associated species: *Achillea millefolium, Myosotis alpestris, Leucopoa kingii, Erigeron ochroleucus, Sedum lanceolatum, Galium boreale, Phacelia hastata, Erigeron compositus, & Elymus trachycaulus.*

Habitat: West-facing midslope of calcareous rubble and talus with pockets of dry, whitish-gray limey clay soil. Community of *Phlox multiflora, Cirsium hookerianum, Festuca idahoensis, & Potentilla ovina.* Substrate derived from Bighorn Dolomite.
Elevation: 9650 feet
Size: 1 acre

Managed Area: Bighorn National Forest.

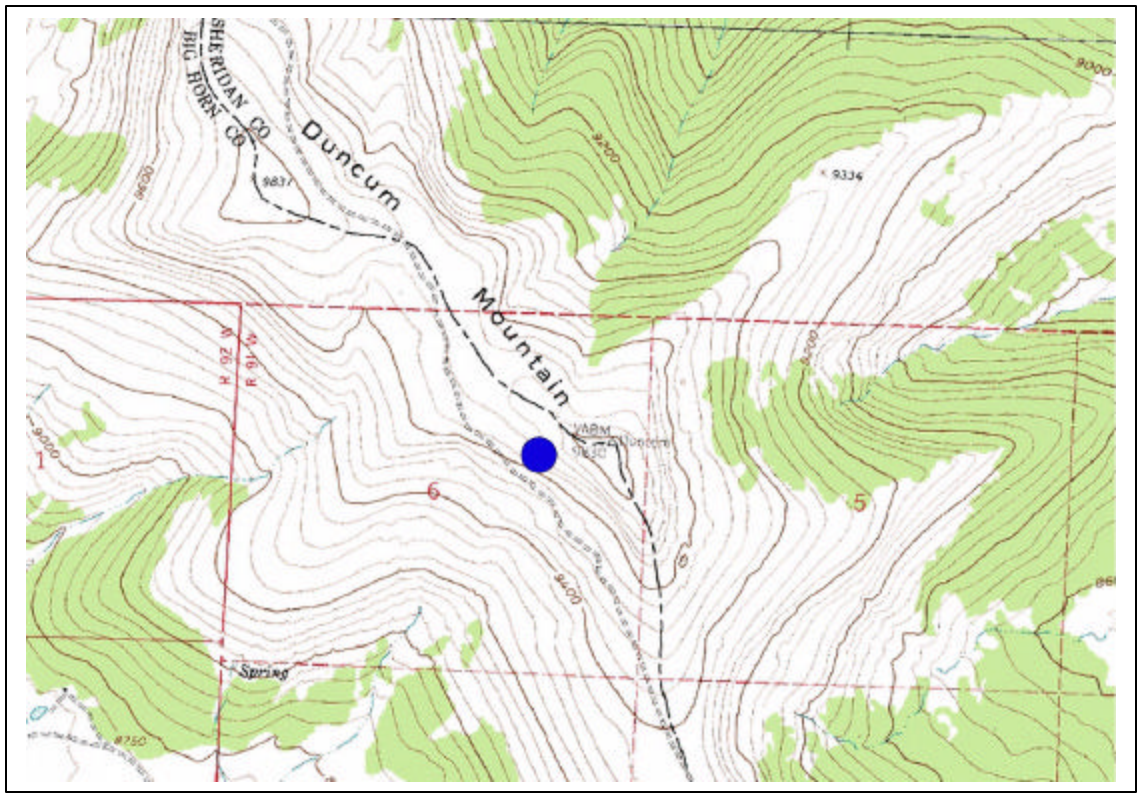
Specimens: Fertig, W. (19778). 2001. RM.

Author: Walter Fertig
Edition Date: 01-09-15

Penstemon caryi Occurrence # 031
Bald Mountain Quad

T56N R91W S6 (NE4 of SW4 of NE4)

Bighorn Range, west slope of Duncum Mountain, east of USFS Road 11, ca 3.75 miles north of US Highway Alt 14 and 10 miles south of the Montana state line.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 032

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Big Horn
USGS Quad Name: Brokenback Narrows
Latitude: 440920N (centrum)
South Latitude: 440917N
North Latitude: 440923N
Longitude: 1072138W (centrum)
East Longitude: 1072136W
West Longitude: 1072140W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T48N R87W S6 (NE4 of SW4)
Location: Bighorn Range, base of buttes ca 1.5 air miles southwest of Brokenback Narrows and ca 1 air mile north-northeast of Sand Springs.

Population Data
Last Observed: 2000-06-27
First Observed: 2000-06-27
2000-06-27: 129 plants observed by Laura Welp (population estimated at 200) in 75 x 50 meter area. 60% in flower, 10% vegetative, and 30% fruiting. Plants occur in small, scattered clumps. Associated species: *Sedum lanceolatum, Senecio, Bromus tectorum, Koeleria macrantha, Poa*, and *Erigeron*.

Habitat: Flat, weathered limey-sandstone outcrops (derived from the Tensleep Sandstone or Amsden Formation) in open *Pinus ponderosa/Juniperus* forest with open understory and sandy soil.
Elevation: 7000 feet
Size: 1 acres

Comments: Located ca 3-4 miles NE of Occurrence # 026.

Managed Area: BLM Worland Field Office

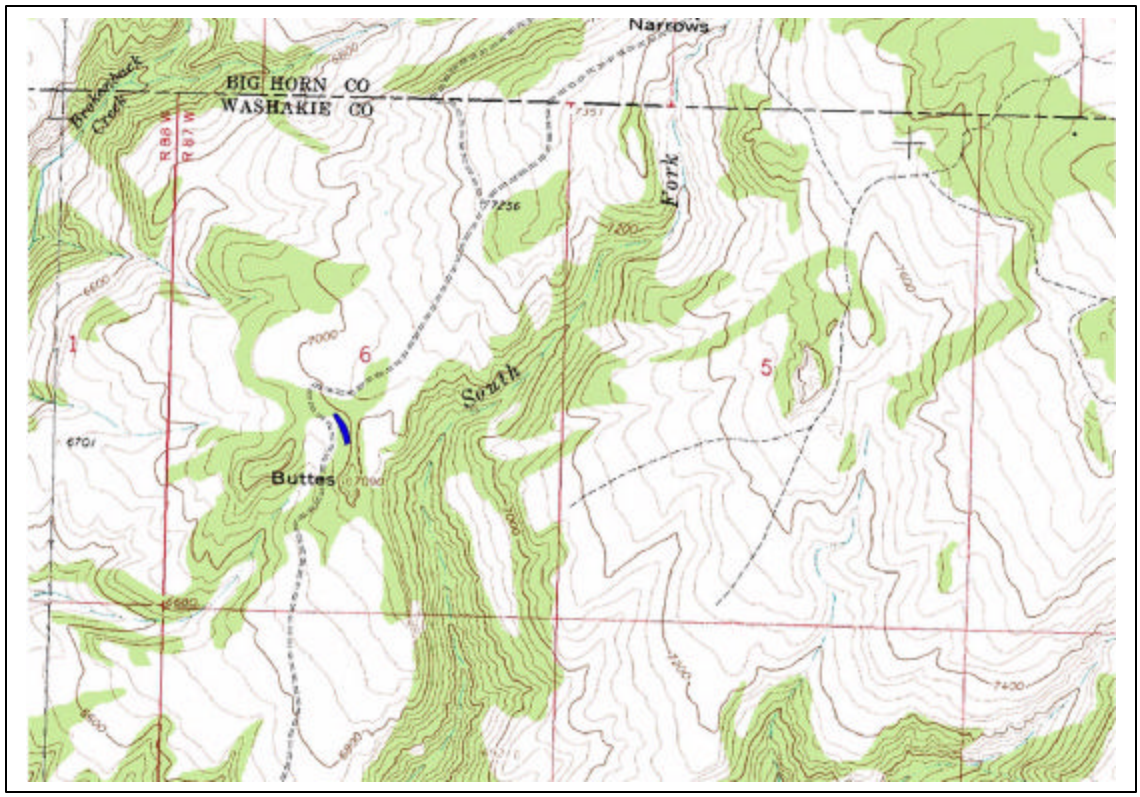
Specimens: Welp, L. (8009). 2000. RM.

Author: Walter Fertig
Edition Date: 01-09-28

Penstemon caryi Occurrence # 032
Brokenback Narrows Quad

T48N R87W S6 (NE4 of SW4)

Bighorn Range, base of buttes ca 1.5 air miles southwest of Brokenback Narrows and ca 1 air mile north-northeast of Sand Springs.



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PENSTEMON CARYI
CARY BEARDTONGUE
Occurrence # 033

Status
Data Sensitive?: No
Identification verified: Yes
Global Heritage Rank: G3
WYNDD State Rank: S2
Federal Status: USFS Region 2: Sensitive; WY BLM: Sensitive
WY Distribution Note: Regional endemic

Location
County: Washakie
USGS Quad Name: Old Maid Gulch
Latitude: 440309N (centrum)
South Latitude: 440307N
North Latitude: 440312N
Longitude: 1071920W (centrum)
East Longitude: 1071910W
West Longitude: 1071930W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T47N R87W S9 (NE4 of SW4)
Location: Bighorn Range, west of Canyon Ridge on south side of Sand Draw Road (FS Road 43601), ca 0.5 miles east of Sand Spring and 2 miles south of Leigh Creek Campground on Tensleep Creek.

Population Data
Last Observed: 2000-06-06
First Observed: 1999-06-04
2000-06-06: 1482 individuals observed in survey by Bernie Bornong, Tucker Galloway, and Nathan Gross. 80% of plants in flower and 20% vegetative. Associated species: balsamroot, lupine, Oregon grape, Sawsepal penstemon, Ponderosa pine, Rocky Mountain juniper, Limber pine, bluegrass, Idaho fescue, and larkspur.

1999-06-04/28: 550-750 plants observed in flower and fruit by Kevin O'Dea, Jo Ann Storlie, and Ann Humphrey. With *Lupinus, Pinus ponderosa, Ipomopsis, Ivesia gordonii, Opuntia polyacantha, Juniperus scopulorum, Thermopsis*, and *Oenothera*.

Habitat: Limestone cliffs and bedrock outcrops (derived from the Tensleep and Amsden formations) in open grassland.
Elevation: 6120-6240 feet
Size: 5 acres

Comments: In vicinity of Occurrence # 020.

Managed Area: Bighorn National Forest

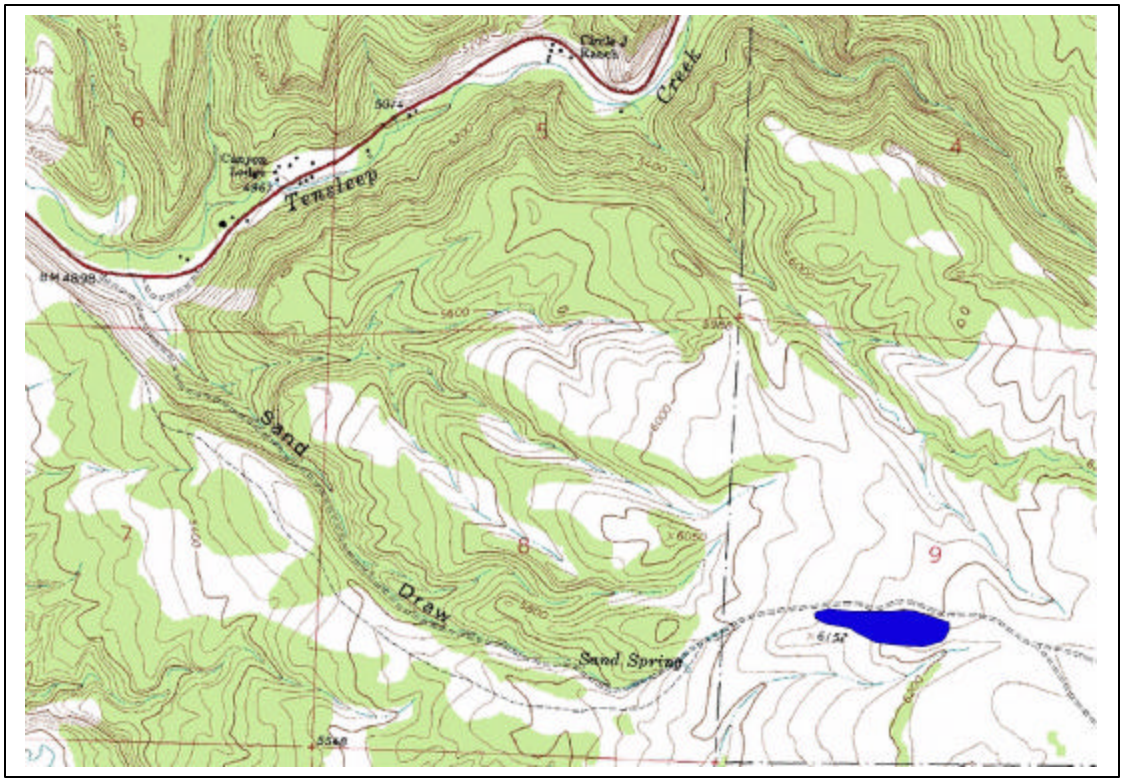
Sources: O'Dea, Kevin. WYNDD botany intern 1998-2000; Bighorn NF seasonal botanist, 1999.

Author: Walter Fertig
Edition Date: 01-10-03

Penstemon caryi Occurrence # 033
Old Maid Gulch Quad

T47N R87W S9 (NE4 of SW4)

Bighorn Range, west of Canyon Ridge on south side of Sand Draw Road (FS Road 43601), ca 0.5 miles east of Sand Spring and 2 miles south of Leigh Creek Campground on Tensleep Creek.



Appendix B.
Survey Routes

WYNDD Surveys for Cary beardtongue were conducted by Laura Welp and Walter Fertig from 1999-2001. Potential areas for survey were determined from BLM land management maps and USGS topographic maps based on the presence of suitable habitat on accessible public lands. Surveyed locations are summarized below:

Surveyed Sites 1999-2001

DATE	SURVEYOR	COORDINATES	LOCATION	*P. CARYI* FOUND?
22 June 1999	Welp	T58N R95W S24 SW4	Narrows, Bighorn Canyon NRA	No
23 June 1999, 1 July 2000	Welp	T57N R94W S2 SE4	John Blue Canyon Road	Yes
24 June 1999	Welp	T58N R94W S26 SW4	Slopes on E bank of Bighorn Canyon, S of Montana state line	No
24 June 1999	Welp	T58N R94W S20 NW4	Slopes on E bank of Bighorn Canyon, S of Montana state line	No
26 June 1999, 30 June 2000	Welp	T51N R89W S7 SE4, S8 W2	Along road on divide between Webber Canyon and Alkali Creek	Yes
28 June 1999, 29 June 2000	Welp	T49N R89W S21-22	Ridge along BLM Road 1117	No
28 June 1999, 29 June 2000	Welp	T49N R89W S15 SW4, S16 SE4, S22 N2, S23 NW4	NW slopes of Cedar Mountain on S side of BLM Road 1117	No
28 June 1999	Welp	T49N R89W S17 W2, S18 NE4	Ridge 1.5 miles SE of Hyattville	No
14 July 1999	Fertig	T48N R83W S19 NE4	Billy Creek Road	No
19 July 1999	Fertig & Bornong	T54N R85W S28 SE4	Red Grade Road	No
29 July 1999	Fertig	T56N R87W S21 SE4	Steamboat Rock	No
27 June 2000	Welp	T45N R87W S4, 9, 10	E of Big Trails Road and N of Otter Creek	No
27 June 2000	Welp	T48N R88W S14 S2	Ridge between Brokenback Creek and S Fork Brokenback Creek	Yes
27 June 2000	Welp	T48N R87W S6 S2	1 mile NNE of Sand Springs	Yes
28 June 2000	Welp	T50N R89W S1 SE4, T50N R88W S5 SW4, S7 NW4	Along Cold Springs Road, S of Medicine Lodge Canyon	Yes
28 June 2000	Welp	T49N R88W S14 SE4, S23 NE4 & SW4	Along BLM Road 1117 (and side roads) west of Luman Creek	Yes
28 June 2000	Welp	T49N R87W S19 NE4	Along BLM Road 1117	Yes
28 June 2000	Welp	T49N R88W S24 N2	Along BLM Road 1117	Yes
28 June 2000	Welp	T49N R88W S24 SE4, T49N R87W S19 SW4	South of BLM Road 1117	Yes
30 June 2000	Welp	T52N R89W S19 SE4, S30 NE4	SW rim of Trapper Canyon	Yes
30 June 2000	Welp	T52N R89W S34 SE4	South side Alkali Road	Yes

30 June 2000	Welp	T53N R90W S35 SW4, T52N R90W S4 NE4	South end Black Mountain	Yes
1 July 2000	Welp	T53N R89W S14 N2	Upper Shell Canyon	Yes
3 July 2000	Welp	T56N R92W S30 N2	Vicinity of Five Springs campground	Yes
3 July 2000	Welp	T56N R92W S25 SE4	Switchback of old US Hwy 14	No
3 July 2000	Welp	T56N R92W S22 S2, S27 NE4	South flank Medicine Mountain	Yes
24 June 2001	Fertig & WY Native Plant Society	T47N R86W S32 SE4	TNC Tensleep Preserve	Yes
24 June 2001	Fertig	T48N R86W S9 SE4, S16 NE4	High Park	No
28 July 2001	Fertig	T55N R90W S8 W2	Ridge N of US Hwy Alt 14	No*
28 July 2001	Fertig	T56N R91W S6 NE4	West side Duncum Mountain	Yes
29 July 2001	Fertig	T58N R92W S34 NW4	Mesa on S side of Cookstove Basin and Trout Creek	No
29 July 2001	Fertig	T55N R91W S36 S2	S end Hunt Mountain	No
31 July 2001	Fertig	T54N R90W S20 NE4	Wolf Springs Mesa	No

* Unidentified *Penstemon* observed in late fruit (not collected) - may be *P. caryi.*

Appendix C.
2000 Monitoring Data

Transect Locations

Transect # 1
County: Big Horn
Occurrence: #005
Legal Description: T51N R89W S4 SE4SE4
GPS of corner: 44?26'02.37" 107?32'30.53"
Transect Bearing (from 0 towards 30 m): 207° SW.
USGS Quad: Bush Butte.
Directions: Drive 1.6 road miles from the junction of BLM roads 1109 (Red Gulch Road) and 1111 (Alkali Road) to a two-track just west of a corral. Drive 0.1 road miles past the corral to a large limber pine. From the north side of the tree, walk ca 42 meters at 34?N to endpoint of transect. Then walk 30 meters at 207?N to cornerpoint (see photo, right)
Habitat: Long (ca 250 m) low calcareous ridge with *Artemisia tridentata* var. *vaseyana* and *Haplopappus nuttallii/ Stipa comata,* with scattered large *Pinus flexilis. Penstemon caryi* and *Lupinus* are the dominant forbs at this time of year. *P. caryi* is most dense at the base of the south side of the ridge where soils are sandy and deep. This population is unusually dense and extensive.

Right, above: view of transect # 1 from endpoint to cornerpoint. Photo by L. Welp, 29 June 2000.

Transect # 2
County: Big Horn.
Occurrence: # 005
Legal Description: T51N R89W S4 SE4SE4
GPS of corner: 44?26'01.04" 107?32'32.62"
Transect Bearing (from 0 towards 40 m): 10° ENE.
USGS Quad: Bush Butte
Directions: Drive 1.6 road miles from the junction of BLM roads 1109 (Red Gulch Road) and 1111 (Alkali Road) to a two-track just west of a corral. Drive 0.1 road miles past the corral to a large limber pine. From the north side of the tree, walk ca 13 meters at 337?N to cornerpost of transect (see photo on next page).
Habitat: Low calcareous ridge with *Artemisia tridentata* var. *vaseyana* and *Haplopappus nuttallii/Stipa comata,* with scattered large *Pinus flexilis.*
Comments: Tape was not stretched taut, but laid on ground and anchored with rocks.

Above, left: view of transect # 2 from endpoint. Photo by L. Welp, 29 June 2000. **Above, right:** view of transect # 3 from corner to south. Photo by L. Welp, 29 June 2000.

Transect # 3
County: Big Horn.
Occurrence: # 005
Legal Description: T51N R89W S8 W2
GPS of corner: 44?24'42.14" 107?34'36.26" 2052 meters
Transect Bearing (from 0 towards 50 m): 270° S.
USGS Quad: Bush Butte
Directions: Drive along the Red Grad Road 1.0 road miles west of the junction of BLM roads 1111 (Alkali Road) and 1109 (Red Gulch Road) to a prominent calcareous outcrop close to the road (see photo above, right). From the north end of this outcrop, walk ca 8 meters at 40?N to cornerpost.
Habitat: Site is at the base of a calcareous outcrop in sandy soil in rolling *Artemisia tridentata* var. *vaseyana/Stipa comata* vegetation types. Associate species are *Haplopappus nuttallii, Lupinus* sp., *Poa* sp. *Phacelia* sp.

Methods

Three permanent 0.5 x 30-50 meter belt transects were established following the protocol of Lesica (1987). Plots were selected subjectively at known *Penstemon caryi* colonies to reflect "typical" density and habitat conditions. Starting points were marked by re-bar and low rock piles. For each transect, 0.5 x 1 meter plots were framed by meter sticks and read from the left side of the baseline tape. Every other plot was recorded, beginning at 0.0-0.5 m, then 1.0-1.5 m, 2.0-2.5 m, etc. to the endpoint. In each plot, data were collected on the number, frequency, and density of individual plants in each of four age/size classes: Seedlings (non-

flowering rosettes less than 2 cm in diameter), Vegetative (non-flowering rosettes greater than 2 cm in diameter), Reproductive (flowering or fruiting plants with at least 1 inflorescence), and Dead (dead plants of any size class).

Results:

Total density ranged from 4.5-6.6 plants per square meter in the 3 plots. No seedlings or dead plants were encountered during June 2000. Density of vegetative plants ranged from 1.9-3.7 per square meter, while reproductive plants averaged 2.6-2.8 individuals per square meter. These density figures are higher than long-term monitoring reports from The Nature Conservancy's Tensleep Preserve (Humphrey 2001) and may reflect more favorable growing conditions or moisture at Occurrence # 005. Reproductive plants account for 43.6-57.1% of the sampled populations at the 3 transects. Frequency of plants ranges from 60-94% of all plots.

Recommendations

Follow-up monitoring should be conducted on an annual to biennial basis over the next 5-10 years to determine the longevity of individual plants and to assess whether populations experience shifts in distribution or abundance. Qualitative to semi-quantitative assessments should also be conducted on a frequent basis to assess gross population trend and impacts from possible threats.

Penstemon caryi
Transect # 1 Census Data

Date: 29 June 2000 Surveyor: Laura Welp

Plot # (location)	Total #	# Seedlings	# Vegetative	# Reproductive	# Dead
1 (0-0.5 m)	0	0	0	0	0
2 (1-1.5 m)	0	0	0	0	0
3 (2-2.5 m)	0	0	0	0	0
4 (3-3.5 m)	2	0	0	2	0
5 (4-4.5 m)	4	0	3	1	0
6 (5-5.5 m)	13	0	8	5	0
7 (6-6.5 m)	19	0	11	8	0
8 (7-7.5 m)	4	0	1	3	0
9 (8-8.5 m)	5	0	2	3	0
10 (9-9.5 m)	9	0	3	6	0
11 (10-10.5 m)	3	0	0	3	0
12 (11-11.5 m)	2	0	0	2	0
13 (12-12.5 m)	1	0	0	1	0
14 (13-13.5 m)	1	0	0	1	0
15 (14-14.5 m)	0	0	0	0	0
16 (15-15.5 m)	1	0	0	1	0
17 (16-16.5 m)	1	0	0	1	0
18 (17-17.5 m)	0	0	0	0	0
19 (18-18.5 m)	0	0	0	0	0
20 (19-19.5 m)	0	0	0	0	0
21 (20-20.5 m)	1	0	0	1	0
22 (21-21.5 m)	0	0	0	0	0
23 (22-22.5 m)	0	0	0	0	0
24 (23-23.5 m)	2	0	2	0	0
25 (24-24.5 m)	1	0	1	0	0
26 (25-25.5 m)	0	0	0	0	0
27 (26-26.5 m)	0	0	0	0	0
28 (27-27.5 m)	0	0	0	0	0
29 (28-28.5 m)	0	0	0	0	0
30 (29-29.5 m)	3	0	1	2	0
TOTAL	72	0	32	40	0

Transect: 15 square meters

Density: # Seedlings per square meter: 0
Vegetative rosettes per square meter: 2.13
Reproductive plants per square meter: 2.67
Total # of plants per square meter: 4.8

Frequency: Seedlings: 0/30 (0%)
Vegetative: 9/30 (30%)
Reproductive: 15/30 (50%)
Total Plants: 18/30 (60%)

Phenology: # Seedlings: 0/72 (0%)
Vegetative: 32/72 (44.4%)
Reproductive: 40/72 (55.6%)

Penstemon caryi
Transect # 2 Census Data

Date: 29 June 2000 Surveyor: Laura Welp

Plot # (location)	Total #	# Seedlings	# Vegetative	# Reproductive	# Dead
1 (0-0.5 m)	1	0	0	1	0
2 (1-1.5 m)	0	0	0	0	0
3 (2-2.5 m)	0	0	0	0	0
4 (3-3.5 m)	0	0	0	0	0
5 (4-4.5 m)	0	0	0	0	0
6 (5-5.5 m)	1	0	1	0	0
7 (6-6.5 m)	9	0	2	7	0
8 (7-7.5 m)	6	0	0	6	0
9 (8-8.5 m)	7	0	3	4	0
10 (9-9.5 m)	1	0	0	1	0
11 (10-10.5 m)	3	0	1	2	0
12 (11-11.5 m)	3	0	1	2	0
13 (12-12.5 m)	3	0	0	3	0
14 (13-13.5 m)	5	0	3	2	0
15 (14-14.5 m)	4	0	2	2	0
16 (15-15.5 m)	4	0	1	3	0
17 (16-16.5 m)	1	0	0	1	0
18 (17-17.5 m)	0	0	0	0	0
19 (18-18.5 m)	0	0	0	0	0
20 (19-19.5 m)	0	0	0	0	0
21 (20-20.5 m)	0	0	0	0	0
22 (21-21.5 m)	3	0	1	2	0
23 (22-22.5 m)	2	0	0	2	0
24 (23-23.5 m)	0	0	0	0	0
25 (24-24.5 m)	0	0	0	0	0
26 (25-25.5 m)	0	0	0	0	0
27 (26-26.5 m)	7	0	5	2	0
28 (27-27.5 m)	9	0	5	4	0
29 (28-28.5 m)	2	0	0	2	0
30 (29-29.5 m)	1	0	0	1	0
31 (30-30.5 m)	8	0	6	2	0
32 (31-31.5 m)	3	0	2	1	0
33 (32-32.5 m)	0	0	0	0	0
34 (33-33.5 m)	2	0	1	1	0
35 (34-34.5 m)	2	0	2	0	0
36 (35-35.5 m)	0	0	0	0	0
37 (36-36.5 m)	0	0	0	0	0
38 (37-37.5 m)	2	0	2	0	0
39 (38-38.5 m)	2	0	1	1	0
40 (39-39.5 m)	0	0	0	0	0
TOTAL	91	0	39	52	0

Transect: 20 square meters
Density: # Seedlings per square meter: 0
Vegetative rosettes per square meter: 1.95
Reproductive plants per square meter: 2.60
Total # of plants per square meter: 4.55
Phenology: # Seedlings: 0/91 (0%)
Vegetative: 39/91 (42.9%)
Reproductive: 52/91 (57.1%)
Frequency: Seedlings: 0/40 (0%)
Vegetative: 17/40 (42.5%)
Reproductive: 22/40 (55%)
Total Plants: 25/40 (62.5%)

Transect # 3 Census Data

Date: 29 June 2000 Surveyor: Laura Welp

Plot # (location)	Total #	# Seedlings	# Vegetative	# Reproductive	# Dead
1 (0-0.5 m)	0	0	0	0	0
2 (1-1.5 m)	1	0	1	0	0
3 (2-2.5 m)	3	0	1	2	0
4 (3-3.5 m)	4	0	3	1	0
5 (4-4.5 m)	1	0	0	1	0
6 (5-5.5 m)	5	0	5	0	0
7 (6-6.5 m)	5	0	1	4	0
8 (7-7.5 m)	3	0	1	2	0
9 (8-8.5 m)	4	0	4	0	0
10 (9-9.5 m)	4	0	3	1	0
11 (10-10.5 m)	1	0	1	0	0
12 (11-11.5 m)	4	0	1	3	0
13 (12-12.5 m)	8	0	1	7	0
14 (13-13.5 m)	1	0	1	0	0
15 (14-14.5 m)	2	0	1	1	0
16 (15-15.5 m)	10	0	6	4	0
17 (16-16.5 m)	4	0	4	0	0
18 (17-17.5 m)	5	0	2	3	0
19 (18-18.5 m)	4	0	4	0	0
20 (19-19.5 m)	4	0	2	2	0
21 (20-20.5 m)	1	0	0	1	0
22 (21-21.5 m)	6	0	5	1	0
23 (22-22.5 m)	7	0	3	4	0
24 (23-23.5 m)	2	0	0	2	0
25 (24-24.5 m)	3	0	3	0	0
26 (25-25.5 m)	3	0	1	2	0
27 (26-26.5 m)	1	0	0	1	0
28 (27-27.5 m)	3	0	1	2	0
29 (28-28.5 m)	11	0	4	7	0
30 (29-29.5 m)	4	0	3	1	0
31 (30-30.5 m)	4	0	1	3	0
32 (31-31.5 m)	1	0	0	1	0
33 (32-32.5 m)	9	0	6	3	0
34 (33-33.5 m)	3	0	1	2	0
35 (34-34.5 m)	1	0	1	0	0
36 (35-35.5 m)	3	0	0	3	0
37 (36-36.5 m)	1	0	0	1	0
38 (37-37.5 m)	1	0	1	0	0
39 (38-38.5 m)	4	0	4	0	0
40 (39-39.5 m)	2	0	1	1	0
41 (40-40.5 m)	3	0	1	2	0
42 (41-41.5 m)	4	0	3	1	0
43 (42-42.5 m)	3	0	2	1	0
44 (43-43.5 m)	4	0	3	1	0
45 (44-44.5 m)	1	0	1	0	0
46 (45-45.5 m)	3	0	2	1	0
47 (46-46.5 m)	0	0	0	0	0
48 (47-47.5 m)	0	0	0	0	0
49 (48-48.5 m)	3	0	3	0	0
Plot #	Total #	# Seedlings	# Vegetative	# Reproductive	# Dead
50 (49-49.5 m)	1	0	0	1	0

TOTAL	165	0	93	72	0

Transect: 25 square meters

Density: # Seedlings per square meter: 0
Vegetative rosettes per square meter: 3.72
Reproductive plants per square meter: 2.88
Total # of plants per square meter: 6.6

Phenology: # Seedlings: 0/91 (0%)
Vegetative: 93/165 (56.4%)
Reproductive: 72/165 (43.6%)

Frequency: Seedlings: 0/50 (0%)
Vegetative: 40/50 (80%)
Reproductive: 33/50 (66%)
Total Plants: 47/50 (94%)

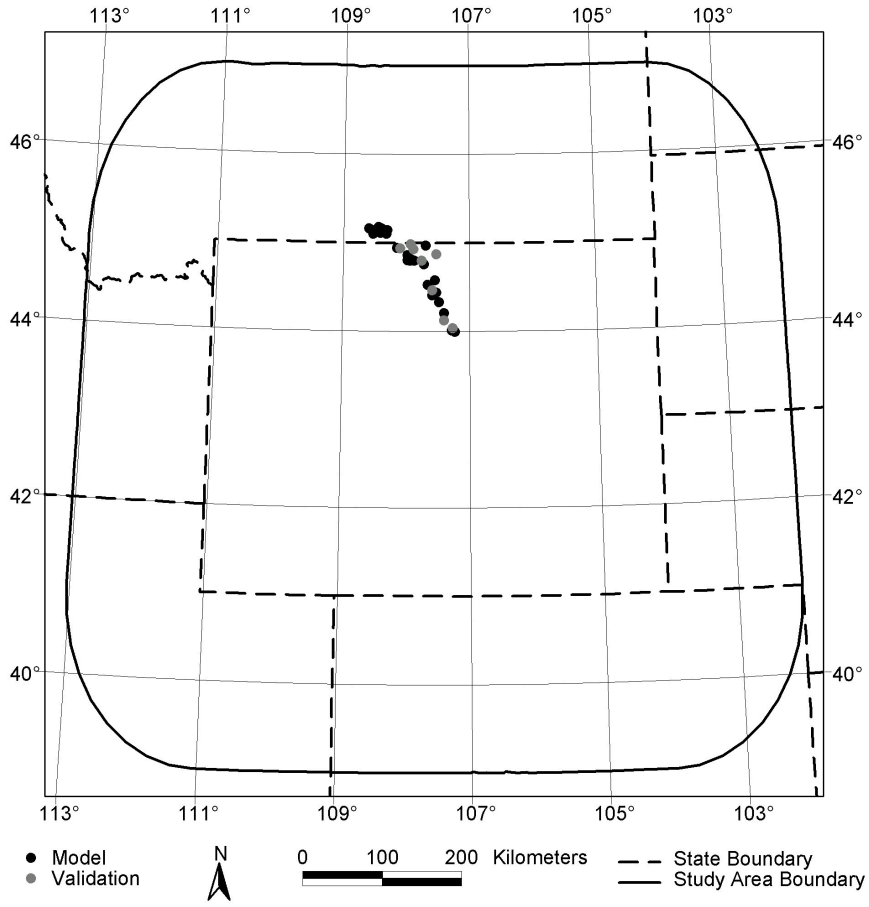
Appendix D. Potential Habitat Model of *Penstemon caryi*

Created by Rob Thurston and Walter Fertig (from Fertig 2002, in ed.)

Penstemon caryi Pennell

Known Distribution in Wyoming and Region

Black dots represent present points used in model construction and gray dots indicate present points used for validation.



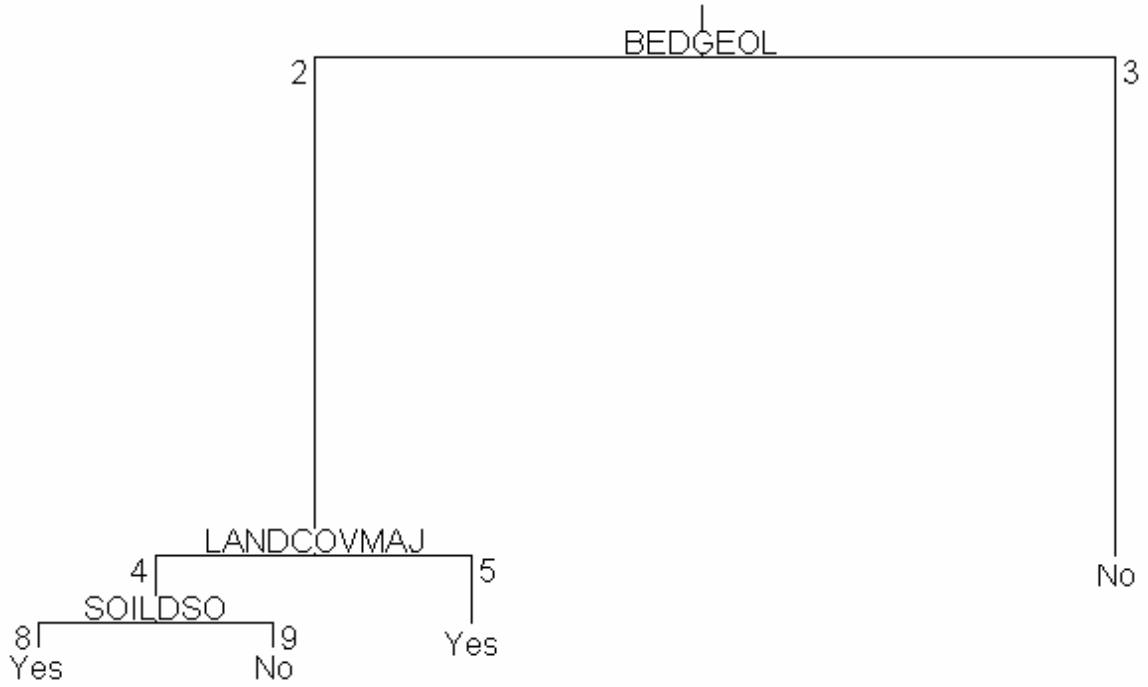
Numbers of Points for Modeling

	Model-Building Total (WY/Non-WY)	Validation WY Only	Total
Known Present	27 (17/10)	8	35
Known Absent	865 (865/0)	182	1047
Total	892 (882/10)	190	1082

Data Source (Records)
Wyoming Natural Diversity Database (19)
Rocky Mountain Herbarium (6)
Montana Natural Heritage Program (10)

Modeling Notes
Independent Variables: Elevation, January mean precipitation, April mean precipitation, July mean precipitation, October mean precipitation, January mean temperature, April mean temperature, July mean temperature, October mean temperature, June maximum temperature, July maximum temperature, August maximum temperature, April minimum temperature, May minimum temperature, June minimum temperature, major GAP land cover, bedrock geology, soil dominant order, and soil dominant suborder.
Minimum Number of Observations Before Split: 3
Minimum Node Size: 6
Minimum Node Deviance: 0.01
Minimum Percent for Pruning: 4
Biomes used for validation: Foothills, Intermountain Desert/Great Plains grasslands, Rocky Mountain Forest

Classification Tree Used in Model Building
See Classification Tree Output and Path Composition and Likelihood tables (next page) for definitions of present ("Yes") and absent ("No") pathways.



Classification Tree Output

The root node (number 1) indicates the number of data points used in construction of this tree (892), the number of absent and present points (865 and 27, respectively), and the percentage of absent and present points represented at the node. Subsequent node numbers correspond with the branch numbers in the Classification Tree on the preceding page and indicate the environmental variable selected at that node, the values or categories represented, the number of points at the node, percentage and raw number of absent and present points at the node, percentage of absent and present points at the node relative to the total available pool of present and absent points in the entire model, and whether the node is predicted to represent "presence" (yes) or "absence" (no) for the species. Nodes that end with an * are terminal nodes.

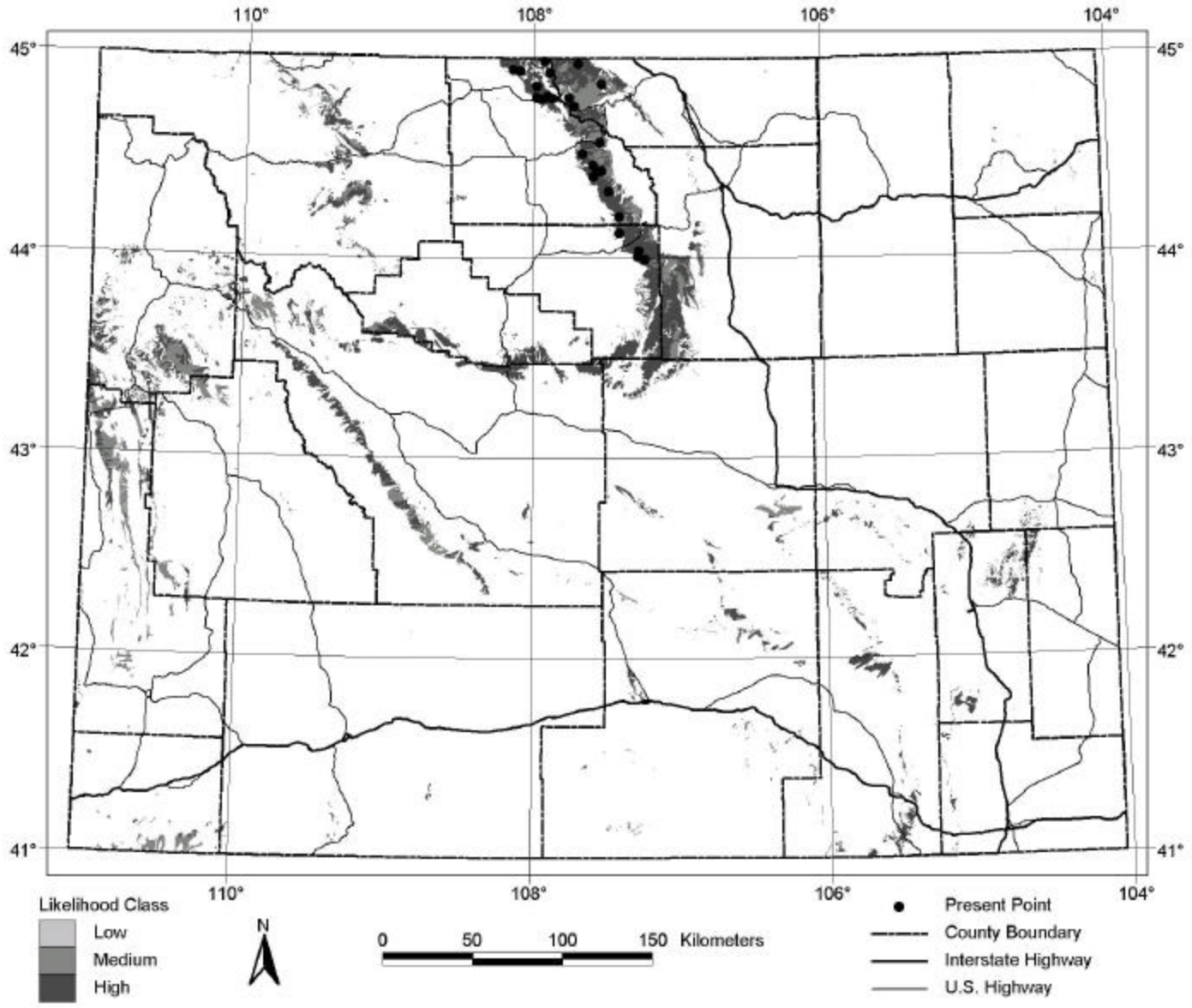
1) root 892 (865,27) (100,100) Yes
  2) BEDGEOL (Bedrock geology): Early Paleozoic, Quaternary landslide 92 (66,26) (7.6,96.3) Yes
    4) LANDCOVMAJ (Land cover): Alpine bare rock & soil, Aspen forest, Desert shrub, Forest-dominated riparian, Human disturbed, Lodgepole pine, Mesic upland shrub grassland, Mountain big sagebrush, Ponderosa pine, Subalpine meadow 43 (39,4) (4.5,14.8) Yes
      8) SOILDSO (Soil dominant suborder): Fluvents, Cryolls 22 (18,4) (2.1,14.8) **Yes ***
      9) SOILDSO (Soil dominant suborder): Cryalfs, Ustalfs, Orthents, Cryepts, Ustolls, Rock 21 (21,0) (2.4,0) No *
    5) LANDCOVMAJ (Land cover): Douglas-fir, Juniper woodland, Limber pine woodland & scrub, Mixed grass prairie, Spruce-fir, Wyoming big sagebrush 49 (27,22) (3.1,81.5) **Yes ***
  3) BEDGEOL (Bedrock geology): Eocene volcanic extrusive, Eocene volcanic intrusive, Early Eocene, Late Eocene, Cretaceous mixed sandstone/shale, Cretaceous shale, Cretaceous sandstone, Miocene/Pliocene, Oligocene, Precambrian felsic, Precambrian mafic, Permian/Triassic/Jurassic, Paleocene, Quaternary alluvium, Quaternary lacustrine, Quaternary sand, Quaternary till, Quaternary felsic volcanic, Tertiary/ Quaternary conglomerate, Late Tertiary felsic volcanic 800 (799,1) (92.4,3.7) No *

Path Composition and Likelihood

Each pathway that results in a prediction of presence "Yes" for this species is listed, along with its component nodes. The percentage of present points used in model construction per path is indicated, as is the likelihood of points falling within the path, based on a three-part ranking system (<10% of points = Low, 10-49.99% = Medium, and > or = 50% = High).

Yes Path	Node List	% of Present Points	Likelihood Class
A	8, 4, 2	14.8	Medium
B	5, 2	81.5	High

Predicted Distribution of *Penstemon caryi* in Wyoming



Area of Predicted Distribution: 11,143 km^2 (4.4% of WY)

Classification Rates for Wyoming Points

Points that are known to be present (but are predicted by the model as absent) are considered false negatives or omission errors, while points that are known to be absent (but are modeled as present) are false positives or commission errors.

Model-Building Points

	Model Present	Model Absent
Known Present	16/17 (94.1%)	1/17 (5.9%)
Known Absent	45/865 (5.2%)	820/865 (94.8%)

Total Correct: 836/882 (94.8%)
Total Incorrect: 46/882 (5.2%)

Validation Points

	Model Present	Model Absent
Known Present	7/8 (87.5%)	1/8 (12.5%)
Known Absent	8/182 (4.4%)	174/182 (95.6%)

Total Correct: 181/190 (95.3%)
Total Incorrect: 9/190 (4.7%)