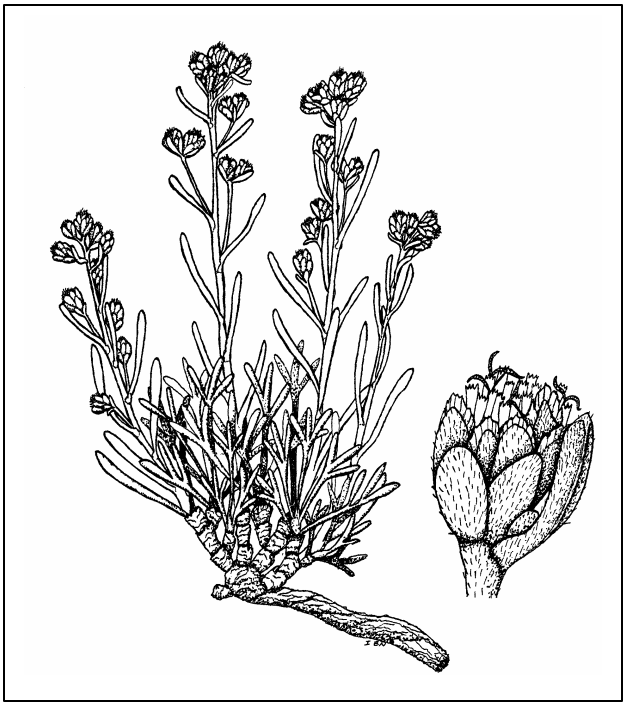
Status of Porter's Sagebrush (*Artemisia porteri*) in Wyoming



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ABSTRACT

Porter's sagebrush is endemic to the Wind River and Powder River basins in central Wyoming. It is found primarily in sparsely vegetated *Artemisia pedatifida, A. longifolia,* or *A. porteri* communities on barren clay or ashy badlands, flats, or gullies derived from the Wind River, Wagon Bed, or Frontier formations. This species is currently known from 11 extant occurrences consisting of at least 60 subpopulations covering less than 1250 acres. Individual colonies typically number from 100-1000 individuals and occupy areas of 1-50 acres. Based on surveys in 1999, the current population of Porter's sagebrush is conservatively estimated at 50,000-75,000 plants. Porter's sagebrush is primarily threatened by mineral development (oil, natural gas and uranium) within its limited range and specialized habitat. This species was designated as Sensitive by the BLM in 2001 and occurs primarily on BLM lands in the Buffalo, Casper, and Lander field offices. No populations currently receive formal protection, although the population in the Lysite Badlands is managed under special use regulations in the BLM Lander Resource Area Resource Management Plan. Porter's sagebrush is now known to be more widespread and abundant in Wyoming than previously suspected. Until sufficient habitat is afforded protection or management strategies are developed and implemented for this species in mineral extraction areas, *A. porteri* should remain a BLM state Sensitive species.

ACKNOWLEDGEMENTS

I would like to thank the following individuals for their contributions to this project: Laura Welp Fertig of WYNDD assisted with field surveys and established monitoring plots in 1999; Richard and Beverly Scott of Central Wyoming College shared information from their field surveys in 1999-2000; Amy Roderick Taylor provided information from her general floristic surveys of 1997-1998; George P. Jones of WYNDD shared information on a new population from Johnson County he discovered in 1997; Sue Oberlie of the BLM provided information and maps from pipeline surveys in Fremont County; Scott Laursen of WYNDD assisted with digitizing element occurrence locations in ArcView; and Jeff Carroll of the BLM Wyoming State Office provided funding and logistic support.

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INTRODUCTION

Porter's sagebrush (*Artemisia porteri*) was first collected by University of Wyoming botany professor Cedric L. Porter near the Sand Draw Oil Field in Fremont County, Wyoming in July 1949. It was described as a new species two years later by Arthur Cronquist of the New York Botanical Garden and named in honor of its discoverer (Cronquist 1951). Over the next 26 years this species was observed at only two other locations in the state and was recommended for listing as Threatened under the Endangered Species Act by the Smithsonian Institution in 1975 (Ayensu and DeFilipps 1978). Surveys by Robert Dorn, Robert Lichvar, Ellen Collins, and B.E. Nelson in 1979 documented two new occurrences and over 25 new subpopulations, prompting the US Fish and Wildlife Service to drop *A. porteri* from the candidate list in 1983.

Due to its limited geographic range and high habitat specificity, *Artemisia porteri* has remained a species of special concern in Wyoming and was listed as "Sensitive" by the Bureau of Land Management (BLM) Wyoming State Office in 2001. In order to assess the conservation status of this species, the BLM contracted with the University of Wyoming and the Wyoming Natural Diversity Database (WYNDD) to assemble information on the known distribution, abundance, life history, and threats to Porter's sagebrush on public lands in central Wyoming. The results of this study are discussed in the following report.

METHODS

Information on the habitat and distribution of *Artemisia porteri* was obtained from scientific literature, specimens from the Rocky Mountain (RM) and Central Wyoming College herbaria, unpublished consultant reports and knowledgeable individuals. USGS topographic maps, geologic maps 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 August 1999 (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 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 *Artemisia porteri* (Appendix D) using Classification Tree Analysis and GIS (Fertig 1999; Fertig et al. 2002 in ed.; Fertig and Thurston 2002 in ed.). Based on information from WYNDD and RM, we used 19 randomly selected locations of *A. porteri* to construct the model and 6 locations for validation. An additional 959 absent points (locations where this species has not been documented despite recent,

intensive field sampling) were selected for model building from the RM's database of Wyoming collection sites and 182 absent points were chosen to validate the model. Environmental attributes for each present and absent point were derived from digital coverages in ArcView version 3.2. Selected environmental variables included elevation, local relief, average January, April, July, and October precipitation and air temperature, maximum July air temperature, number of wet days, number of frost days, growing degree days, total January and July shortwave radiation (Thornton et al. 1997), Gap land cover (Driese et al. 1997), bedrock geology (Love and Christiansen 1985), surficial geology (Case et al. 1998), and Wyoming soil classification (Munn and Arneson 1998). Using presence/absence as the response variable and a pruning algorithm to eliminate terminal nodes capturing fewer than 0.2% of possible points, we created a simple classification tree model in S-Plus version 1.1 that identified four 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 (Figure 3 and Appendix D). The validation data set was compared to this final map to determine the classification success rate.

SPECIES INFORMATION

Classification:

Scientific Name: *Artemisia porteri* Cronquist (1951). Holotype: USA: Fremont Co. Ca 10 miles east of Sand Draw Oil Field and 40 miles southeast of Riverton. 6 July 1949. *Porter, C.L. 4969* (RM holotype, NY isotype).

Common Name: Porter's sagebrush, Porter's wormwood.

Family: Asteraceae or Compositae (Sunflower family).

Synonyms: None.

Phylogenetic Relationships: The genus *Artemisia* (sensu lato) contains at least 50 species in North America and more than 100 worldwide (Cronquist 1994). Dorn (2001) recognizes 22 species and 11 additional varieties in Wyoming. Porter's sagebrush belongs to section *Dracunculus*, a group in which only the marginal flowers are fertile and the disk flowers at the center of the head are sterile with aborted ovaries (Cronquist 1994). *A. porteri* is believed to be most closely related to *A. pedatifida*, from which it differs in leaf shape and overall stature (Cronquist 1951).

Legal Status: Porter's sagebrush is listed as Sensitive by the BLM Wyoming State Office. This species was formerly a Category 2 (C2) candidate for listing under the Endangered Species Act but was dropped to Category 3C status in 1983 following surveys that found it to be more abundant and widespread than originally suspected (US Fish and Wildlife Service 1983). *A. porteri* receives no legal protection under Wyoming state law.

Natural Heritage Rank: The Association for Biodiversity Information (formerly the heritage division of The Nature Conservancy) and the network of state natural heritage programs gives *Artemisia porteri* a rank of G2, indicating that the species is "imperiled because of rarity" throughout its geographic range and is known from 6-20 extant populations worldwide (Fertig and Heidel 2002). *A. porteri* is also ranked S2 in the state of Wyoming.

Description: Porter's sagebrush is a mat-forming perennial subshrub with numerous slender annual stems less than 15 cm tall (Figures 1-2). The leaves are silvery-pubescent and 2-5 cm long. Stem leaves are mostly entire, while the basal leaves may be entire or three-lobed. Flower heads are arranged in a long, narrow, leafy, spike-like inflorescence. Each head consists of 30-40 disk flowers (ray flowers are lacking) within a pubescent involucre 4.5-7 mm long. Flowers at the center of the head are staminate, while those on the margins produce fruit (Cronquist 1951; Clark and Dorn 1979; Fertig et al. 1994; Fertig and Jones 1997).

Similar Species: *Artemisia pedatifida* has shorter (6-20 mm long), mostly three-parted leaves and shorter involucres. *A. longifolia* usually has longer leaves (often over 6 cm) and a more elongate inflorescence. *A. ludoviciana* is a tall perennial forb that dies back to a woody base.

Figure 1. Line drawing of Artemisia porteri *by Isobel Nichols from Fertig et al. (1994). Inset at bottom right depicts individual flower heads with perfect flowers around the margins and sterile, staminate flowers at the center.*

Figure 2. Photo of Artemisia porteri *by Jennifer Whipple from the Sand Draw oil field area of southeastern Fremont County, Wyoming, June 1992. Photo from Fertig et al. (1994).*

Geographic Range: *Artemisia porteri* is endemic to central Wyoming in the Wind River Basin and southwestern Powder River Basin of Fremont, Natrona, and Johnson counties (Figure 3). It is known from 11 occurrences consisting of at least 60 discrete subpopulations and occupying a minimum area of 1250 acres (506 ha). The entire global range of the species is contained within an area of approximately 60 x 80 miles (96.5-128 km). The location of Wyoming populations is summarized in Table 1 and more detailed population data and maps are provided in Appendix A.

Potential Distribution in Wyoming: Based on modeling, 3,076 square kilometers of potential habitat occurs for *Artemisia porteri* in Wyoming (1.2% of the state's area) (Appendix D). Most of this potential habitat is located in the Wind River Basin and Beaver Rim area (Fremont and Natrona counties) and the southwestern Powder River Basin (Johnson and Natrona counties) and coincides with the known distribution of the species (Figure 3). Additional areas of potential habitat may exist in the southern Bighorn Basin in Hot Springs, Park, and Washakie counties, and the Pine Ridge area of eastern Natrona and northwestern Converse counties. To date, no populations of *A. porteri* have been documented in the Bighorn Basin or Pine Ridge area, despite recent and on-going floristic surveys of these areas (Roderick et al. 1999; Taylor 2000). The absence of Porter's sagebrush in these areas may be due to poor dispersal, competition from closely related taxa, or recent extirpation, or may be an artifact of errors resulting from inadequate location or environmental variables used to create the model (Fertig et al. 2002, in ed.).

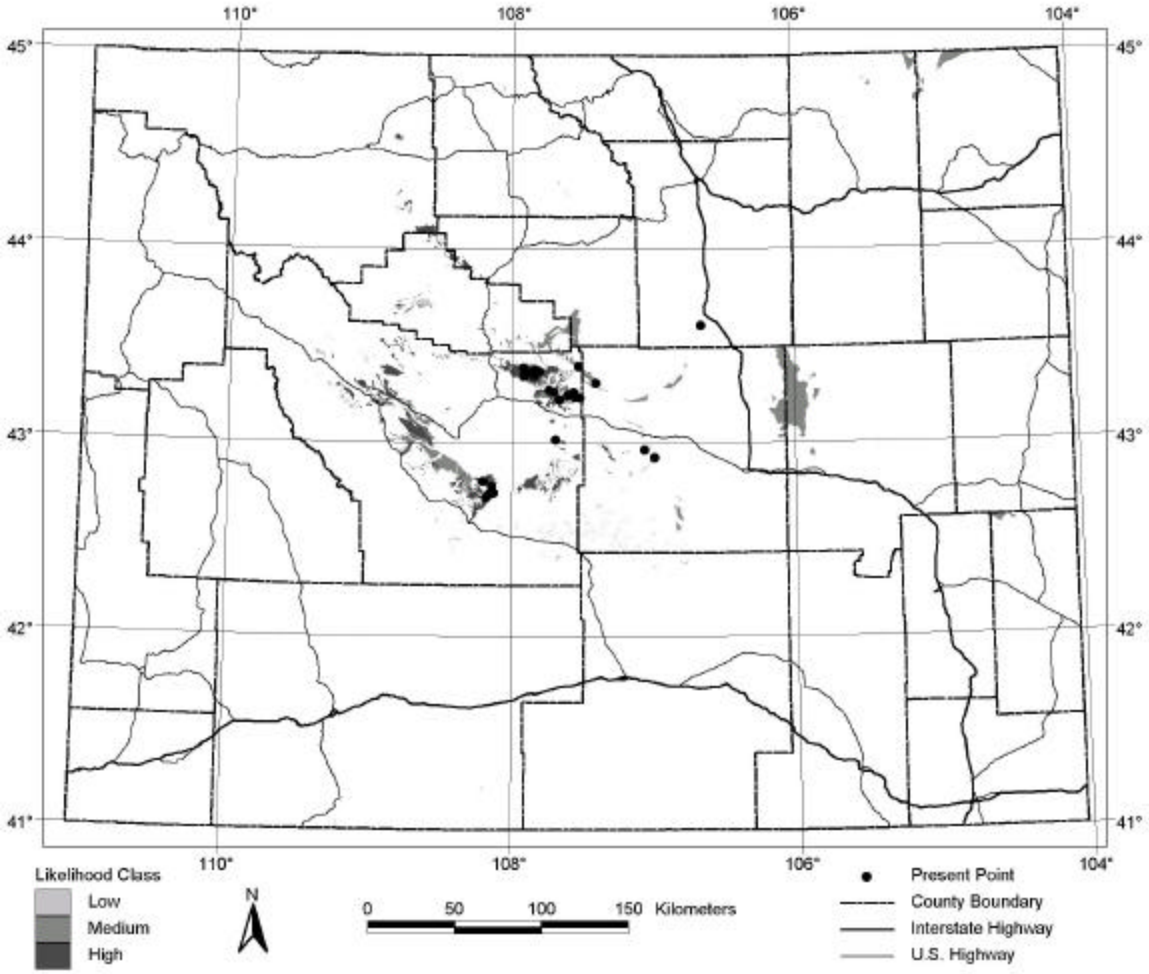

Figure 3. Known and potential distribution of Artemisia porteri *in Wyoming. Known populations are indicated by black dots. Potential distribution based on classification tree modeling is depicted by gray shading.*

Extent of Surveys in Wyoming: Porter's sagebrush was first collected by Cedric L. Porter of University of Wyoming in July 1949 in the Sand Draw area of southeastern Fremont County, Wyoming (Cronquist 1951). A. Stanton collected a vegetative specimen from the vicinity of Lost Cabin in the Wind River Basin of eastern Fremont County on 31 January, 1963 that was sent to Dr. Porter for positive confirmation. Herb Fisser of the Department of Range Science at the University of Wyoming collected a third specimen in the Cedar Ridge area of northeastern Fremont County in June 1969 (confirmed by Ronald Hartman). Robert Dorn relocated Fisser's Cedar Ridge population in 1977. In 1979 Robert Dorn, Robert Lichvar, and Ellen Collins of the Wyoming Natural Heritage Program and B.E. Nelson of the Rocky Mountain Herbarium relocated or discovered 25 colonies of *Artemisia porteri* in Fremont and Natrona counties representing 5 element occurrences. Ronald Hartman of the Rocky Mountain Herbarium located a new colony in the Lost Cabin area in 1981. June Haines (1988) and Hollis Marriott (1986) surveyed a new population in the Lysite Badlands area for the BLM in 1986. In 1988, Dr. Jim Locklear of the Nebraska **[continued on page 12]**

Table 1. Locations of Porter's sagebrush in Wyoming

Occurrence # 001
County: Fremont
USGS Quad: Cottonwood Pass
Latitude: 43º 23' 35"N (centrum)
South Latitude: 43º 23' 28" N
North Latitude: 43º 23' 40" N
Longitude: 107º 32' 17" W (centrum)
East Longitude: 107º 32' 10" W
West Longitude: 107º 32' 25" W
Township/Range/Section: T40N R89W S32 (NE4 OF SE4); S33 (NW4).
Location: Wind River Basin, ca 9 air miles northeast of Lost Cabin on Big Horn Trail, ca 31.5 air miles east-northeast of Shoshoni.

Occurrence # 002
County: Fremont
USGS Quads: Lysite SE, Madden and Moneta
Latitude: 43º 14' 05" N (centrum)
South Lat: 43º 13' 10" N
North Lat: 43º 15' 35" N
Longitude: 107º 33' 45" W (centrum)
East Long: 107º 31' 50" W
West Long: 107º 40' 51" W
Township/Range/Section: T38N R89W S18 (SW4SW4); S19 (NE4 OF NW4); S28 (S4 of SW4 of NW4 & N4 of NW4 of SW4); S30 (W2 of NE4); T38N R90W S13 (NE4 OF SE4); S14 (SE4SE4SE4 & SW4SW4); S22 (E4 of NE4NE4, SW4 of NE4, & NW4 of SE4); S23 (W4 of NW4NW4)
Location: Wind River Basin, ca 4-5 miles southeast of Lost Cabin between the South Fork of Sand Creek and Alkali Creek, ca 0.75-3 air miles west of the Natrona County line and ca 7 air miles northeast of Moneta.

Occurrence # 006
County: Fremont
USGS Quads: De Pass, Gates Butte, Guffy Peak, and Picard Ranch
Latitude: 43º 22' 00" N (centrum)
South Lat: 43º 20' 35" N
North Lat: 43º 23' 20" N
Longitude: 107º 55' 00" W (centrum)
East Long: 107º 51' 05" W
West Long: 107º 55' 47" W
Township/Range/Section: T39N R92W S2 (line between SW4 & NW4); S6 (NW4NE4); S7 (N2 of SE4 & SE4 of NE4); S8 (W2 of NW4); S9 (NE4); S10 (W2 of SE4); S11 (SW4SW4); S12 (S2 of NE4 & N2 of S2); S14 (N2); S15 (N2); S16 (NE4 of SE4); S17 (W2 of SW4); S18 (E2 of SE4 & SW4SW4); T40N R92W S31 (SW4)
Location: Northern Wind River Basin, flats on the north side of Cedar Ridge south of Copper Mountain, including the badlands bordering Dry Creek on the north and south side of Badwater Road, and the south and west side of Steffen Hill, (ca 10 air miles northwest of Lysite).

Occurrence # 011
County: Fremont
USGS Quad: Sand Draw
Latitude: 42º 46' 25" N (centrum)
South Latitude: 42º 42' 55" N
North Latitude: 42º 48' 03" N
Longitude: 108º 08' 55" W (centrum)
East Longitude: 108º 08' 07" W
West Longitude: 108º 12' 37" W
Township/Range/Section: T32N R95W S2 (NW4 of SE4); S13 (W2 of NW4, SE4 of SW4 & SW4 of SE4); S14 (E2 of NE4); S23 (W4 of SW4 of NW4, W4 of NW4 of SW4, & SW4SW4); S24 (NE4 of NW4 & NW4 of NE4); S28 (SE4 of NE4 & NE4 of SE4); T33N R95W S26 (S2 of NW4 of SW4 & N2 of SW4SW4; S28 (SE4SE4).
Location: Southern Wind River Basin, Big Sand Draw Oil Field area north of Beaver Rim, from the west side of WY Highway 135 along McTurk Draw northeast to Big Sand Draw at base of Oil Mountain.

Table 1. Continued

Occurrence # 015
County: Natrona
USGS Quad: Badwater
Latitude: 43º 18' 40" N (centrum)
South Latitude: 43º 18' 12" N
North Latitude: 43º 19' 00" N
Longitude: 107º 25' 22" W (centrum)
East Longitude: 107º 24' 58" W
West Longitude: 107º 25' 45" W
Township/Range/Section: T39N R88W S32 (NE4 & NE4 OF SE4); S33 (W2 OF SW4)
Location: Wind River Basin, "1 mile south-southeast of Badwater" [on northeast side of Cedar Ridge, ca 0.75 miles north of Cedar Gap and 0.4 miles west of Badwater Road].

Occurrence # 017
County: Fremont
USGS Quads: Gates Butte and Lysite.
Latitude: 43º 16' 10" N (centrum)
South Lat: 43º 15' 35" N
North Lat: 43º 16' 35" N
Longitude: 107º 44' 10" W (centrum)
East Long: 107º 42' 35" W
West Long: 107º 45' 23" W
Township/Range/Section: T38N R91W S9 (E2 OF SE4); S10 (S2); S11; S13 (NW4 OF SW4); S14 (S2 OF NE4); S15 (N2)
Location: Wind River Basin, Lysite badlands, ca. 2 air miles west of Lysite [ridge on south bank of Badwater Creek, extending from ca 0.5 miles west of the Moneta-Lysite Road 2.25 miles west to Day Butte].

Occurrence # 018
County: Johnson
USGS Quad: TTT Ranch
Latitude: 43º3616N (centrum)
South Latitude: 43º3610N
North Latitude: 43º3618N
Longitude: 106º4015W (centrum)
East Longitude: 106º4008W
West Longitude: 106º4020W
Township/Range/Section: T42N R82W S14 (SE4 of NW4 of SW4).
Location: Powder River Basin, knoll on north side of Lone Bear Road (TTT Ranch Road) ca 0.6 miles north of Murphy Creek, 7.5 miles south of Kaycee and 3.5 miles southwest of Interstate 25. Also on south side of Lone Bear Road on small ridge 0.1 miles east of two-track road to well and drill site on Murphy Creek.

Occurrence # 019
County: Natrona
USGS Quad: Gaylord Reservoir
Latitude: 42º 57' 46" N (centrum)
South Latitude: 42º 57' 37" N
North Latitude: 42º 58' 10" N
Longitude: 107º 04' 33" W (centrum)
East Longitude: 107º 04' 11" W
West Longitude: 107º 05' 07" W
Township/Range/Section: T35N R85W S30 (SW4 of SE4 of SW4); S31 (NW4NW4, S2 of NW4, & NW4NW4 of SE4); T35N R86W S36 (E4 of NE4)
Location: Casper Arch, badlands on east and west sides of County Road 211 on divide between Wallace Creek and Middle Fork Casper Creek, ca 1.5 miles northeast of Gaylord Reservoir and 6.5 miles southwest of the town of Powder River.

Occurrence # 020
County: Natrona
USGS Quads: Gaylord Reservoir and Square Top Butte
Latitude: 42º 55' 30" N (centrum)
South Latitude: 42º 54' 56" N
North Latitude: 42º 55' 53" N
Longitude: 107º 00' 09" W (centrum)
East Longitude: 106º 59' 45" W
West Longitude: 107º 00' 30" W
Township/Range/Section: T34N R85W S11 (SE4 of SW4SW4 & E4 of SW4); Sec 15 (S2 of NE4 of SE4)

Table 1. Continued

Location: Casper Arch, badlands to north and southwest of Square Top Butte, ca 4 miles west of Pine Mountain. Population extends from badlands at head of southeast tributary washes of Coyote Creek northeast to the flats ca 0.5 miles north of Square Top Butte (a distance of ca 1.5 miles).

Occurrence # 021
County: Fremont
USGS Quad: Moneta
Latitude: 43º 13' 20" N (centrum)
South Latitude: 43º 13' 10" N
North Latitude: 43º 13' 30" N
Longitude: 107º 40' 35" W (centrum)
East Longitude: 107º 40' 20" W
West Longitude: 107º 40' 49" W
Township/Range/Section: T38N R90W S31 (NE4NE4, SW4 of NE4, & NW4 of SE4 of NE4)
Location: Wind River Basin, ridge system on divide between Reservoir Creek and Alkali Creek northeast of junction of Moneta-Lysite Road and road to Madden, ca 2 miles east of the Moneta Hills, 3.2 miles south of Lysite, and 4 miles north-northeast of Moneta.

Occurrence # 022
County: Fremont
USGS Quad: Seventy-one Reservoir
Latitude: 43º 01' 03" N (centrum)
South Latitude: 43º 01' 00" N
North Latitude: 43º 01' 05" N
Longitude: 107º 42' 09" W (centrum)
East Longitude: 107º 42' 04" W
West Longitude: 107º 42' 14" W
Township/Range/Section: T35N R91W S11 (SW4 of NE4 of SE4)
Location: Wind River Basin, east side of Castle Garden Road (Love Ranch Road) ca 0.3 miles east of reservoir at head of tributary branch of Chalk Hills Draw, ca 9 miles south of Moneta.

[continued from page 9] Statewide Arboretum collected seed from the Sand Draw area for the Center for Plant Conservation rare plant seedbank. Robert Dorn led a field trip to the Sand Draw population for members of the Wyoming Native Plant Society in June 1992. George Jones of WYNDD revisited portions of the Sand Draw population in 1994 while conducting a survey for other rare plants of the Beaver Rim area. In 1995, Dorn revisited a known occurrence in the Badwater area of western Natrona County. Walter Fertig and George Jones resurveyed two known occurrences in the Copper Mountain area of Fremont County for the BLM (Fertig and Jones 1997). Jones discovered the first occurrence from Johnson County in 1997 while conducting a rapid ecological assessment for The Nature Conservancy in the Powder River Basin. Amy Roderick Taylor discovered a new occurrence near Gaylord Reservoir in Natrona County during a general floristic survey in 1998 (Roderick et al. 1999; Taylor 2000). Walter Fertig and Laura Welp of WYNDD revisited 8 occurrences and established permanent demographic monitoring plots in 1999. Dr Richard and Beverly Scott of Central Wyoming College resurveyed several known locations in the Sand Draw and Lost Cabin areas and discovered 3 new occurrences in Fremont and Natrona counties during pipeline survey work in 1999-2000 (ENSR 2000; Scott and Scott 2000).

Habitat: Porter's sagebrush occurs in sparsely vegetated clay flats, gullies, depressions, and badlands slopes at 4960-7000 feet (1510-2135 m) (Figure 4). Most populations are found on pale whitish or red to green-banded silty loams derived from shales or consolidated volcanic ash of the Eocene Wagon Bed or Wind River formations. Occasionally, these sites may be rich in gypsum or bentonite. One occurrence in the Powder River Basin in Johnson County is found on gray sandstones and sandy shales of the Cretaceous Frontier Formation. Throughout its range, *Artemisia porteri* is found on fine-textured, poorly-drained aridisols or entisols that sometimes have a surface layer of broken light-colored sandstone flakes.

Artemisia porteri may be locally dominant or co-dominant with *A. pedatifida, A. longifolia* or *Atriplex gardneri*. Common associated species in these communities include *Achnatherum hymenoides, Elymus lanceolatus, Bouteloua gracilis, Koeleria macrantha, Platyschkuhria integrifolia, Oonopsis multicaulis, Erigeron pulcherrimus,* and *Musineon divaricatum* (Table 2). Porter's sagebrush communities are often replaced by *Artemisia tridentata* var. *wyomingensis-Chrysothamnus nauseosus* grasslands on rockier sites or by *A. pedatifida* on rolling clay plains or gravelly knolls. Total vegetative cover in *A. porteri* habitat is often as low as 1-5% in gypsum-rich sites, but more frequently ranges from 15-25%.

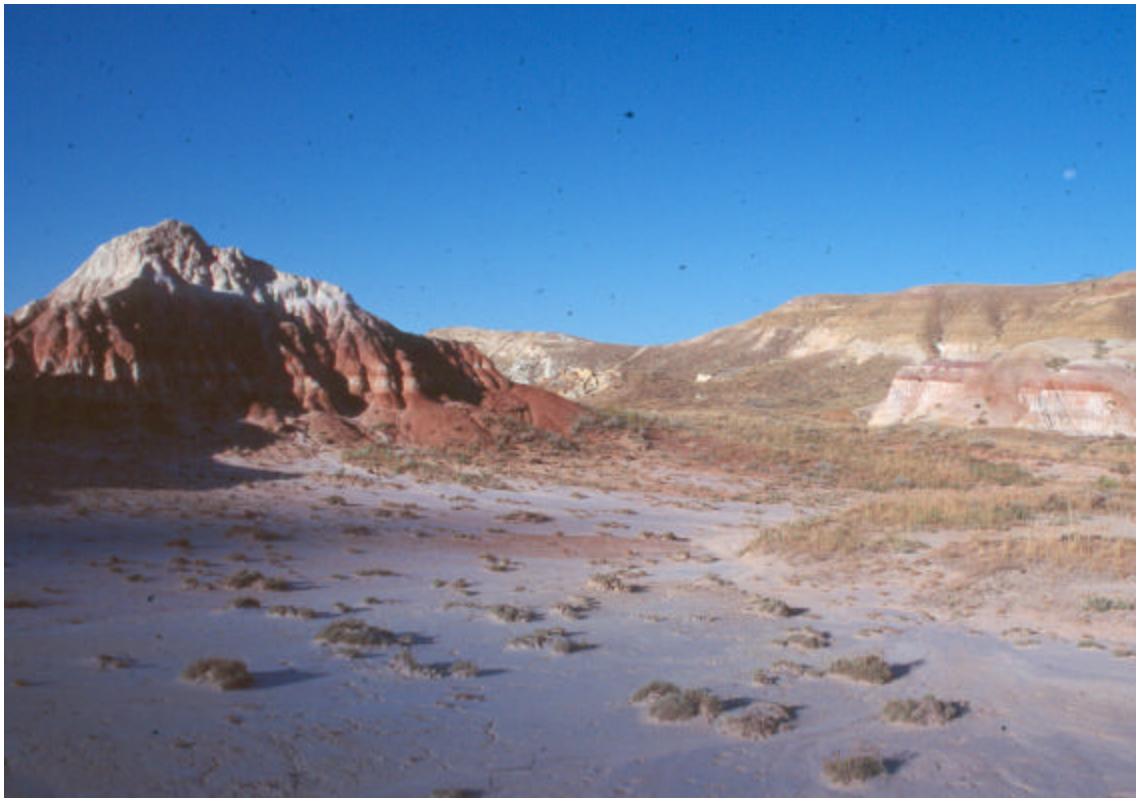

Figure 4. Habitat of Artemisia porteri *on barren clay knolls and flats of the Wind River Formation in vicinity of Gaylord Reservoir, Natrona County, Wyoming (Occurrence # 019). WYNDD photograph by Laura Welp, August 1999.*

Average annual precipitation within the range of *Artemisia porteri* is 8-12 inches (203-305 mm), with peak precipitation coming as rain in May and June (Martner 1986). Mean annual temperature is 40-44º F (4.4-6.6º C). January mean high and low temperatures are 30-34 º F (-1.1 - 1.1º C) and 2 to 10º F (- 16.5 to - 12.1º C), respectively. July mean high temperature is 86-88º F (29.7-30.8º C) and July low temperature averages 52-56º F (11-13.2º C). The mean length of the frost-free season averages 100 days and the mean number of days with a maximum temperature over 90º F (31.9º C) is 10-20 (Martner 1986; Knight 1994).

Table 2. Species commonly associated with Porter's sagebrush

Scientific Name	**Common Name**	**Growth Form**
Achnatherum [*Oryzopsis*] *hymenodies*	Indian ricegrass	Perennial graminoid
Artemisia longifolia	Long-leaf wormwood	Shrub
Artemisia pedatifida	Birdfoot sagebrush	Shrub
Artemisia tridentata var. *wyomingensis*	Wyoming big sagebrush	Shrub
Atriplex gardneri	Gardner saltbush	Shrub
Atriplex suckleyi	Suckley's saltbush	Annual forb
Bouteloua gracilis	Blue grama	Perennial graminoid
Elymus lanceolatus var. *lanceolatus*	Thickspike wheatgrass	Perennial graminoid
Eremogene [*Arenaria*] *hookeri*	Hooker's sandwort	Perennial forb
Erigeron pulcherrimus	Basin fleabane	Perennial forb
Eriogonum brevicaule	Shortstem wild buckwheat	Perennial forb
Gutierrezia sarothrae	Broom snakeweed	Shrub
Hordeum jubatum	Fox-tail barley	Perennial graminoid
Koeleria macrantha	Prairie junegrass	Perennial graminoid
Lesquerella arenosa var. *arenosa*	Great Plains bladderpod	Perennial forb
Musineon divaricatum	Leafy wild parsley	Perennial forb
Oonopsis [*Haplopappus*] *multicaulis*	Branched false goldenweed	Perennial forb
Penstemon arenicola	Red Desert beardtongue	Perennial forb
Phlox muscoides	Moss phlox	Perennial forb
Platyschkuhria integrifolia	Basin-daisy	Perennial forb
Sarcobatus vermiculatus	Greasewood	Shrub
Sporobolus airoides	Alkali sacaton	Perennial graminoid

Population Size and Trends: Porter's sagebrush is currently known from 11 occurrences consisting of 60 discrete subpopulations (Tables 1, 3; Appendix A). Individual colonies range in size from 1-50 acres and number in the low hundreds to low thousands. Surveys of 30 subpopulations in 8 occurrences in 1999 documented 30,000 individuals. Extrapolating from this figure to account for unsurveyed and potential habitat, the current population of *Artemisia porteri* is conservatively estimated at 50,000-75,000 individuals.

Long-term trend data are not available for most populations of Porter's sagebrush. All known occurrences have either been revisited or discovered since 1999 and are extant. At least one subpopulation has not been relocated since first being discovered in 1979 and is presumed extirpated (Occurrence # 001, Section 33 colony). Other populations revisited since 1979 are still present and in most cases vigorous and abundant. Although some habitat has almost certainly been altered or lost during development of oil and natural gas fields and pipelines in the Sand Draw and Lysite areas, the overall population of Porter's sagebrush in central Wyoming is probably stable at present.

Population Biology and Ecology: *Artemisia porteri* flowers from early June through late July or early August. Fruits are produced from late July to early September. The flowers of Porter's sagebrush are highly reduced and numerous in erect, spike-like panicles and are adapted for wind pollination. Seed dispersal is also facilitated by wind or gravity. Germination requirements and seedling biology is not known for this species, but establishment is probably episodic and dependent on suitable spring or summer moisture conditions. No seedlings were observed in surveys or demographic plots in 1999.

Porter's sagebrush is often locally abundant in suitable microhabitats and may be the dominant or codominant species in its vegetative community. Plants are often distributed non-randomly in clumps, but individual clumps may be widely scattered and do not occupy all available habitat. Densities range from 0.8 to 2.8 plants per square meter based on monitoring studies in 1979 (Environmental Research and Technology, Inc. 1979) and 1999 (Appendix C).

Due to its low stature and dense covering of white pubescence, *Artemisia porteri* does not appear to be favored browse for livestock or native ungulates. Predation of seed and flower heads by insects or rodents has been observed at some sites in the Lysite area. Porter's sagebrush is most often found in sites with vegetative cover under 25%, suggesting that it does not compete well with other species on less severe habitats. Although it frequently co-occurs with *Artemisia pedatifida* and *A. longifolia,* this species does not appear to hybridize in the wild.

Current Management: All known occurrences of Porter's sagebrush are on lands managed by the BLM Buffalo, Casper, and Lander Field Offices or the state of Wyoming. Some populations may extend onto private inholdings surrounded by public lands in the vicinity of Lysite and the Copper Mountains. No populations are currently found within protected lands, although one occurrence (#017) in the Lysite Badlands area has special management restrictions under the BLM Lander Resource Management Plan (USDI Bureau of Land Management 1987). This site was recommended for designation as an Area of Critical Environmental Concern by Marriott (1986), but no action has been taken on this proposal.

Table 3. Abundance and trend information for known populations of Porter's sagebrush

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Occurrence # 001
Area: 20 acres
Number of Plants: 635 plants counted by Laura Welp in August 1999 (population estimated at 1500).
Density: Clumped-patchy.
Evidence of Reproduction: 50% of plants in flower or fruit in August 1999.
Trends: Sec 32 colony was discovered in 1996 and was still extant and healthy in 1999. Sec 33 colony reported by B.E. Nelson in 1979 could not be relocated by Jones in 1996 or Welp in 1999.

Occurrence # 002
Area: 45 acres.
Number of Plants: Laura Welp counted 983 plants at 3 of 9 known subpopulations in August 1999 (total population at these sites estimated at 1700). 3 additional colonies surveyed by Richard and Bev Scott in 1999, but no census data available.
Density: Plants may be clumped or widely scattered.
Evidence of Reproduction: 1-5% of population in flower or fruit in August 1999.
Trends: Population has been known since 1963, but trend data are not available for all subpopulations.

Occurrence # 006
Area: 500 acres.
Number of Plants: 6030 plants counted in 3 of 9 known subpopulations by Laura Welp in August 1999. Population estimated at 11,200 for these subpopulations.
Density: Ranges from 3-23 plants per 10 square meters (Environmental Research & Technology 1979). Density estimated at 2.7 plants per square meter in demographic plots established in 1999.
Evidence of Reproduction: Observed in flower and fruit on 26 August 1999 by L. Welp.
Trends: Population estimated at 5000-8000 at 5 subpopulations by Fertig in 1996 (Fertig and Jones 1997). Current population is probably stable.

Occurrence # 011
Area: 85 acres
Number of Plants: 774 plants counted in 3 subpopulations by Laura Welp in August 1999 (population estimated at 1400 at these sites). 3 additional populations surveyed by Richard and Bev Scott in 1999.
Density: Density of 1-5 stems per square meter reported by Ellen Collins in 1979. Density of 0.84 plants per square meter recorded by Welp in monitoring transect established in 1999.
Evidence of Reproduction: 12-75% of plants in flower or fruit at 3 sites in 1999.
Trends: Population has been known since 1949 and is probably stable, although some habitat may have been lost during development of Sand Draw oil field.

Occurrence # 015
Area: 10-20 acres
Number of Plants: 831 plants counted by Laura Welp in 1999 (population estimated at 1500-2000).
Density: Reported as 2 stems per square meter by Ellen Collins in 1979.
Evidence of Reproduction: Observed in flower and fruit by Robert Dorn in August 1995 and by Laura Welp in August 1999.
Trends: Population has been known since 1979, but trend data are not available.

Occurrence # 017
Area: 450 acres.

Table 3. Continued

Number of Plants: 560 plants counted by Laura Welp in August 1999 (estimated at 1000).
Density: Reported as "sporadic" by Marriott (1986).
Evidence of Reproduction: 80% of population observed in flower of fruit by Welp in 1999.
Trends: Population reported at 100-1000 plants by Marriott (1986). Current trends are probably stable.

Occurrence # 018
Area: 4-5 acres.
Number of Plants: 525-1025 plants observed in 2 colonies by W. Fertig in August 1999.
Density: Plants typically clustered, with individual clusters widely scattered.
Evidence of Reproduction: Observed in late fruit on 29 August 1999.
Trends: Probably stable at present, but population has only been known since 1997.

Occurrence # 019
Area: 40 acres.
Number of Plants: Total population estimated at 20,000-35,000 individuals by W. Fertig and Laura Welp.
Density: Individual clumps are widely spaced, but clusters of 50 plants may occur in areas of 10 x 15 meters.
Evidence of Reproduction: 80% of population in fruit on 29 August 1999.
Trends: Not known since population was only discovered in 1998.

Occurrence # 020
Area: 10 acres.
Number of Plants: Census data not available.
Density: Not reported.
Evidence of Reproduction: Observed in fruit by Richard Scott on 12 July 2000.
Trends: Not known (population just discovered in 2000).

Occurrence # 021
Area: 45 acres.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Not reported.
Trends: Not known (population just discovered in 1999 by Richard and Bev Scott).

Occurrence # 022
Area: 4 acres
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Not reported.
Trends:
Not known (population just discovered in 1999 by Richard and Bev Scott).

Existing and Potential Threats: The primary threat to Porter's sagebrush is loss of habitat due to impacts from road or pipeline construction associated with oil, natural gas, or uranium mining. Numerous roads currently bisect occupied habitat in the Lysite and Sand Draw areas and probably have resulted in direct mortality of individuals from blading and trampling. Roads can also indirectly impact this species by providing increased access for off-highway vehicle recreation and invasive weeds. Some populations in the Sand Draw area co-occur with large patches of cheatgrass (*Bromus tectorum*) that may have become established following road construction. Studies in 1979 suggest that Porter's sagebrush may be able to recolonize old roadcuts however, if use is low (Environmental Research and Technology, Inc. 1979). Impacts from vehicles are probably greatest when surfaces are wet following rain. The barren habitats occupied by this species can be readily avoided during road or pipeline construction or efforts can be taken to reduce permanent impacts. This species is not typically grazed by livestock

Due to recent field investigations by WYNDD staff and Richard and Bev Scott of Central Wyoming College, Porter's sagebrush is now known to be more widespread and abundant in Wyoming than previously documented. Until sufficient populations are afforded some measure of habitat protection or management strategies for this species are designed and implemented within mineral extraction areas, *A. porteri* should retain its Sensitive status on BLM lands in Wyoming.

SUMMARY

Porter's sagebrush is endemic to the Wind River and Powder River basins in central Wyoming. It is found primarily in sparsely vegetated *Artemisia pedatifida, A. longifolia,* or *A. porteri* communities on barren clay or ashy badlands, flats, or gullies derived from the Wind River, Wagon Bed, or Frontier formations. This species is currently known from 11 extant occurrences consisting of at least 60 subpopulations covering less than 1250 acres. Individual colonies typically number from 100-1000 individuals and occupy areas of 1-50 acres. Based on surveys in 1999, the current population of Porter's sagebrush is conservatively estimated at 50,000-75,000 plants. Porter's sagebrush is primarily threatened by mineral development (oil, natural gas and uranium) within its limited range and specialized habitat. This species was designated as Sensitive by the BLM in 2001 and occurs primarily on BLM lands in the Buffalo, Casper, and Lander field offices. No populations currently receive formal protection, although the population in the Lysite Badlands is managed under special use regulations in the BLM Lander Resource Area Resource Management Plan. Porter's sagebrush is now known to be more widespread and abundant in Wyoming than previously suspected. Until sufficient habitat is afforded protection or management strategies are developed and implemented for this species in mineral extraction areas, *A. porteri* should remain a BLM state Sensitive species.

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Appendix A.
Element Occurrence Records and Location Maps

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 001

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Name: Cottonwood Pass
Latitude: 432335N (centrum)
South Latitude: 432328N
North Latitude: 432340N
Longitude: 1073217W (centrum)
East Longitude: 1073210W
West Longitude: 1073225W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T40N R89W S32 (NE4 OF SE4); S33 (NW4).
Location: Wind River Basin, ca 9 air miles northeast of Lost Cabin on Big Horn Trail, ca 31.5 air miles east-northeast of Shoshoni.

Population Data
Last Observed: 1999-08-27
First Observed: 1979-08-01
Data: 1999-08-27: Sec 32 colony: 635 plants counted by Laura Welp (population estimated at 1500). 50% of plants in flower/fruit and 50% vegetative.

1996-07-03: Sec 32 colony: Several hundred plants observed by G.P. Jones. Fewer than 10% of all plants in flower. Sec 33 colony could not be relocated.

1979-08-01: Sec 33 colony: Observed in flower and fruit by B.E. Nelson.

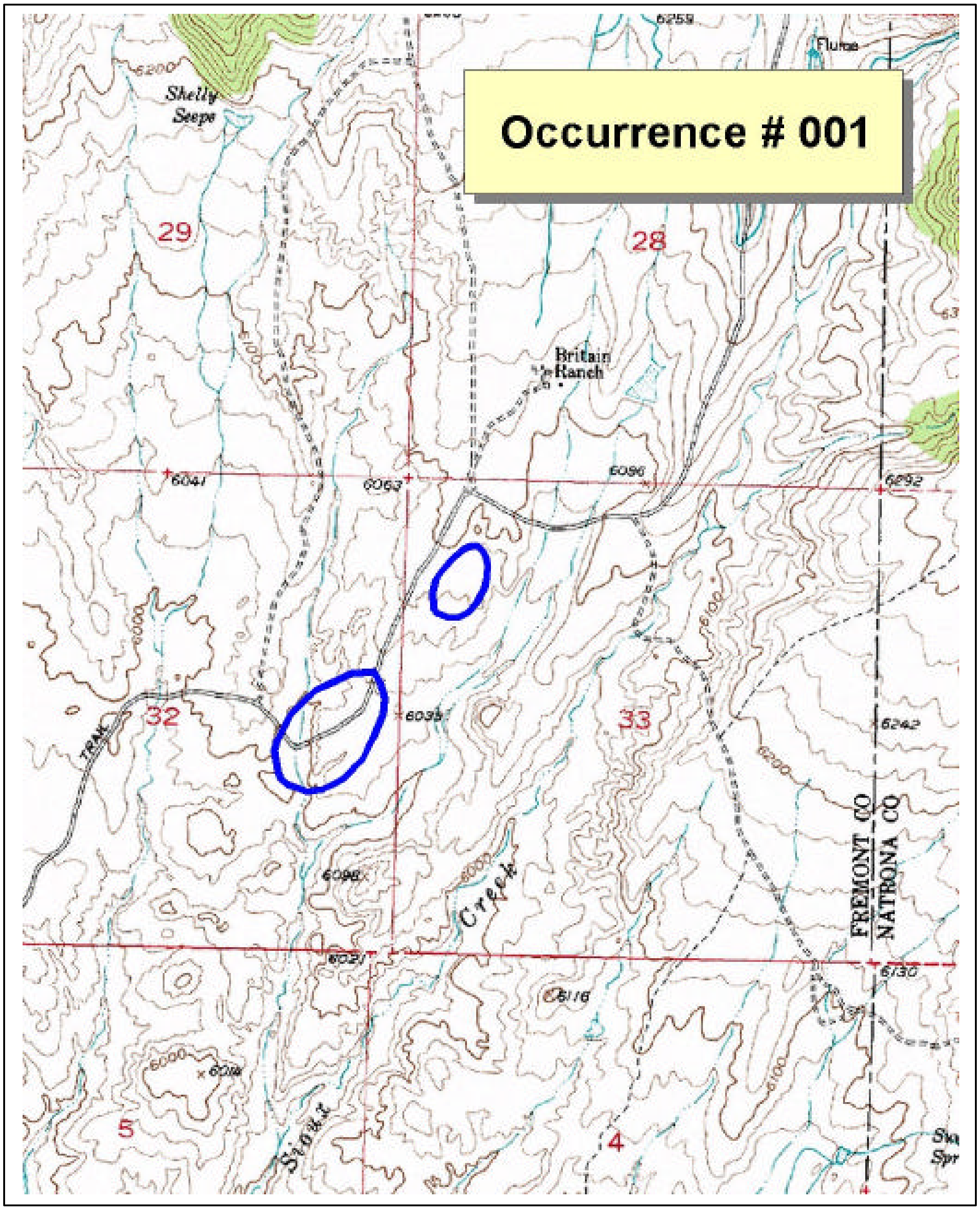
Habitat: Barren, light-colored slopes and barren shale outcrops of the Wagon Bed Formation along the edges of south-running, shallow draws. Surrounding vegetation dominated by *Artemisia pedatifida*.
Elevation: 5500 feet
Size: 20 acres

Managed Area: BLM Lander Field Office

Specimens: Nelson, B.E. (4233). 1979. RM.

Sources:
Fertig, W. and G. Jones. 1997. Plant species of special concern and plant associations of the Copper Mountain ecosystem, Fremont County, Wyoming. Report prepared for the BLM Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.

Author: Walter Fertig
Edition Date: 97-03-06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Creek
Sioux
6021
6116
6130
6018
5
4
Flume
6259
TRAIL

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 002

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Name: Lysite SE, Madden, and Moneta
Latitude: 431405N (centrum)
South Lat: 431310N
North Lat: 431535N
Longitude: 1073345W (centrum)
East Long: 1073150W
West Long: 1074051W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T38N R89W S18 (SW4SW4); S19 (NE4 OF NW4); S28 (S4 of SW4 of NW4 & N4 of NW4 of SW4); S30 (W2 of NE4); T38N R90W S13 (NE4 OF SE4); S14 (SE4SE4SE4 & SW4SW4); S22 (E4 of NE4NE4, SW4 of NE4, & NW4 of SE4); S23 (W4 of NW4NW4)
Location: Wind River Basin, ca 4-5 miles southeast of Lost Cabin between the South Fork of Sand Creek and Alkali Creek, ca 0.75-3 air miles west of the Natrona County line and ca 7 air miles northeast of Moneta.

Population Data
Last Observed: 1999-08-27
First Observed: 1963-01-31
Data: Known from 9 main subpopulations.

1999-08-27: Sec 13/18 colony: 462 plants counted (600 estimated) in survey by Laura Welp. 1% of population in fruit, 99% vegetative. Demographic Transect #2 established in SE4 of Sec 13. 2.8 plants per square meter observed in transect with 6% in flower. Sec 28 colony: 202 plants counted (500 estimated) by L. Welp with 5% of population in flower or fruit. Sec 30 colony: 319 plants counted (600 estimated) with 10-15% in flower or fruit.

1999-06/07: 3 colonies located in survey of Lost Creek Pipeline by Richard Scott in Sec 14, 22 and 22/23.

1998-07-22: Sec 14 SE4 colony: Observed in flower by R. Dorn.

1981-06-28: Sec 18 colony: Observed in flower by R.L. Hartman.

1979-08-17: Sec 28 colony: reported as "abundant" by R. Lichvar. Occurs with *Atriplex* and *Haplopappus*. Sec 30 colony: reported as "frequent" by Lichvar and Dorn. In flower, corolla yellow. Occurs with *Astragalus, Haplopappus* and *Artemisia pedatifida*. Density of 16 stems per 10 sq meters observed by E. Collins. Cover of *A. porteri* less than 2%.

1979-07-13: Sec 13 colony: In flower. Occurs with *Oryzopsis hymenoides, Haplopappus multicaulis, Artemisia pedatifida, Atriplex gardneri, Sarcobatus vermiculatus, Koeleria macrantha, Astragalus*, and *Phlox*.

1963-01-31: Collected in vegetative condition (with dried remnant fruit stalks) by A. Stanton.

Habitat: Openings within *Artemisia tridentata* var. *wyomingensis/Oryzopsis hymenoides/Elymus lanceolatus* grasslands on clay flats and gentle hills with sparse

vegetation. Soils whitish or light-colored silty loams derived from shales of the Wind River Formation.
Elevation: 5500-5600 feet
Size: ca 45 acres.

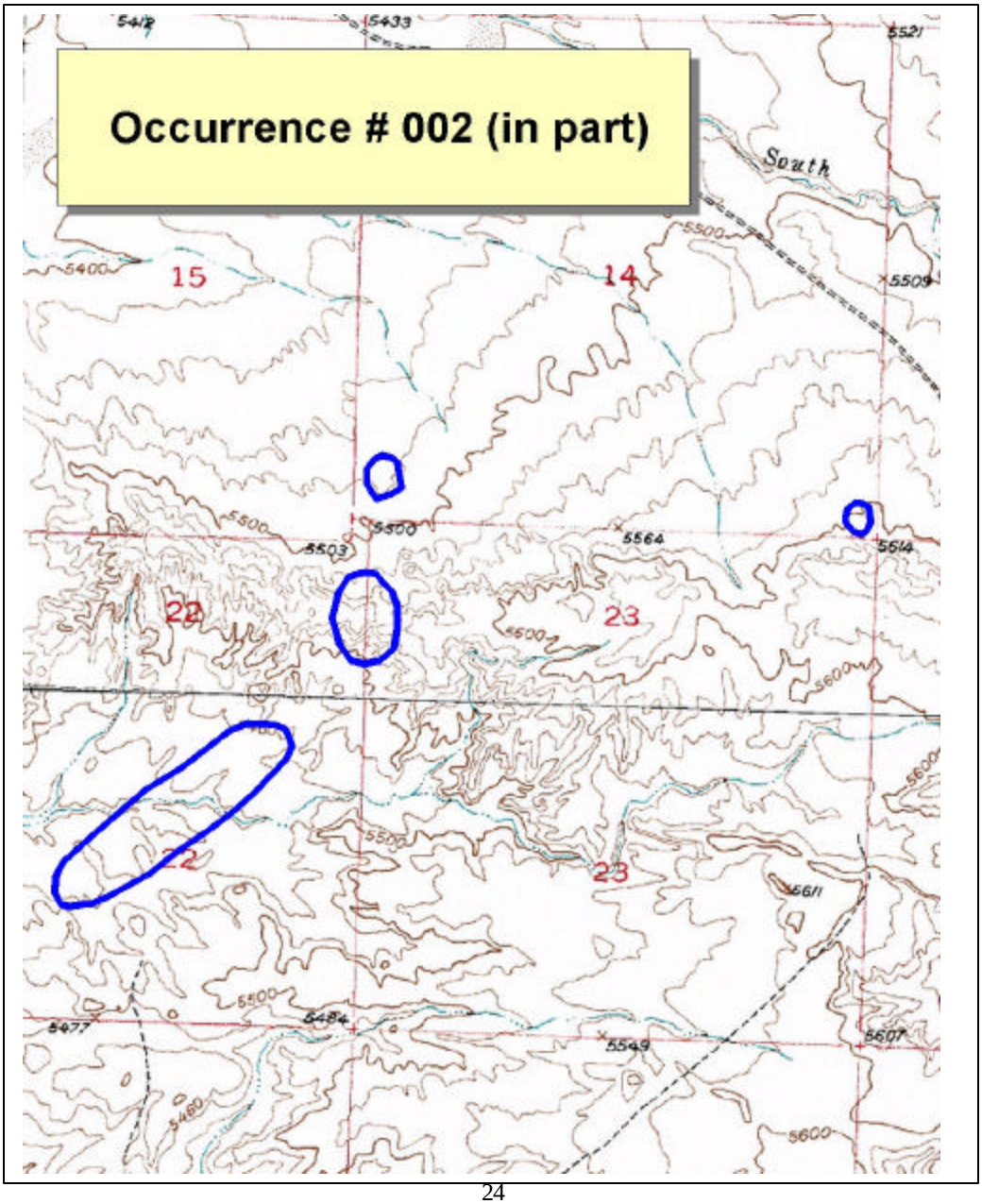
Comments: Includes former EOs 003 and 004.

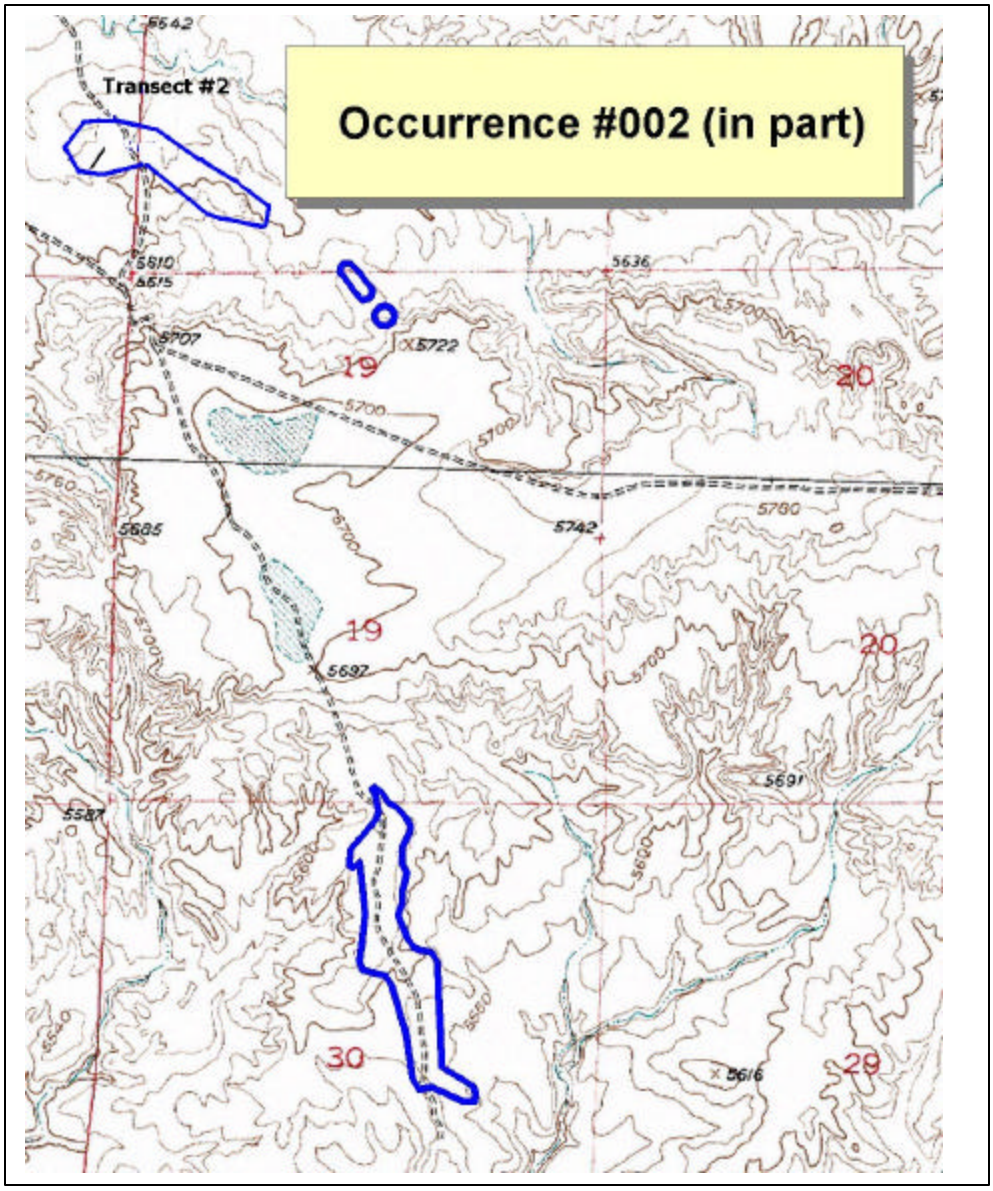
Managed Area: BLM Lander Field Office

Specimens: Lichvar, R.W. (2347, 2349, 2351). 1979. RM.
Dorn, R.D. (3394, 3396). 1979; (7649). 1998. RM.
Hartman, R.L. (13167). 1981. RM.
Stanton, A. (s.n.). 1963. RM. (Det. by C.L. Porter).

Sources: Environmental Research & Technology, Inc. 1979. Studies on distribution of Porter sagewort (*Artemisia porteri*) in the Wind River Basin. Unpublished report prepared for Rocky Mountain Energy Company.

Author: Walter Fertig
Edition Date: 02-09-23

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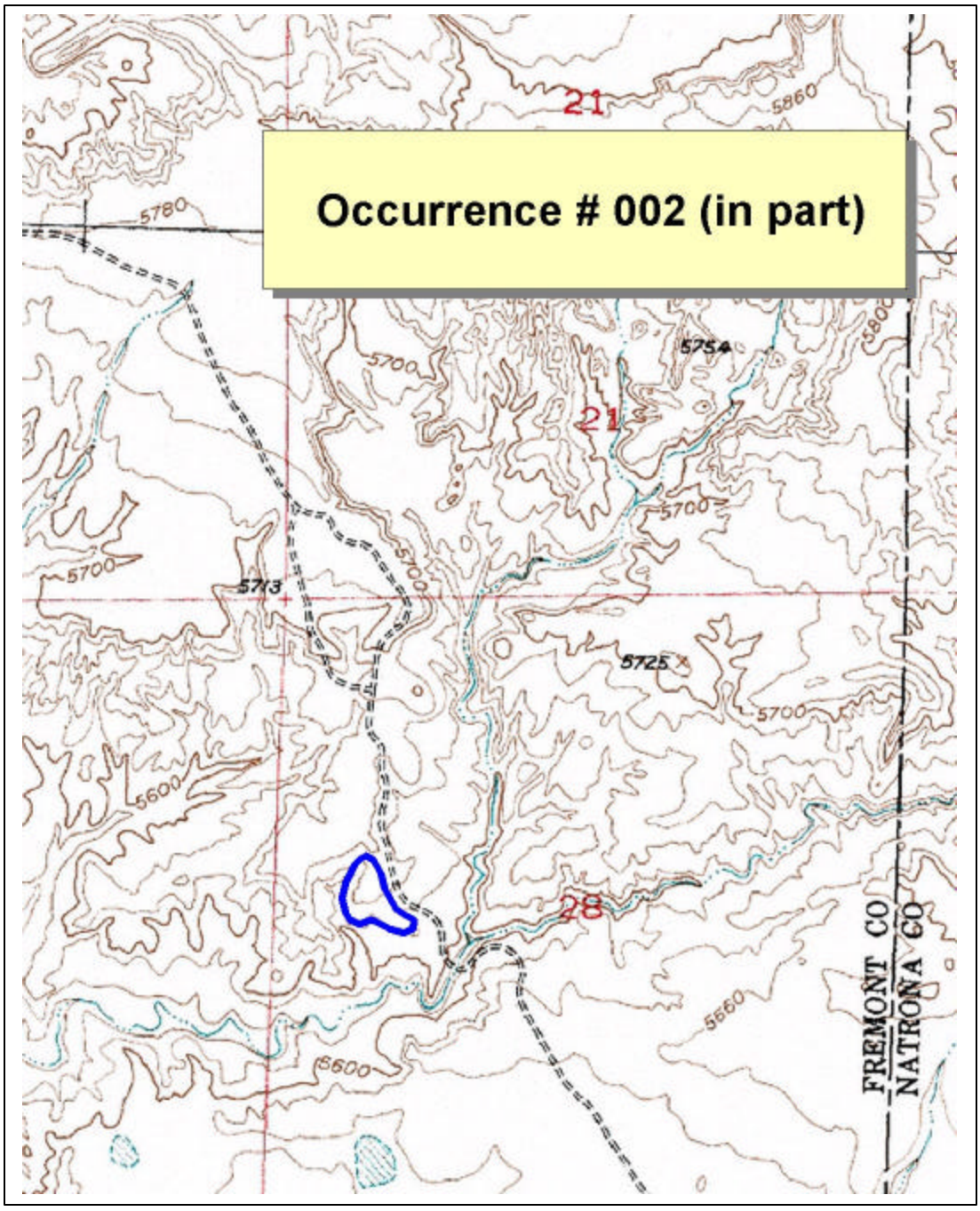
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FREMONT CO
NATRONA CO

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 006

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Names: De Pass, Gates Butte, Guffy Peak, and Picard Ranch
Latitude: 432200N (centrum)
South Lat: 432035N
North Lat: 432320N
Longitude: 1075500W (centrum)
East Long: 1075105W
West Long: 1075547W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T39N R92W S2 (line between SW4 & NW4); S6 (NW4NE4); S7 (N2 OF SE4 & SE4 OF NE4); S8 (W2 OF NW4); S9 (NE4); S10 (W2 OF SE4); S11 (SW4SW4); S12 (S2 OF NE4 & N2 OF S2); S14 (N2); S15 (N2); S16 (NE4 OF SE4); S17 (W2 OF SW4); S18 (E2 OF SE4 & SW4SW4); T40N R92W S31 (SW4)
Location: Northern Wind River Basin, flats on the north side of Cedar Ridge south of Copper Mountain, including the badlands bordering Dry Creek on the north and south side of Badwater Road, and the south and west side of Steffen Hill, (ca 10 air miles northwest of Lysite).

Last Observed: 1999-08-26

First Observed: 1969-06-28

Data: 1999-08-26: 7 large subpopulations surveyed by Laura Welp. Sec 15 colonies (4 subpopulations): 2186 plants counted (estimated at 3500) with 25% in late flower or fruit and 75% vegetative. Distribution patchy. Sec 10 colony: 3096 plants counted (5000 estimated) with 35% in flower or fruit. Sec 17 colony: 136 plants counted (200 estimated). Sec 18 colony: 612 plants counted (2500 estimated) with 20% in flower and 5% in fruit. Demographic Plot #1 established in Sec 15 NE4NE4. Average density 2.72 plants per square meter.

1996-06-13: In flower, bud, and vegetative. Population estimated at 5000-8000 plants in one colony in Sec 15. Plants vary from widely scattered to locally dominant and dense. Occurs with *Artemisia pedatifida, A. longifolia, Atriplex gardneri, Penstemon arenicola, Lesquerella arenosa* var. *arenosa, Phlox muscoides, Halogeton glomeratus, Haplopappus multicaulis, Erigeron pulcherrimus, Oryzopsis hymenoides, Musineon divaricatum,* and *Platyschkuhria integrifolia*.

1979-08-01: In fruit.

1979-07-13: 10 subpopulations found in survey. Plants in flower, corolla yellow. Reported as "frequent". Occurs with *Artemisia pedatifida, Haplopappus, Hordeum jubatum, Platyschkuhria, Phlox muscoides, Eriogonum brevicaule, Leptodactylon, Arenaria hookeri, Atriplex suckleyi, A. gardneri,* and *Oryzopsis hymenoides.*

1979-06-21: 16 subpopulations located in survey. Plants mostly in flower. Also occurs with *Artemisia longifolia* and *Cymopterus*. Densities range from 3-23 stems per 10 square meters. Colonies found to range in size from 0.5 acres to about 0.5 square miles.

1977-07-25: Observed in flower and fruit by R. Dorn. Occurs with *Astragalus grayi.*

1969-06-28: Sec 9 colony: Observed in flower by Herb Fisser.

Habitat: Typically found in semi-barren low desert shrub communities dominated by *Artemisia pedatifida, A. porteri, A. longifolia, Elymus lanceolatus* var. *lanceolatus* and *Bouteloua gracilis* on dry, whitish ashy-clay hills, gravelly-clay flats, and shaley erosional gullies of the Wagon Bed Formation. Soils poorly developed and appear to have a high gypsum content. Vegetative cover low, ranging from less than 1% to 25%. Often replaced by *Artemisia pedatifida* on gravelly knolls. Absent from sites with high graminoid cover.
Elevation: 5500-5600 feet
Size: 500 acres

Comments: Extensive EO that includes former EOs 006, 007, 008, 009, and 010.

Managed Area: BLM Lander Field Office, State of Wyoming, and private.

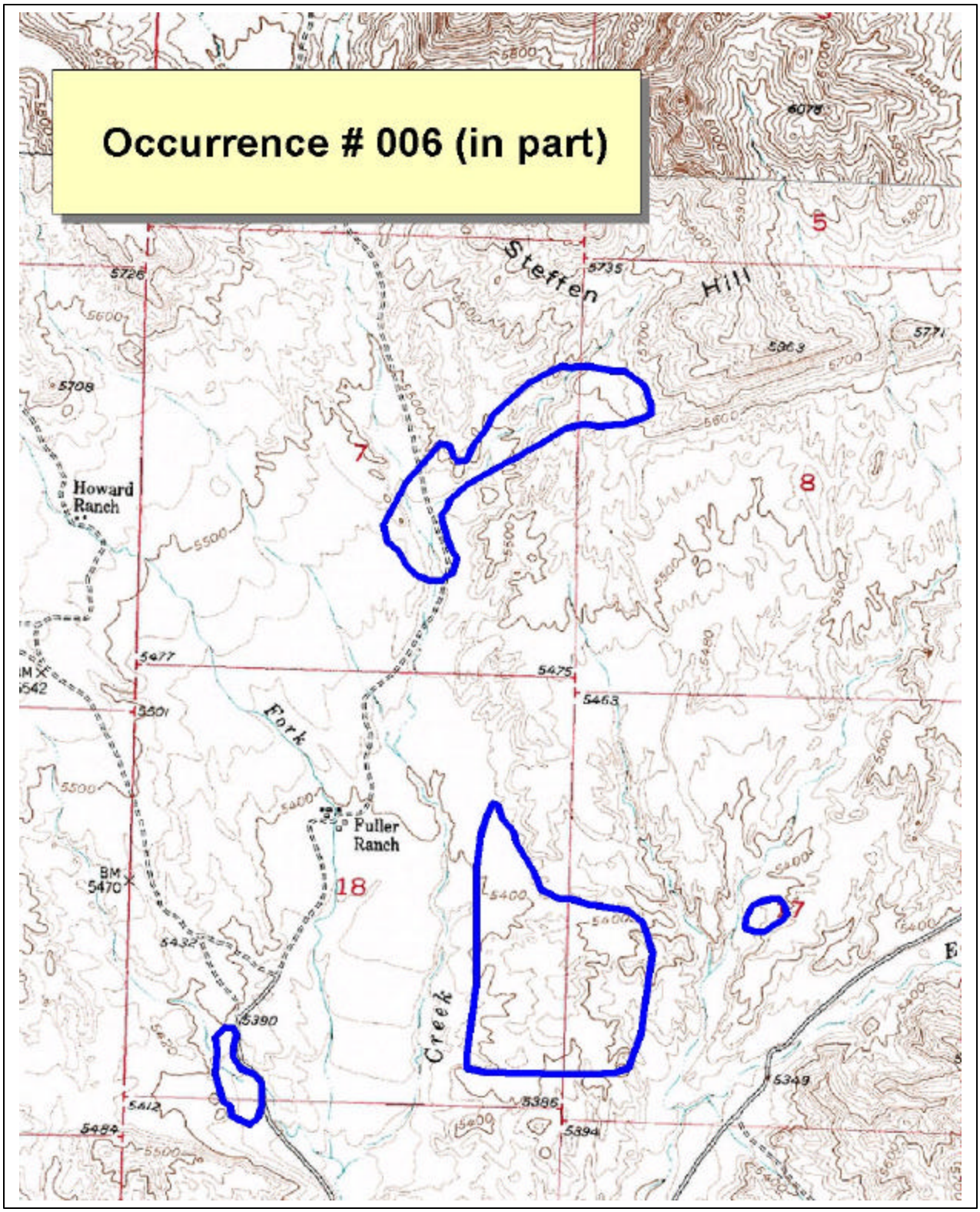
Management Comments: Habitat of this species contains numerous claim stakes (mostly for uranium) and an extensive network of 2-track roads. Individual plants can be found growing in the older road beds that receive little vehicle use.

Specimens: Dorn, R.D. (2977, 2983). 1977; (3238, 3239, 3240, 3242, 3332, 3333, 3334, 3335, 3336, 3337, 3338). 1979. RM.
Collins, E.B. (3B-1). 1979. RM.
Hartman, R.L. (10389). 1979. RM.
Lichvar, R.W. (1656, 1934). 1979. RM.
Fisser, H.G. (691). 1969. RM. (Det. by R. Hartman, 1969).
Fertig, W. (16522, 16616). 1996. RM.

Sources:
Environmental Research & Technology, Inc. 1979. Studies on distribution of Porter sagewort (*Artemisia porteri*) in the Wind River Basin. Unpublished report prepared for Rocky Mountain Energy Company.

Fertig, W. and G. Jones. 1997. Plant species of special concern and plant associations of the Copper Mountain ecosystem, Fremont County, Wyoming. Unpublished report prepared for the BLM Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.

Author: Walter Fertig
Edition Date: 98-03-05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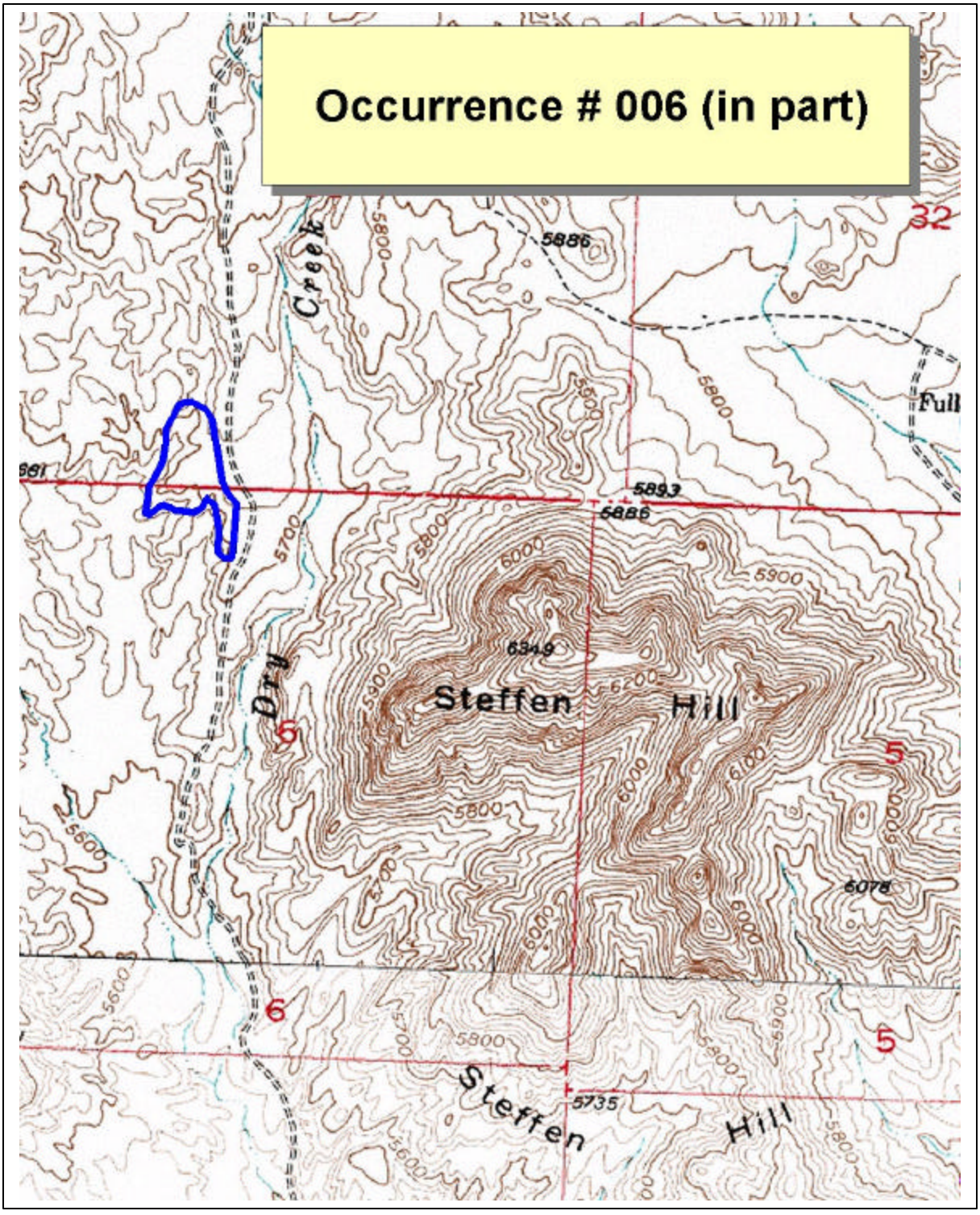
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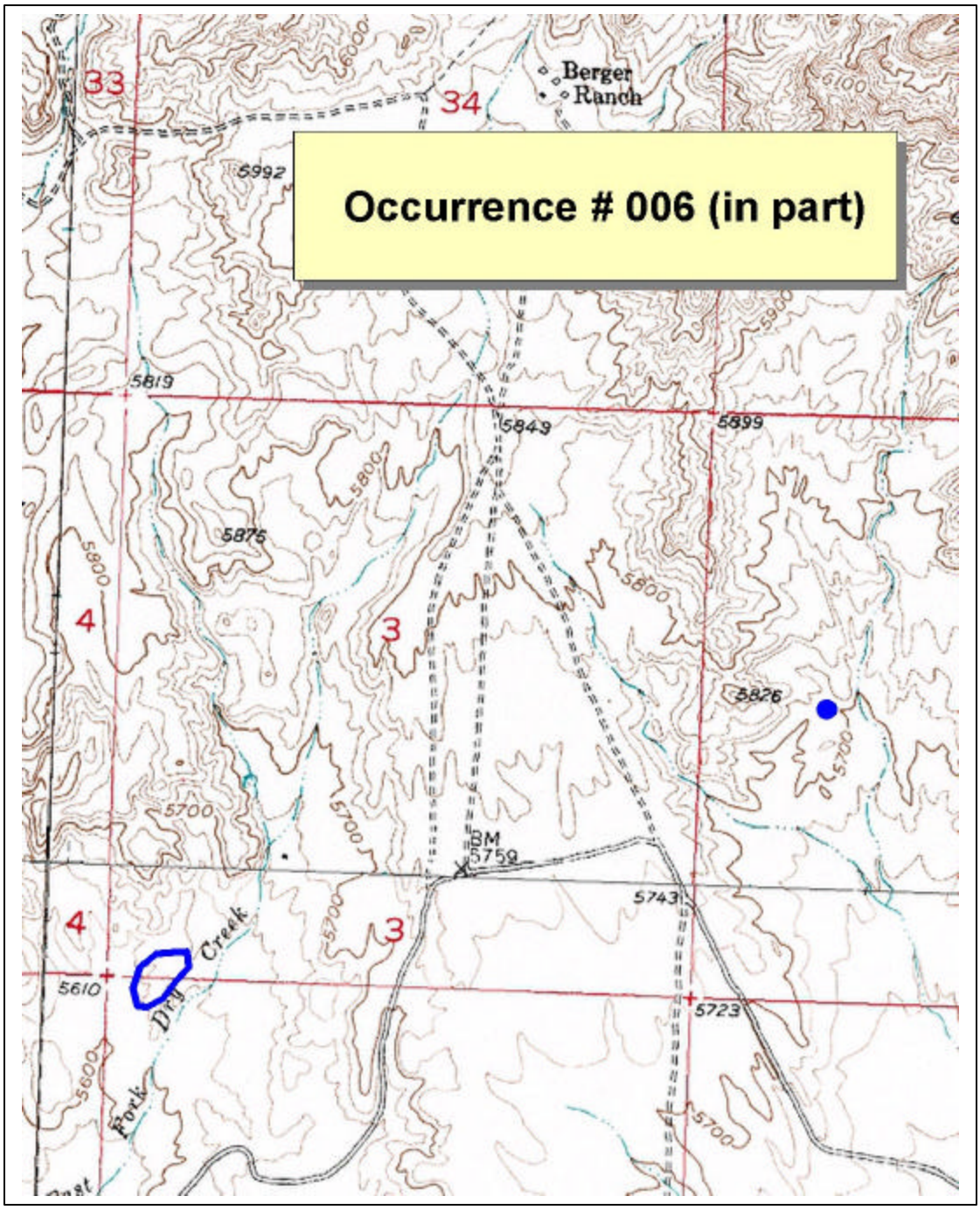
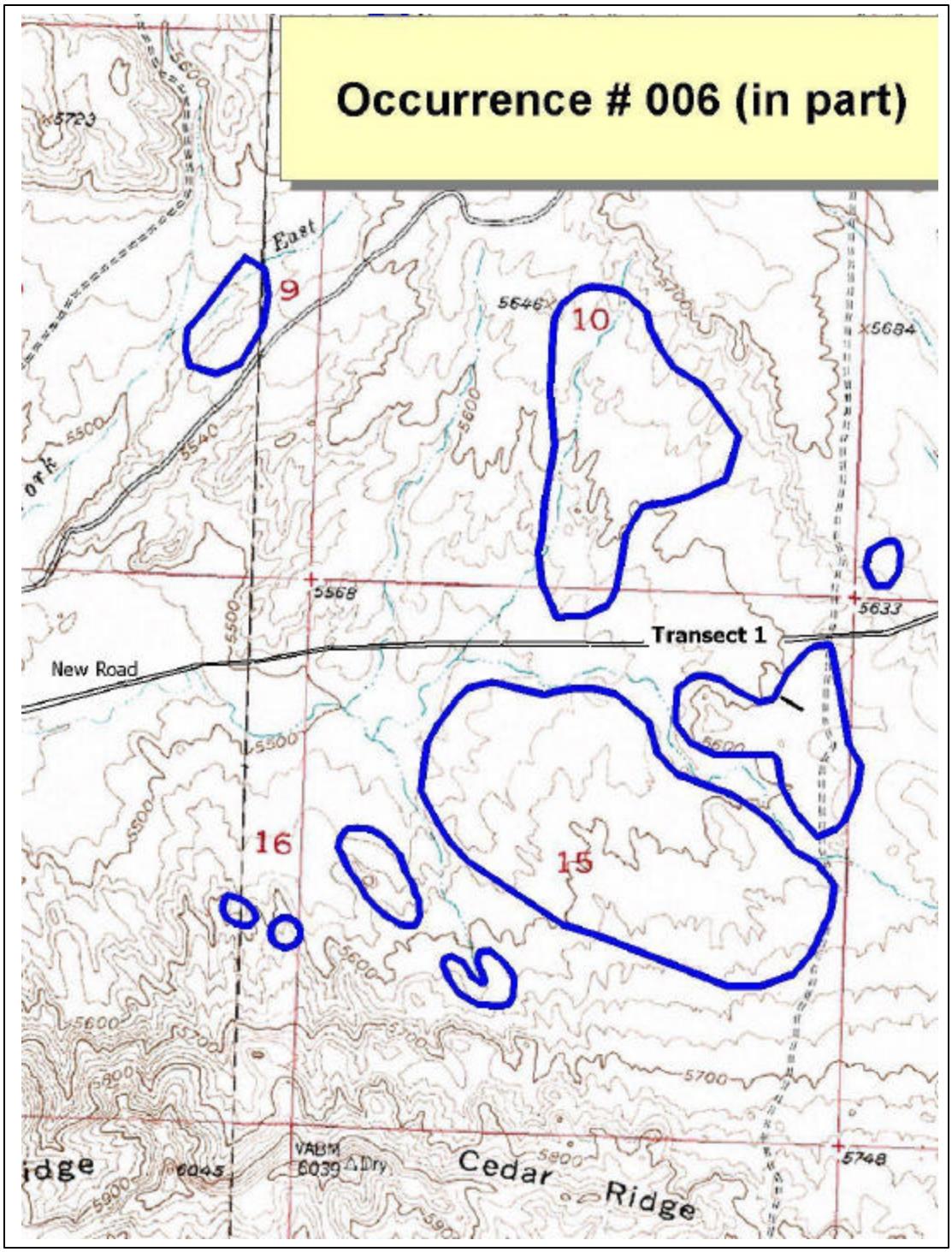

Occurrence # 006 (in part)
Berger Ranch
33
34
4
3
4
3
5992
5819
5849
5899
5875
5826
5700
5743
5610
5723
BM 5759
Dry Creek
Fork


Occurrence # 006 (in part)
East
9
10
16
15
Transect 1
New Road
Cedar Ridge
5568
5633
5748
5646
5684
5723
5540
5500
5600
5700
5800
5900
VABM
6039
Dry

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 011

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Name: Sand Draw
Latitude: 424625N (centrum)
South Latitude: 424255N
North Latitude: 424803N
Longitude: 1080855W (centrum)
East Longitude: 1080807W
West Longitude: 1081237W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T32N R95W S2 (NW4 of SE4); S13 (W2 of NW4, SE4 of SW4 & SW4 of SE4); S14 (E2 of NE4); S23 (W4 of SW4 of NW4, W4 of NW4 of SW4, & SW4SW4); S24 (NE4 of NW4 & NW4 of NE4); S28 (SE4 of NE4 & NE4 of SE4); T33N R95W S26 (S2 of NW4 of SW4 & N2 of SW4SW4); S28 (SE4SE4).
Location: Southern Wind River Basin, Big Sand Draw Oil Field area north of Beaver Rim, from the west side of WY Highway 135 along McTurk Draw northeast to Big Sand Draw at base of Oil Mountain.

Population Data
Last Observed: 1999-08-28
First Observed: 1949-07-06
Data: Known from 8 main colonies in an area 5.5 x 4 miles.

1999-08-28: 3 subpopulations surveyed by Laura Welp. Sec 26 colony: 572 plants observed (1000 estimated). Demographic transect # 3 established at this site and has an average density of 0.84 plants per square meter with 12% in reproductive condition. Sec 28 colony: 102 plants counted (estimated at 200). 60% in flower or fruit. Sec 23 colony: 100 plants counted (200 estimated) with 75% in flower or fruit.

1999-06/07: 2 medium-sized colonies in Sec 23 surveyed along Lost Springs pipeline by Dick and Bev Scott.

1994-08-20: Observed in late fruit at Sec 14 colony by G.P. Jones.

1992-06-27: Observed in flower and bud at one colony just south of Sand Draw oil field during the 1992 Wyoming Native Plant Society field trip.

1988-08-03: Sec 28 colony: Observed in fruit by J. Locklear.

1979-08-15: Observed in flower or fruit by E. Collins at 6 colonies. Density observed to range from 1-5 stems per sq meter. *A. porteri* cover typically less than 1%. Occurs with *Artemisia tridentata, Sarcobatus vermiculatus, Haplopappus multicaulis, Atriplex gardneri, Cirsium*, and *Agropyron*. More habitat in general vicinity.

1979-07-14: Flowering plants and seedlings observed in Sec 28 colony by R. Moore. Also found with *Oryzopsis hymenoides* and *Astragalus*.

1949-07-06: Observed in flower by C.L. Porter. Occurs with *Artemisia pedatifida*.

Habitat: Barren shale flats, small depressions on bare hillsides, and eroded badlands slopes and ridges of the Wind River Formation.

Vegetative cover typically very sparse (often as low as 1%). Communities dominated by *Atriplex gardneri, Artemisia pedatifida,* or locally by *A. porteri*. Soils clay or bentonite rich, with red, white, or greenish banding.
Elevation: 6000-7000 feet
Size: 85 acres

Comments: This EO includes former EOs 012, 013, 014, and 016.

Managed Area: BLM Lander Field Office

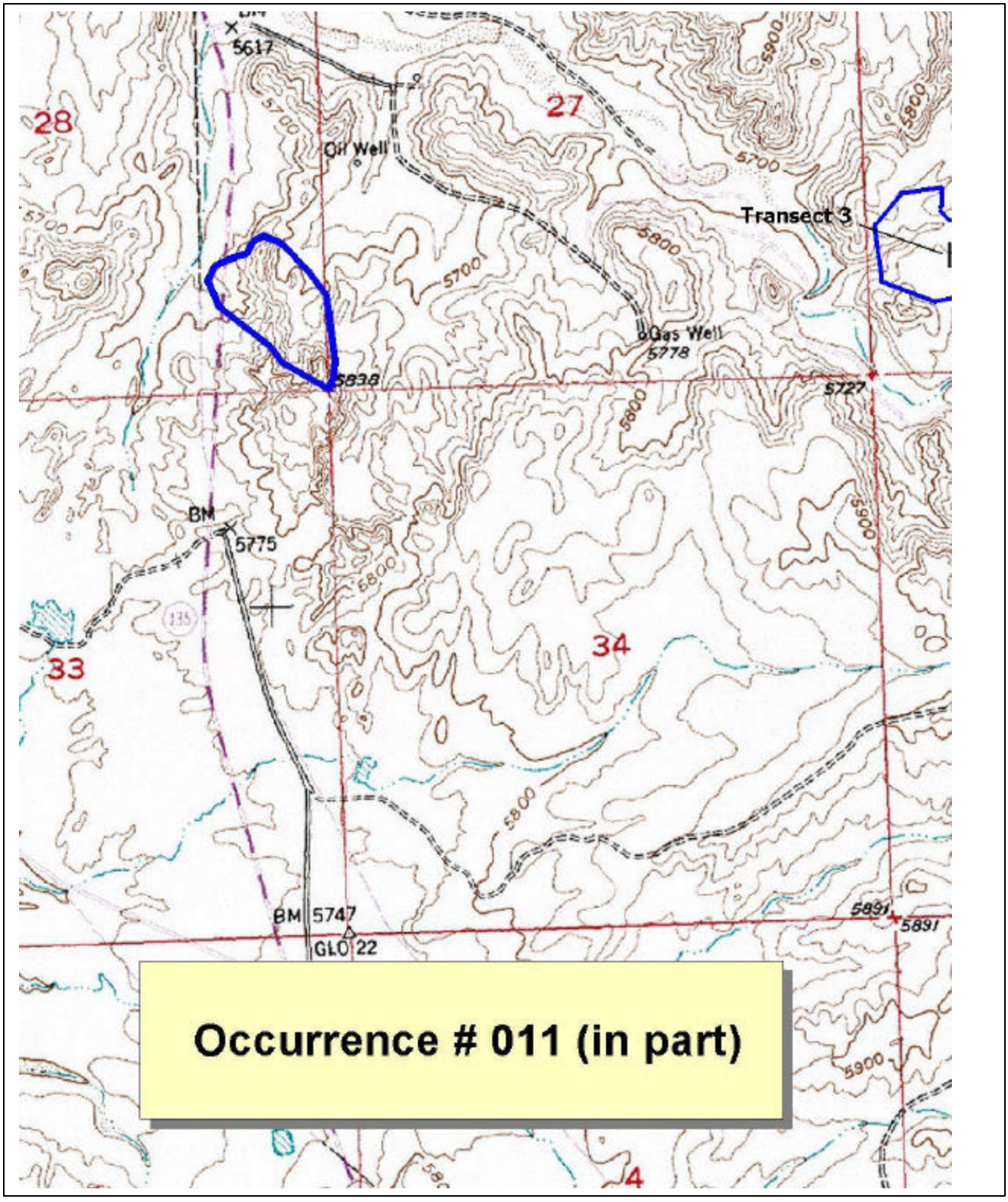
Management Comments: Some plants observed by Collins to be growing well in heavily grazed and trampled livestock pasture. No signs of herbivory on *A. porteri* plants was observed. Collins also observed evidence of plants recolonizing recently disturbed roadbed areas and borrow pits near the highway in 1979.

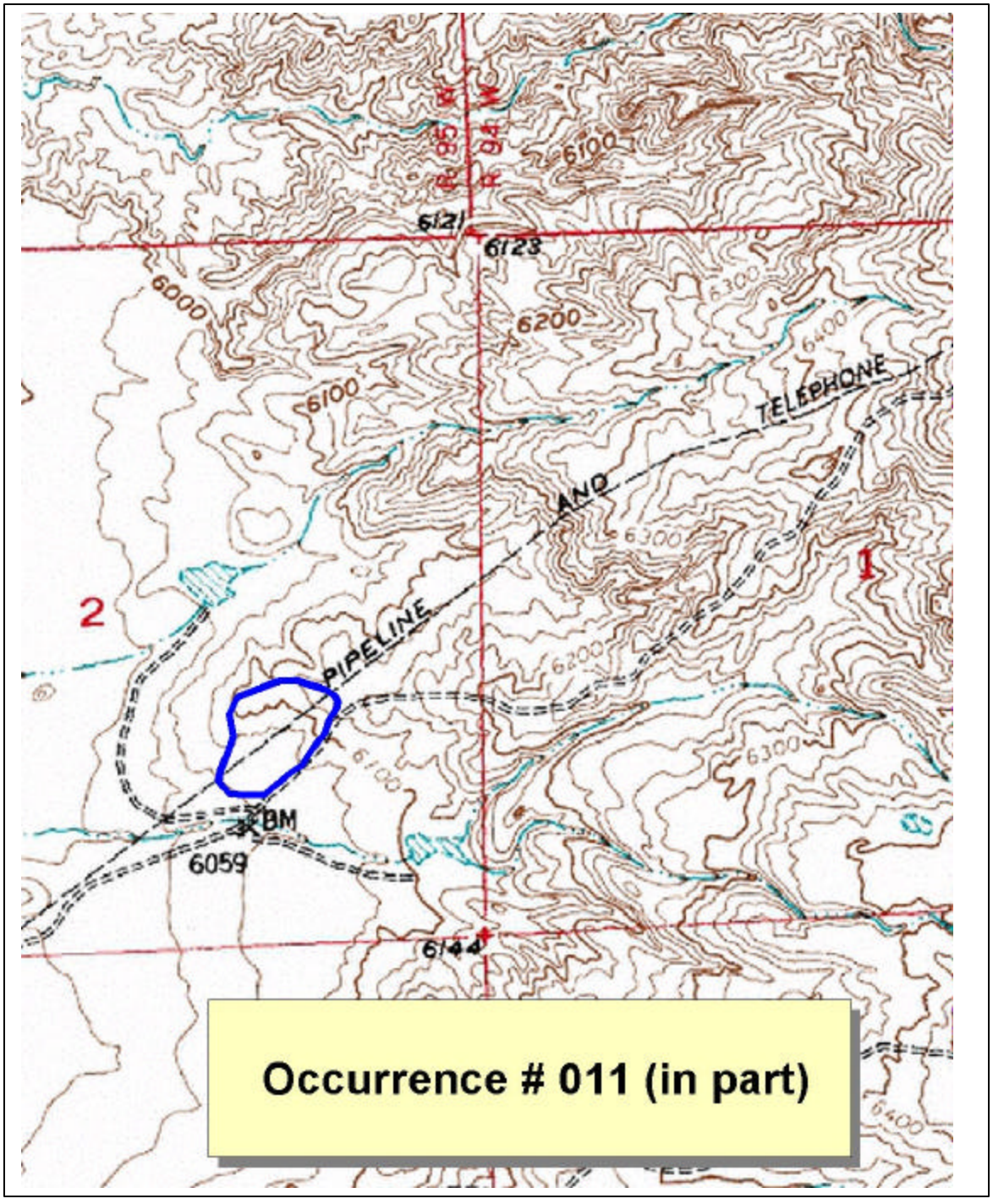
Specimens:
Hartman, R.L. (13536). 1981. RM.
Locklear, J. (115). 1988. RM.
Porter, C.L. (4969). 1949. RM Type
Jones, G.P. (708). 1994. RM.

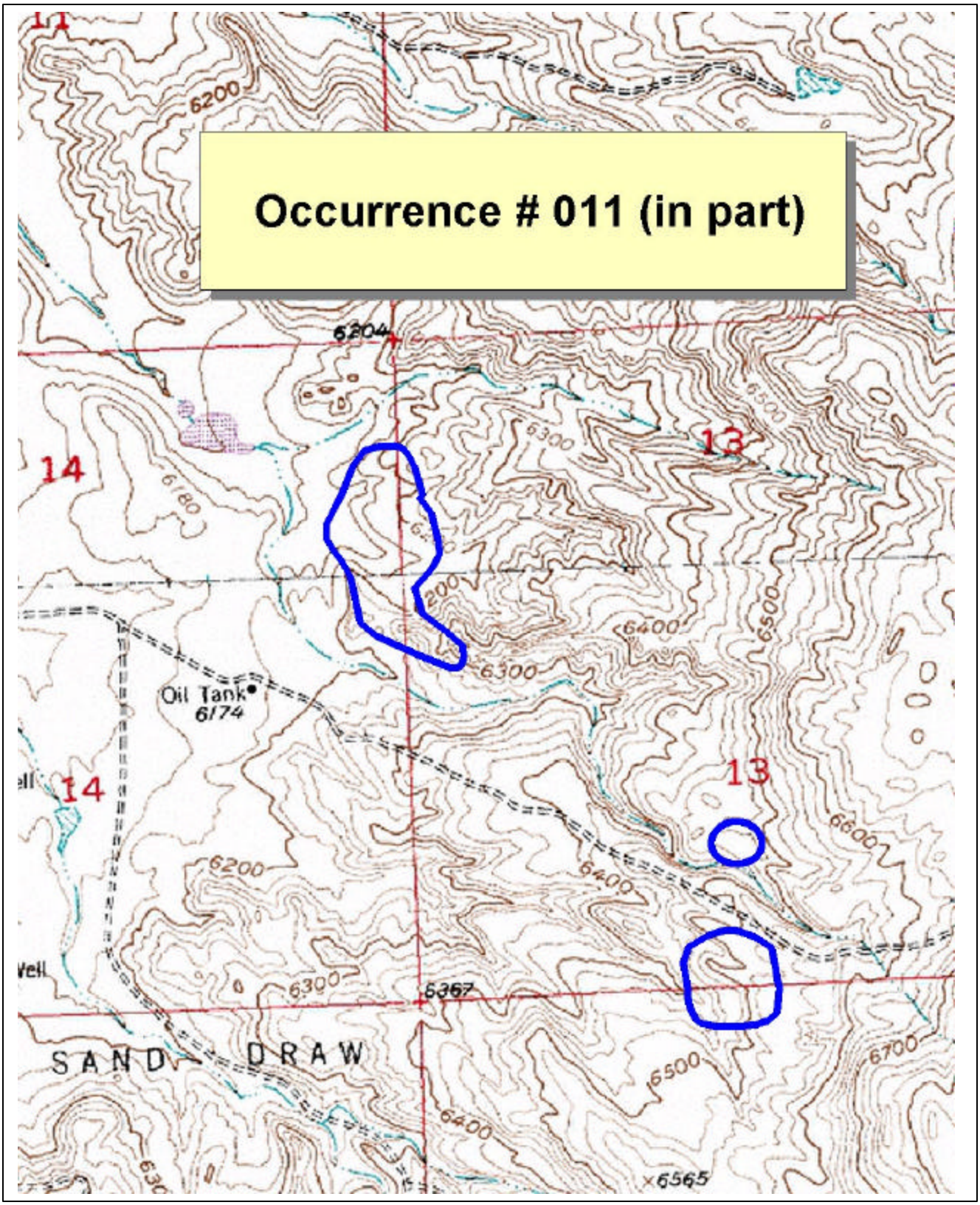
Sources:
Cronquist, A. 1951. A new *Artemisia* from Wyoming. Madrono 11:145-146.

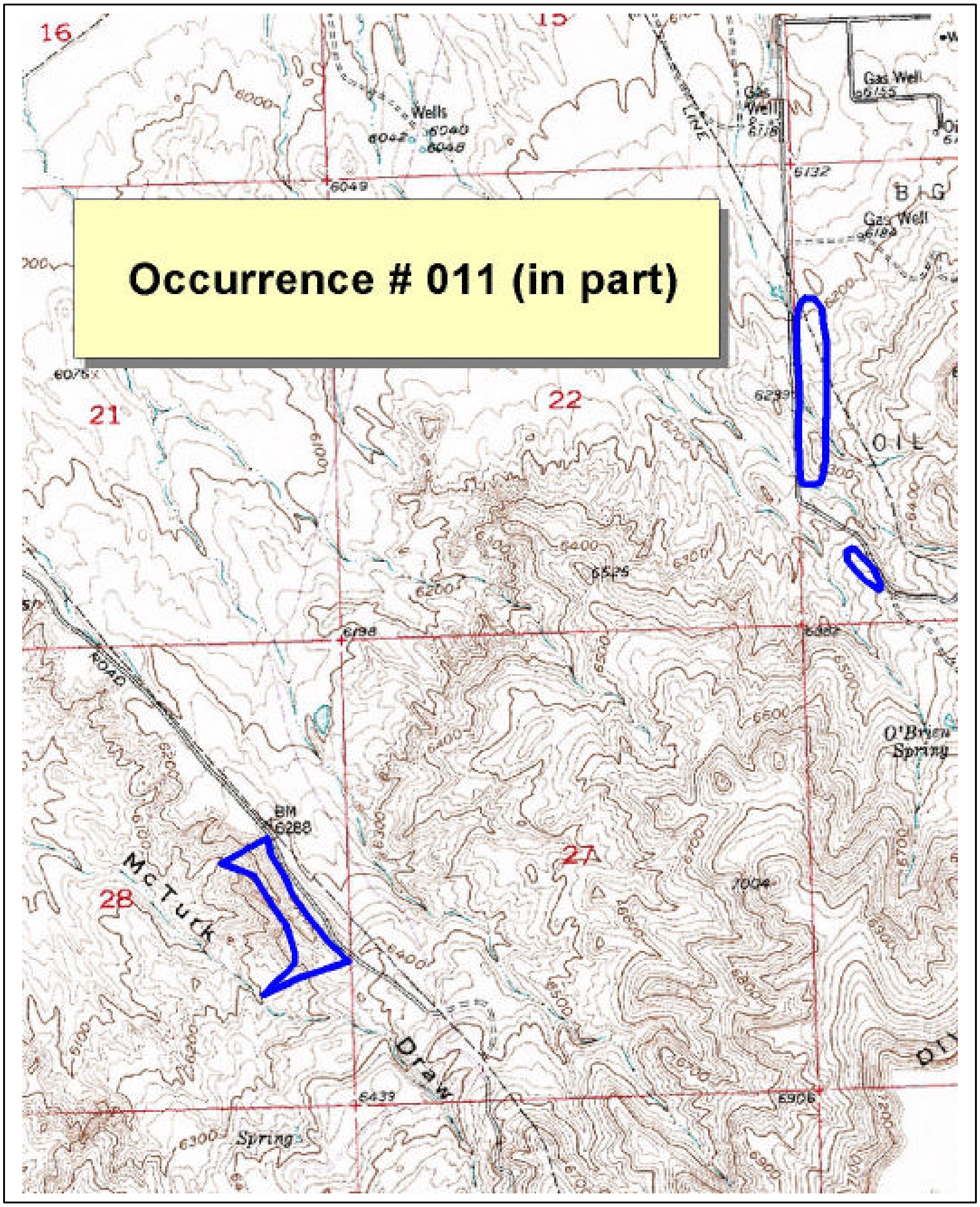
Environmental Research & Technology, Inc. 1979. Studies on distribution of Porter sagewort (*Artemisia porteri*) in the Wind River Basin. Unpublished report prepared for Rocky Mountain Energy Company.

Author: Walter Fertig
Edition Date: 02-09-24


28
27
34
33
Oil Well
Gas Well
5778
Transect 3
5617
5775
BM
5747
GLO
22
5838
5727
5891
5891
5700
5800
5900
Occurrence # 011 (in part)


6100
6121
6123
6000
6200
6100
TELEPHONE
AND
PIPELINE
2
1
BM
6059
6144
Occurrence # 011 (in part)


Occurrence # 011 (in part)
6200
6204
6300
6400
6500
6600
6700
6180
14
13
Oil Tank
6174
6367
SAND DRAW
×6565


Occurrence # 011 (in part)
16
15
21
22
27
28
Wells
Gas Well
B I G
O I L
ROAD
McTurk
Draw
O'Brien Spring
Spring
BM 6288

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 015

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Natrona
USGS Quad Name: Badwater
Latitude: 431840N (centrum)
South Latitude: 431812N
North Latitude: 431900N
Longitude: 1072522W (centrum)
East Longitude: 1072458W
West Longitude: 1072545W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T39N R88W S32 (NE4 & NE4 OF SE4); S33 (W2 OF SW4)
Location: Wind River Basin, "1 mile south-southeast of Badwater" [on northeast side of Cedar Ridge, ca 0.75 miles north of Cedar Gap and 0.4 miles west of Badwater Road].

Population Data
Last Observed: 1999-08-27
First Observed: 1979-08-16
Data: 1999-08-27: 831 plants counted by Laura Welp (population estimated at 1500-2000). &0% of plants in flower or fruit.

1995-08-12: observed in flower and fruit by R. Dorn. Occurs with *Atriplex* and *Haplopappus multicaulis*.

1979-08-16: In flower. Occurs in isolated patches of suitable habitat. Density averages 2 stems per sq meter. *A. porteri* cover observed by E. Collins as less than 1%. With *Artemisia tridentata* and *Elymus smithii*.

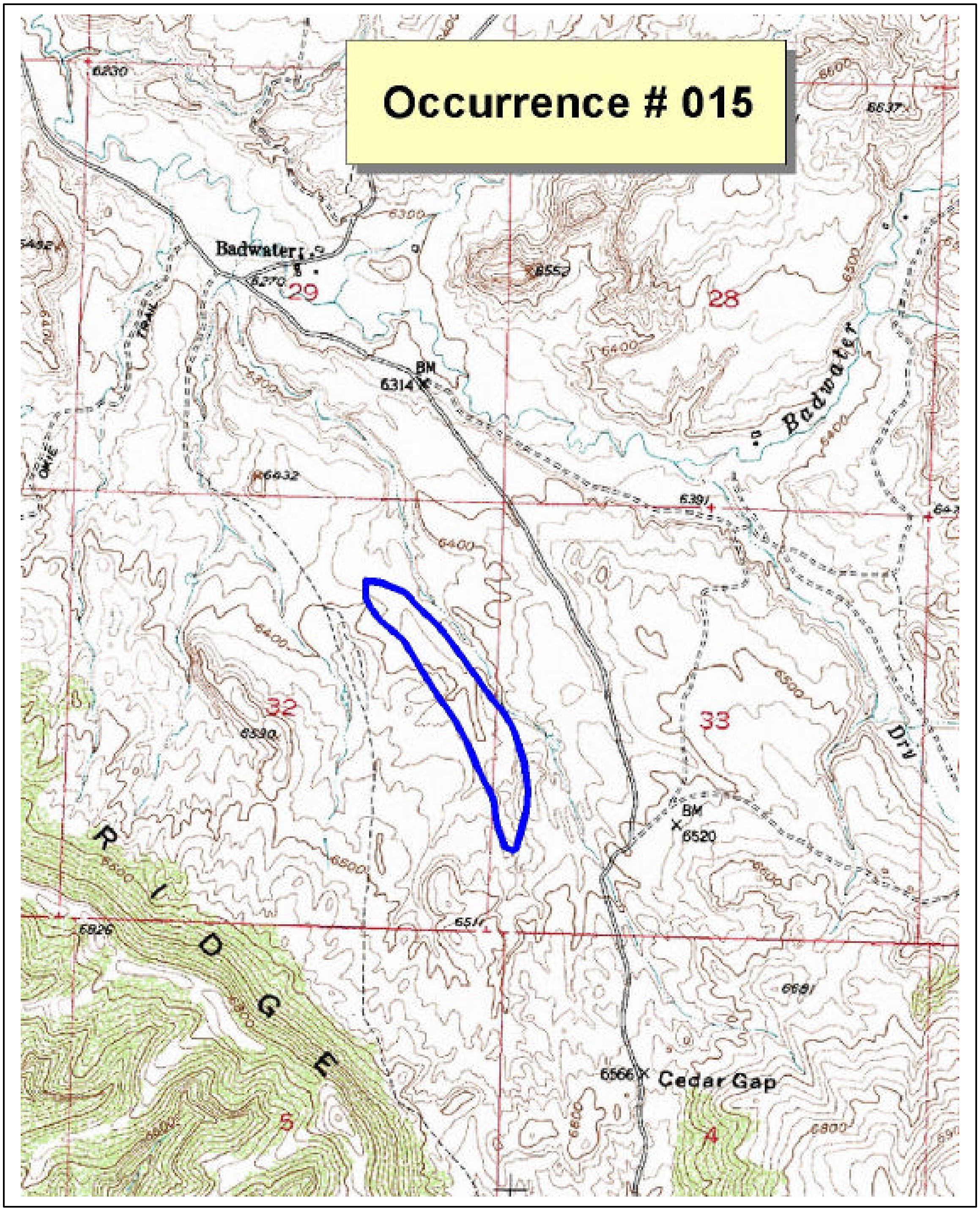
Habitat: Barren clay slopes and dry hills. Soils greenish-white and derived from the Wind River Formation.
Elevation: 6400 feet
Size: 10-20 acres

Managed Area: State of Wyoming

Specimens: Dorn, R. (6406). 1995. RM.

Sources:
Environmental Research & Technology, Inc. 1979. Studies on distribution of Porter sagewort (*Artemisia porteri*) in the Wind River Basin. Unpublished report prepared for Rocky Mountain Energy Company.

Author: Walter Fertig
Edition Date: 97-01-14


Occurrence # 015
Badwater
29
28
32
33
5
4
Badwater
Dry
BM
6314
BM
6520
6566
Cedar Gap
R I D G E
6552
6432
6391
6590
6511
6826
6681
6837
6270
6230

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 017

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Names: Gates Butte and Lysite.
Latitude: 431610N (centrum)
South Lat: 431535N
North Lat: 431635N
Longitude: 1074410W (centrum)
East Long: 1074235W
West Long: 1074523W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T38N R91W S9 (E2 OF SE4); S10 (S2); S11; S13 (NW4 OF SW4); S14 (S2 OF NE4); S15 (N2)
Location: Wind River Basin, Lysite badlands, ca. 2 air miles west of Lysite [ridge on south bank of Badwater Creek, extending from ca 0.5 miles west of the Moneta-Lysite Road 2.25 miles west to Day Butte].

Population Data
Last Observed: 1999-08-28
First Observed: 1986-07-29
Data: 1999-08-28: 560 plants observed by Laura Welp (population estimated at 1000). 20% of plants in vegetative condition and 80% in flower or fruit.

1986-07-29: ca 30% of plants observed in flower and 70% vegetative. Population estimated at 100-1000 individuals. Occurs with *Artemisia tridentata*, *A. pedatifida*, and *Chrysothamnus*. Distribution very sporadic.

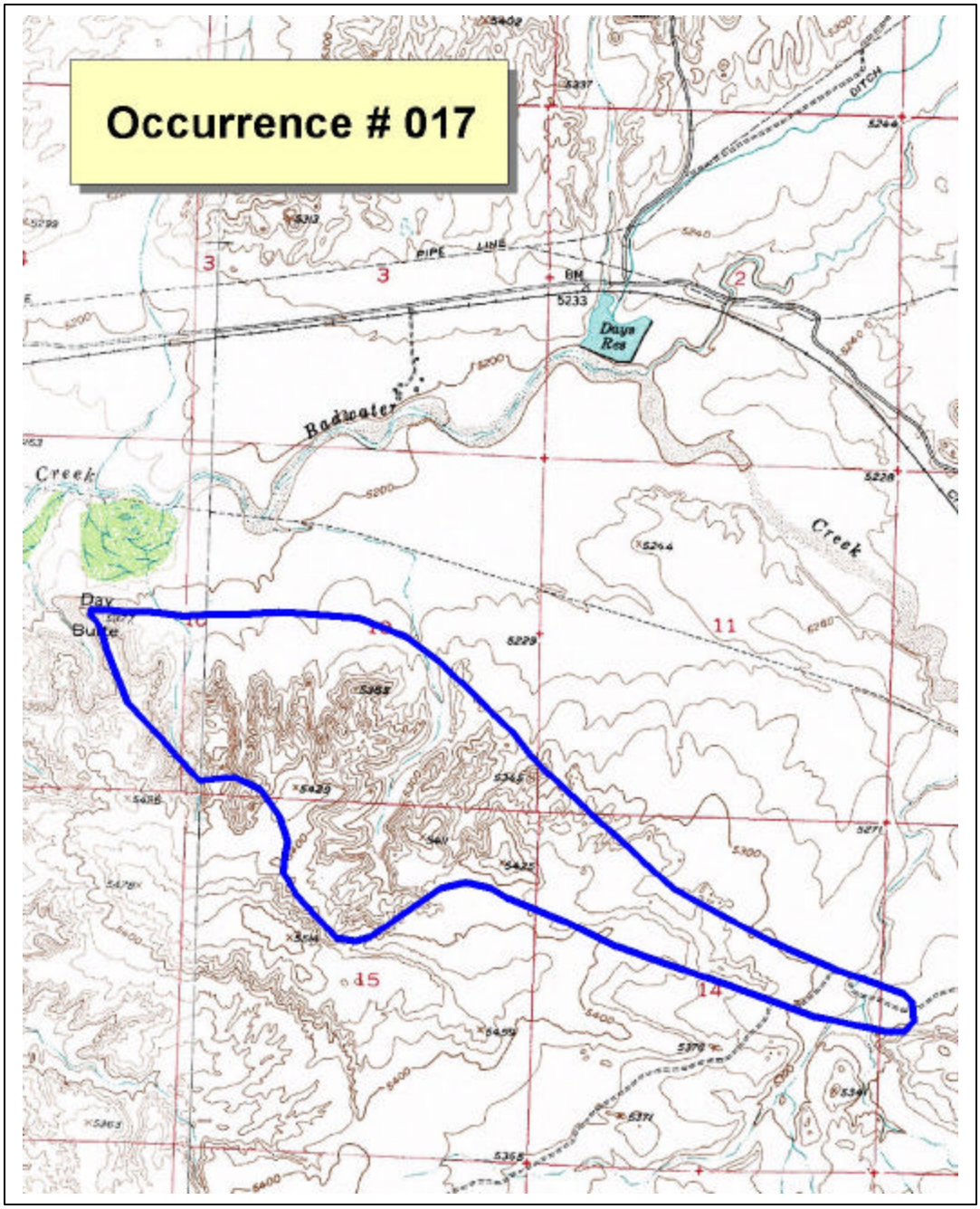
Habitat: Eroded badland slopes with little vegetation. Substrate very pale (almost white), derived from the Lost Cabin Member of the Wind River Formation. Tufaceous mudstones and some type of ash beds may also be present.
Elevation: 5300 feet
Size: 450 acres

Managed Area: BLM Lander Field Office and State of Wyoming. This site was recommended as an Area of Critical Environmental Concern by Marriott (1986).

Specimens: Marriott, H.J. (10148, 10520). 1986. RM.

Sources:
Marriott, H.J. 1986. Evaluation of the Lysite Badlands as a potential Area of Critical Environmental Concern. Prepared for the Bureau of Land Management, Lander Resource Area, by the Wyoming Natural Diversity Database, Laramie, WY.

Author: Walter Fertig
Edition Date: 97-01-14


Occurrence # 017
PIPE LINE
DITCH
BM
5233
Days Res
Badwater
Creek
Creek
Day Butte
3
2
11
14
15

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 018

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Johnson
USGS Quad Name: TTT Ranch
Latitude: 433616N (centrum)
South Latitude: 433610N
North Latitude: 433618N
Longitude: 1064015W (centrum)
East Longitude: 1064008W
West Longitude: 1064020W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T42N R82W S14 (SE4 of NW4 of SW4).
Location: Casper Arch, knoll on north side of Lone Bear Road (TTT Ranch Road) ca 0.6 miles north of Murphy Creek, 7.5 miles south of Kaycee and 3.5 miles southwest of Interstate 25. Also on south side of Lone Bear Road on small ridge 0.1 miles east of two-track road to well and drill site on Murphy Creek.

Population Data
Last Observed: 1999-08-29
First Observed: 1997-07-27
Data: 1999-08-29: 2 small colonies observed in late fruit or vegetative condition by W. Fertig. Colony on north side of TTT road contained 500-1000 individuals. Many individuals form large clumps (up to 30 inches across). Plants are typically clustered, with individual clusters widely scattered. Little evidence of establishment of new plants in summer of 1999. Found with *Sporobolus airoides, Eriogonum brevicaule, Atriplex suckleyi, Kochia americana, Haplopappus nuttallii, Hymenoxys acaulis, Arenaria hookeri,* and *Gutierrezia sarothrae*. Colony on south side of road very sparse (less than 25 plants) in an area of less than 1 acre. Additional potential habitat may occur in the vicinity.

1997-07-27: Observed by George Jones during Rapid Ecological Assessment Project in Northern Great Plains.

Habitat: Erosional washes and semi-barren exposures of gray, crumbly clay-shale with surface of gray or brown sandstone flakes on slopes of small knolls. Substrate derived from the Frontier Formation. Community of *Artemisia porteri, Sporobolus airoides, Eriogonum brevicaule,* and *Atriplex suckleyi* on clays and *Artemisia tridentata* var. *wyomingensis, Arenaria hookeri,* and *Poa secunda* on rock outcrops.
Elevation: 4960-4980 feet
Size: 4-5 acres

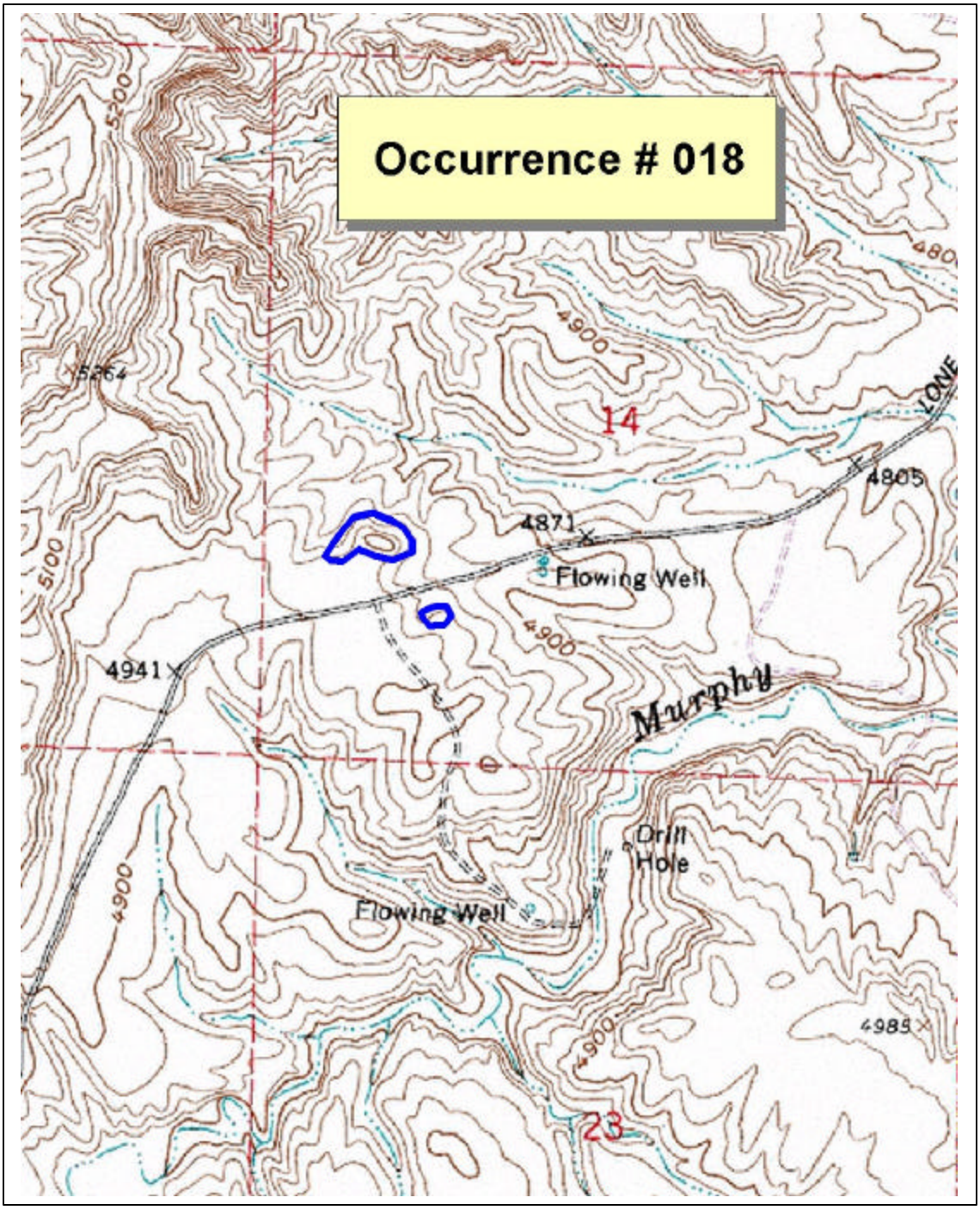
Comments: First record for Johnson County and the Powder River Basin.

Managed Area: BLM Buffalo Field Office

Specimens: Fertig, W. (19007). 1999. RM.

Sources:
Fertig, Walter. Botanist. Wyoming Natural Diversity Database, University of Wyoming, PO Box 3381, Laramie, Wyoming 82071.

Author: Walter Fertig
Edition Date: 99-07-26


Occurrence # 018
5200
5264
4900
14
4805
4871
Flowing Well
5100
4900
4941
Murphy
Drill Hole
Flowing Well
4900
4985
23

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 019

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Natrona
USGS Quad Name: Gaylord Reservoir
Latitude: 425746N (centrum)
South Latitude: 425737N
North Latitude: 425810N
Longitude: 1070433W (centrum)
East Longitude: 1070411W
West Longitude: 1070507W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T35N R85W S30 (SW4 of SE4 of SW4); S31 (NW4NW4, S2 of NW4, & NW4NW4 of SE4); T35N R86W S36 (E4 of NE4)
Location: Casper Arch, badlands on east and west sides of County Road 211 on divide between Wallace Creek and Middle Fork Casper Creek, ca 1.5 miles northeast of Gaylord Reservoir and 6.5 miles southwest of the town of Powder River.

Population Data
Last Observed: 1999-08-30
First Observed: 1998-08-11
Data: 1999-08-29/30: 12 essentially confluent subpopulations surveyed by Walter Fertig and Laura Welp. Total population estimated at 20,000-35,000 individuals. 10,000-25,000 plants estimated in 6 colonies on east side of County Road 211. 80% of population in late fruit and 20% vegetative. Plants often form large, loose clumps making it difficult to identify individual genets. Clumps average 9-12 inches across x 6 inches wide, but may reach sizes of 30 inches across. Individual clumps are usually widely spaced, but may also be in clusters of up to 50 clumps in an area of 30 x 45 feet. Mix of stem ages found within clumps (young shoots, reproductive shoots, mature vegetative branches). Isolated clumps are often small and may represent recent recruitment. No seedlings observed. Occurs with *Astragalus hyalinus, Gutierrezia sarothrae, Haplopappus multicaulis, Ipomopsis congesta, Arenaria hookeri, Oryzopsis hymenoides, Astragalus bisulcatus, Elymus lanceolatus, Atriplex suckleyi, Platyschkuhria integrifolia,* and *Musineon divaricatum*. 6 additional colonies surveyed on west side of County Road. Population of these colonies estimated at 10,000 individuals.

1998-08-11: Observed in flower and fruit by Amy Roderick Taylor. Occurs with *Artemisia pedatifida, Achillea, Machaeranthera, Eriogonum brevicaule* var. *brevicaule,* and *Platyschkuhria integrifolia*.

Habitat: Semi-barren slopes and bases of clay mounds and badlands ridges on crumbly, gray, fine-textured clay-shale soils derived from the Wind River Formation. Vegetation on slopes is dominated by *Artemisia porteri, Atriplex gardneri*, and *Koeleria macrantha* with vegetative cover averaging 20-30%. Barren clay slicks at the base of clay mounds are usually dominated by *Artemisia pedatifida, A. porteri,* and *Atriplex gardneri* and have average vegetative cover of 5%. *Artemisia porteri* is absent from flats with high cover of siltstone or sandstone, sandy areas, and clay slopes with dense cover of *Artemisia tridentata* var. *wyomingensis,*

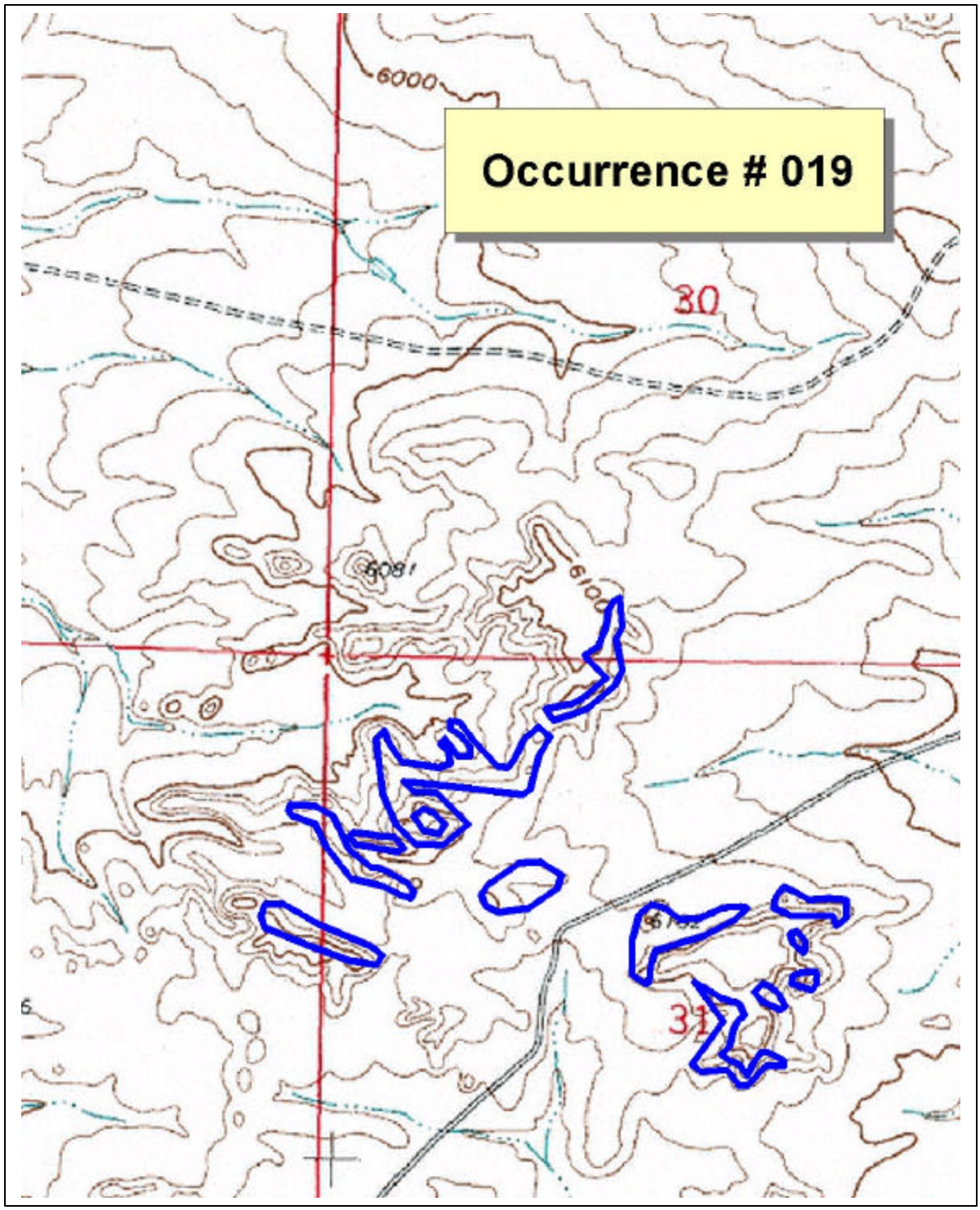
Elymus spicatus, or *Chrysothamnus nauseosus*. *A. porteri* is largely replaced by *A. pedatifida* on rolling clay plains away from the badlands outcrops.
Elevation: 6040-6100 feet
Size: 40 acres

Managed Area: BLM Casper Field Office and State of Wyoming

Specimens: Roderick, A. (7976). 1998. RM.
Fertig, W. (19004). 1999. RM.
Welp, L. (7993). 1999. RM.

Sources:
Roderick, A.J., B.E. Nelson, and R.L. Hartman. 1999. Final report on the general floristic inventory of the Upper North Platte and Laramie River drainages. Report prepared for the Bureau of Land Management Rawlins and Casper Districts by the Rocky Mountain Herbarium, University of Wyoming, Laramie, WY.

Author: Walter Fertig
Edition Date: 01-09-17


Occurrence # 019
6000
30
6081
6100
31

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 020

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Natrona
USGS Quad Name: Gaylord Reservoir and Square Top Butte
Latitude: 425530N (centrum)
South Latitude: 425456N
North Latitude: 425553N
Longitude: 1070009W (centrum)
East Longitude: 1065945W
West Longitude: 1070030W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T34N R85W S11 (SE4 of SW4SW4 & E4 of SW4); Sec 15 (S2 of NE4 of SE4)
Location: Casper Arch, badlands to north and southwest of Square Top Butte, ca 4 miles west of Pine Mountain. Population extends from badlands at head of southeast tributary washes of Coyote Creek northeast to the flats ca 0.5 miles north of Square Top Butte (a distance of ca 1.5 miles).

Population Data
Last Observed: 2000-07-12
First Observed: 2000-07-12
Data: 2000-07-12: 14 colonies documented in field by Dick Scott (consisting of 9 main subpopulations). Plants mostly in fruit. 15 plants observed at one colony north of Square Top Butte (other colonies not censused).

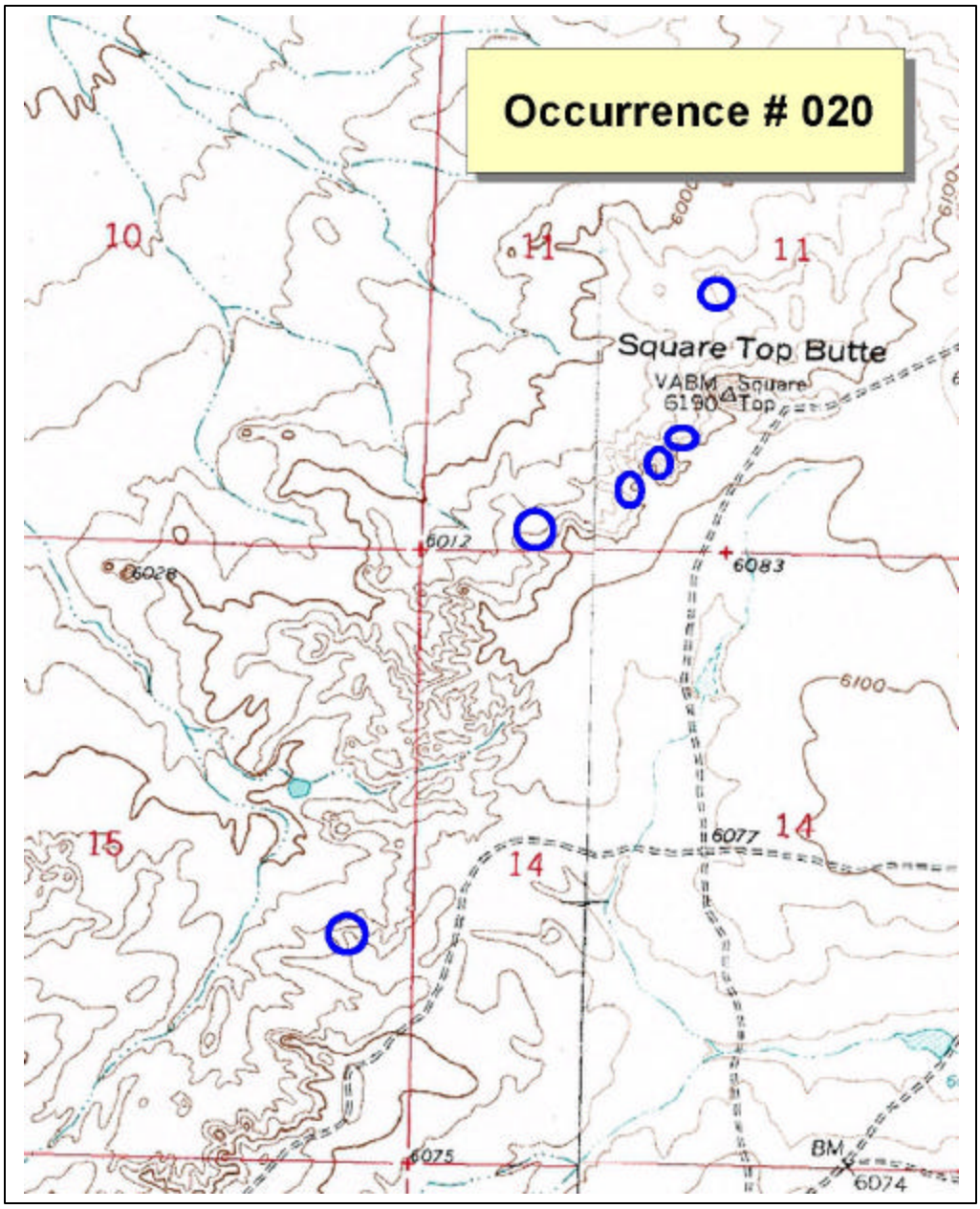
Habitat: Barren clay slopes and badlands of the Eocene Wind River Formation.
Elevation: 6040-6100 feet
Size: 10 acres

Managed Area: BLM Casper Field Office

Sources:
ENSR. 2000. Summary report of the special status plant surveys for the Petro Source CO2 pipeline. Report prepared for Petro Source and the Bureau of Land Management Casper Field Office by ESNR consulting, Ft. Collins, CO.

Scott, R.W. and B.J. Scott. 2000. Vascular plant survey of the proposed PetroSource carbon dioxide pipeline. Report prepared for ENSR.

Author: Walter Fertig
Edition Date: 01-09-18


Occurrence # 020
10
11
11
Square Top Butte
VABM Square Top
6190
6012
6028
6083
6100
15
14
14
6077
6075
BM
6074

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 021

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Name: Moneta
Latitude: 431320N (centrum)
South Latitude: 431310N
North Latitude: 431330N
Longitude: 1074035W (centrum)
East Longitude: 1074020W
West Longitude: 1074049W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T38N R90W S31 (NE4NE4, SW4 of NE4, & NW4 of SE4 of NE4)
Location: Wind River Basin, ridge system on divide between Reservoir Creek and Alkali Creek northeast of junction of Moneta Lysite Road and road to Madden, ca 2 miles east of the Moneta Hills, 3.2 miles south of Lysite, and 4 miles north-northeast of Moneta.

Population Data
Last Observed: 1999-06/07
First Observed: 1999-06/07
Data: 1999-06/07: surveyed along Lost Creek pipeline route by Dick and Bev Scott.

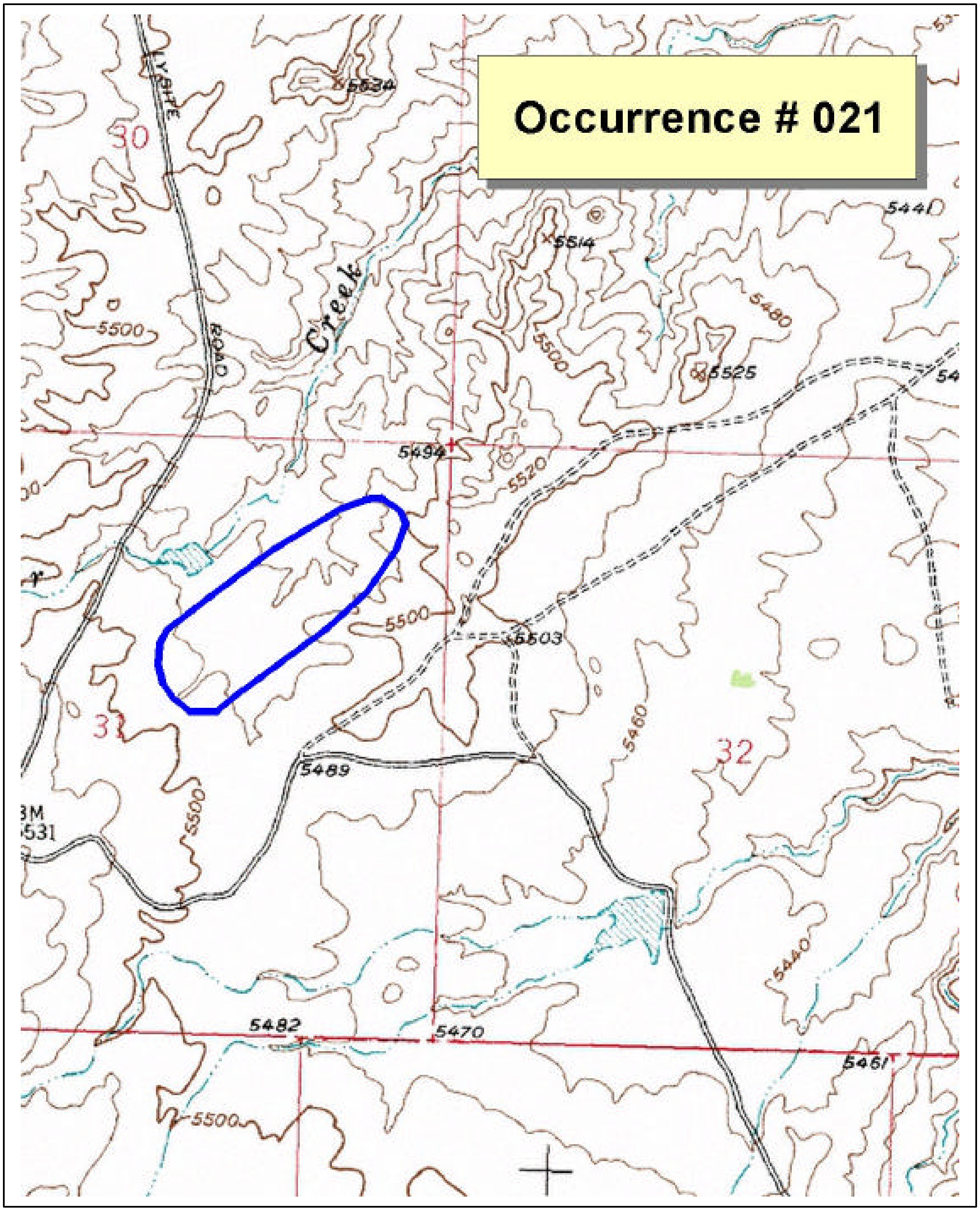
Habitat: Semi-barren slopes and outcrops of Wind River Formation.
Elevation: 5500-5540 feet
Size: 45 acres

Comments: In vicinity of Occurrence # 002.

Managed Area: BLM Lander Field Office

Sources: Scott, Dr. Richard. Retired Botany professor, Biology Dept. Central Wyoming College, Riverton, WY.

Author: Walter Fertig
Edition Date: 01-09-19


Occurrence # 021
Creek
ROAD
5534
5514
5441
5480
5500
5525
5494
5520
5503
5460
5489
5440
5482
5470
5461
30
31
32
BM
5531

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

ARTEMISIA PORTERI
Porter's sagebrush
Occurrence # 022

Status
Data Sensitive?: No
Identification verified: Yes
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: WY BLM: Sensitive.
WY Distribution Note: State Endemic

Location
County: Fremont
USGS Quad Name: Seventy-one Reservoir
Latitude: 430103N (centrum)
South Latitude: 430100N
North Latitude: 430105N
Longitude: 1074209W
East Longitude: 1074204W
West Longitude: 1074214W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T35N R91W S11 (SW4 of NE4 of SE4)
Location: Wind River Basin, east side of Castle Garden Road (Love Ranch Road) ca 0.3 miles east of reservoir at head of tributary branch of Chalk Hills Draw, ca 9 miles south of Moneta.

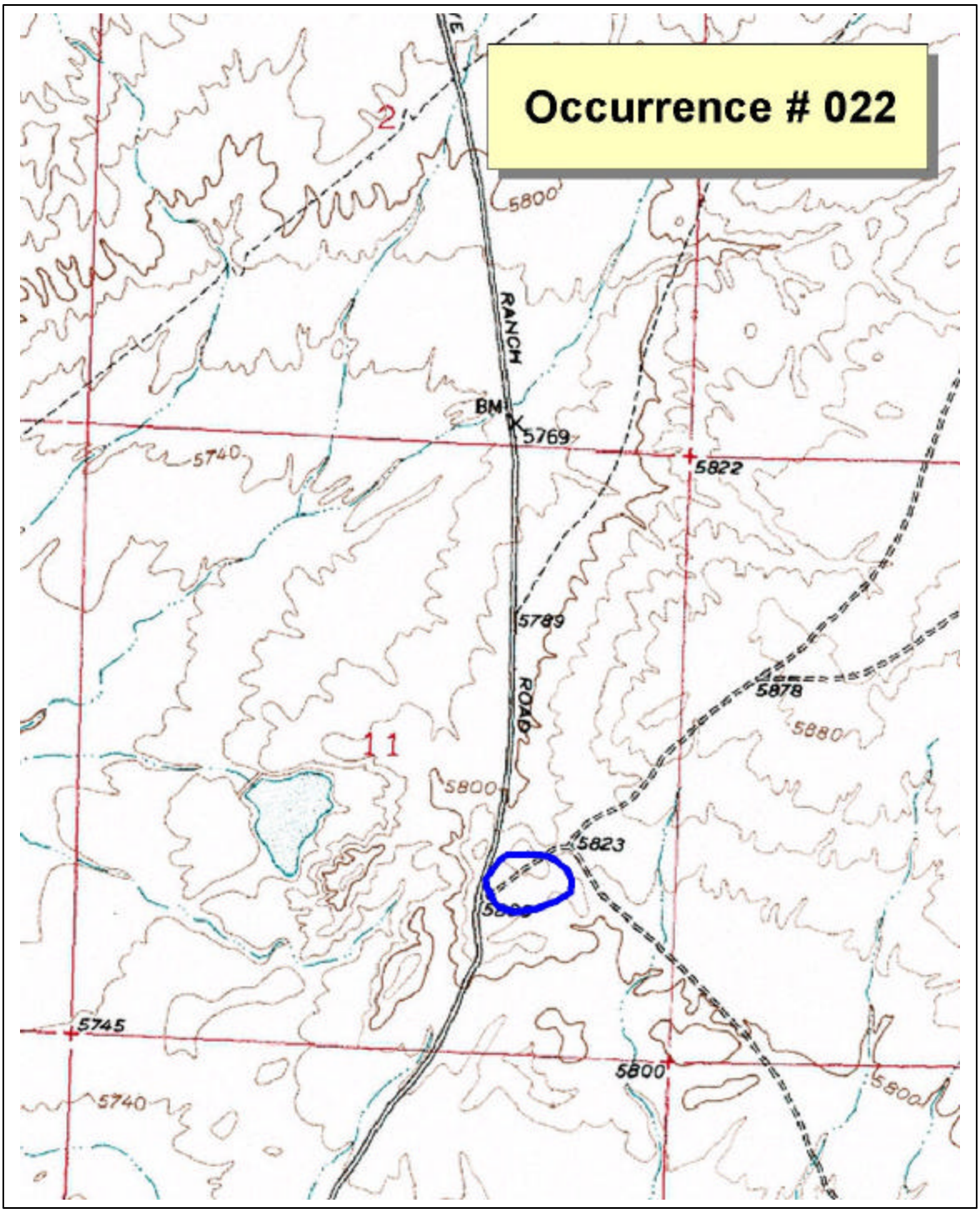
Population Data
Last Observed: 1999-06/07
First Observed: 1999-06/07
Data: 1999-06/07: surveyed by Dick and Bev Scott near Lost Creek pipeline route.

Habitat: Semi-barren knolls of Wind River Formation.
Elevation: 5820-5830 feet
Size: 4 acres

Managed Area: BLM Lander Field Office

Sources:
Scott, Dr. Richard. Retired Botany professor, Biology Dept. Central Wyoming College, Riverton, WY.

Author: Walter Fertig
Edition Date: 01-09-19


Occurrence # 022
2
11
RANCH
ROAD
BM
5769
5822
5789
5878
5880
5800
5823
5745
5740
5800

Appendix B.
Survey Routes

Surveys for *Artemisia porteri* were conducted by Walter Fertig (August 1999) and Laura Welp (August 1999). Potential areas for survey were determined from BLM land management maps and USGS topographic maps based on the presence of badlands of the Wind River, Wagon Bed, or Frontier formations on accessible public lands in central Wyoming.

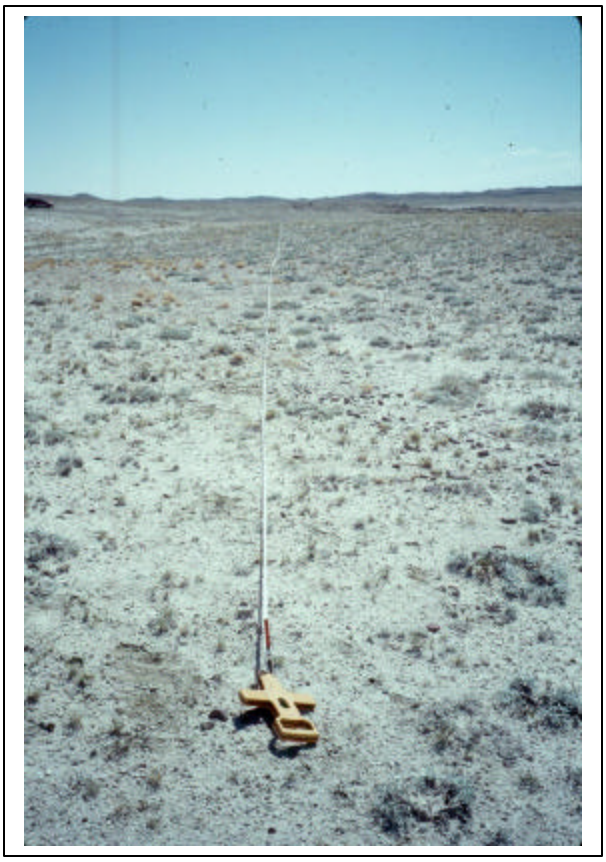
Date	**Surveyor**	**Township-Range-Section Coordinates**	**County**	***A. porteri* found?**
26 Aug 1999	Welp	T39N R92W S10 S2 & S15 N2	Fremont	Yes
26 Aug 1999	Welp	T39N R92W S17 SW4 & S18 E2	Fremont	Yes
27 Aug 1999	Welp	T38N R90W S13 SE4; T39N R89W S18 SW4	Fremont	Yes
27 Aug 1999	Welp	T40N R89W S32 NE4 OF SE4	Fremont	Yes
28 Aug 1999	Welp	T38N R91W S9, S10, S14	Fremont	Yes
28-29 Aug 1999	Welp	T33N R95W S26 SW4	Fremont	Yes
28 Aug 1999	Welp	T32N R95W S28 NE4	Fremont	Yes
28 Aug 1999	Welp	T32N R95W S23 NW4	Fremont	Yes
28 Aug 1999	Welp	T32N R95W S13 NW4 & S14 NE4	Fremont	Yes
28 Aug 1999	Fertig	T34N R86W S29 SW4 & S32 N2	Natrona	No
29 Aug 1999	Fertig	T35N R85W S31 NW4 & T35N R86W S36 NE4	Natrona	Yes
29 Aug 1999	Fertig	T39N R82W S8 NW4	Natrona	No
29 Aug 1999	Fertig	T42N R82W S14 SW4	Johnson	Yes
29 Aug 1999	Fertig	T43N R82W S35 NE4	Johnson	No
30 Aug 1999	Welp	T35N R85W S31 NW4 & T35N R86W S36 NE4	Natrona	Yes

Appendix C.
1999 Monitoring Data

Transect Locations

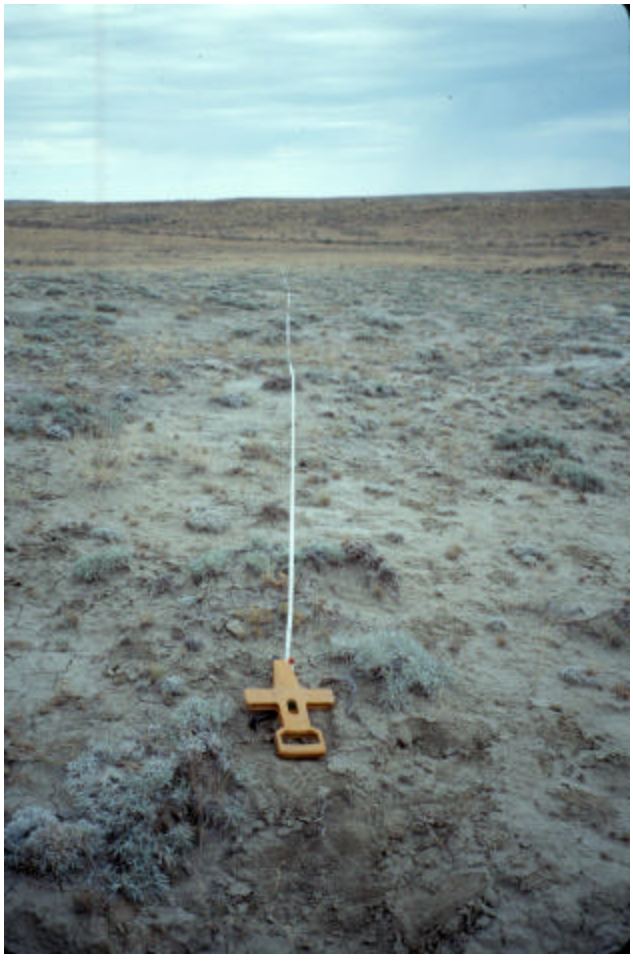
Transect # 1
County: Fremont
Occurrence: # 006
Legal Description: T39N R92W S15 S2 of SE4 of NE4NE4
Transect Bearing (from 0 towards 50 m): 298° WNW.
USGS Quad: Gates Butte
Directions: Drive to junction of Point of Mountain Road/Bridger Creek Road and turn left on Point of Mountain Road. Drive 1.1 miles to 2-track on south side of road. Drive 0.1 miles down 2-track. Walk ca 140 paces at 280 degrees west along low ridge line (see photos below) toward peak.
Habitat: *Artemisia porteri/Achnatherum hymenoides* desert scrub grassland with 10-40% vegetative cover. Occurs with *Eriogonum brevicaule, Artemisia pedatifida, Oonopsis multicaulis, & Astragalus kentrophyta.*

Photo at bottom left: View of transect 1 from origin to north.
Photo at bottom right: View of transect 1 to south from endpoint.
Both photos by Laura Welp, 26 August 1999.



Transect # 2
County: Fremont
Occurrence: 002
Legal Description:
Transect Bearing (from 0 towards 50 m): 20° N.
USGS Quad: Lysite SE
Directions: Drive ca 4 miles along Lost Cabin Road to 2 track leading off south side of road. Drive 1.5 miles to Creek Drive 0.3 miles from South Fork Sand Creek to top of first rise (but not all the way to the top of the hill). From highest point on road, walk ca 120 paces at 250° S to corner of transect.
Habitat: Sparse *Artemisia porteri/Achnatherum hymenoides* community within opening in denser *Artemisia tridentata* var. *wyomingensis/Elymus lanceolatus/Achnatherum hymenoides* stand.

Photo below: Transect 2 looking to south from endpoint. Photo by Laura Welp, 27 August 1999



Transect # 3
County: Fremont
Occurrence: 011
Legal Description: T33N R95W S26 NW4 of SE4 of SW4
Transect Bearing (from 0 towards 50 m): 360°N
USGS Quad: Sand Draw
Directions: Take Big Sand Draw Road east from WY Highway 135 for ca 1 mile. Take 2-track heading east across dry wash for ca 0.25 miles to divide between 2 low mesas and continue for another 0.3 miles to second wash. From wash, turn left and walk over low rise towards low cliff face. Walk along cliff face for ca 47 meters. Corner post is ca 5 m perpendicular to cliff face.
Habitat: Natural amphitheatre of Lost Creek member of Wind River Formation on bare, loose, white substrate. Surrounding community of *Artemisia tridentata* var. *wyomingensis*.

Photo at right, above: View of transect3 from endpoint.
Photo at right, below: View of Transect 3 from origin.
Both photos by Laura Welp, 29 August 1999.

Methods

Three permanent 0.5 x 50 meter belt transects were established following the protocol of Lesica (1987). Plots were selected subjectively at known *Artemisia porteri* 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 vegetative (non-flowering plants or rosettes) and reproductive (flowering or fruiting plants with at least 1 inflorescence) plants.

Results

Total density ranged from 0.8-2.8 plants per square meter in the 3 plots. No seedlings or dead plants were encountered during August 1999**.** Density of vegetative plants ranged from 0.6-2.6 per square meter, while reproductive plants averaged 0.2-0.8 individuals per square meter. Frequency of plants ranges from 34-68% 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.

Artemisia porteri
Transect # 1 Census Data

Date: 26 August 1999 Surveyor: Laura Welp

Plot # (location)	Total #	# Vegetative Plants	# Reproductive Plants	% Vegetative Cover
1 (0-0.5 m)	3	2	1	40
2 (1-1.5 m)	0	0	0	15
3 (2-2.5 m)	0	0	0	15
4 (3-3.5 m)	0	0	0	20
5 (4-4.5 m)	0	0	0	40
6 (5-5.5 m)	0	0	0	40
7 (6-6.5 m)	0	0	0	5
8 (7-7.5 m)	4	4	0	30
9 (8-8.5 m)	3	1	2	60
10 (9-9.5 m)	1	1	0	10
11 (10-10.5 m)	0	0	0	20
12 (11-11.5 m)	0	0	0	15
13 (12-12.5 m)	0	0	0	25
14 (13-13.5 m)	2	2	0	15
15 (14-14.5 m)	3	3	0	25
16 (15-15.5 m)	2	0	2	20
17 (16-16.5 m)	2	2	0	20
18 (17-17.5 m)	3	2	1	10
19 (18-18.5 m)	0	0	0	10
20 (19-19.5 m)	2	1	1	30
21 (20-20.5 m)	0	0	0	10
22 (21-21.5 m)	1	0	1	15
23 (22-22.5 m)	3	1	2	15
24 (23-23.5 m)	0	0	0	5
25 (24-24.5 m)	2	2	0	10
26 (25-25.5 m)	3	3	0	20
27 (26-26.5 m)	2	2	0	10
28 (27-27.5 m)	3	1	2	15
29 (28-28.5 m)	1	0	1	10
30 (29-29.5 m)	1	1	0	5
31 (30-30.5 m)	2	1	1	30
32 (31-31.5 m)	1	1	0	5
33 (32-32.5 m)	2	1	1	10
34 (33-33.5 m)	3	3	0	40
35 (34-34.5 m)	1	0	1	5
36 (35-35.5 m)	1	0	1	30
37 (36-36.5 m)	1	1	0	5
38 (37-37.5 m)	2	0	2	40
39 (38-38.5 m)	0	0	0	0
40 (39-39.5 m)	1	1	0	5
41 (40-40.5 m)	1	0	1	10
42 (41-41.5 m)	5	4	1	10
43 (42-42.5 m)	0	0	0	5
44 (43-43.5 m)	3	2	1	15
45 (44-44.5 m)	0	0	0	5
46 (45-45.5 m)	0	0	0	5

Plot # (location)	Total #	# Vegetative Plants	# Reproductive Plants	% Vegetative Cover
47 (46-46.5 m)	1	1	0	10
48 (47-47.5 m)	0	0	0	10
49 (48-48.5 m)	1	1	0	10
50 (49-49.5 m)	2	2	0	15
TOTAL	**68**	**46**	**22**	

Transect: 25 square meters
Density: # Vegetative plants per square meter: 1.84
Reproductive plants per square meter: 0.88
Total # of plants per square meter: 2.72

Phenology: Vegetative: 67.6%
Reproductive: 32.4%

Frequency: Vegetative: 52% (26/50)
Reproductive: 34% (17/50)
Total Plants: 66% (33/50)

Artemisia porteri
Transect # 2 Census Data

Date: 27 August 1999 Surveyor: Laura Welp

Plot # (location)	Total #	# Vegetative Plants	# Reproductive Plants	% Vegetative Cover
1 (0-0.5 m)	2	1	1	25
2 (1-1.5 m)	4	2	2	20
3 (2-2.5 m)	1	1	0	10
4 (3-3.5 m)	0	0	0	20
5 (4-4.5 m)	1	1	0	5
6 (5-5.5 m)	1	1	0	25
7 (6-6.5 m)	1	1	0	10
8 (7-7.5 m)	2	2	0	10
9 (8-8.5 m)	0	0	0	1
10 (9-9.5 m)	0	0	0	5
11 (10-10.5 m)	1	1	0	5
12 (11-11.5 m)	3	3	0	15
13 (12-12.5 m)	0	0	0	5
14 (13-13.5 m)	3	3	0	15
15 (14-14.5 m)	0	0	0	10
16 (15-15.5 m)	2	2	0	20
17 (16-16.5 m)	0	0	0	20
18 (17-17.5 m)	0	0	0	20
19 (18-18.5 m)	0	0	0	50
20 (19-19.5 m)	0	0	0	15
21 (20-20.5 m)	1	1	0	10
22 (21-21.5 m)	2	2	0	20
23 (22-22.5 m)	2	2	0	10

Plot # (location)	Total #	# Vegetative Plants	# Reproductive Plants	% Vegetative Cover
24 (23-23.5 m)	0	0	0	15
25 (24-24.5 m)	2	2	0	30
26 (25-25.5 m)	4	4	0	20
27 (26-26.5 m)	2	2	0	15
28 (27-27.5 m)	4	4	0	20
29 (28-28.5 m)	5	5	0	20
30 (29-29.5 m)	5	5	0	25
31 (30-30.5 m)	3	3	0	20
32 (31-31.5 m)	1	1	0	15
33 (32-32.5 m)	0	0	0	10
34 (33-33.5 m)	4	4	0	25
35 (34-34.5 m)	2	2	0	25
36 (35-35.5 m)	1	1	0	20
37 (36-36.5 m)	1	1	0	25
38 (37-37.5 m)	1	1	0	15
39 (38-38.5 m)	0	0	0	10
40 (39-39.5 m)	2	2	0	15
41 (40-40.5 m)	1	1	0	25
42 (41-41.5 m)	2	1	1	35
43 (42-42.5 m)	0	0	0	50
44 (43-43.5 m)	0	0	0	35
45 (44-44.5 m)	1	1	0	30
46 (45-45.5 m)	1	1	0	45
47 (46-46.5 m)	0	0	0	15
48 (47-47.5 m)	1	1	0	40
49 (48-48.5 m)	0	0	0	10
50 (49-49.5 m)	1	1	0	25
TOTAL	**70**	**66**	**4**	

Transect: 25 square meters
Density: # Vegetative plants per square meter: 2.64
Reproductive plants per square meter: 0.16
Total # of plants per square meter: 2.80

Phenology: Vegetative 94.3*%
Reproductive: 5.7%

Frequency: Vegetative: 68% (34/50)
Reproductive: 6% (3/50)
Total Plants: 68% (34/50)

Artemisia porteri
Transect # 3 Census Data

Date: 29 August 1999 Surveyor: Laura Welp

Plot # (location)	Total #	# Vegetative Plants	# Reproductive Plants	% Vegetative Cover
1 (0-0.5 m)	0	0	0	25
2 (1-1.5 m)	0	0	0	60
3 (2-2.5 m)	0	0	0	40
4 (3-3.5 m)	0	0	0	5
5 (4-4.5 m)	0	0	0	1
6 (5-5.5 m)	1	0	1	70
7 (6-6.5 m)	1	1	0	10
8 (7-7.5 m)	1	1	0	5
9 (8-8.5 m)	0	0	0	1
10 (9-9.5 m)	0	0	0	5
11 (10-10.5 m)	1	0	1	5
12 (11-11.5 m)	0	0	0	0
13 (12-12.5 m)	1	1	0	40
14 (13-13.5 m)	0	0	0	0
15 (14-14.5 m)	2	1	1	15
16 (15-15.5 m)	0	0	0	5
17 (16-16.5 m)	0	0	0	25
18 (17-17.5 m)	0	0	0	5
19 (18-18.5 m)	0	0	0	70
20 (19-19.5 m)	1	1	0	20
21 (20-20.5 m)	0	0	0	5
22 (21-21.5 m)	1	0	1	25
23 (22-22.5 m)	0	0	0	30
24 (23-23.5 m)	1	1	0	50
25 (24-24.5 m)	0	0	0	10
26 (25-25.5 m)	0	0	0	40
27 (26-26.5 m)	1	0	1	80
28 (27-27.5 m)	0	0	0	10
29 (28-28.5 m)	0	0	0	15
30 (29-29.5 m)	0	0	0	5
31 (30-30.5 m)	3	2	1	15
32 (31-31.5 m)	2	2	0	15
33 (32-32.5 m)	1	1	0	10
34 (33-33.5 m)	1	1	0	1
35 (34-34.5 m)	0	0	0	0
36 (35-35.5 m)	0	0	0	0
37 (36-36.5 m)	0	0	0	20
38 (37-37.5 m)	0	0	0	25
39 (38-38.5 m)	0	0	0	40
40 (39-39.5 m)	1	1	0	60
41 (40-40.5 m)	0	0	0	50
42 (41-41.5 m)	0	0	0	40
43 (42-42.5 m)	0	0	0	40
44 (43-43.5 m)	0	0	0	70
45 (44-44.5 m)	0	0	0	50
46 (45-45.5 m)	0	0	0	30

Plot # (location)	Total #	# Vegetative Plants	# Reproductive Plants	% Vegetative Cover
47 (46-46.5 m)	1	1	0	50
48 (47-47.5 m)	1	1	0	40
49 (48-48.5 m)	0	0	0	50
50 (49-49.5 m)	0	0	0	80
TOTAL	**21**	**15**	**6**	

Transect: 25 square meters
Density: # Vegetative plants per square meter: 0.6
Reproductive plants per square meter: 0.24
Total # of plants per square meter: 0.84

Phenology: Vegetative 71.4%
Reproductive: 28.6%

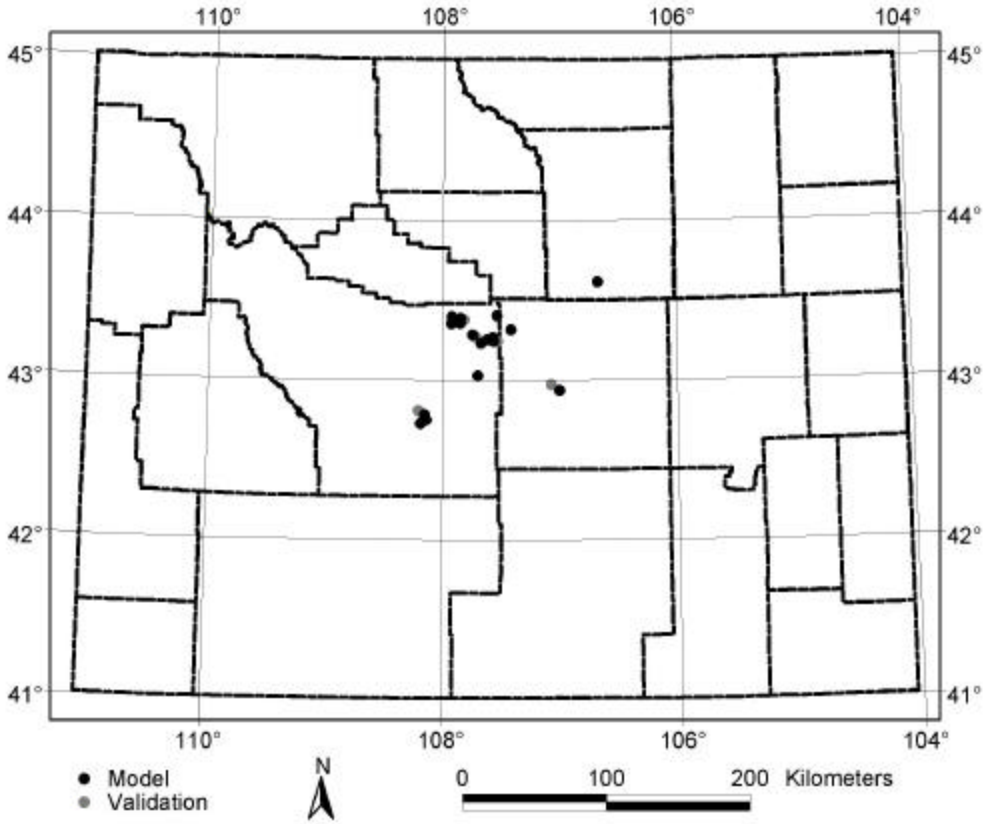
Frequency: Vegetative: 26% (13/50)
Reproductive: 12% (6/50)
Total Plants: 34% (17/50)

Appendix D.
Potential Habitat Model of Porter's Sagebrush

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

Artemisia porteri Cronq.

Known Distribution in Wyoming and Region
Black dots represent present points for *A. porteri* used in model construction and gray dots indicate present points used for validation.



Numbers of Points for Modeling
This table includes the number of present and absent points from Wyoming used in building and validating the classification tree model.

	Model-Building	Validation	Total
Known Present	19	6	25
Known Absent	959	182	1141
Total	978	188	1166

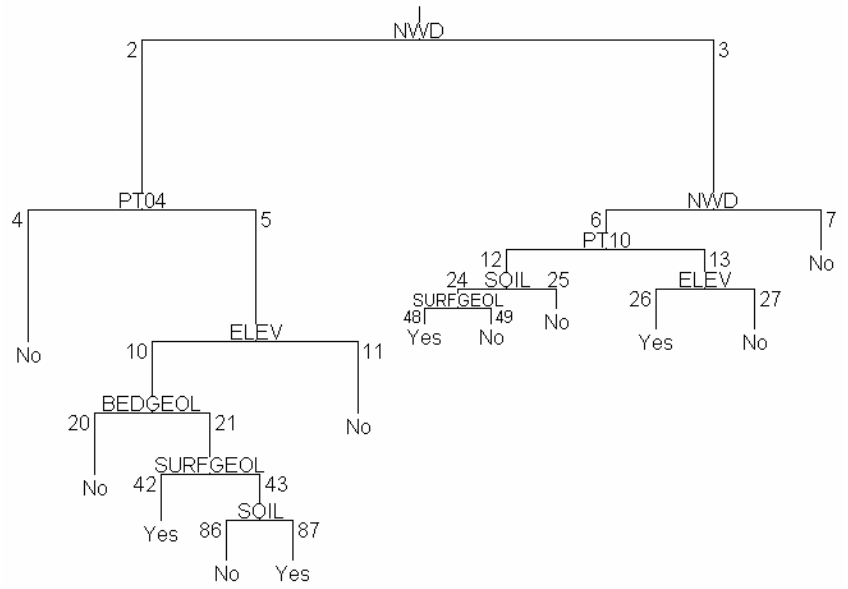
Data Source (Records):
This table lists the sources used for location data and the number of present points derived from each source.

Rocky Mountain Herbarium (1)
Wyoming Natural Diversity Database (24)

Modeling Notes
The following table contains a list of the environmental factors used as independent (predictor) variables for the model and the parameters used for classification tree analysis and pruning. "Biomes used for validation" lists only the major biome types in which this species is known or likely to occur in Wyoming.

Independent Variables: Elevation (ELEV), Local relief (RELIEF), Total January precipitation (PT01), Total April mean precipitation (PT04), Total July mean precipitation (PT07), Total October mean precipitation (PT10), Number of wet days (NWD), Total January shortwave radiation (RT01), Total July shortwave radiation (RT07), Average January air temperature (TA01), Average April air temperature (TA04), Average July air temperature (TA07), Average October air temperature (TA10), Maximum July air temperature (TX07), Number of frost days (NFD), Growing degree days (GDD), major GAP land cover (LANDCOV), bedrock geology (BEDGEOL), Wyoming soil classification (SOIL), and Surficial geology (SURFGEOL).
Minimum number of observations before split: 2
Minimum node size: 4
Minimum node deviance: 0.01
Minimum percent for pruning: 0.2
Biomes used for validation: Foothills, Intermountain Desert Steppe/Great Plains Grassland, Intermountain Desert Steppe

Classification Tree Used in Model Building
This figure depicts the final pruned tree used for construction of the *A. porteri* model and shows the environmental variable and node numbers associated with each split. The terminal nodes are designated by "Yes" if the species is predicted to be present, or "No" if it is predicted to be absent. See the Classification Tree Output and Path Composition and Likelihood tables on the next



two pages for the specific values or categories of each variable used for splitting nodes and the number and percentage of points in each node.

Classification Tree Output

The root node (number 1) indicates the number of data points used in construction of this tree (978), the number of absent and present points (959 and 19, respectively), and the percentage of absent and present points represented at the node. Subsequent lines specify the node numbers (which correspond with the nodes in the classification tree on the preceding page), the environmental variable selected at the node, the values or categories represented, the total number of points at each node, the number of absent and present points at the node, the percentage of absent and present points at the node relative to the total available pool of absent and present points in the entire model, and whether the node represents presence (Yes) or absence (No) of the species. Nodes that end with an * are terminal nodes.

Node_Num) Node_Def Node_Size (Num_No,Num_Yes) (Pct_No,Pct_Yes) Node_Type
1) root 978 (959,19) (100,100) Yes
  2) NWD<49.75 days 126 (111,15) (11.6,78.9) Yes
    4) PT04<2.775 cm 81 (81,0) (8.4,0) No *
    5) PT04>2.775 cm 45 (30,15) (3.1,78.9) Yes
      10) ELEV<1992 m 28 (13,15) (1.4,78.9) Yes
        20) BEDGEOL: Cretaceous mixed sandstone/shale (Kmix), Cretaceous shale (Ksh), Miocene/ Pliocene (MiPl), Permian/Triassic/Jurassic (PTJ), Paleocene (Pal) 8 (8,0) (0.8,0) No *
        21) BEDGEOL: Early Eocene (Eoe), Late Eocene (Eol), Quaternary alluvium (Qal), Quaternary sand (Qs) 20 (5,15) (0.5,78.9) Yes
          42) SURFGEOL: bedrock (Ri), dissected alluvial fan (fdi), landslide (li), slopewash (sci) 12 (0,12) (0,63.2) **Yes ***
          43) SURFGEOL: residuum (ri), terrace deposits (ti) 8 (5,3) (0.5,15.8) Yes
            86) SOIL: WY15,WY16C,WY17C,WY34 5 (5,0) (0.5,0) No *
            87) SOIL:WY42,WY44 3 (0,3) (0,15.8) **Yes ***
      11) ELEV>1992 m 17 (17,0) (1.8,0) No *
  3) NWD>49.75 days 852 (848,4) (88.4,21.1) No
    6) NWD<58.05 days 234 (230,4) (24,21.1) No
      12) PT10<3.355 cm 213 (212,1) (22.1,5.3) No
        24) SOIL:WY34 18 (17,1) (1.8,5.3) Yes
          48) SURFGEOL: bedrock (Ri) 3 (2,1) (0.2,5.3) **Yes ***
          49) SURFGEOL: bench (bi), dissected alluvial fan (fdi), alluvial fan (fi), residuum (ri), slopewash (sci), shallow terrace deposits (tre) 15 (15,0) (1.6,0) No *
        25) SOIL:WY06C,WY10,WY14,WY15,WY16C,WY17C,WY27,WY35,WY38C,WY40C,WY42, WY44 195 (195,0) (20.3,0) No *
      13) PT10>3.355 cm 21 (18,3) (1.9,15.8) Yes
        26) ELEV<1983.5 m 5 (2,3) (0.2,15.8) **Yes ***
        27) ELEV>1983.5 m 16 (16,0) (1.7,0) No *
    7) NWD>58.05 days 618 (618,0) (64.4,0) No *

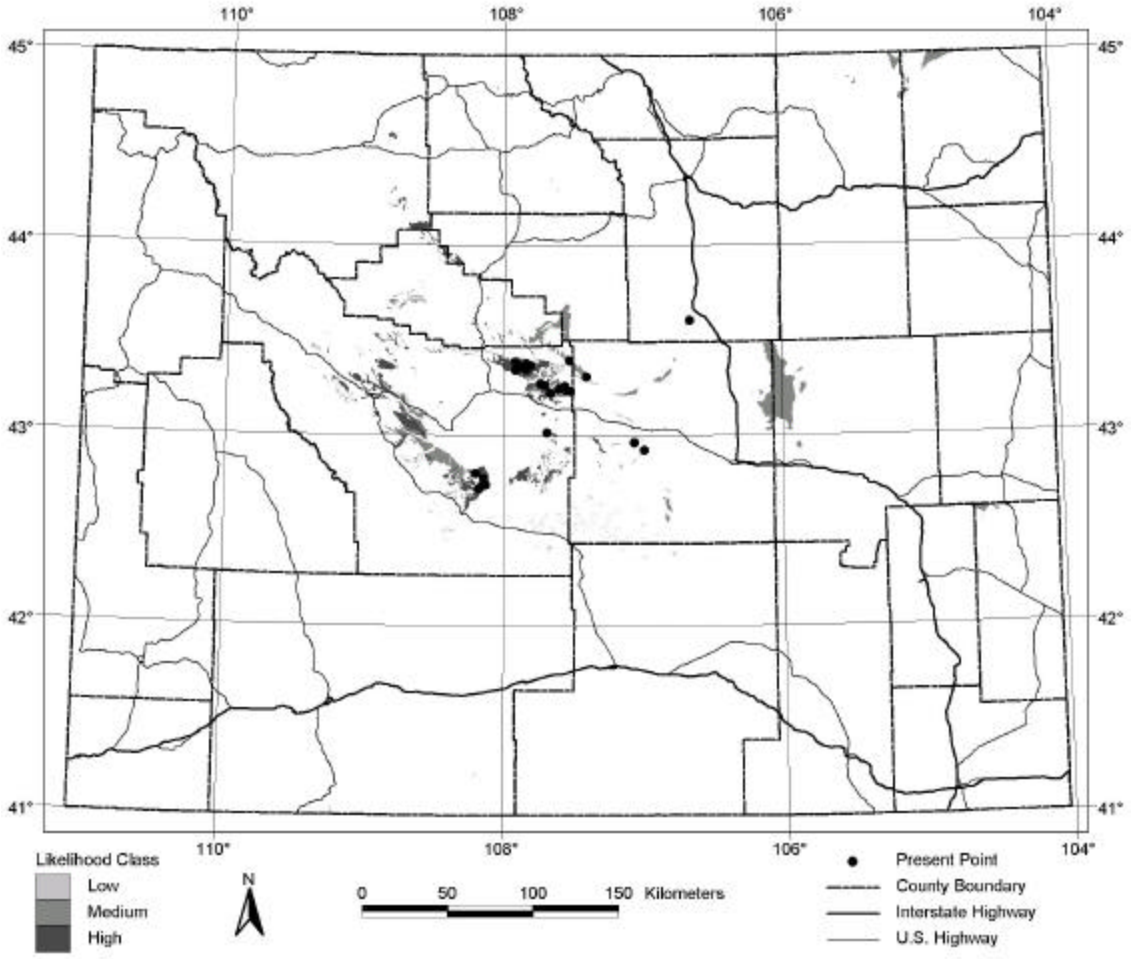
Path Composition and Likelihood

This table lists the nodes that comprise each of the four "yes" (predicted present) paths for the model shown above. The percentage of present points in the terminal "Yes" node for each path is indicated, as is the likelihood of points falling within the path based on a three-part scoring system (Low, Medium, High).

Yes Path	Node List	% of Present Points	Likelihood Class
a	42, 21, 10, 5, 2	63.2	High
b	87, 43, 21, 10, 5, 2	15.8	Medium
c	48, 24, 12, 6, 3	5.3	Low
d	26, 13, 6, 3	15.8	Medium

Predicted Distribution of *Artemisia porteri* in Wyoming

The Classification Tree Output and Path Composition tables are used to define the values and variables that are intersected in GIS to produce four discrete maps of potential habitat for this species (one map for each path). These maps are merged to form the final predicted distribution



map for this species in Wyoming. The paths are color-coded to indicate the likelihood class, with darker areas representing a higher probability of occurrence. White areas on the map represent areas where this species is not expected to occur. Black dots superimposed over the map indicate known present locations used to build and validate the model.

Classification Rates

The following tables indicate the number of known present and absent points correctly classified in the model-building and validation datasets for the *A. porteri* model. Points that are known to be present but predicted by the model as absent are considered false negatives or omission errors, while points that are known to be absent but predicted as present by the model are false positives or commission errors.

Model-Building Points

	Model Present	**Model Absent**
Known Present	18/19 (94.7%)	1/19 (5.3%)
Known Absent	4/959 (0.4%)	955/959 (99.6%)

Total Correct: 973/978 (99.5%)
Total Incorrect: 5/978 (0.5%)

Validation Points

	Model Present	**Model Absent**
Known Present	4/6 (66.7%)	2/6 (33.3%)
Known Absent	1/182 (0.5%)	181/182 (99.5%)

Total Correct: 185/188 (98.4%)
Total Incorrect: 3/188 (1.6%)

Area of Predicted Distribution:

This entry indicates the area and percentage of the state in which the modeled species may potentially occur.

3,076 km^2 (1.2% of WY)