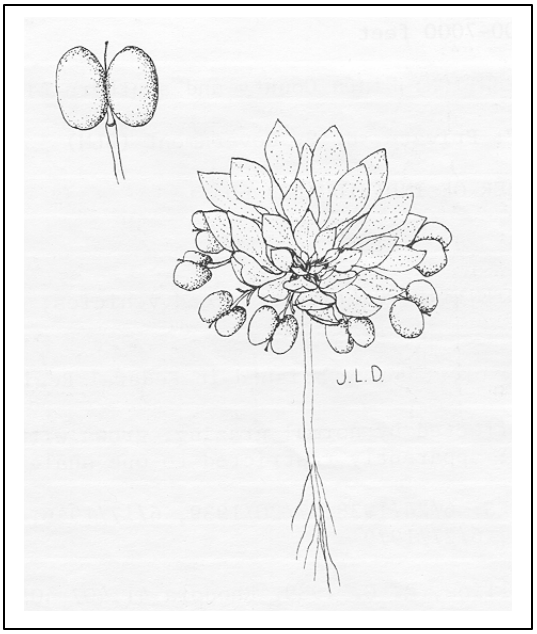
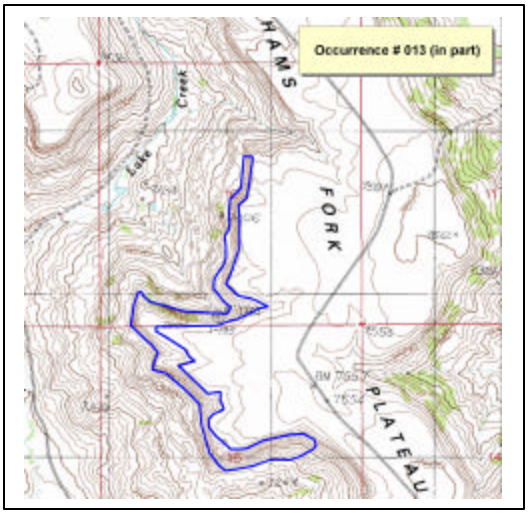
Status of
Tufted Twinpod (*Physaria condensata*)
in Southwest Wyoming





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By

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ABSTRACT

Tufted twinpod (*Physaria condensata*) is a local endemic restricted to the Overthrust Belt in southern Lincoln, southwestern Sublette, and northern Uinta counties, Wyoming. This species occurs primarily on calcareous sandstone or shaley slopes and ridges of desert mesas in sparsely vegetated cushion plant-bunchgrass communities. *P. condensata* is currently known from 16 extant and one historical occurrences, 4 of which have been discovered in surveys by Rocky Mountain Herbarium or WYNDD staff since 1995. These populations consist of at least 43 discrete subpopulations, each consisting of one to several hundred individuals. The total world population of *P. condensata* is currently estimated at 40,000 to 60,000 individuals. Although trend data are lacking for most populations, this species is thought to be stable at present. Two occurrences are currently protected within Fossil Butte National Monument, although one of these may be impacted by a proposed fossil quarry. One other occurrence is given special management recognition within the BLM Kemmerer Field Office's Kemmerer Cushion Plant No Surface Occupancy Area. Populations on public or state lands may be potentially impacted by soil erosion or compaction associated with off-highway vehicle recreation, grazing, or mineral exploration. Due to its strong association with rim habitats, *P. condensata* can be readily avoided in most management situations.

ACKNOWLEDGEMENTS

I would like to thank the following individuals for their assistance with this project: Gilian Walford assisted with field surveys in 1999; Clay Kyte, naturalist at Fossil Butte National Monument, shared information from his recent surveys of *Physaria condensata* habitat on the Monument; Rob Thurston of the University of Wyoming, helped develop the potential distribution model for this species (Appendix C); Scott Laursen of WYNDD assisted with digitizing populations of *Physaria condensata* in Arc-view; Laura Welp of WYNDD helped enter new location records; and Jeff Carroll of the BLM Wyoming State Office provided funding for this project.

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INTRODUCTION

Tufted twinpod (*Physaria condensata*) was first recognized as a distinct species by Dr. Reed Rollins of Harvard University in 1939 (Rollins 1939). At that time, the species was known only from the slopes of Bridger Butte in Uinta County, Wyoming. During the next 35 years, Tufted twinpod was reported from only one additional site, prompting the Smithsonian Institution to recommend the species for listing as "Threatened" under the Endangered Species Act in 1975 (Ayensu and DeFillips 1978). Surveys by Robert Dorn and Robert Lichvar from 1977-1982 demonstrated that *P. condensata* was more widespread and abundant in southwestern Wyoming than previously suspected, and the species was dropped as a candidate for federal protection (US Fish and Wildlife Service 1985).

Due to its limited geographic range and high habitat specificity, *Physaria condensata* 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 Tufted twinpod on public lands in southwest Wyoming. The results of this study are discussed in the following report.

METHODS

Information on the habitat and distribution of *Physaria condensata* was obtained from scientific literature, specimens from the Rocky Mountain (RM) and Fossil Butte National Monument (FoBu) herbaria, the digital specimen database of the New York Botanical Garden, unpublished 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 Walter Fertig and Gillian Walford of WYNDD in May and July 1996, June 1997, June-July 1998, June-July 1999, and July 2000 (survey routes are listed 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 (Appendix A).

Rob Thurston of WYNDD and I developed a potential habitat model for *Physaria condensata* (Appendix C) using Classification Tree Analysis and GIS (Fertig 1999; Fertig et al. 2002 in ed.). Based on information from WYNDD and RM, we used 18 randomly selected locations of *P. condensata* to construct the model and 5 locations for validation. An additional 960 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 175 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 0.8% 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 (Figure 4 and Appendix C). The validation data set was compared to this final map to determine the classification success rate.

SPECIES INFORMATION

Classification

Scientific Name: *Physaria condensata* Rollins. Type specimen: USA, Wyoming, Uinta County, limy knoll-crest, foothills of Bridger Butte, 3 miles west of Fort Bridger. 24 June 1938. *Rollins* 2385 (GH type, RM isotype).

Common Name: Tufted twinpod.

Family: Brassicaceae or Cruciferae (Mustard family).

Synonyms: None.

Phylogenetic Relationships: Rollins (1993) recognizes 22 species in the genus *Physaria*, all of which are restricted to western North America. Dorn (2001) lists 10 species of *Physaria* for Wyoming. Eight of Wyoming's taxa are state or regional endemics, suggesting that the state is a center of speciation within the genus.

Rollins (1939) noted similarities in "technical characters" between *Physaria condensata* and *P. didymocarpa*, with the two taxa differing mostly in growth habit. Lichvar (1982) conducted a taxonomic assessment of *P. condensata* and several allied species and concluded that *P. condensata* was a distinct species and not merely a stunted growth form responding to a highly stressed habitat. Based on similarities in replum shape, growth form, and habitat requirements, Lichvar (1983) hypothesized that *Physaria condensata* and *P. dornii* were derived from *P. didymocarpa* var. *integrifolia* [synonym = *P. integrifolia*]. This whole species complex (including the related *P. eburniflora* endemic to central Wyoming) may have evolved from populations of the more northerly ranging *P. didymocarpa* that became isolated in the basins and desert mountain ranges of southwestern and central Wyoming during wetter periods in the late Pleistocene (Rollins 1981; Lichvar 1983). All of these species intergrade to some degree, indicating that the group is still actively evolving and therefore taxonomically unstable (Dorn 1988, p. iv).

Legal Status: Tufted twinpod is listed as Sensitive by the BLM Wyoming State Office. *Physaria condensata* was formerly a C2 candidate for listing under the Endangered Species Act (US Fish and Wildlife Service 1983). 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. *P. condensata* was dropped to Category 3C status in 1985, indicating that it was more abundant or widespread than previously thought (US Fish and Wildlife Service 1985).

Natural Heritage Rank: NatureServe (formerly the Association for Biodiversity Information and the heritage division of The Nature Conservancy) and the network of state natural heritage programs gives *Physaria condensata* a rank of G2, indicating that the species is imperiled because of rarity (typically known from 6-20 extant occurrences rangewide) or because of factors making it vulnerable to extinction. *P. condensata* is ranked S2 in Wyoming, indicating that it is equally rare within the state (Fertig and Heidel 2000).

Description: Tufted twinpod is a prostrate, rosette-forming perennial forb with ascending stems to 8 cm high (Figures 1-3). The silvery-pubescent basal leaves are obovate, acute-tipped, entire, and 0.5-1.5 cm long x 4-8 mm wide. Stem leaves are smaller and reduced upwards. The inflorescence is a compact, few-flowered raceme of bright yellow, 4-petaled flowers 4-7 mm long. Fruits are inflated, deeply 2-lobed pods 0.5-1 cm wide and have appressed to spreading silvery hairs. The membranous partition (replum) between each half of the fruit is oblong to obovate, 3-4 mm long, and usually bears 4 stubby seed-bearing stalks (funiculi). Seeds are flat and lack a membranous margin (Rollins 1939, 1993; Dorn and Dorn 1980; Fertig et al. 1994; Fertig 2000).

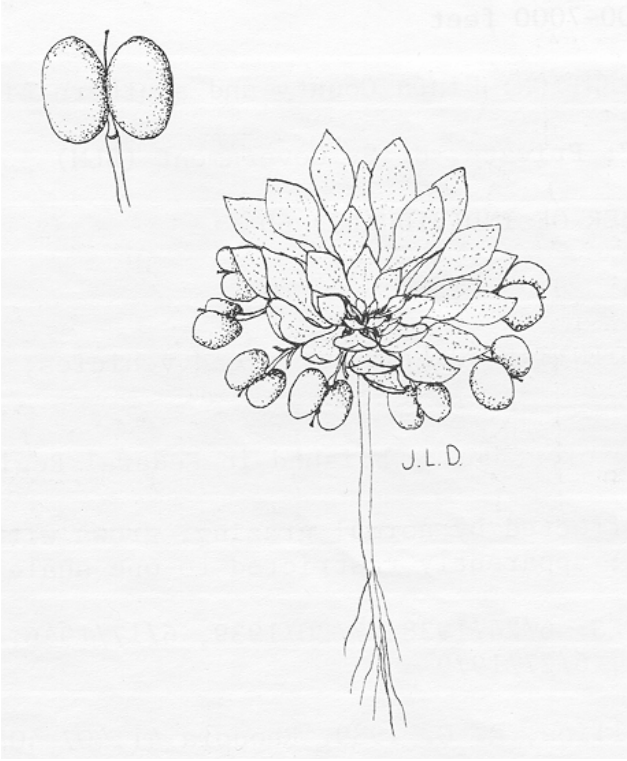

Figure 1. Line drawing of Physaria condensata *by Jane Dorn from Fertig et al. (1994).*

Figure 2. Photo of Physaria condensata *in flower by Charmaine Refsdal Delmatier.*

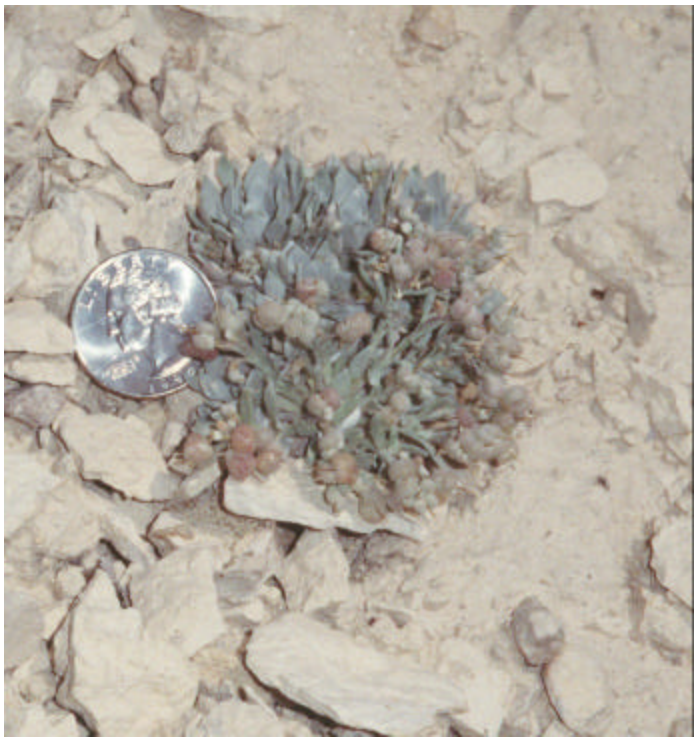

Figure 3. Photo of Physaria condensata *in fruit from ridge ca 2 miles east of Fossil Butte (Lincoln County, WY), July 1996. WYNDD photo by W. Fertig.*

Similar Species: *Physaria eburniflora* has whitish or pale flowers and spreading hairs on the fruit. *P. dornii* has mature fruits over 1.5 mm wide, longer leaves, and a more erect basal rosette. *P. didymocarpa* has erect stems and leaves that are often toothed. *P. acutifolia* has more erect stems and a narrowly linear replum with only 2 funiculi per face (Fertig et al. 1994).

Geographic Range: Tufted twinpod is endemic to the southern Overthrust Belt and lower Green River Basin in Lincoln, Uinta, and Sublette counties, Wyoming (Figure 4). It is known from 17 occurrences consisting of at least 43 discrete subpopulations and occupying a minimum area of 160-175 acres. The entire global range of the species is contained within an area of approximately 60 x 85 miles. The location of Wyoming populations is summarized in Table 1 and more detailed population data and maps are provided in Appendix A.

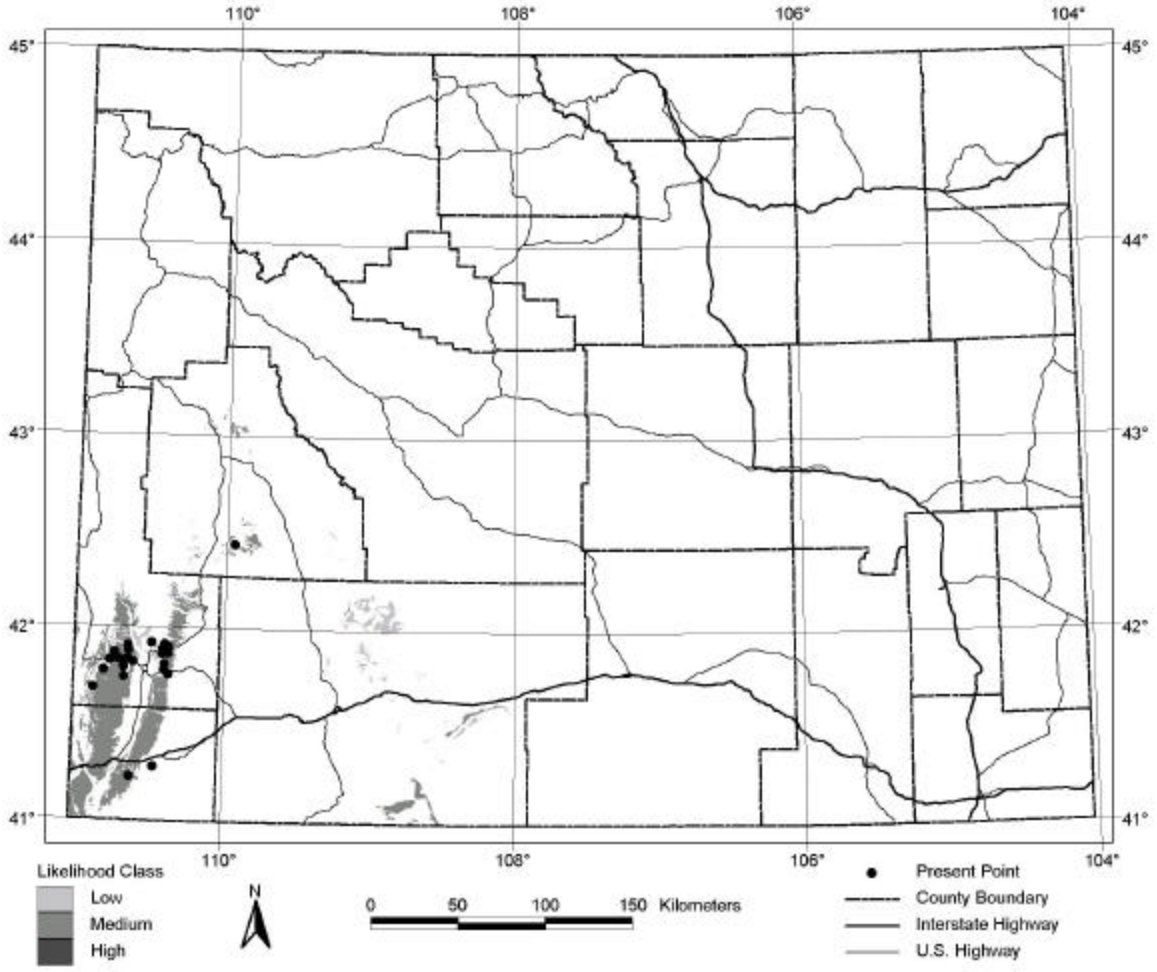

Figure 4. Known and potential distribution of Physaria condensata *in Wyoming. Known populations are indicated by black dots. Potential distribution based on classification tree modeling is depicted by gray shading.*

Table 1. Locations of known populations of Tufted twinpod in Wyoming

Occurrence # 003
County: Lincoln
USGS Quad: Nugget
Latitude: 41? 49' 42" N (centrum)
Longitude: 110? 47' 49" W (centrum)
Town/Range/Section: T21N R118W S3
Location: Overthrust Belt, Tunp Range, "14 miles west of Kemmerer" [thought to be ca 0.5 miles north of WY Highway 30 on east side of Dempsey Ridge].

Occurrence # 004
County: Sublette
USGS Quad: Sugar Loaf NW
Latitude: 42? 26' 15" N (centrum)
Longitude: 109? 57' 30" W (centrum)
Town/Range/Section: T28N R110W S6
Location: Green River Basin, Reardon Draw, south-southeast of Big Piney.

Occurrence # 005
County: Uinta
USGS Quad: Fort Bridger
Latitude: 41? 16' 37" N (centrum)
Longitude: 110? 28' 53" W (centrum)
Town/Range/Section: T15N R116W S15 (S1/2).
Location: Overthrust Belt, southern slopes of Bridger Butte, [ca 3.5 miles southwest of Fort Bridger and ca 2.75 miles south of Interstate 80].

Occurrence # 007
County: Lincoln
USGS Quad: Willow Springs
Latitude: 41? 47' 50" N (centrum)
South Latitude: 41? 46' 17" N
North Latitude: 41? 48' 32" N
Longitude: 110? 25' 47" W (centrum)
East Long: 110? 25' 05" W
West Long: 110? 25' 47" W

Town/Range/Section: T21N R115W S12 (W1/2), 14 (E1/2), 24 (SW4)
Location: Overthrust Belt, along ridge on east side of Alkali Creek, north of US Highway 30 between Kemmerer and Opal. Population extends from just north of highway for ca 2.5 miles.

Occurrence # 008
County: Lincoln
USGS Quad: Sublet
Latitude: 41? 55' 10" N (centrum)
Longitude: 110? 30' 51" W (centrum)
Town/Range/Section: T22N R115W S6 (NW4)
Location: Overthrust Belt, Tunp Range, Oyster Ridge, ca 3 air miles north of Highway 189 and ca 9-10 air miles north of Kemmerer.

Occurrence # 009
County: Lincoln
USGS Quad: Fossil
Latitude: 41? 49' 57" N (centrum)
South Latitude: 41? 49' 44" N
North Latitude: 41? 52' 12" N
Longitude: 110? 44' 05" W (centrum)
East Longitude: 110? 43' 33" W
West Longitude: 110? 45' 35" W
Town/Range/Section: T21N R117W S5 (N2 of SW4 of NW4); S6 (N2 of NE4 & NE4 of NW4).
Location: Overthrust Belt, summit ridge along the south arm of Fossil Butte from just west of Point 7350 west-northwest ca 1 mile to the head of the quarry trail draw, ca 0.9-1.2 air miles north of US Highway 30.

Occurrence # 010
County: Lincoln
USGS Quad: Fossil

Table 1. Continued

Latitude: 41? 48' 05" N (centrum)
Longitude: 110? 43' 13" W (centrum)
Town/Range/Section: T21N R117W S17 (NE4)
Location: South Tunp Range: ca 1 air mile south of Highway 30 near Clear Creek and northeast end of Fossil Ridge.

Occurrence # 012
County: Lincoln
USGS Quad: Nugget
Latitude: 41? 51' 58" N (centrum)
South Latitude: 41? 51' 45" N
North Latitude: 41? 52' 29" N
Longitude: 110? 45' 58" W (centrum)
East Long: 110? 45' 13" W
West Long: 110? 47' 15" W
Town/Range/Section: T22N R118W S23 (S2 of NW4); S24 (SE4 of SW4SW4); S25 (NE4NE4 of NW4).
Location: Overthrust Belt, south and west slopes of Cundick Ridge, ca 3.2-3.6 miles north of US Highway 30 and ca 0.75 miles northwest of the north end of Fossil Butte.

Occurrence # 013
County: Lincoln
USGS Quads: Fossil and Kemmerer Reservoir
Latitude: 41? 53' 34" N (centrum)
South Latitude: 41? 50' 53" N
North Latitude: 41? 56' 37" N
Longitude: 110? 41' 00" W (centrum)
East Longitude: 110? 40' 15" W
West Longitude: 110? 43' 00" W
Town/Range/Section: T22N R117W S27, 35 (NW4); T21N R117W S2 (NW4NW4), 3 (NE4NE4); T22N R117W S10 (SW4 of NE4, E4 of SE4, & S4 of SW4), 15 (NW4 & SE4); T23N R117W S29 (NW4 of SE4)
Location: Overthrust Belt, Tunp Range, south end of Hams Fork Plateau, three main locations: (1) ca 5 air miles north of US Highway 189/30 [on the rim of the east side of the north Fork Twin Creek and Lake Creek valleys], ca 13 air miles northwest of Kemmerer; (2) ca 1.5 air miles north of US Highway 189/30 west of Kemmerer. Also North Fork of Twin Creek 3 air miles east of Fossil Butte National Monument; (3) on ridge ca 2 air miles east of Fossil Butte, on north side of Union Pacific Railroad, ca 1.5 miles north of U.S. Highway 30, ca 7 air miles west-northwest of Kemmerer.

Occurrence # 015
County: Lincoln
USGS Quads: Fossil and Warfield Creek
Latitude: 41? 47' 25" N (centrum)
Longitude: 110? 42' 00" W (centrum)
Town/Range/Section: T21N R117W S21 (N1/2), 22; T20N R118W S1 (SE4)
Location: Overthrust Belt, Tunp Range, ca 1.5 air miles south of US Highway 30 between Clear and Twin Creeks. Also ca 7 air miles west-southwest of Kemmerer [4.6 miles south on County Road 328, then 0.7 mile west on two track].

Occurrence # 016
County: Lincoln
USGS Quads: Round Mountain and Willow Springs
Latitude: 41? 53' 25" N (centrum)
South Latitude: 41? 51' 40" N
North Latitude: 41? 55' 28" N
Longitude: 110? 25' 30" W (centrum)
East Longitude: 110? 24' 02" W
West Longitude: 110? 26' 38" W
Town/Range/Section: T22N R115W S1 (W1/2), 2 (NE4), 12 (SW4 & N2 of NW4), 13 (NW4), 14 (NE4 of W2), 22 (E2), 23 (W2), 26 (NW4); T23N R115W S34 (SW4); T22N R114W S19 (SW4), S20 (SW4), S30 (N2).

Table 1. Continued

Location: Overthrust Belt, Tunp Range, 5 main locations: (1) just north of Wyoming Highway 189, ca 9 air miles northeast of Kemmerer and ca 1-1.5 miles west of Round Mountain. Also on ridge on south side of South Fork of Slate Creek, ca 0.3 air miles north of US Highway 189 and ca 0.6 miles northwest of Round Mountain; (2) headwaters of Craven Creek, ca 1.25 air miles west of Craven Creek Reservoir; (3) near Middle Fork Slate Creek, ca 2.25 miles northwest of Round Mountain and ca 10 air miles north-northeast of Kemmerer; (4) between South and Middle Forks Slate Creek, ca 2 air miles north of Round Mountain and ca 10 air miles north-northeast of Kemmerer (north of Wyoming Highway 189); (5) on ridge north of Craven Creek, ca 1 mile south of Round Mountain.

Occurrence # 019
County: Lincoln
USGS Quad: Fossil
Latitude: 41? 48' 10" N (centrum)
Longitude: 110? 38' 50" W (centrum)
Town/Range/Section: T21N R117W S13 (NW4)
Location: S Tunp Range, ca 1 air mile south of WY Highway 30, ca 5 air miles W of Kemmerer on ridge east of Fossil Ridge.

Occurrence # 020
Counties: Lincoln and Sublette
USGS Quads: Anderson Canyon, La Barge, La Barge SE, and Names Hill.
Latitude: 42? 15' 22" N (centrum)
South Latitude: 42? 13' 45" N
North Latitude: 42? 17' 30" N
Longitude: 110? 09' 24" W (centrum)
East Longitude: 110? 05' 02" N
West Longitude: 110? 09' 24" N
Town/Range/Section: T27N R112W S24 (NW4 of NE4); S33 (SW4 of SE4); T27N R111W S30 (SE4 of NW4); T26N R112W S14 (SE4 of SW4); S15 (SW4 of NE4).
Location: Green River Basin, three main locations: (1) on north and south rims of Bird Canyon, ca 4.5 air miles northeast of La Barge; (2) on rim ca 0.5-1.5 air miles north of Steed Canyon, Little Colorado Desert, ca 3-4 air miles southeast of La Barge; (3) on rim ca 1.5 air miles northeast of La Barge.

Occurrence # 023
County: Lincoln
USGS Quad: Nugget
Latitude: 41? 46' 29" N (centrum)
Longitude: 110? 50' 30" W (centrum)
Town/Range/Section: T21N R118W S29 (N2)
Location: Overthrust Belt, ca 16 air miles west of Kemmerer [ca 3.5 air miles south of Nugget Canyon].

Occurrence # 024
County: Lincoln
USGS Quad: Windy Point
Latitude: 41? 40' 55" N (centrum)
South Latitude: 41? 40' 52" N
North Latitude: 41? 40' 57" N
Longitude: 110? 54' 35" W (centrum)
East Longitude: 110? 54' 29" W
West Longitude: 110? 54' 41" W
Town/Range/Section: T20N R119W S30 (S2 of SE4)
Location: Overthrust Belt, southwest end of Bear River Divide. East-west running ridge on northeast side of Bridger Basin, ca 2 air miles northeast of Bridger Hill and ca 10 air miles south of Orr.

Occurrence # 025
County: Lincoln
USGS Quad: Fossil
Latitude: 41? 49' 14" N (centrum)
South Latitude: 41? 49' 10" N
North Latitude: 41? 49' 16" N

Table 1. Continued

Longitude: 110? 38' 15" W (centrum)
East Longitude: 110? 38' 03" W
West Longitude: 110? 38' 36" W
Town/Range/Section: T21N R116W S7 (N2 of NW4NW4); T21N R117W S12 (N2 of NE4).
Location: Overthrust Belt, butte on east side of Hay Hollow and on north side of Union Pacific Railroad and U.S. Highway 30, ca 4.5 miles east of Fossil Butte and ca 5 air miles northwest of Kemmerer.

Occurrence # 026
County: Uinta
USGS Quad: Piedmont Reservoir
Latitude: 41? 13' 30" N (centrum)
Longitude: 110? 38' 27" W (centrum)
Town/Range/Section: T14N R117W S6 (SE4 of NE4NE4)
Location: Overthrust Belt, ridge on divide between Soda Hollow and Piedmont Creek (both tributaries of Muddy Creek), ca 1 mile west of Piedmont and 5 air miles south of Interstate 80, ca 17 miles east of Evanston.

Potential Distribution in Wyoming: Based on modeling, 4,012 square kilometers of potential habitat occurs for *Physaria condensata* in Wyoming (1.6% of the state's area) (Appendix C). Most of this potential habitat is restricted to the desert mountains of the Overthrust Belt in southern Lincoln and western Uinta counties and the Little Colorado Desert of southern Sublette County and coincides with the known distribution of this species (Figure 4). Additional areas of potential habitat may exist in the northern Green River Basin in Sublette County and the Jack Morrow Hills, Kinney Rim, and Delaney Rim areas of Sweetwater County. To date, no populations of *P. condensata* have been found in northern Sublette or Sweetwater County despite extensive floristic surveys over much of these areas (Cramer 1997; Welp 1997; Ward 1998). The absence of Tufted twinpod 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 errors resulting from inadequate location or environmental variables used to create the model (Fertig et al. 2002, in ed.).

Extent of Surveys in Wyoming: Tufted twinpod was apparently first collected in 1923 by Edwin Payson and George Armstrong of the University of Wyoming on Oyster Ridge between Kemmerer and Opal, Wyoming. This specimen was initially misidentified, however, and its true identity remained unknown until the early 1980s. Reed Rollins collected the type specimen on the slopes of Bridger Butte west of Fort Bridger in 1938 and formally described the plant as a new species the following year (Rollins 1939). Rollins revisited this population in 1939 and 1946 (WYNDD and RM records). In 1957, Rollins located a new population on "shaley hills" 14 miles west of Kemmerer. Dr. Alan Beetle of the University of Wyoming discovered the fourth population of Tufted twinpod on Fossil Butte in June 1966 and relocated the population again in 1973 during a vegetation mapping study of the National Monument, but misidentified the specimens as *P. didymocarpa* (Beetle and Marlow 1974) and *P. acutifolia*. The proper identity of Beetle's specimens was not detected until 2000 (Fertig 2000) and the exact locality of his collection sites is not known. Robert Litzinger, a botanical consultant, discovered an additional population on Fossil Butte National Monument in 1977, but his specimen was also initially misidentified. Robert Dorn relocated the Bridger Butte population in 1977 and discovered new populations at Devils Gate and

the north slope of the Ferris Mountains in Carbon County. The Carbon County material differed in flower color and pubescence and was later described as a new species (*Physaria eburniflora*) by Rollins (1981). In 1979, Rollins revisited southwest Wyoming and discovered one new population. Dorn and Robert Lichvar of the Wyoming Natural Heritage Program conducted surveys for *P. condensata* in southwestern Wyoming from 1980-1983 and discovered 6 new occurrences and relocated 5 previously known populations (Lichvar 1982; Whiskey Basin Consultants 1982). Hollis Marriott summarized existing location data for Tufted twinpod for the BLM in 1988, but did not conduct any field inventories (Marriott 1988). In 1993, Ron Kass, a Utah botanical consultant, reported one new population during a pipeline survey in southwest Wyoming (Kass 1993). Charmaine Refsdal Delmatier, Ron Hartman, and Tom Cramer of the University of Wyoming discovered one new population and relocated one other colony during general floristic surveys of southwestern Wyoming in 1994-1995 (Hartman & Cramer 1995; Refsdal 1996). Environmental consultant Juli Crane relocated one population while conducting a survey for a pipeline project in 1994. Walter Fertig and Jill Walford of WYNDD discovered 2 new populations and relocated 5 others during rare plant surveys along the Overthrust Belt in southwest Wyoming from 1996-2000. Clay Kyte of Fossil Butte National Monument surveyed several colonies on Fossil Butte and Cundick Ridge on the Monument from 1996-2000 (Kyte 2000).

Habitat: Tufted twinpod occurs primarily on south, west, or east facing, semi-barren, wind-blasted upper slopes and rims of calcareous shale or sandstone desert mesas at elevations of 6000-7760 feet (1830-2365 m) (Figures 5-6). Populations are typically found in cushion plant/bunchgrass

Figure 5. Habitat of Physaria condensata *along the rim and upper slopes of white calcareous sandstone of the Eocene Green River formation on the south slope of Fossil Butte in Fossil Butte National Monument (Occurrence # 009). WYNDD photograph by W. Fertig, June 1997.*

communities dominated by *Eriogonum brevicaule, Machaeranthera grindelioides, Cymopterus terebinthinus, Phlox hoodii, Poa secunda, Elymus spicatus,* and *Achnatherum hymenoides* (Table 2) within openings in more dense *Juniperus osteosperma* or *Artemisia tridentata* var. *wyomingensis* communities. Occasionally, *Physaria condensata* may also occur in cushion plant communities with scattered *Artemisia arbuscula, Chrysothamnus viscidiflorus, Amelanchier utahensis, Atriplex confertifolia, Purshia tridentata,* or *Cercocarpus montanus*. Vegetative cover in *P. condensata* habitat is patchy and typically ranges from 10-40%, while rock and bare soil may account for up to 90% of total cover. Soils are shallow, dry, whitish, tan, or pale reddish rocky clays covered with a thin layer of irregular, brownish-tan sandstone or slate rubble. These entisols or aridisols are derived from the Eocene-age Green River shale or Wasatch Formation (Love and Christiansen 1985). Soils may be seleniferous, based on the presence of *Stanleya pinnata.* Tufted twinpod is usually found on convex or concave slopes of 10-15 degrees and becomes rare to absent on summit flats, even in areas with low vegetative cover and shallow, rocky soils.

Average annual precipitation within the range of *Physaria condensata* is 8-10 inches (203-254 mm), with peak precipitation coming as rain from April to June (Martner 1986). Mean annual temperature is 36-40º F (2.2-4.4º C). January mean high and low temperatures are 26-30º F (- 3.3 to -1.1ºC) and -4 to 8º F (- 19.8 to - 13.2º C), respectively. July mean high temperature is 80-82º F (26.4-27.5º C) and July low temperature averages 40-46º F (4.4 - 7.7º C).

Figure 6. Habitat of Physaria condensata *on chalky, calcareous slopes of the Green River Formation covered by broken fragments of bleached shale and slate on ridge 2 miles east of Fossil Butte (Occurrence # 013). Tufted twinpod plants are located in open areas amid clumps of cushion plants and bunch grasses and occasional shrubs. WYNDD photograph by W. Fertig, July 1996.*

Table 2. Species commonly associated with Tufted twinpod in Wyoming

Scientific Name	Common Name	Growth Form
Achnatherum [*Oryzopsis*] *hymenoides*	Indian ricegrass	Perennial graminoid
Astragalus jejunus var. *jejunus*	Starveling milkvetch	Perennial forb
Astragalus spatulatus	Tufted milkvetch	Perennial forb
Castilleja flava	Yellow paintbrush	Perennial forb
Caulanthus crassicaulus	Thick-stem wild cabbage	Perennial forb
Chaenactis douglasii var. *montana*	Dusty-maiden	Perennial forb
Cryptantha caespitosa	Tufted cat's-eye	Perennial forb
Cymopterus terebinthinus var. *albiflorus*	Turpentine wavewing	Perennial forb
Elymus spicatus	Bluebunch wheatgrass	Perennial graminoid
Eriogonum brevicaule var. *brevicaule*	Shortstem wild buckwheat	Perennial forb
Eriogonum brevicaule var. *laxifolium*	Shortstem wild buckwheat	Perennial forb
Hymenopappus filifolius var. *luteus*	Fine-leaf woollywhite	Perennial forb
Ipomopsis spicata var. *spicata*	Spiked skyrocket	Perennial forb
Krascheninnikovia lanata	Winterfat	Shrub
Lesquerella condensata	Dense bladderpod	Perennial forb
Lesquerella prostrata	Prostrate bladderpod	Perennial forb
Linum lewisii	Blue flax	Perennial forb
Machaeranthera grindelioides [*Haplopappus nuttallii*]	Rayless tansy-aster	Perennial forb
Minuartia [*Arenaria*] *nuttallii*	Brittle stitchwort	Perennial forb
Oenothera cespitosa	Tufted evening-primrose	Perennial forb
Oxytropis sericea	White locoweed	Perennial forb
Packera cana [*Senecio canus*]	Silver-woolly groundsel	Perennial forb
Penstemon paysoniorum	Payson's beardtongue	Perennial forb
Phlox hoodii	Carpet phlox	Perennial forb
Poa secunda	Curly bluegrass	Perennial graminoid
Stanleya pinnata	Golden prince's plume	Perennial forb
Stenotus [*Haplopappus*] *acaulis*	Stemless mock goldenweed	Perennial forb

Population Size and Trends: Tufted twinpod is currently known from 16 extant occurrences and one historical record that consist of at least 43 discrete subpopulations (Table 1; Appendix A). Individual colonies range in size from less than 1 acre to about 40 acres and contain one to several hundred individuals. Robert Lichvar surveyed 6 large occurrences (consisting of 16 main subpopulations) in 1982 and estimated the total population of the species at 21,200 plants (Whiskey Basin Consultants 1982). Based on Lichvar's data and more recent surveys of 5 additional occurrences by Clay Kyte, Jill Walford, and Walter Fertig, the global population of *Physaria condensata* numbers at least 36,000 individuals. Extrapolating from these counts, the estimate of 40,000-60,000 individuals by Fertig et al. (1998) is probably a reasonable assessment.

Long-term trend data are not available for most populations of *P. condensata.* Populations at Fossil Butte (Occurrence #009 & 012) and the Round Mountain area north of Kemmerer (Occurrence # 016) have been revisited on several occasions since the late 1970s or early 1980s and appear to be stable. Other populations at Bridger Butte (Occurrence # 005) and Alkali Creek (Occurrence # 007) were first documented in the early 1920s or 1930s and were still present and viable when resurveyed by Lichvar in 1982. Monitoring plots have been established on Cundick Ridge in Fossil Butte National Monument (Occurrence # 012, Kyte 2000), but have not been established elsewhere in the range of this species

Population Biology and Ecology: *Physaria condensata* primarily flowers from mid May to late June, although flowers may occasionally be found into early July. Fruits begin to form in late May, but ripen mostly in mid June through July. Flowers are probably pollinated by small bees or flies, but the specific pollinators have yet to be identified. Tufted twinpod reproduces exclusively by seed. Individual plants may produce 50-200 fruits, each with 6-12 ovules, although the number of ovules surviving to form mature seeds is typically 2-4 per fruit. Herbivory of fruits and seeds is relatively common by rodents and ants. Seeds are dispersed passively or by dehiscence of the bladdery fruit pods and may blow short distances in the wind. The clumped nature of most populations of Tufted twinpod suggests that seed dispersal distances are short, numerous seeds ripen from the same fruiting pod, or seedling establishment is enhanced by proximity to established plants. Germination requirements and seedling biology are not known for this species, but establishment is probably episodic and limited to suitable microsites with low cover or years with adequate moisture.

Colonies of Tufted twinpod usually occur in areas of low cover and poor soil development, suggesting that this species does poorly under competition with other vegetation on richer sites. With the exception of fruits and seeds, the plant's low stature, dense covering of hairs, and presence of inedible mustard oils prevents its foliage from being browsed by most native herbivores or livestock.

P. condensata is closely related to *P. dornii* and the two taxa are sympatric in the southern Overthrust Belt in Uinta County, south of Interstate 80. A population of *P. condensata* from the Soda Hollow area (Occurrence # 026) is morphologically intermediate with *P. dornii* and may show effects of introgression from *P. dornii* populations in the vicinity (Fertig 1998). Hybridization has not been documented with *P. eburniflora*, another closely related species with an allopatric distribution in central Wyoming.

Table 3. Demographic information for populations of Tufted twinpod in Wyoming.

Occurrence # 003
Area: Not reported
Number of Plants: Not reported
Density: Not reported
Evidence of Reproduction: Not reported
Trends: Not known. Population has not been relocated since 1957.

Occurrence # 004
Area: Not reported.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Observed in late flower and fruit on 2 July 1983 by R. Dorn.
Trends: Not known. Population has not been relocated since 1983.

Occurrence # 005
Area: Not reported.
Number of Plants: 136 plants counted (178 estimated) at 2 small colonies by Lichvar in 1982.
Density: Not reported.
Evidence of Reproduction: Observed in fruit on 16 June 1982 and in flower on 29 May 1982 by R. Lichvar.
Trends: Population has not been resurveyed since 1982, but has been known since 1938.

Occurrence # 007
Area: ca 5-10 acres.
Number of Plants: 2382 plants counted in survey by R. Lichvar in May 1982. Total population estimated at 15,880 plants (Whiskey Basin Consultants 1982).
Density: Not reported.
Evidence of Reproduction: Observed in fruit by R. Dorn on 3 July 1982 and in flower and early fruit by R. Lichvar on 30 May 1982.
Trends: Population has not been relocated since 1982, but has been known since 1923.

Occurrence # 008
Area: Not reported
Number of Plants: Not reported
Density: Not reported
Evidence of Reproduction: Observed in fruit by Rollins and Rollins in June 1979.
Trends: Population has not been relocated since May 1982, but has been known since 1979.

Occurrence # 009
Area: 10 acres.
Number of Plants: 720 plants observed in survey by W. Fertig in June 1997. Total population estimated at 7000 plants.
Density: Typically in clusters of 3-4 plants. Density as high as 9 plants per square meter in favorable sites.
Evidence of Reproduction: Observed in flower and fruit on 9 June 1997.
Trends: Population has been known since 1982. Lichvar estimated population at only 254 individuals in 1982, but his survey may have not included all available habitat.

Occurrence # 010
Area: Not reported.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Observed in flower and early fruit by Lichvar on 19 June 1982.
Trends: Not known. Population has not been relocated since 1982.

Occurrence # 012
Area: 5-7 acres.
Number of Plants: 1166 plants counted by Clay Kyte in quarry survey in 2000.
Density: Patchy.
Evidence of Reproduction: Observed in fruit on 15 July 2000 by Kyte and Fertig.
Table 3. Continued

Trends: Population is probably stable and has been revisited frequently since first being documented in 1977.

Occurrence # 013
Area: 80+ acres.
Number of Plants: Population estimated at 4000-5000 plants by W. Fertig in July 1996.
Density: Patchy and clumped.
Evidence of Reproduction: Observed in fruit on 3 July 1996.
Trends: Population has been known since 1982 and is apparently stable.

Occurrence # 015
Area: Not reported.
Number of Plants: Lichvar counted 237 plants in one of two known subpopulations in 1982 (population estimated at 339 plants). Second colony was discovered but not censused by C. Refsdal Delmatier in 1995.
Density: Not reported.
Evidence of Reproduction: Observed in late fruit by Refsdal Delmatier in September 1995.
Trends: Population was first discovered in 1982 and relocated in 1995.

Occurrence # 016
Area: ca 95 acres.
Number of Plants: Population estimated at 200-500 in limited survey by W. Fertig in June 1997. Lichvar observed 856 plants over larger area in 1982 (total population estimated at 3800).
Density: Plants clumped, with individual clumps widely scattered.
Evidence of Reproduction: 25% of population in flower or fruit on 7 June 1997.
Trends: Population is probably stable and has been known since 1982.

Occurrence # 019
Area: Not reported.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Not reported.
Trends: Population has not been relocated since May 1982.

Occurrence # 020
Area: Not reported.
Number of Plants: 1-3 plants observed at each of 4 locations in pipeline survey in two locations by Ron Kass.
Density: Widely scattered.
Evidence of Reproduction: Not reported.
Trends: Not known. Population has not been resurveyed since 1993.

Occurrence # 023
Area: Not reported.
Number of Plants: Not reported.
Density: Not reported.
Evidence of Reproduction: Observed in fruit by C. Refsdal Delmatier on 10 July 1995.
Trends: Not known. Population has only been known since 1995.

Occurrence # 024
Area: 5 acres.
Number of Plants: Population estimated at 200-500. Reported as "locally abundant but patchy" by W. Fertig in July 1996.
Density: Patchy.
Evidence of Reproduction: Observed in fruit on 4 July 1996.
Trends: Not known. Population has only been known since 1996.

Occurrence # 025
Area: 5 acres
Number of Plants: Locally abundant on rim. Population estimated at 200-500 plants by W. Fertig in 1997.
Density: Patchy.

Table 3. Continued

Evidence of Reproduction: Observed in fruit on 1 July 1999 by G. Walford.
Trends: Population has been known since 1997 and was relocated in 1999.

Occurrence # 026
Area: 1 acre.

Number of Plants: Population estimated at 100-200 plants by G. Walford.
Density: Plants widely scattered.
Evidence of Reproduction: Observed in fruit by G. Walford on 30 June 1999.
Trends: Not known. Population has only been known since 1999.

Current Management: Two populations of Tufted twinpod are protected within Fossil Butte National Monument (Fertig 2000; Kyte 2000) and part of one occurrence is within the Kemmerer Cushion Plant No Surface Occupancy Area (USDI Bureau of Land Management 1986). All other known populations are on state or BLM-administered lands managed for multiple use in the Kemmerer, Pinedale, and Rock Springs field offices.

Existing and Potential Threats: Tufted twinpod is potentially threatened by trampling or soil compaction associated with off-highway vehicle recreation. Populations in the Fossil Butte area may be impacted by the development or expansion of limestone or fossil quarries (Kyte 2000). Some populations may occur within active or expanding oil and natural gas fields and could be vulnerable to surface disturbing activities associated with pipeline or well pad construction or mineral exploration. Most populations are located on rim areas with highly erosive soils that can be readily avoided during construction. This species is not directly affected by grazing, but could be secondarily impacted by competition from exotic plants or soil compaction or erosion if livestock are congregated at stock ponds or salt blocks located in occupied habitat (Fertig et al. 1998).

SUMMARY

Tufted twinpod (*Physaria condensata*) is a local endemic restricted to the Overthrust Belt in southern Lincoln, southwestern Sublette, and northern Uinta counties, Wyoming. This species occurs primarily on calcareous sandstone or shaley slopes and ridges of desert mesas in sparsely vegetated cushion plant-bunchgrass communities. *P. condensata* is currently known from 16 extant and one historical occurrences, 4 of which have been discovered in surveys by Rocky Mountain Herbarium or WYNDD staff since 1995. These populations consist of at least 43 discrete subpopulations, each consisting of one to several hundred individuals. The total world population of *P. condensata* is currently estimated at 40,000 to 60,000 individuals. Although trend data are lacking for most populations, this species is thought to be stable at present. Two occurrences are currently protected within Fossil Butte National Monument, although one of these may be impacted by a proposed fossil quarry. One other occurrence is given special management recognition within the BLM Kemmerer Field Office's Kemmerer Cushion Plant No Surface Occupancy Area. Populations on public or state lands may be potentially impacted by soil erosion or compaction associated with off-highway vehicle recreation, grazing, or mineral exploration. Due to its strong association with rim habitats, *P. condensata* can be readily avoided in most management situations.
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Appendix A.
Element Occurrence Records and Location Maps

Note: Blue triangles denote locations of "medium" precision (within 1.5 miles of the inferred location) and blue polygons represent exact locations

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WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 003

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Nugget
Latitude: 414942N
Longitude: 1104749W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T21N R118W S3
Location: Overthrust Belt, Tunp Range, "14 miles west of Kemmerer" [thought to be ca 0.5 miles north of WY Highway 30 on east side of Dempsey Ridge].

Population Data
Last Observed: 1957-07-27
First Observed: 1957-07-27
Data: 1957-07-27: In fruit.

Habitat
Habitat: Shaley hill.
Elevation: 7000 feet
Size: Not reported

Comments: This occurrence has not been relocated according to Lichvar (1982).

Managed Area: BLM Kemmerer Field Office

Specimens: Rollins, R.C. (57254). 1957. US, NY.

Sources:
Lichvar, R.W. 1982. Taxonomy of *Physaria condensata.* Unpublished report prepared for the Wyoming Bureau of Land Management by the Wyoming Natural Heritage Program.

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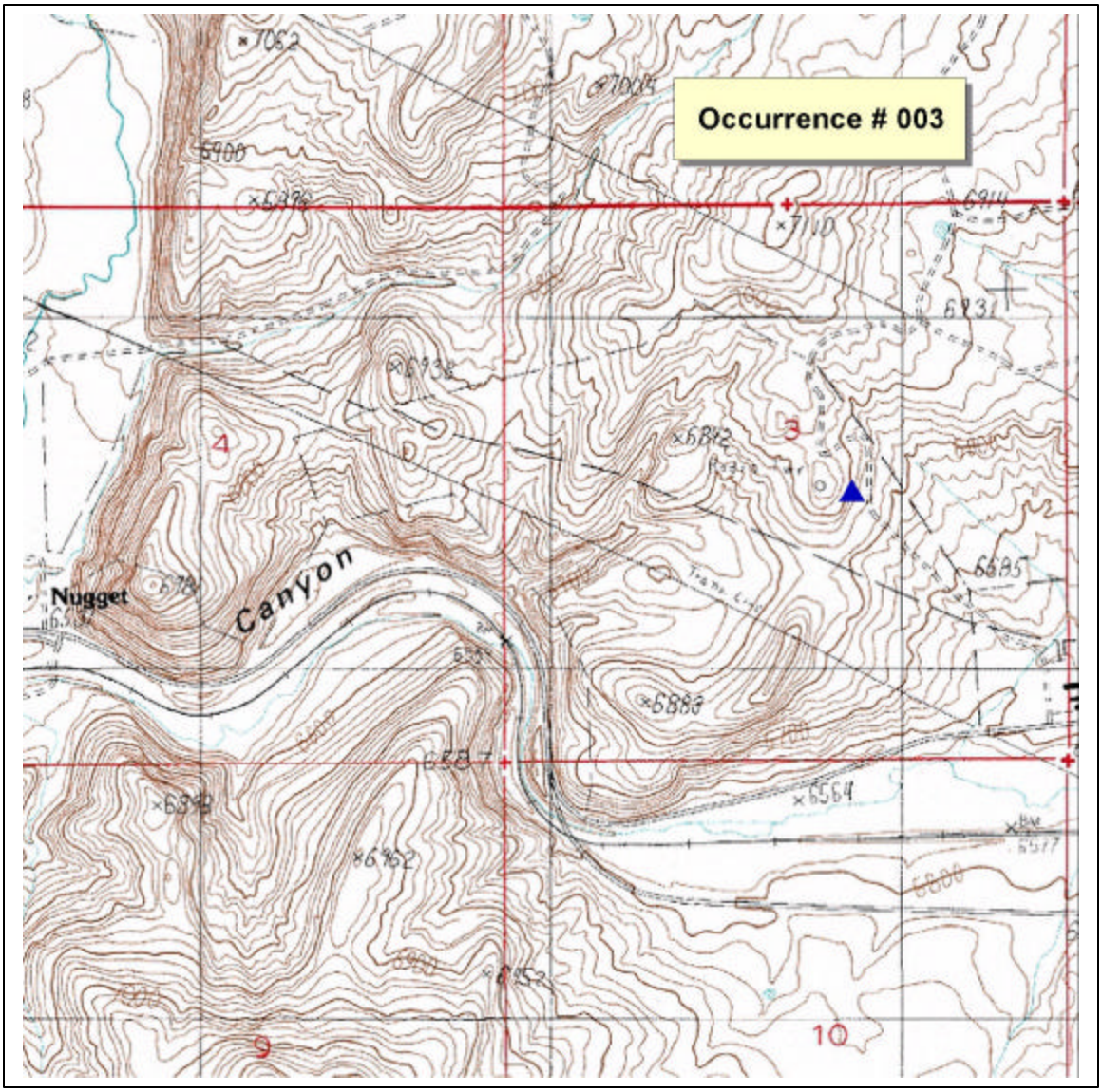
Author: Walter Fertig
Edition Date: 00-06-21


Occurrence # 003
Nugget
Canyon
4
3
9
10

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 004

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Sublette
USGS Quad Name: Sugar Loaf NW
Latitude: 422615N
Longitude: 1095730W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T28N R110W S6
Location: Green River Basin, Reardon Draw, south-southeast of Big Piney.

Population Data
Last Observed: 1983-07-02
First Observed: 1983-07-02
Data: 1983-07-02: In late flower and fruit. Occurs with *Haplopappus, Penstemon*.

Habitat
Habitat: Barren clay-shale slopes.
Elevation: 7200 feet
Size: Not reported

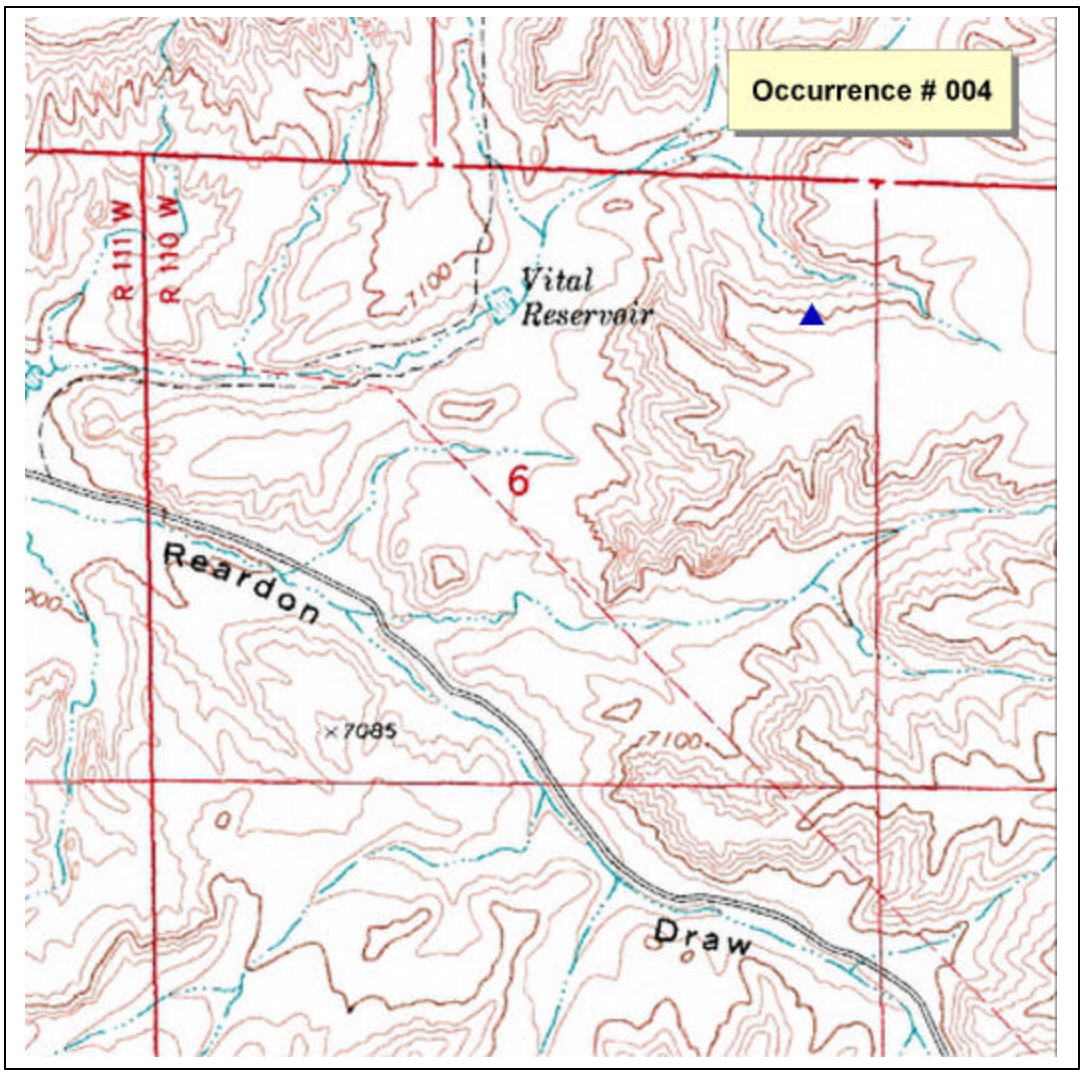
Managed Area: BLM Pinedale Field Office

Specimens: Dorn, R.D. (3839). 1983. RM.

Sources:
Dorn, Robert D. Botanical Consultant, Mountain West Environmental Services, Box 1471, Cheyenne, WY 82003.

Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and their habitats on the Rock Springs District, Bureau of Land Management. Prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database.

Author: Walter Fertig
Edition Date: 96-02-14


Occurrence # 004
R 111 W
R 110 W
7100
Vital
Reservoir
6
Reardon
7085
7100
Draw

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 005

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Uinta
USGS Quad Name: Fort Bridger
Latitude: 411637N
Longitude: 1102853W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T15N R116W S15 S1/2
Location: Overthrust Belt, southern slopes of Bridger Butte, [ca 3.5 miles southwest of Fort Bridger and ca 2.75 miles south of Interstate 80].

Population Data
Last Observed: 1982-06-16
First Observed: 1938-06-24
Data: 1982-06-15/16: Observed in fruit by R. Lichvar. Occurs with *Oxytropis, Penstemon, Stanleya, Phlox, Astragalus, Cryptantha,* and *Atriplex*.

1982-05-29: Observed in late flower and fruit by R. Lichvar. Occurs with *Oxytropis* and *Hymenoxys*. Population in Sec 14: 74 plants counted, 93 estimated. Population in Sec 15: 62 plants counted, 85 estimated.

1981-06-04: Observed in fruit with *Astragalus*.

1980-06-12: Observed in late flower and fruit by R. Lichvar. Funiculi 2, 3, 4; replum obovate. Occurs with *Cryptantha, Oxytropis, Penstemon,* and *Stanleya*.

1946-06-17: Observed in fruit by R. Rollins.

1939-07-20: Observed in late fruit and vegetative condition by R. Rollins and C. Munoz.

1938-06-24: Observed in fruit by R. Rollins.

Habitat
Habitat: Occurs in 2 main habitats: (1) Clay banks with *Artemisia* and exposed south-facing limey knoll. (2) Juniper-sagebrush community.
Elevation: 6500-7300 feet
Size: Not reported.

Comments: This population expressed both the condensed and spreading forms (the latter in more sheltered habitat). Elevation reported as 6800 feet is too low for legal description.

Managed Area: BLM Kemmerer Field Office

Specimens: Rollins, R.C. (2385). 1938. GH, RM Type; (3074). 1946. RM.
Lichvar, R.W. (2863, 2864). 1980; (4314). 1981; (4781, 4783, 5026, 5028, 5031). 1982. RM.
Rollins, R.C. and C. Munoz (2868). 1939. RM.

Sources:
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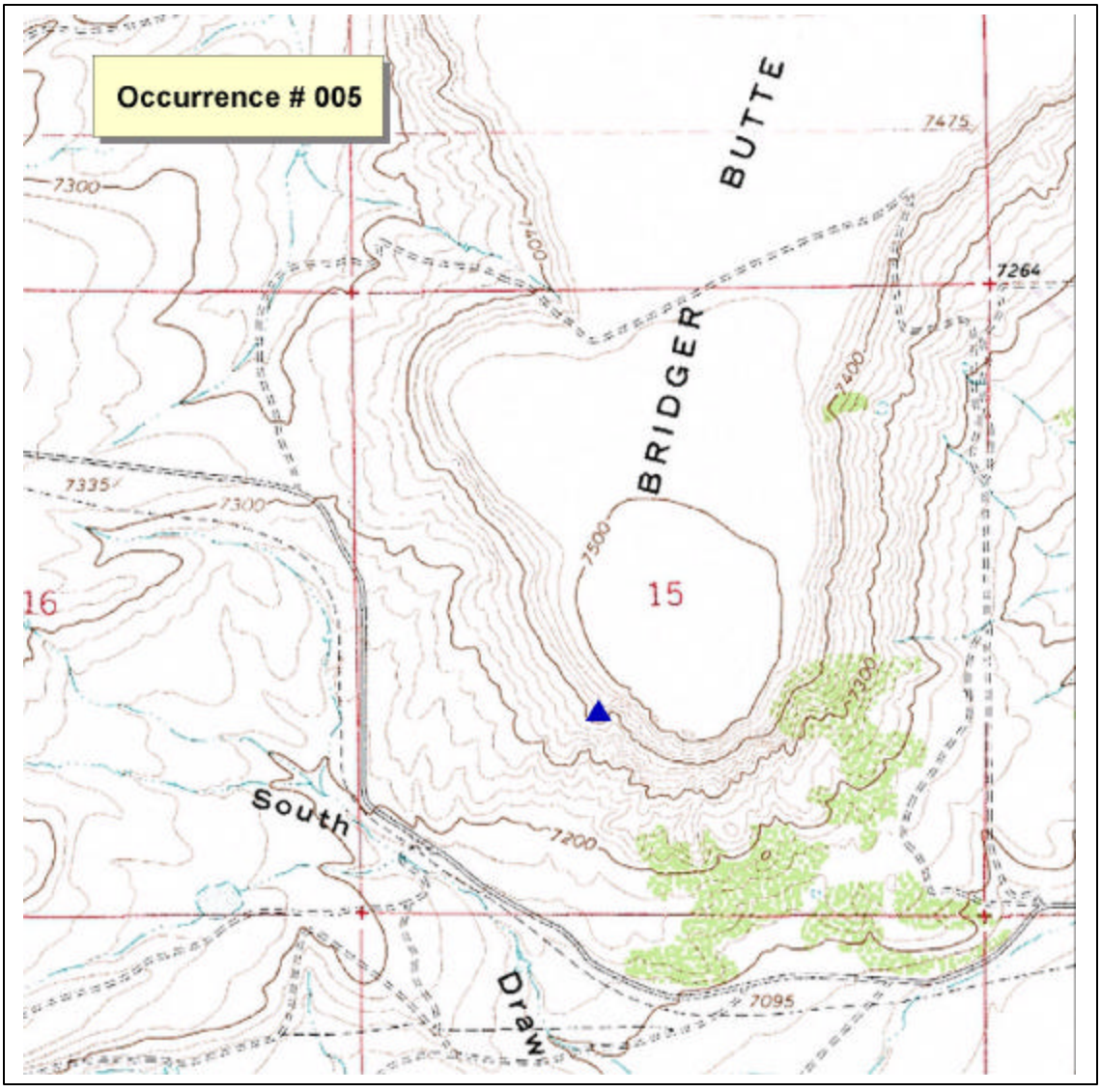
Author: Walter Fertig
Edition Date: 00-06-21



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 007

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Willow Springs
Latitude: 414750N (centrum)
South Latitude: 414617N
North Latitude: 414832N
Longitude: 1102547W (centrum)
East Long: 1102505W
West Long: 1102547W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T21N R115W S12 (SW4), 14 (SE4), 24 (SW4)
Location: Overthrust Belt, along ridge on the east side of Alkali Creek north of US Highway 30 between Kemmerer and Opal. Population extends from just north of highway for ca 2.5 miles.

Population Data
Last Observed: 1982-07-03
First Observed: 1923-06-19
Data: Population consists of 3 subpopulations along a 2.5 mile segment of rim.

1982-07-03: Observed in fruit by R. Dorn. Occurs with *Astragalus jejunus* var. *jejunus* and *Cymopterus*.

1982-05-29/30: Observed in flower and early fruit. 2382 plants counted and 15,880 estimated in population by R. Lichvar. Occurs with *Cymopterus, Senecio, Machaeranthera, Hymenoxys, Astragalus*, and *Phlox*.

1923-06-19: Observed in fruit by E.B. Payson and G.M. Armstrong.

Habitat
Habitat: Calcareous ridges and barren, whitish shale.
Elevation: 6840-7200 feet
Size: ca 5-10 acres.

Managed Area: BLM Kemmerer Field Office

Specimens: Lichvar, R. W. (4784, 4792, 4794, 4795, 4796). 1982. RM.
Dorn, R. (3729). 1982. RM.
Payson, E. B. and G. Armstrong. (3219). 1923. RM.

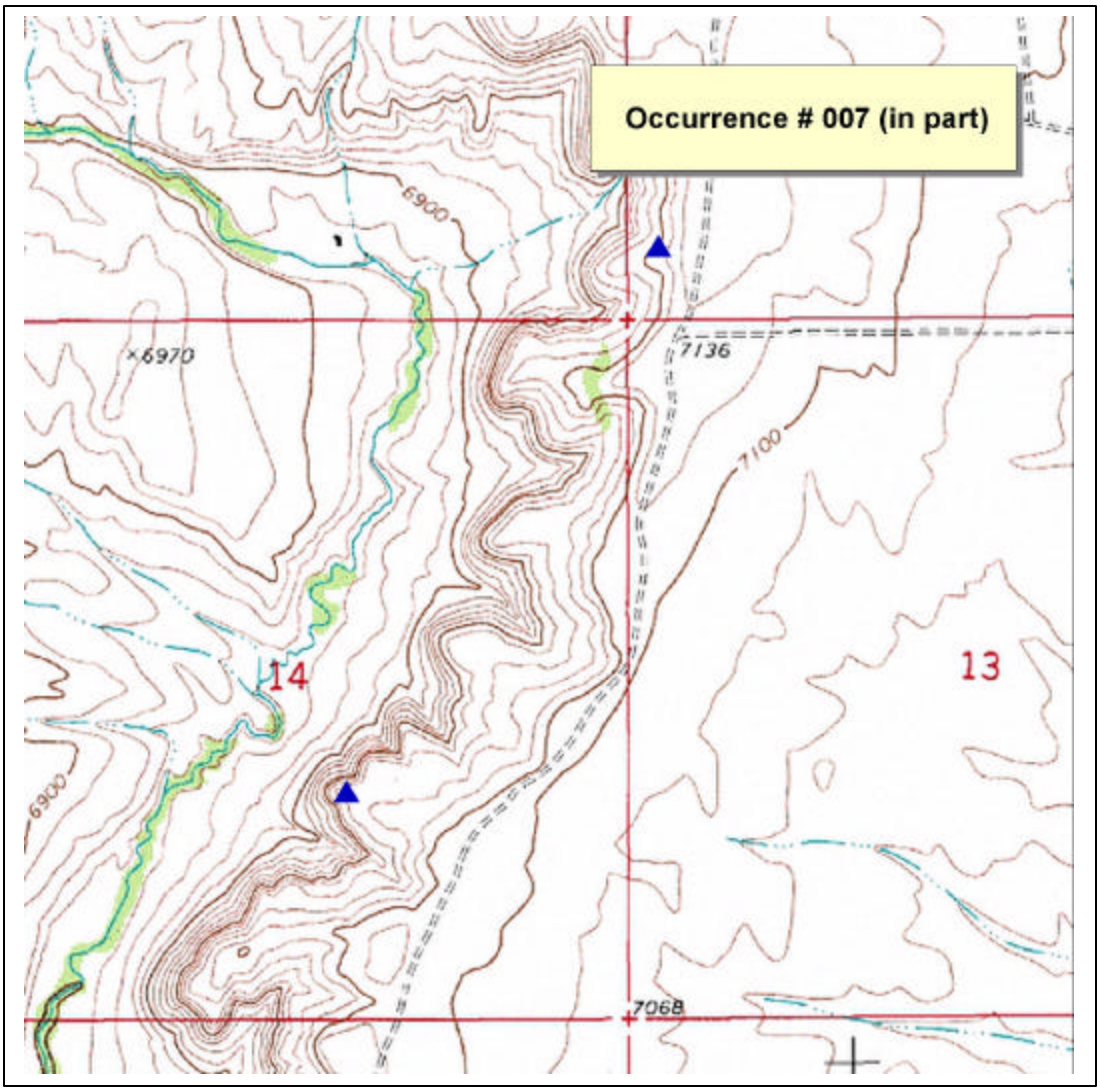
Sources:
Lichvar, R.W. 1982. Taxonomy of *Physaria condensata.* Unpublished report prepared for the Wyoming Bureau of Land Management by the Wyoming Natural Heritage Program.

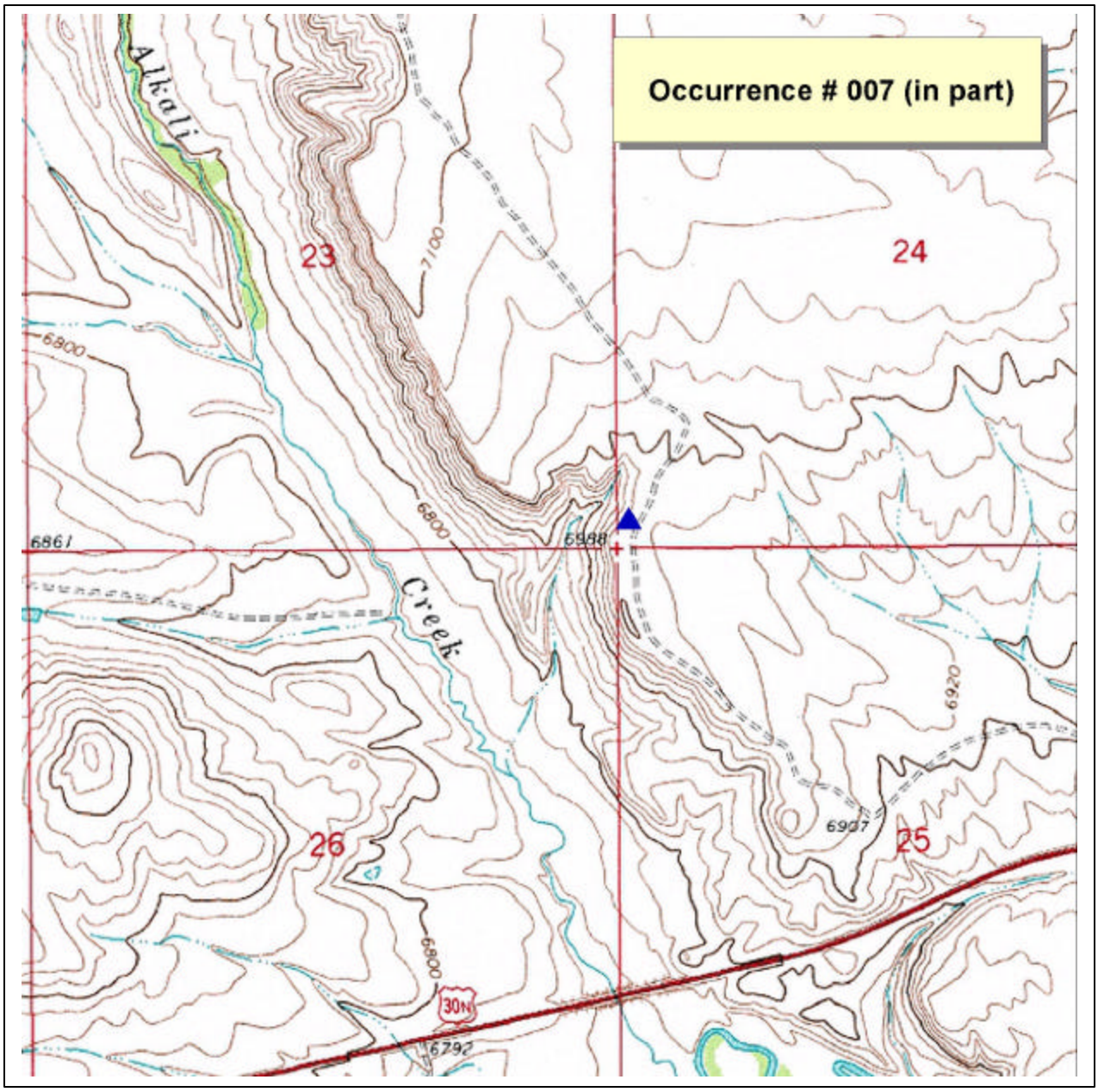
Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and their habitats on the Rock Springs District, Bureau of Land Management. Prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database

Whiskey Basin Consultants. 1982. Threatened and endangered plants inventory for the Bureau of Land Management. Unpublished report prepared by Whiskey Basin Consultants.

Edition Date: 98-05-07

Author: Laura Welp




Occurrence # 007 (in part)
Alkali
Creek
23
24
25
26
7100
6800
6998
6861
6920
6937
6792
30N

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 008

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Sublet
Latitude: 415510N
Longitude: 1103051W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T22N R115W S6 (NW4)
Location: Overthrust Belt, Tunp Range, Oyster Ridge, ca 3 air miles north of Highway 189 and ca 9-10 air miles north of Kemmerer.

Population Data
Last Observed: 1982-05-30
First Observed: 1979-06-24
Data: 1982-05-30: Occurs with *Artemisia* and *Agropyron*.

1979-06-24: Observed in fruit by R.C. Rollins and K.W. Rollins. "Stems prostrate, numerous".

Habitat
Habitat: White packed and baked soil on calcareous ridge in sagebrush hills.
Elevation: 6900 feet
Size: Not reported

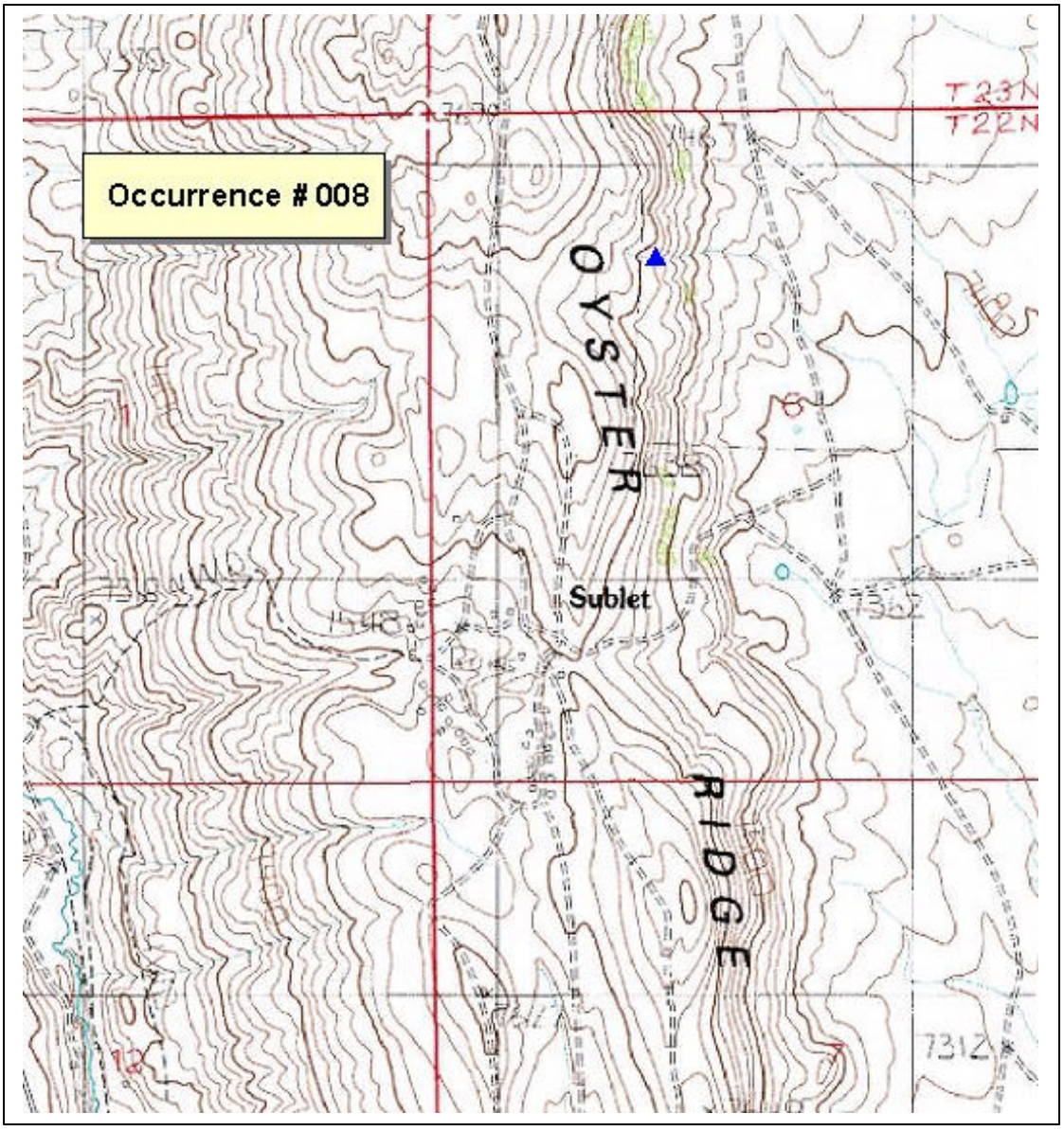
Comments: Rollins collection was estimated at T23 R116 S26 by RM.

Managed Area: BLM Kemmerer Field Office

Specimens: Lichvar, R.W. (4801). 1982. RM.
Rollins, R.C. and Rollins, K.W. (79304). 1979. RM, NY.

Sources:
Lichvar, R.W. 1982. Taxonomy of *Physaria condensata.* Unpublished report prepared for the Wyoming Bureau of Land Management by the Wyoming Natural Heritage Program.

Author: Laura Welp
Edition Date: 98-05-08


Occurrence # 008
T23N
T22N
OYSTER
RIDGE
Sublet

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 009

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Fossil
Latitude: 414957N
South Latitude: 414944N
North Latitude: 415212N
Longitude: 1104405W
East Longitude: 1104333W
West Longitude: 1104535W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T21N R117W S5 (N2 of SW4 of NW4); S6 (N2 of NE4 & NE4 of NW4).
Location: Overthrust Belt, summit ridge along the south arm of Fossil Butte from just west of Point 7350 west-northwest ca 1 mile to the head of the quarry trail draw, ca 0.9-1.2 air miles north of US Highway 30.

Population Data
Last Observed: 1998-07-06
First Observed: 1966-06-23

Data: 1998-07-06: Sec 5 SW4SW4 colony: observed in fruit by Clay Kyte. Plants in fruit. 1997-06-09: 720 plants observed in survey of rim by W. Fertig. Total population estimated at ca 7000 individuals (with much additional habitat along the rim to the west). Plants observed in flower and early fruit, fruits with 3 funiculi per locule. Seedlings also present. Individual plants often extremely small, although older plants may approach *P. dornii* in size. Plants often in clusters of 3-4, but individual clusters may be widely scattered. Densities may be as high as 9 plants per square meter in favorable microsites. Occurs with *Cryptantha caespitosa, Penstemon paysoniorum, Eriogonum brevicaule var. laxifolium, Astragalus jejunus* var. *jejunus, A. kentrophyta, Minuartia nuttallii, Lesquerella alpina, Senecio canus,* and *Linum lewisii.*

1982-05-30: Observed in flower and early fruit by R. Lichvar. 89 plants observed in survey of W2 of Sec 5 by R. Lichvar. Total population estimated at 254 plants. Occurs with *Cymopterus* and *Phlox*.

1966-06-23: Observed in fruit by A.A. Beetle.

Habitat
Habitat: Cushion plant/bunchgrass community with scattered low shrubs (*Atriplex confertifolia* and *Chrysothamnus viscidiflorus*) on fine, tan, whitish, or reddish soils derived from the Angelo Member of the Green River Formation. Soil surface with a thin layer of brownish-tan limestone gravel and lichens. Bare soil cover often 40-50%, rock cover ca 50-75% and vegetative cover often 10-20%.
Elevation: 7300-7600 feet
Size: 10 acres

Comments: In vicinity of EO# 010, 015, 019, and 024.

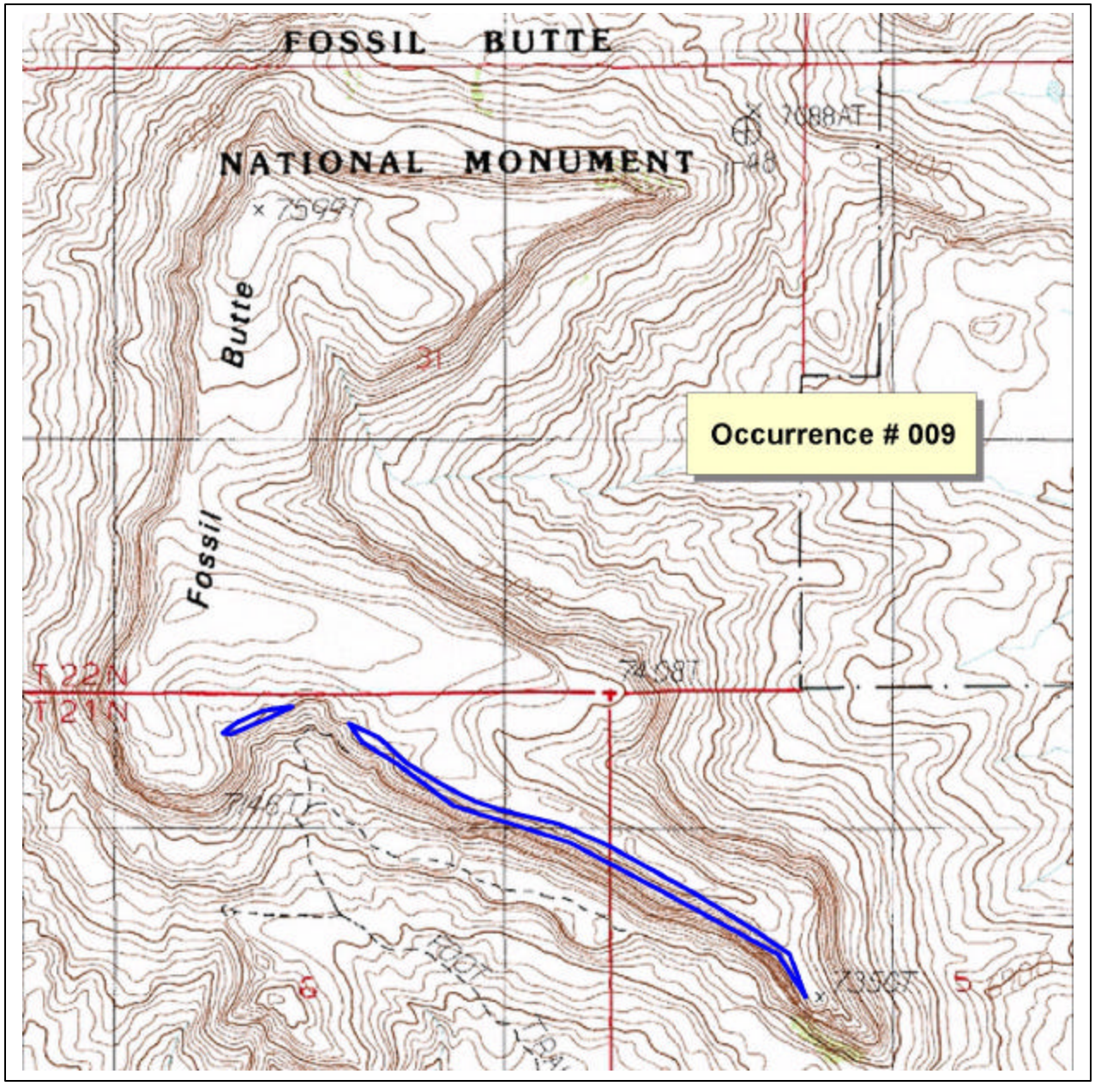
Managed Area: Fossil Butte National Monument
Specimens: Lichvar, R.W. (4802, 5048).

1982. RM.
Kyte, C. (98-29). 1998. FoBu.
Beetle, A.A. (16427). 1966. UW-Range

Sources:
Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and the ir habitats on the Rock Springs District, Bureau of Land Management. Report prepared for the BLM by the Wyoming Natural Diversity Database, Laramie, WY.

Whiskey Basin Consultants. 1982. Threatened and endangered plants inventory for the Bureau of Land Management. Unpublished report prepared by Whiskey Basin Consultants.

Author: Walter Fertig
Edition Date: 01-09-11



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 010

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Fossil
Latitude: 414805N
Longitude: 1104313W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T21N R117W S17 (NE4)
Location: South Tunp Range: ca 1 air mile south of Highway 30 near Clear Creek and northeast end of Fossil Ridge.

Population Data
Last Observed: 1982-06-19
First Observed: 1982-06-19
1982-06-19: Observed in flower and early fruit by R. Lichvar. Occurs with *Cymopterus* and *Erigeron*.

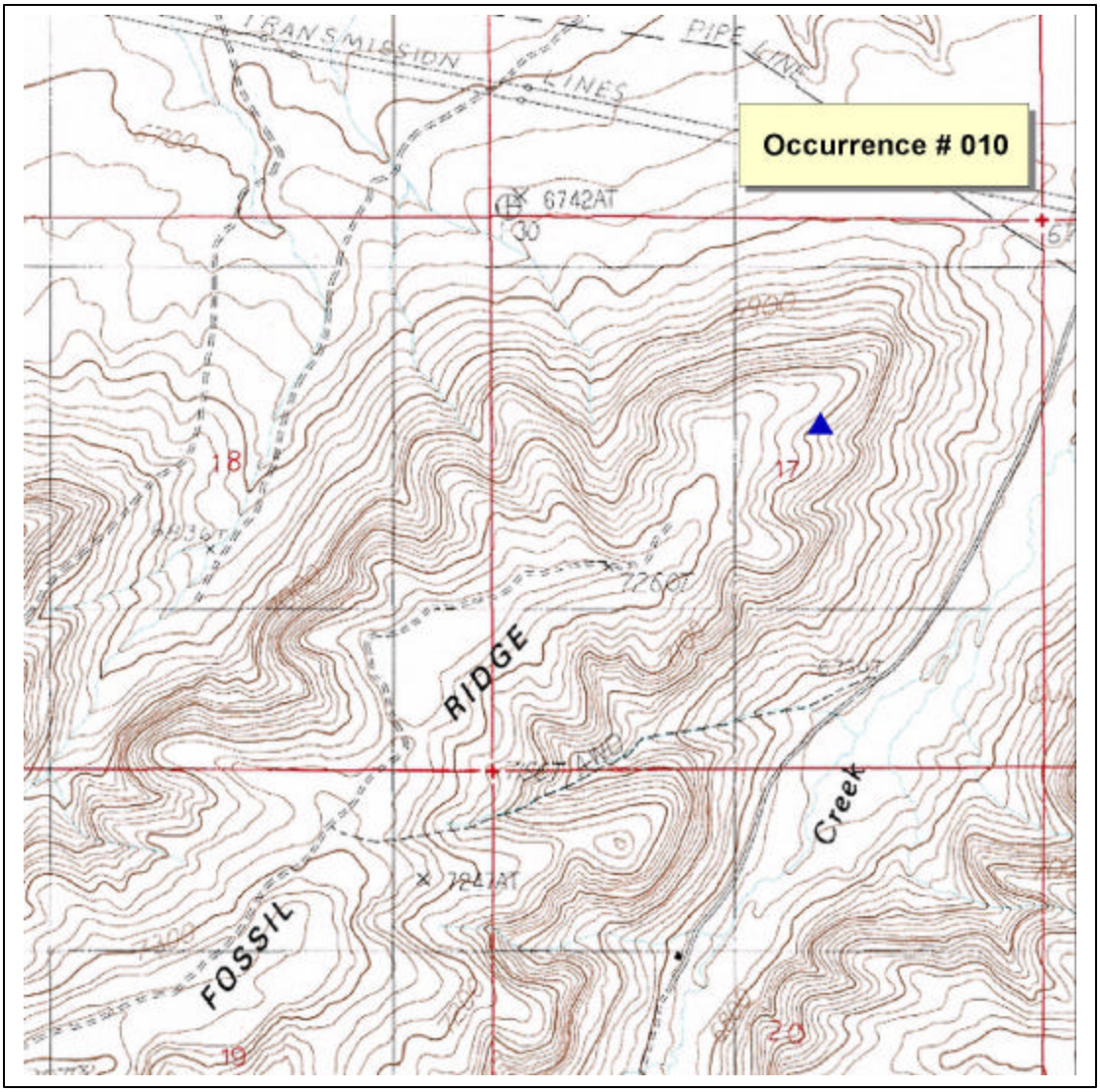
Habitat Calcareous clay.
Elevation: 7200 feet
Size: Not reported

Comments: In vicinity of EO# 009, 015, 019, and 024.

Managed Area: BLM Kemmerer Field Office

Specimens: Lichvar, R.W. (5044). 1982. RM.

Author: Laura Welp
Edition Date: 98-05-07


Occurrence # 010
TRANSMISSION LINES
PIPE LINE
6742AT
30
18
17
RIDGE
Creek
FOSSIL
19
20

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 012

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Nugget
Latitude: 415158N
South Latitude: 415145N
North Latitude: 415229N
Longitude: 1104558W
East Longitude: 1104531W
West Longitude: 1104715W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T22N R118W S23 (S2 of NW4); S24 (SE4of SW4SW4); S25 (NE4NE4 of NW4)
Location: Overthrust Belt, south and west slopes of Cundick Ridge, ca 3.2-3.6 miles north of US Highway 30 and ca 0.75 miles northwest of north end of Fossil Butte.

Population Data
Last Observed: 2000-07-14
First Observed: 1977-06-18
Data:
2000-07-14: Several hundred plants in late fruit or vegetative condition observed at west end and along south rim of Cundick Ridge by W. Fertig and C. Kyte. Plants locally abundant within limited area of suitable habitat. Occurs with *Astragalus jejunus* var. *jejunus, Haplopappus acaulis*, *Elymus spicatus, Linum lewisii*, and occasional *Chrysothamnus*.

2000-summer: south rim and east end of Cundick Ridge censused by Clay Kyte. 1166 flowering, fruiting, and vegetative plants counted in Sec 24-25 colonies (Kyte 2000).

1996-06-06: Sec 24 colony observed in flower by C. Kyte.

1982-06: reported from area by Lichvar (Whiskey Basin Consultants 1982).

1977-06-18: Observed in fruit and vegetative condition by W.J. Litzinger.

Habitat: South and southwest-facing slopes and rim of Green River shale in semi-barren cushion plant/bunchgrass community on poorly developed and wind-blasted soils. Dominant species include *Poa secunda, Oryzopsis hymenoides, Elymus spicatus, Eriogonum brevicaule*, and *Phlox hoodii*.

Elevation: 7600-7800 feet
Size: 5-7 acres

Comments: Formerly included in EO # 009, which is less than 2 miles away but on a separate mesa system isolated by unsuitable habitat.

Managed Area: Fossil Butte National Monument

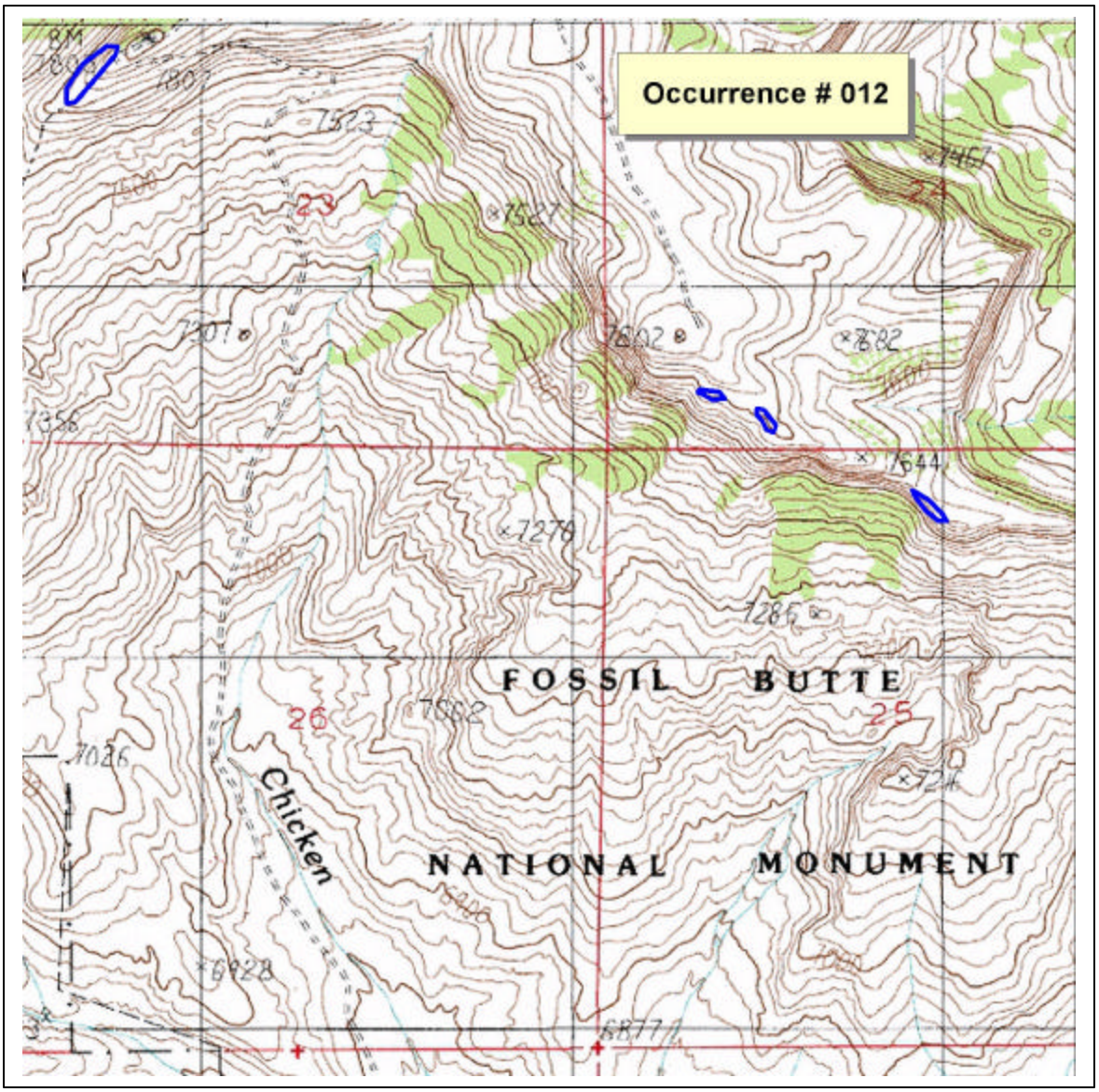
Mgmt Comments: Part of the east end of Cundick Ridge is being studied for a potential fossil quarry. Until 1994, this area was open to motorized vehicles (the access road is now locked and gated).

Specimens: Kyte, C. (96-20). 1996. FoBu. Lichvar, R.W. (5048). 1982. (repository

unknown).
Litzinger, W.J. (1130). 1977. FoBu.

Sources:
Kyte, C.R. 2000. Cundick Ridge Tufted twinpod survey. Report prepared for the US National Park Service and Fossil Butte National Monument.

Author: Walter Fertig
Edition Date: 01-03-30



WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 013

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Fossil and Kemmerer Reservoir
Latitude: 415334N (centrum)
South Latitude: 415053N
North Latitude: 415637N
Longitude: 1104100W (centrum)
East Longitude: 1104015W
West Longitude: 1104300W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T22N R117W S27,35 (NW4); T21N R117W S2 (NW4NW4), 3 (NE4NE4); T22N R117W S10 (SW4 OF NE4, E4 OF SE4, & S4 OF SW4), 15 (NW4 & SE4); T23N R117W S29 (NW4 OF SE4)
Location: Overthrust Belt, Tunp Range, south end of Hams Fork Plateau, three main locations: (1) ca 5 air miles north of US Highway 189/30 [on the rim of the east side of the north Fork Twin Creek and Lake Creek valleys], ca 13 air miles northwest of Kemmerer; (2) ca 1.5 air miles north of US Highway 189/30 west of Kemmerer. Also North Fork of Twin Creek 3 air miles east of Fossil Butte National Monument; (3) on ridge ca 2 air miles east of Fossil Butte, on north side of Union Pacific Railroad, ca 1.5 miles north of U.S. Highway 30, ca 7 air miles west-northwest of Kemmerer.

Population Data
Last Observed: 1996-07-03
First Observed: 1982-06-17
Data:
1996-07-03: Sec 2/3 - observed in fruit and vegetative condition by W. Fertig. Fruit small, with 3-4 funiculi per locule. Population estimated at 4000-5000 plants, widespread and common on slopes and rim of ridge. Occurs with *Eriogonum brevicaule, Senecio canus, Cymopterus terebinthinus, Astragalus jejunus* var. *jejunus, Minuartia nuttallii,* and *Chaenactis douglasii.*

1983-06-18: Observed in flower and fruit by B. Neely and P. Hall.

1982-06-17: Sec 27/35 colony - observed in flower and early fruit by R. Lichvar. Occurs with *Phlox* and *Hymenoxys*. Sec 10/15 colony - occurs with *Cymopterus* and *Phlox*.

Habitat
Habitat: White calcareous shale ridge and steep west-, southwest-, and north-facing slopes with surface layer of fine grey-brown Green River shale and soft, whitish gravel. Soil shallow and undeveloped, possibly with some seleniferous pockets. Two communities: (1) *Artemisia arbuscula* and *Chrysothamnus viscidiflorus* with scattered bunchgrasses and cushion plants; (2) *Amelanchier utahensis* or *Cercocarpus montanus* with bunchgrasses (mostly *Elymus spicatus* and *Oryzopsis hymenoides*). Bare areas dominated by low forbs and cushion plants.
Elevation: 6700-7500 feet
Size: 80+ acres
Comments: EO includes an "M" precision location. Also includes former EO# 14. In

vicinity of EO# 009, 010, 015, 019, and 024.

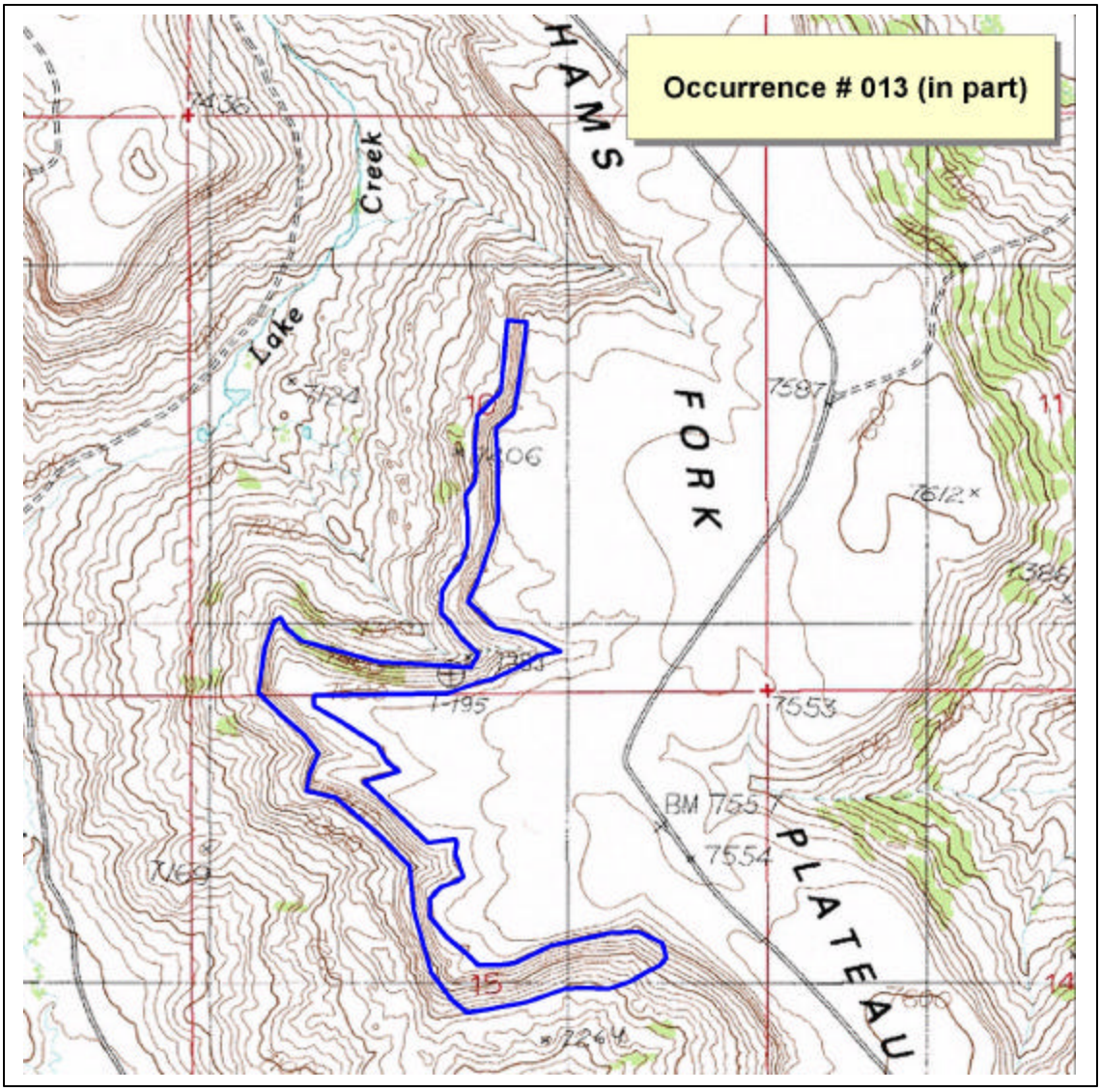
Managed Area: BLM Kemmerer Field Office

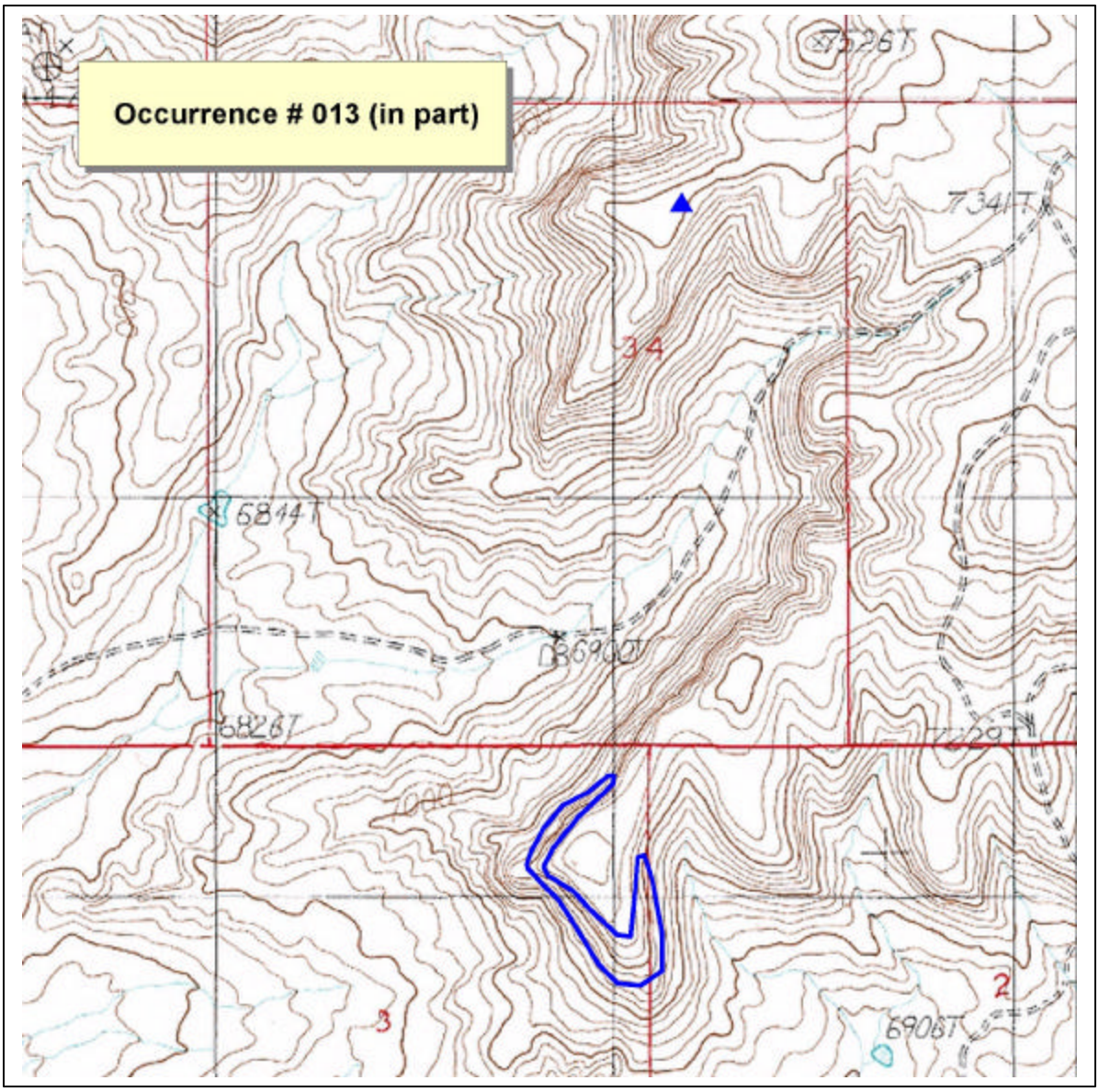
Specimens: Lichvar, R.W. (5040, 5041). 1982. RM.
Neely, E. and P. Hall. (1282). 1983. RM. (annot. by R. Dorn 1986).
Fertig, W. (16739, 16754). 1996. RM.

Sources:
Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and their habitats on the Rock Springs District, Bureau of Land Management. Prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database,

Whiskey Basin Consultants. 1982. Threatened and endangered plants inventory for the Bureau of Land Management. Unpublished report prepared by Whiskey Basin Consultants.

Author: Laura Welp
Edition Date: 98-06-02




Occurrence # 013 (in part)
7526T
7341T
34
6844T
6826T
7129T
6906T
2
3

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 015

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Names: Fossil and Warfield Creek
Latitude: 414725N
Longitude: 1104200W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T21N R117W S21 (N1/2), 22; T20N R118W S1 (SE4)
Location: Overthrust Belt, Tunp Range, ca 1.5 air miles south of US Highway 30 between Clear and Twin Creeks. Also ca 7 air miles west-southwest of Kemmerer [4.6 miles south on County Road 328, then 0.7 mile west on two track].

Population Data
Last Observed: 1995-09-01
First Observed: 1982-06-19
Data: 1995-09-01: Observed in late fruit by C. Refsdal. Occurs with *Artemisia frigida, Stanleya pinnata,* and *Astragalus jejunus*.

1982-06-19: Observed in flower and early fruit by R. Lichvar. Sec 21 population: 237 plants counted, 339 estimated. Occurs with *Eriogonum* and *Cymopterus*. Population includes "the largest specimen of this species ever seen" by Lichvar.

Habitat
Habitat: Calcareous ridges and slopes to 10 degrees on loose whitish clays in semi-barren desert.
Elevation: 6700-7100 feet
Size: Not reported

Comments: In vicinity of EO# 009, 010, 013, 019, and 024.

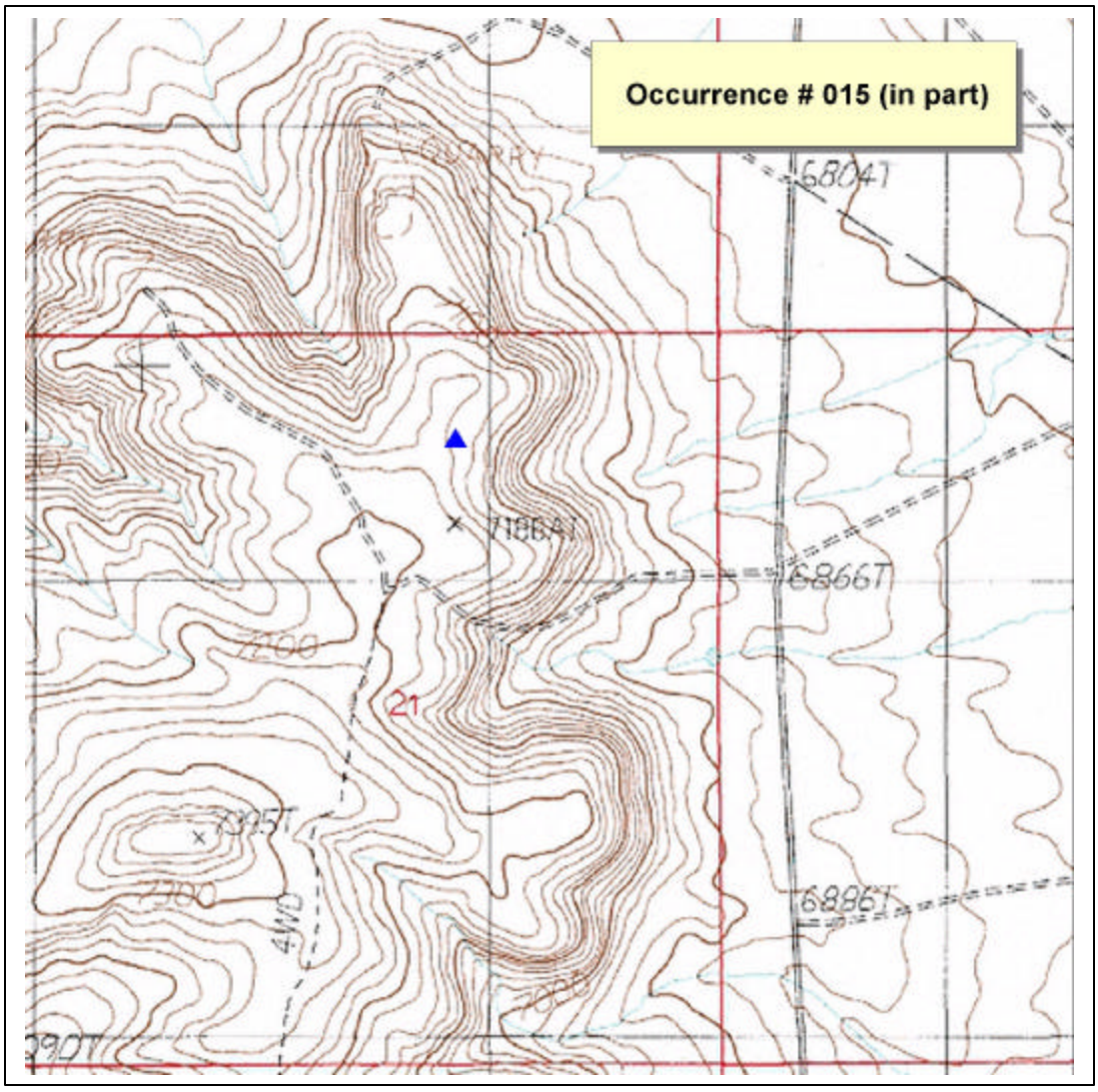
Managed Area: BLM Kemmerer Field Office

Specimens: Lichvar, R.W. (5046) 1982 (RM).
Refsdal, C. (7732). 1995. (RM).

Sources:
Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and their habitats on the Rock Springs District, Bureau of Land Management. Prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, WY.

Whiskey Basin Consultants. 1982. Threatened and endangered plants inventory for the Bureau of Land Management. Unpublished report prepared by Whiskey Basin Consultants.

Author: Walter Fertig
Edition Date: 93-11-22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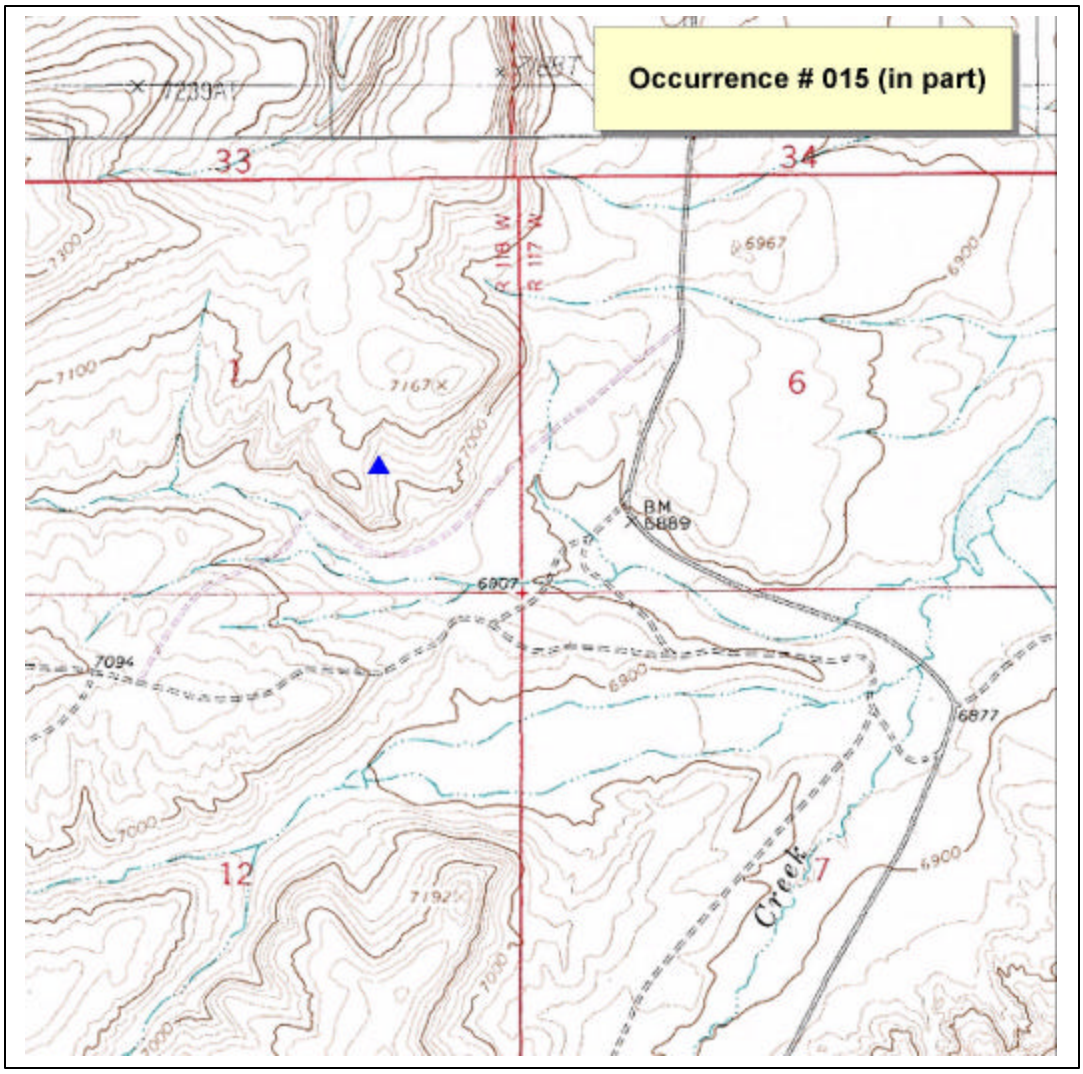
6886T
21


Occurrence # 015 (in part)
33
34
1
6
12
7
7167
6967
6907
6889
BM
7094
6877
7000
6900
Creek

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 016

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Names: Round Mountain and Willow Springs
Latitude: 415325N
Longitude: 1102530W
South Latitude: 415140N
East Longitude: 1102402W
North Latitude: 415528N
West Longitude: 1102638W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T22N R115W S1 (W1/2), 2 (NE4), 12 (SW4 & N2 of NW4), 13 (NW4), 14 (NE4 of W2), 22 (E2), 23 (W2), 26 (NW4); T23N R115W S34 (SW4); T22N R114W S19 (SW4), 20 (SW4), 30 (N2).

Location: Overthrust Belt, Tunp Range, 5 main locations: (1) Just north of Wyoming Highway 189, ca 9 air miles northeast of Kemmerer and ca 1-1.5 miles west of Round Mountain. Also on ridge on south side of South Fork of Slate Creek, ca 0.3 air miles north of US Highway 189 and ca 0.6 miles northwest of Round Mountain; (2) headwaters of Craven Creek, ca 1.25 air miles west of Craven Creek Reservoir; (3) near Middle Fork Slate Creek, ca 2.25 miles northwest of Round Mountain and ca 10 air miles north-northeast of Kemmerer; (4) between South and Middle Forks Slate Creek, ca 2 air miles north of Round Mountain and ca 10 air miles north-northeast of Kemmerer (north of Wyoming Highway 189); (5) on ridge north of Craven Creek, ca 1 mile south of Round Mountain.

Population Data
Last Observed: 1997-06-07
First Observed: 1982-05-30
Data: 1997-06-07: Plants observed mostly in vegetative condition (75%) and in flower and fruit (25%) by W. Fertig. With clumped distribution, but clumps themselves widely spaced. Population estimated at 200-500 plants in area surveyed, with more unsurveyed habitat in vicinity, which may bring the total area population estimate to the low thousands. Plants visited by ants that appear to be consuming fruit wall (possible seed predator?).

1982-05-30/06-15/06-17 survey: Observed in late flower and fruit by R. Lichvar. 856 plants observed, 3800 estimated. Occurs with *Ipomopsis, Agropyron, Phlox muscoides, Artemisia, Eriogonum, Cymopterus*, and *Astragalus*.

Habitat
Habitat: Bowl-like depression and erosional gullies of white, chalky clay with scattered brown or grey sandstone gravel on surface. Barrens at edge of rim overlooking stream and surrounded by *Artemisia tridentata-Purshia* grasslands, vegetative cover ca 15-25 %. Also in erosional gullies, rare to absent on lower slopes of white chalky soils and from draws with dense cover of shrubs or adjacent convex slopes with high vegetative cover. Sandy calcareous and clay ridges and slopes to 10 degrees. Occurs with

Chaenactis douglasii, Eriogonum brevicaule, Haplopappus nuttallii, Cymopterus terebinthinus, and *Linum lewisii.*

Elevation: 6000-7350 feet
Size: ca 95 acres

Comments: Contains former EOs# 006, 011, 017, and 018. In vicinity of EO# 007.

Managed Area: BLM Kemmerer Field Office (Cushion Plant Community No Surface Occupancy Area).

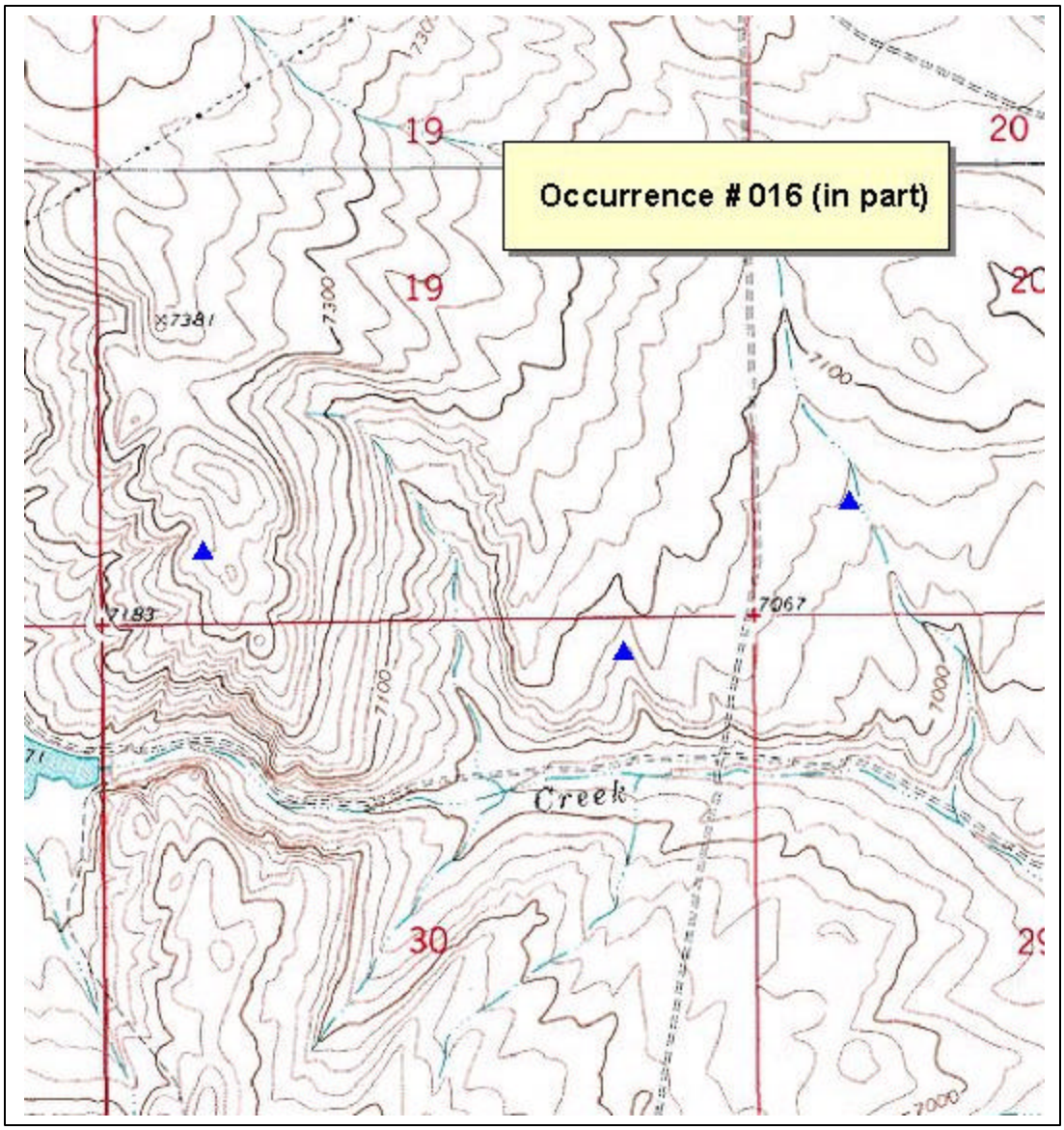
Specimens: Lichvar, R.W. (4785, 4790, 4797, 4800, 4801, 5032, 5034, 5037). 1982. RM; (5036). 1982. NY? (Fide Dorn 11-93. Not in RM).
Fertig, W. (17474). 1997. RM.

Sources:
Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and their habitats on the Rock Springs District, Bureau of Land Management. Prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, WY.

Whiskey Basin Consultants. 1982. Threatened and endangered plants inventory for the Bureau of Land Management. Unpublished report prepared by Whiskey Basin Consultants.

Fertig, W., L. Welp, and S. Markow. 1998. The status of rare plants in southwest Wyoming. Report prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, Wyoming.

Author: Laura Welp
Edition Date: 98-06-02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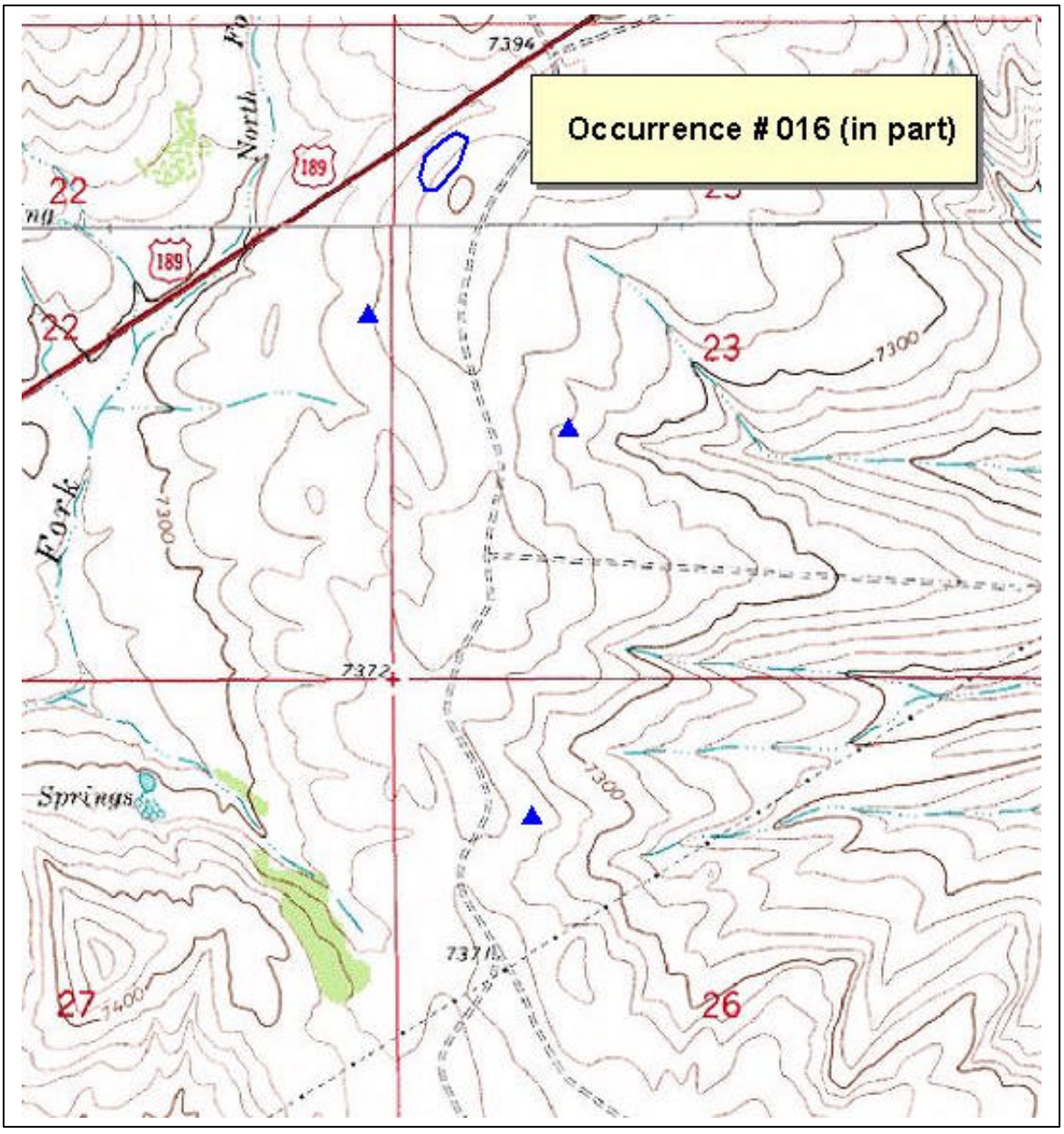
20
19
7381
7300
7100
7183
7067
7100
7000
Creek
30
7000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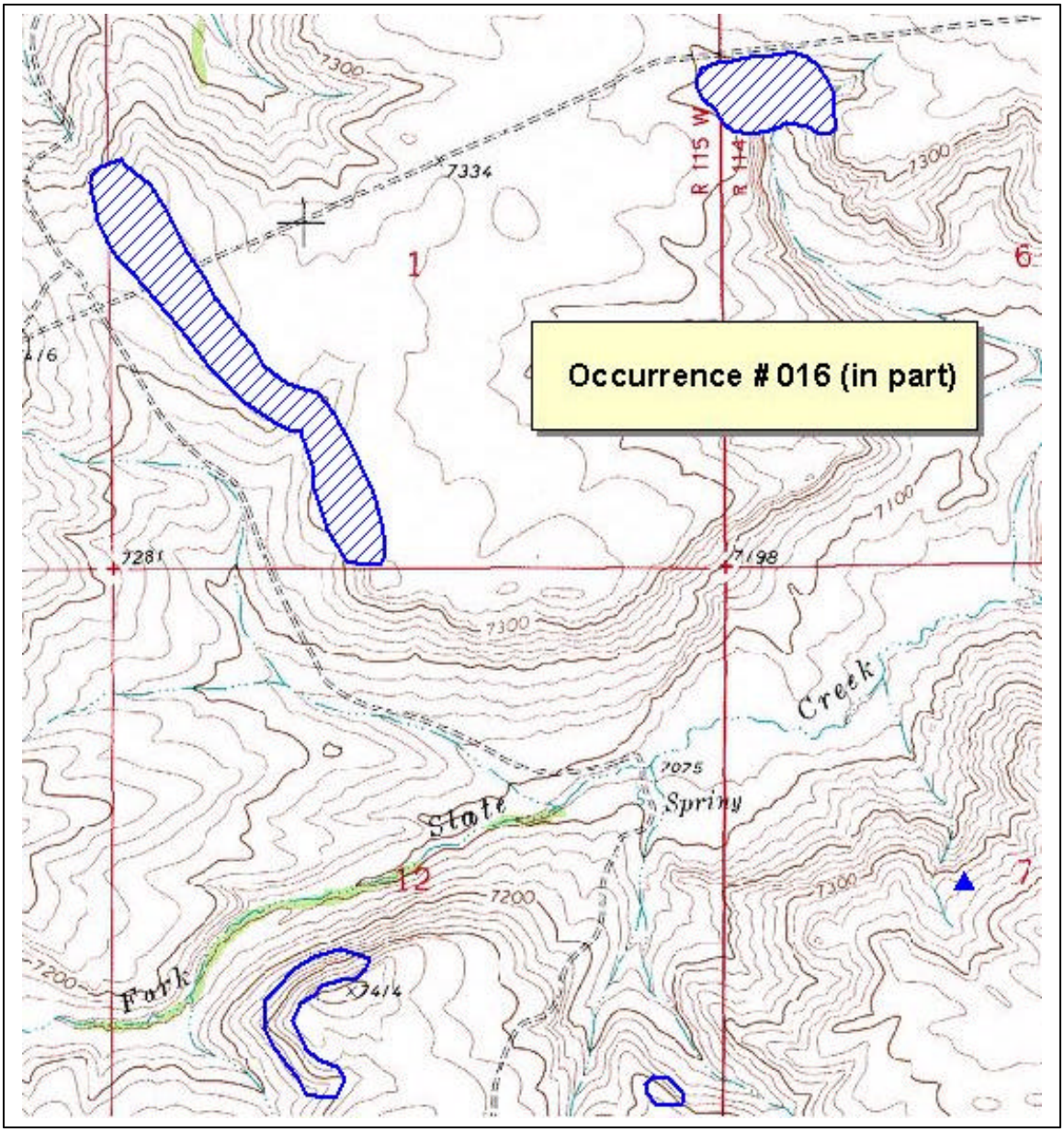
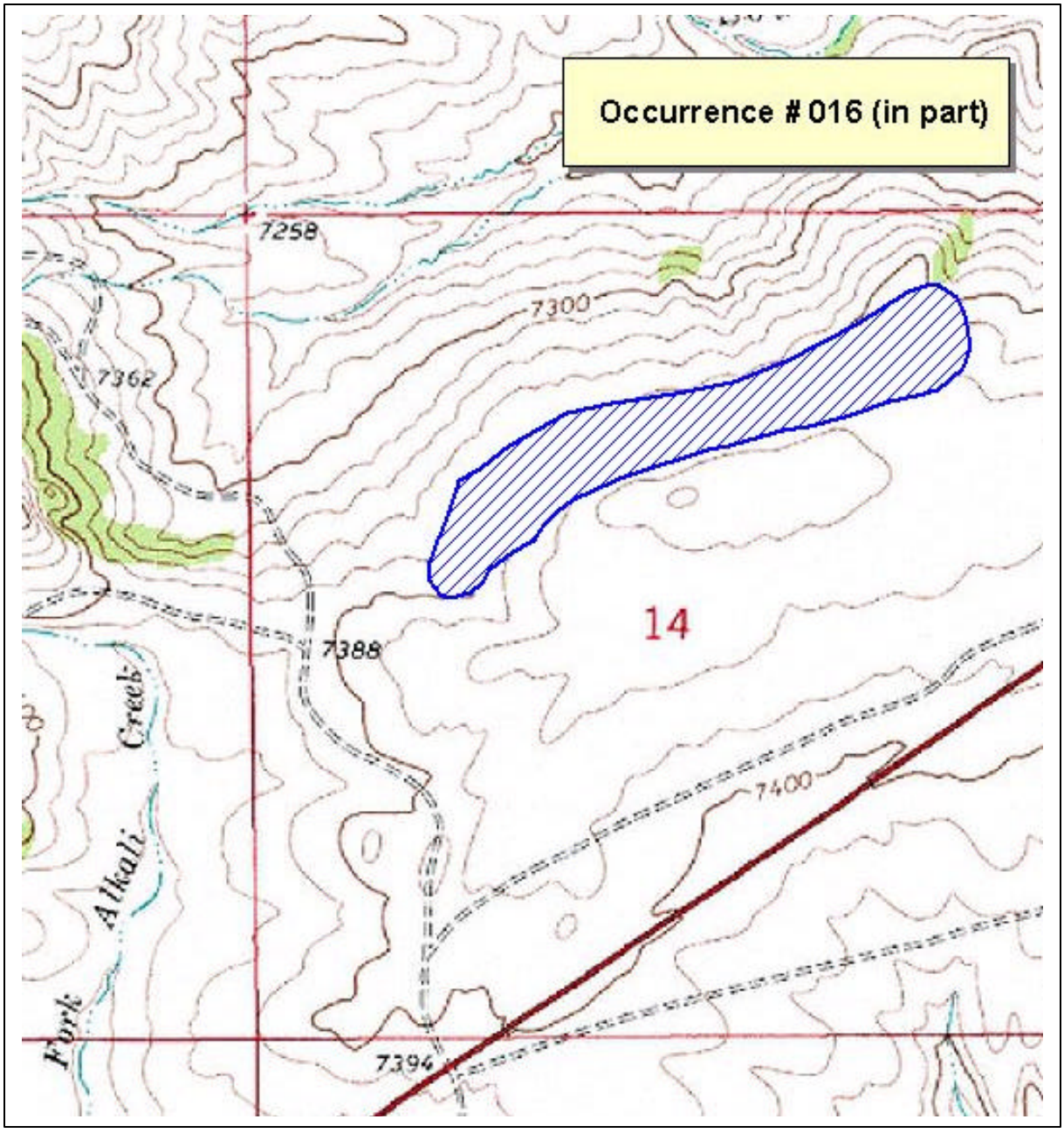
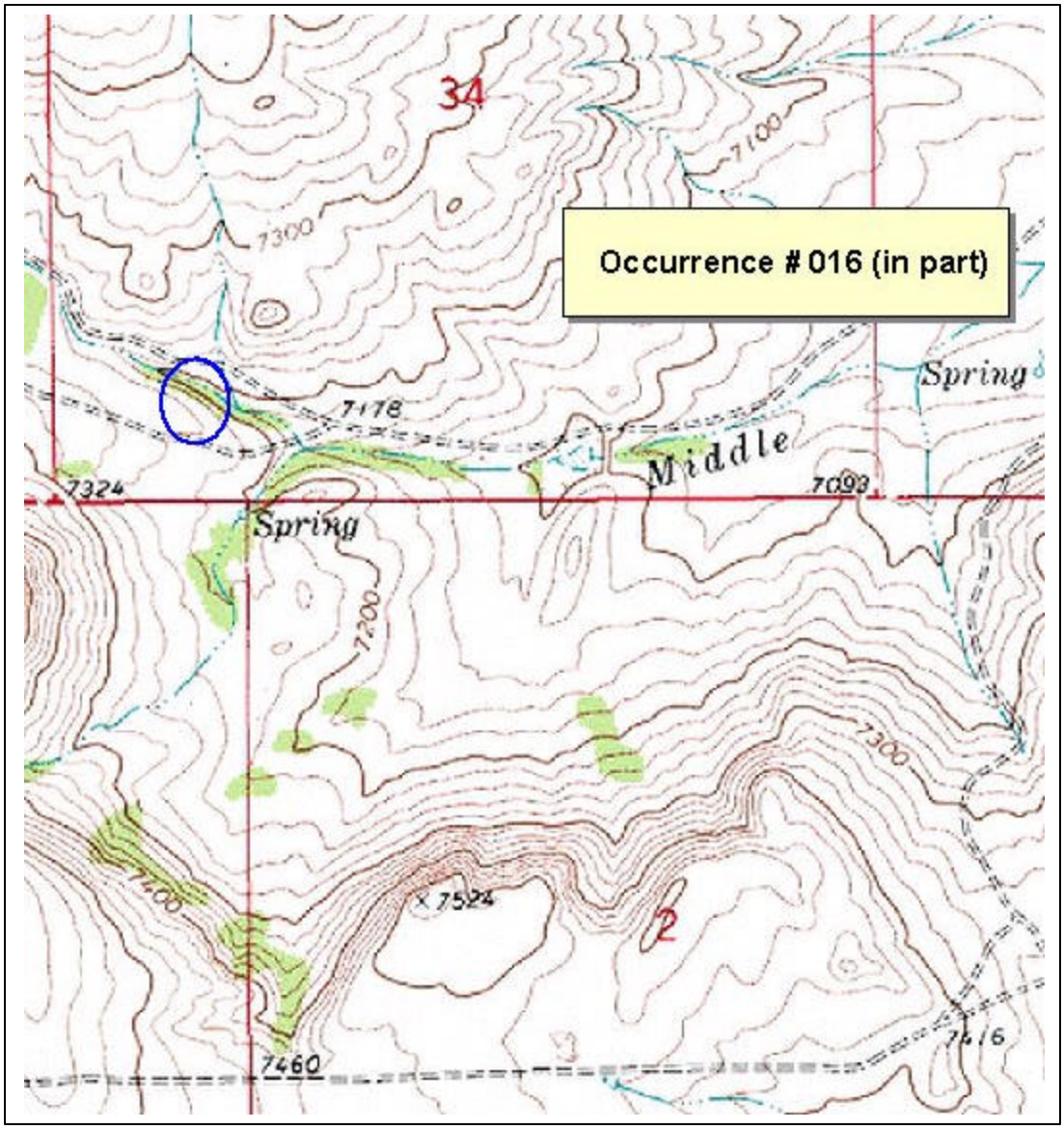
7394
North
189
22
189
22
23
7300
Fork
7300
7372
Springs
7300
7370
27
1400
26


Occurrence # 016 (in part)
7300
7334
R 115 W
R 114 W
1
6
7281
7198
7100
7300
Creek
7075
Spring
State
12
7200
7300
7
7200
Fork
7414


Occurrence # 016 (in part)
7258
7300
7362
14
7388
7400
7394
Alkali Creek
Fork


Occurrence # 016 (in part)
34
7100
7300
7178
Spring
Middle
7324
7093
Spring
7200
7300
7400
7524
2
7460
7416

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 019

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Fossil
Latitude: 414810N
Longitude: 1103850W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T21N R117W S13 NW4
Location: S Tunp Range, ca 1 air mile south of WY Highway 30, ca 5 air miles W of Kemmerer on ridge east of Fossil Ridge.

Population Data
Last Observed: 1982-05
First Observed: 1982-05

Habitat
Habitat: Calcareous ridges and slopes to 10 degrees.
Elevation: 7200 feet
Size: Not estimated.

Comments: Specimen not in RM, possibly in NY. Cited in 1982 Whiskey Basin Consultants report.

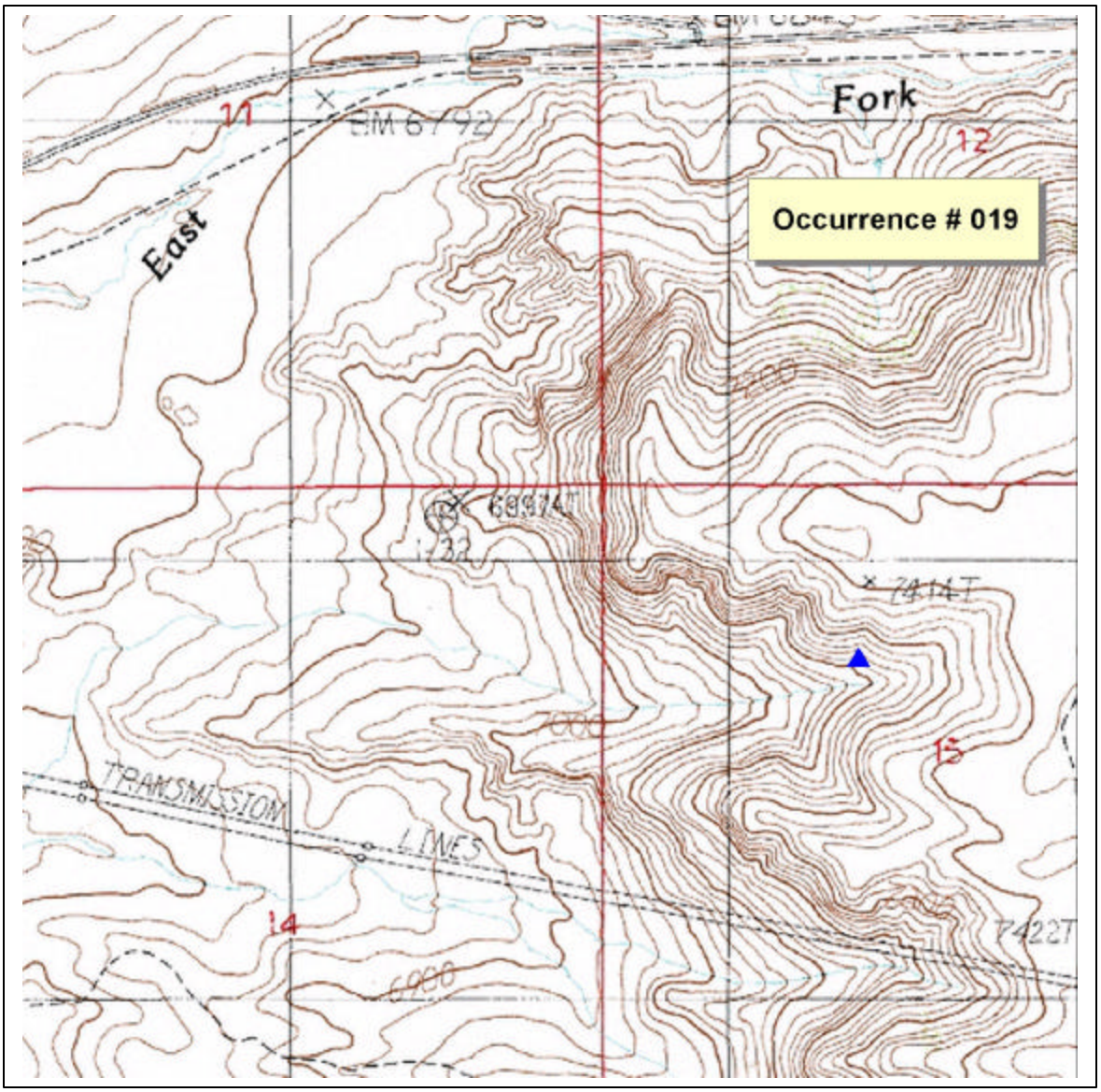
Managed Area: BLM Kemmerer Field Office

Specimens: Lichvar, R.W. (4594). 1982. NY?

Sources:
Marriott, H.J. 1988. Draft habitat management plan for threatened, endangered and sensitive plant species and their habitats on the Rock Springs District, Bureau of Land Management. Prepared for the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, WY.

Whiskey Basin Consultants. 1982. Threatened and endangered plants inventory for the Bureau of Land Management. Unpublished report prepared by Whiskey Basin Consultants.

Author: Walter Fertig
Edition Date: 93-11-22


Occurrence # 019
Fork
East
11
12
14
15
TRANSMISSION
LINES
EIM 6792
7422T

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 020

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Sublette; Lincoln
USGS Quad Names: Anderson Canyon, La Barge, La Barge SE, and Names Hill
Latitude: 421522N
South Lat: 421345N
North Lat: 421730N
Longitude: 1100924W
East Long: 1100502W
West Long: 1100924W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T27N R112W S24 (NW4 of NE4); S33 (SW4 of SE4); T27N R111W S30 (SE4 of NW4); T26N R112W S14 (SE4 of SW4); S15 (SW4 of NE4).
Location: Green River Basin, three main locations: (1) On north and south rims of Bird Canyon, ca 4.5 air miles northeast of La Barge; (2) on rim ca 0.5-1.5 air miles north of Steed Canyon, Little Colorado Desert, ca 3-4 air miles southeast of La Barge; (3) on rim ca 1.5 air miles northeast of La Barge.

Last Observed: 1993-07-05
First Observed: 1993-06-11
Data: 1993-06-11,15-17: Widely scattered but moderately abundant. Occurs with *Artemisia, Stipa, Poa secunda, Oryzopsis hymenoides*, and *Elymus*.

1993-07-4/5: Sec 14 - 2 plants found; Sec 15 - 1 plant found. Plants scattered on ridgetops with *Artemisia, Chrysothamnus, Stipa, Astragalus, Eriogonum brevicaule, Arenaria hookeri*, and *Elymus*.

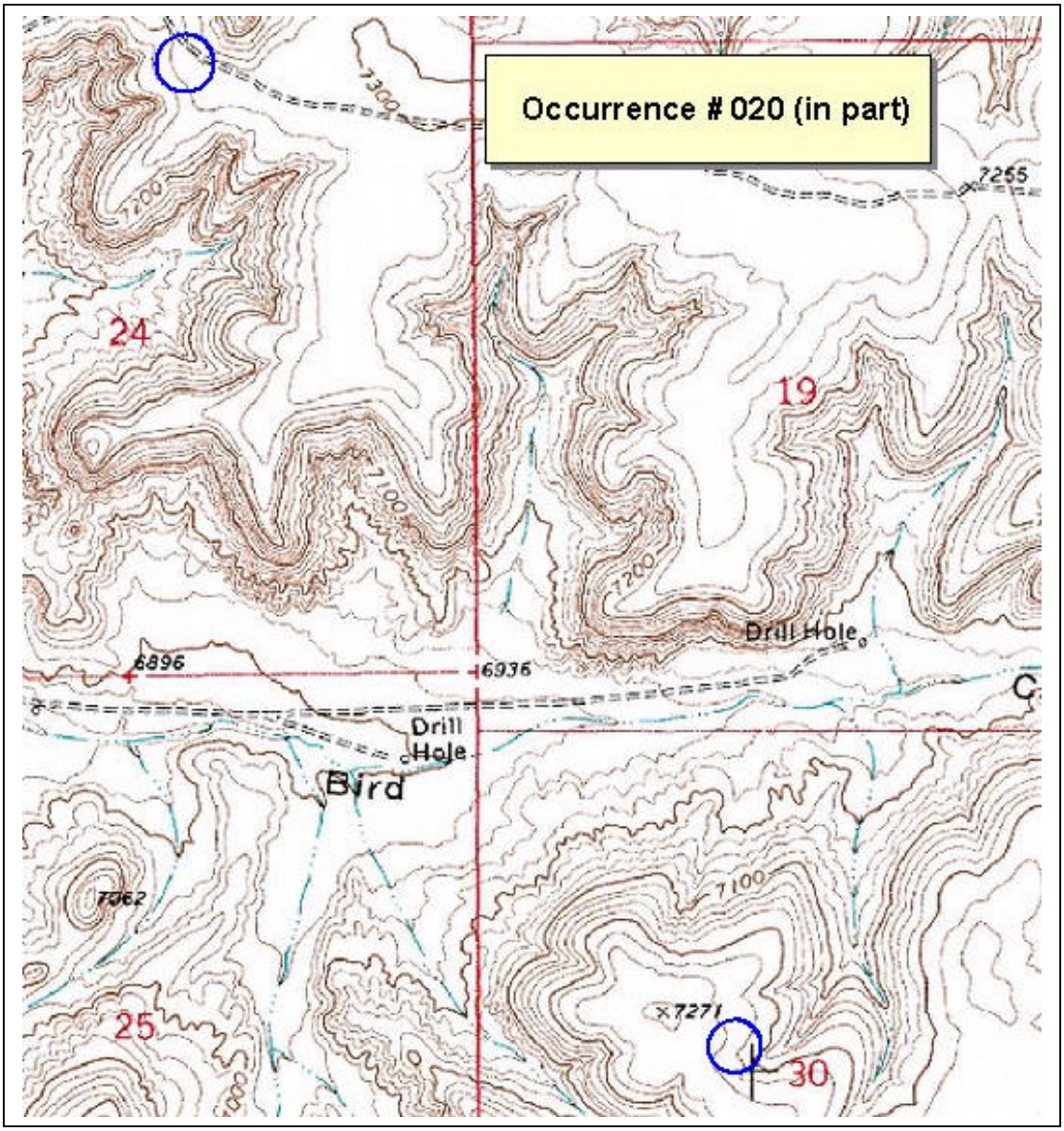
Habitat
Habitat: In sagebrush steppe on steep, white shale and sandstone derived from Eocene Green River and Wasatch formations. Along roadside and on barren slopes.
Elevation: 6800-7250 feet
Size: Not estimated

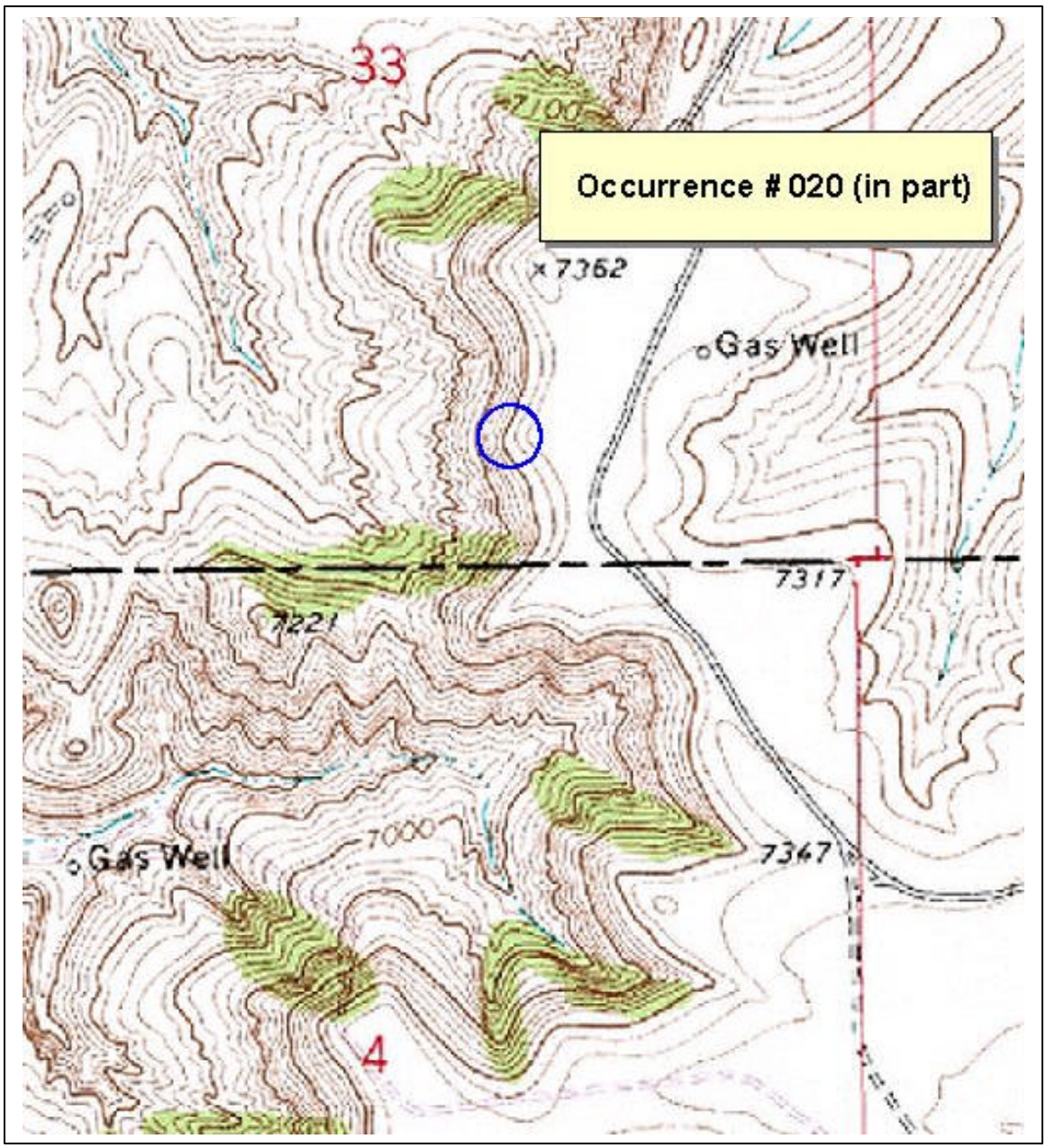
Comments: Occurrence needs positive identification. No voucher specimens were collected. EO based on information in Ron Kass's report (with typing errors that placed Sec 24/30 colony in the wrong township).

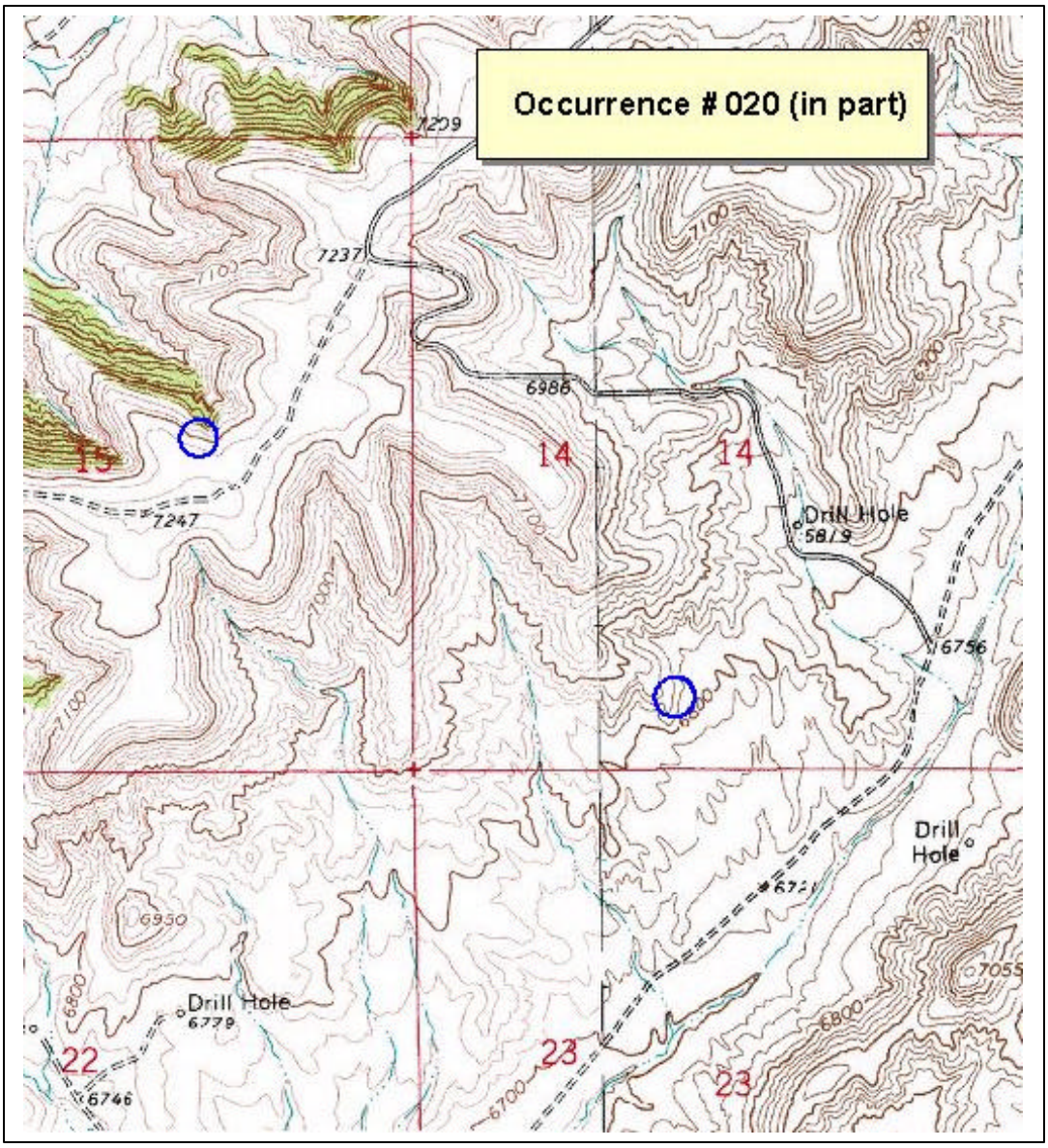
Managed Area: BLM Rock Springs Field Office

Sources:
Kass, Ronald J. 1993. Sensitive plant survey report on Basin Operating Company: Bird Canyon Project. Prepared for PIC Technologies, Inc.

Author: Laura Welp
Edition Date: 98-06-02


Occurrence # 020 (in part)
7300
7265
7200
24
19
7100
7200
Drill Hole
6896
6936
Drill
Hole
Bird
7062
7100
25
x7271
30


33
7100
Occurrence # 020 (in part)
×7362
Gas Well
7317
7221
Gas Well
7000
7347
4


Occurrence # 020 (in part)
7237
6986
7247
15
14
14
Drill Hole
5819
6756
Drill Hole
6950
Drill Hole
6779
22
6746
23
23
7055
6800
6700

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 023

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Nugget
Latitude: 414629N
Longitude: 1105030W
Map Accuracy: Medium; location is within an approximately 1.5 mi radius from point on USGS topo map.
Town/Range/Section: T21N R118W S29 (N2)
Location: Overthrust Belt, ca 16 air miles west of Kemmerer [ca 3.5 air miles south of Nugget Canyon].

Population Data
Last Observed: 1995-07-10
First Observed: 1995-07-10
Data: 1995-07-10: Observed in fruit by C. Refsdal.

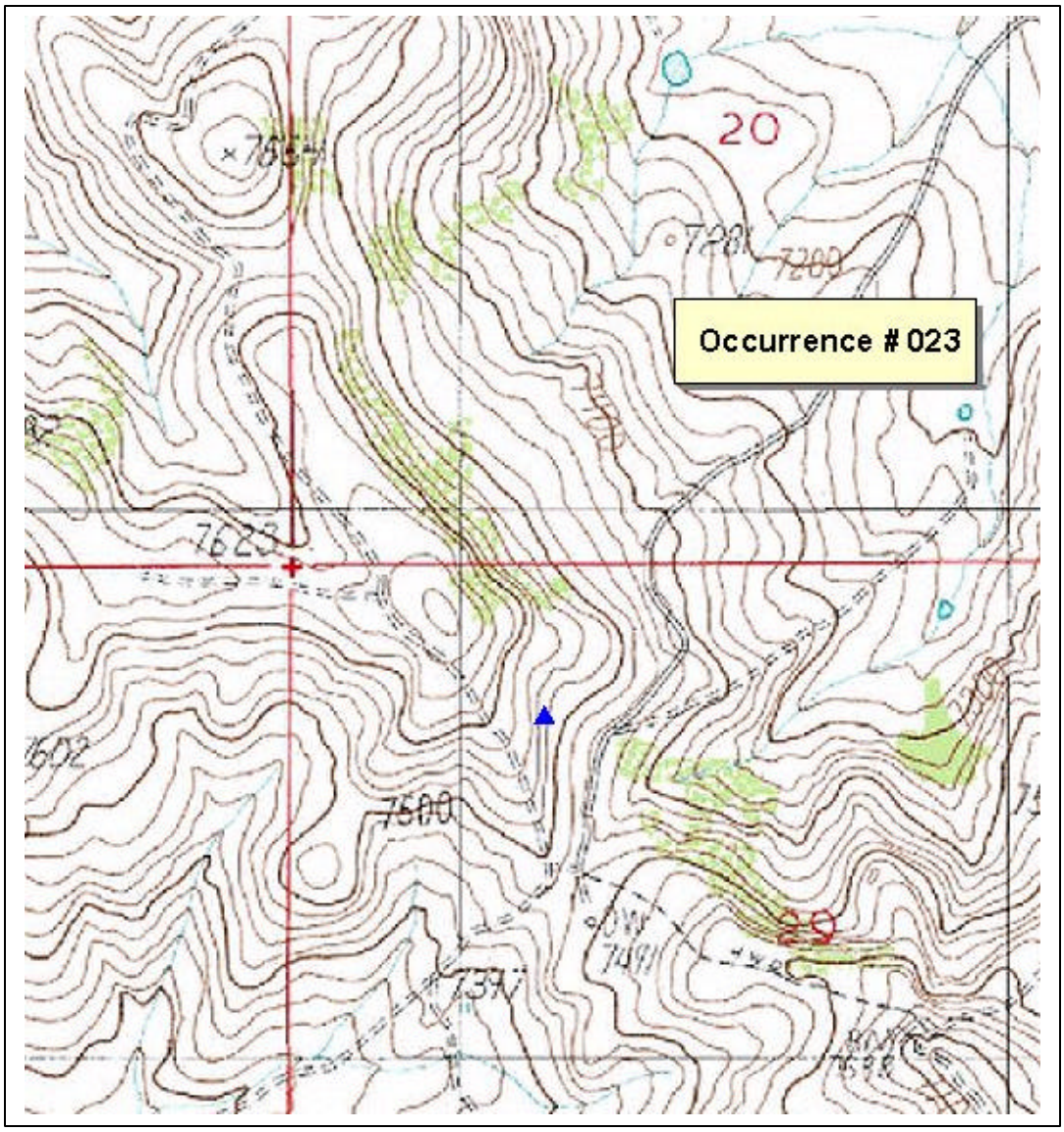
Habitat
Habitat: Cushion plant community on sparsely vegetated limestone slope.
Elevation: 7400-7760 feet
Size: Not recorded

Managed Area: BLM Kemmerer Field Office

Specimens: Refsdal, C. (5201). 1995. RM.

Sources:
Refsdal, C.H. 1996. A general floristic inventory of southwest Wyoming and adjacent northeast Utah, 1994-1995. Unpublished report prepared for the Bureau of Land Management Wyoming State Office, Bureau of Land Management Vernal Supervisor's Office, US Fish and Wildlife Service, and US Forest Service Region 4 by the University of Wyoming, Rocky Mountain Herbarium, Laramie, WY.

Author: Laura Welp
Edition Date: 98-05-08


Occurrence # 023
20
7623
7500
7602
20

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 024

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Windy Point
Latitude: 414055N
South Latitude: 414052N
North Latitude: 414057N
Longitude: 1105435W
East Longitude: 1105429W
West Longitude: 1105441W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T20N R119W S30 (S2 OF SE4)
Location: Overthrust Belt, southwest end of Bear River Divide. East-west running ridge on northeast side of Bridger Basin, ca 2 air miles northeast of Bridger Hill and ca 10 air miles south of Orr.

Last Observed: 1996-07-04
First Observed: 1996-07-04
1996-07-04: Fruit small, 4-6 funiculi per ovule; stalks short, prostrate. Reported as "locally abundant but patchy" by W. Fertig. Occurs with *Artemisia frigida, Krascheninnikovia lanata, Eriogonum brevicaule, Ipomopsis spicata, Haplopappus nuttallii,* and *Astragalus spatulatus.*

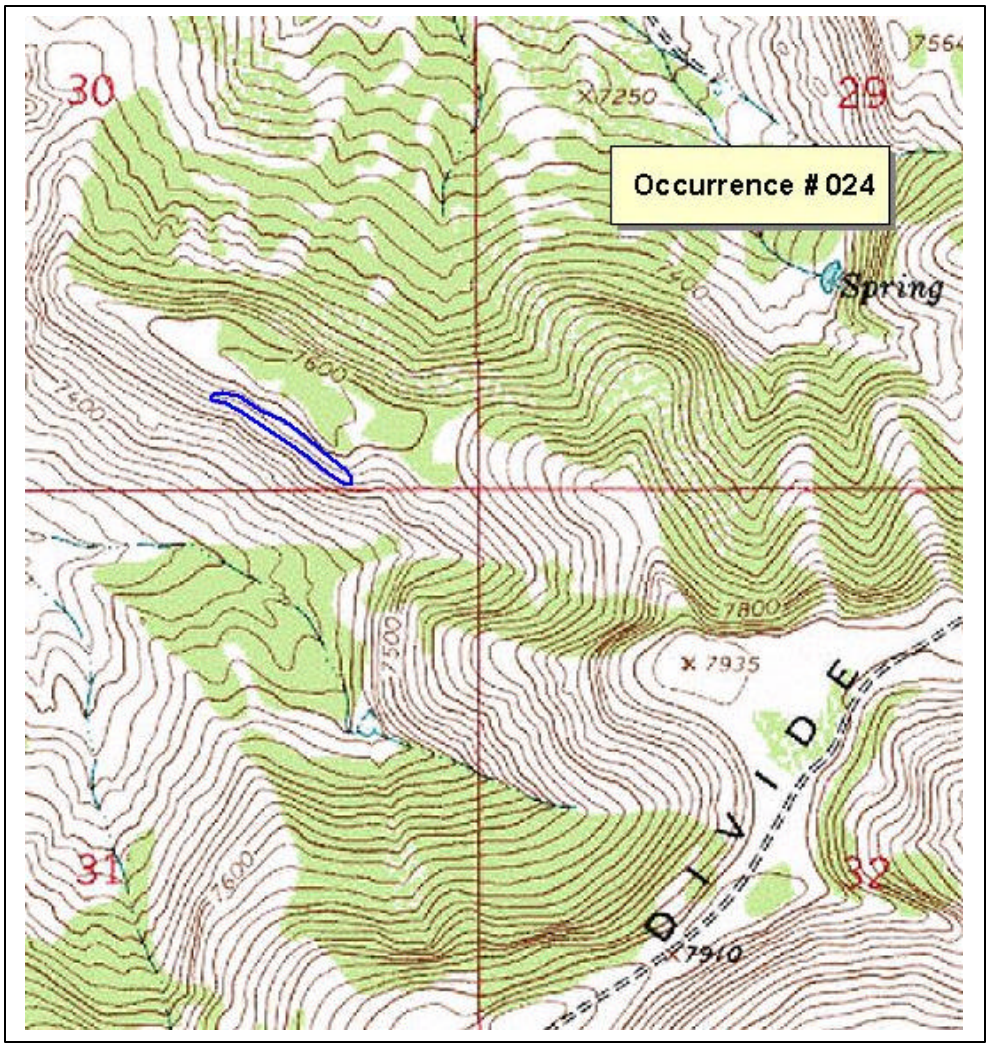
Habitat: Southwest-facing slopes and rim of white chalky sandstone ridge with surface layer of irregular sandstone chips and flakes. Soil may be somewhat seleniferous, based on presence of *Stanleya pinnata.* Low forb and cushion plant community with vegetative cover of ca 30-40%. Slopes have patchy vegetation of alternating bands of cushion plant community interspersed with sagebrush-shadscale grassland.
Elevation: 7500 feet
Size: 5 acres

Comments: In vicinity of EO# 023.

Managed Area: BLM Kemmerer Field Office

Specimens: Fertig, W. (16765). 1996. RM.

Author: Laura Welp
Edition Date: 98-06-02


30
29
31
32
X7250
Occurrence # 024
Spring
7600
7600
7500
7800
X 7935
DIVIDE
X7910

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 025

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Lincoln
USGS Quad Name: Fossil
Latitude: 414914N
Longitude: 1103815W
South Latitude: 414910N
East Longitude: 1103803W
North Latitude: 414916N
West Longitude: 1103836W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T21N R116W S7 (N2 OF NW4NW4); T21N R117W S12 (N2 OF NE4).
Location: Overthrust Belt, butte on east side of Hay Hollow and on north side of Union Pacific Railroad and U.S. Highway 30, ca 4.5 miles east of Fossil Butte and ca 5 air miles northwest of Kemmerer.

Population Data
Last Observed: 1999-07-01
First Observed: 1997-06-07

1999-07-01: Observed in fruit by Jill Walford with *Lesquerella prostrata.*

1997-06-07: Observed in flower and fruit by W. Fertig. Population locally abundant along rim. Occurs with *Cymopterus terebinthinus, Eriogonum brevicaule, Senecio canus, Penstemon procerus, Poa secunda, Caulanthus*, and *Oenothera cespitosa*.

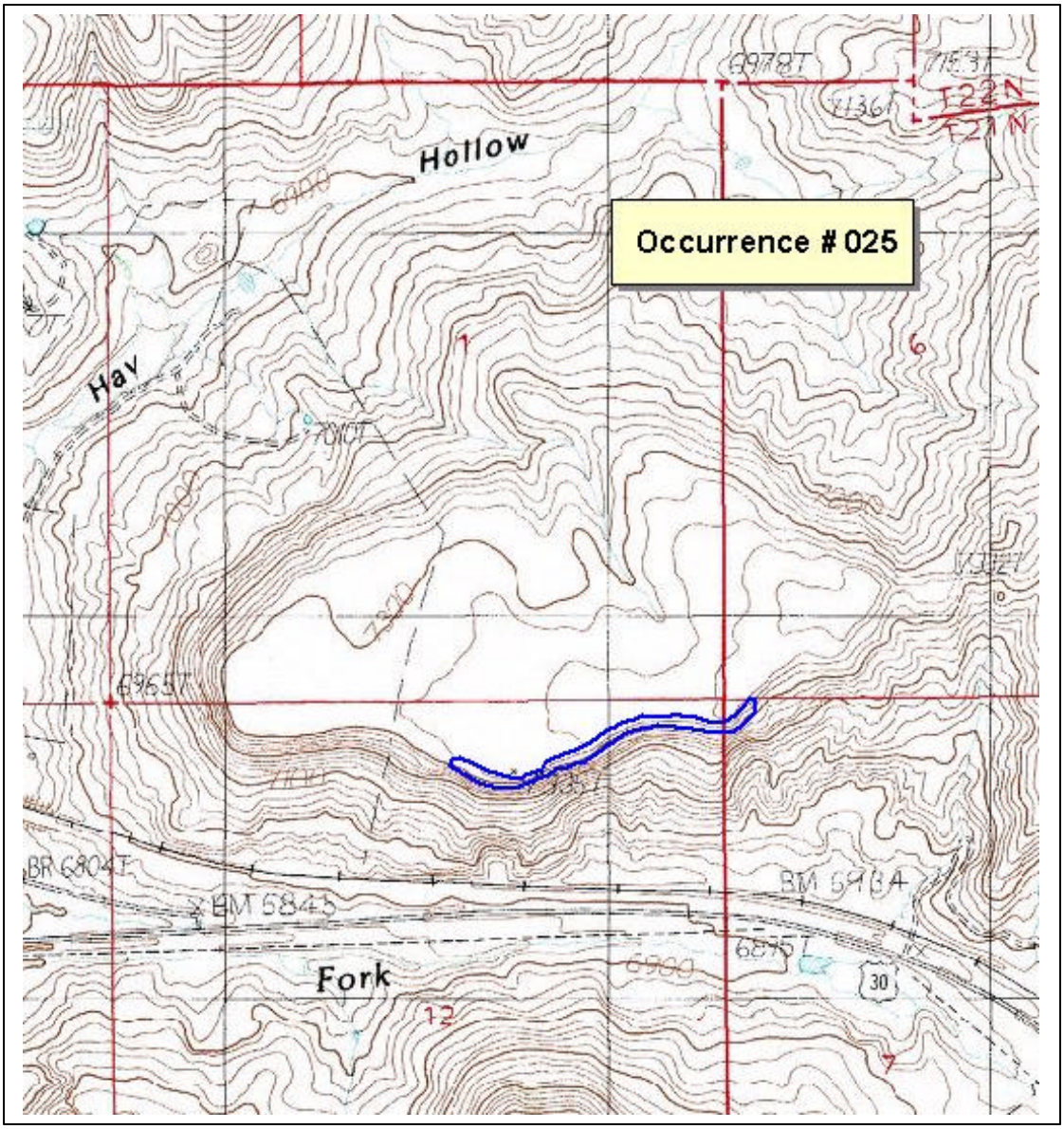
Habitat
Habitat: Rim and upper slopes of butte on chalky white sandstone gravel. Bare soil cover ca 30-40%, white sandstone gravel cover ca 30-50%, vegetative cover 5-15%. Cushion plant community of scattered bunchgrasses (*Elymus spicatus* and *Oryzopsis hymenoides*) with occasional *Artemisia tridentata* and *Purshia tridentata.* Abundant along south-facing slopes just below rim, less frequent on flats on rim. Absent to rare on east-facing rim summit (replaced ecologically by *Lesquerella alpina* var. *condensata*). Absent from lower slopes or benches of similar material. Also absent from red beds.
Elevation: 7320 feet
Size: 5 acres

Comments: In vicinity of EO# 009, 010, 013, 015, 019, and 023.

Managed Area: BLM Kemmerer Field Office

Specimens: Fertig, W. (17475). 1997. RM. Walford, G. (3009). 1999. RM.

Author: Walter Fertig
Edition Date: 00-06-16


Occurrence # 025
Hollow
Fork
T22N
R21N
BM 5845
BM 5984
30

WYOMING NATURAL DIVERSITY DATABASE
-Element Occurrence Record-

PHYSARIA CONDENSATA
TUFTED TWINPOD
Occurrence # 026

Status
Data Sensitive?: N
Identification verified: Y
TNC Global Rank: G2
WYNDD State Rank: S2
Federal Status: USFWS: former Category 2 Candidate; BLM WY State Office: Sensitive.
WY Distribution Note: State Endemic

Location
County: Uinta
USGS Quad Name: Piedmont Reservoir
Latitude: 411330N
Longitude: 1103827W
Map Accuracy: Precise; location is within a 75 foot radius of point on USGS topo map.
Town/Range/Section: T14N R117W S6 (SE4 of NE4NE4)
Location: Overthrust Belt, ridge on divide between Soda Hollow and Piedmont Creek (both tributaries of Muddy Creek), ca 1 mile west of Piedmont and 5 air miles south of Interstate 80, ca 17 miles east of Evanston.

Population Data
Last Observed: 1999-06-30
First Observed: 1999-06-30
Data: 1999-06-30: 100-200 widely scattered plants observed by Jill Walford. 80% of the population in fruit and 20% in vegetative condition. Occurs with *Lesquerella prostrata, Oxytropis sericea, Senecio canus,* and *Hymenopappus filifolius* var. *luteus*.

Habitat: South-facing 15-degree slope of limestone-derived clay covered with rock fragments and gravel. Vegetative cover ca 15%.
Elevation: 7420 feet
Size: 1 acre

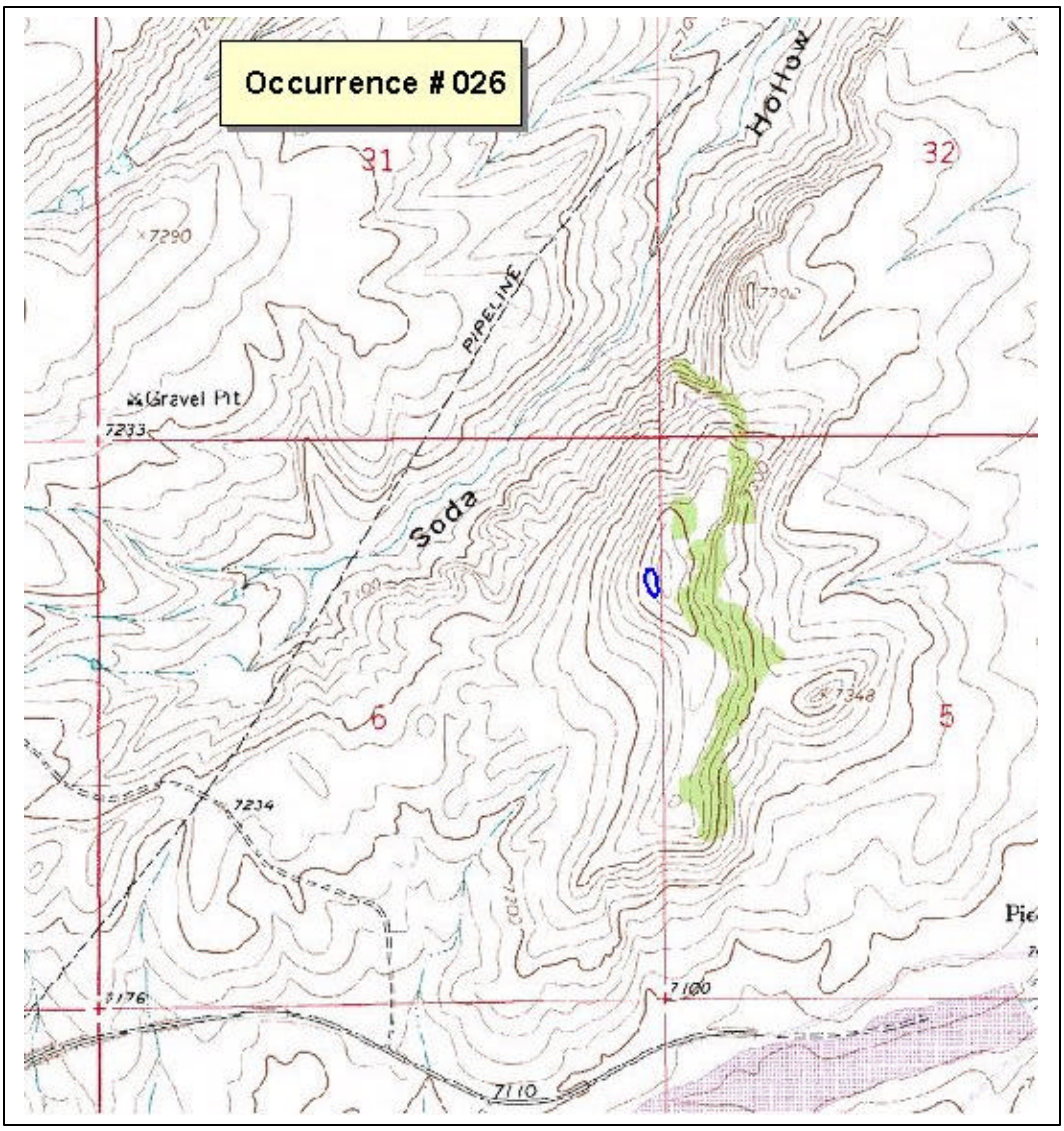
Comments: Originally determined as *Physaria dornii* by Jill Walford, but fruits and leaf blades are too small and branches only slightly exceed the basal rosette. *P. dornii* is found in the vicinity and some introgression or hybridization could be occurring between these populations.

Managed Area: BLM Kemmerer Field Office

Specimens: Walford, G. (3003). 1999. RM.

Sources:
Walford, Gillian. Plant ecologist/botanist and junior high science school teacher from Laramie, WY.

Author: Walter Fertig
Edition Date: 00-06-16


Occurrence # 026
31
32
Hollow
PIPELINE
Gravel Pit
7233
Soda
6
5
7234
7176
7100
7110

Appendix B.
Survey Routes

Surveys for *Physaria condensata* were conducted by Walter Fertig (May and July 1996, June 1997, June-July 1998, July 2000) and Gillian Walford (June-July 1999). Potential areas for survey were determined from BLM land management maps and USGS topographic maps based on the presence of mesas of the Green River or Wasatch formations on accessible public lands in southwest Wyoming.

Surveyed Sites 1996-2000

Date	**Surveyor**	**Township-Range-Section Coordinates**	**County**	***Physaria* species found**
22 May 1996	Fertig	T18N R120W S29 SW4SW4; S30 SE4; S31 N2 of NE4; S32 NW4NW4	Uinta	*P. acutifolia*
22 May 1996 5 July 1996 2 July 1999	Fertig Fertig Walford	T15N R118W S22 S2 of NW4	Uinta	*P. dornii*
22 May 1996 30 June 1999	Fertig Walford	T15N R117W S22 W8 of SE4 & E8 of SE4 of SW4	Uinta	
1 July 1996	Fertig	T21N R119W S1 NW4 of SE4	Lincoln	*P. dornii*
1 July 1996	Fertig	T22N R119W S36 SW4 of SE4	Lincoln	*P. dornii*
2 July 1996	Fertig	T22N R119W S23 NE4NE4; S14 SE4	Lincoln	*P. dornii*
2 July 1996	Fertig	T23N R117W S29 NW4 of SE4	Lincoln	*P. acutifolia*
3 July 1996	Fertig	T23N R118W S6 NW4NW4 & T24N R118W S31 S2 of SW4	Lincoln	*P. dornii*
3 July 1996	Fertig	T21N R117W S3 NE4NE4; S2 NW4NW4	Lincoln	*P. condensata*
4 July 1996	Fertig	T20N R119W S30 S2 of SE4	Lincoln	*P. condensata*
4 July 1996	Fertig	T20N R119W S21 NE4	Lincoln	
5 June 1997	Fertig	T17N R106W S8 NW4 of SW4	Sweetwater	
5 June 1997	Fertig	T18N R106W S30 NE4 of SE4	Sweetwater	
7 June 1997	Fertig	T27N R112W S27 W2	Sublette	
7 June 1997	Fertig	T22N R115W S12 SW4	Lincoln	*P. condensata*
7 June 1997 1 July 1999	Fertig Walford	T21N R116W S7 N2 of NW4NW4 & T21N R117W S12 N2 of NE4	Lincoln	*P. condensata*
8 June 1997	Fertig	T22N R119W S11 NE4NE4 of NW4	Lincoln	*P. integrifolia*
8 June 1997	Fertig	T23N R119W S36 N2 of SW4	Lincoln	*P. dornii* *P. integrifolia*
9 June 1997	Fertig	T21N R117W S5 N2 of SW4 of NW4; S6 N2 of NE4 & NE4 of NW4.	Lincoln	*P. condensata*
9 June 1997	Fertig	T21N R118W S3 NE4 of NW4 of SW4	Lincoln	
10 June 1997	Fertig	T18N R117W S24 SE4 of NW4	Uinta	
Date	**Surveyor**	**Township-Range-Section**	**County**	***Physaria***

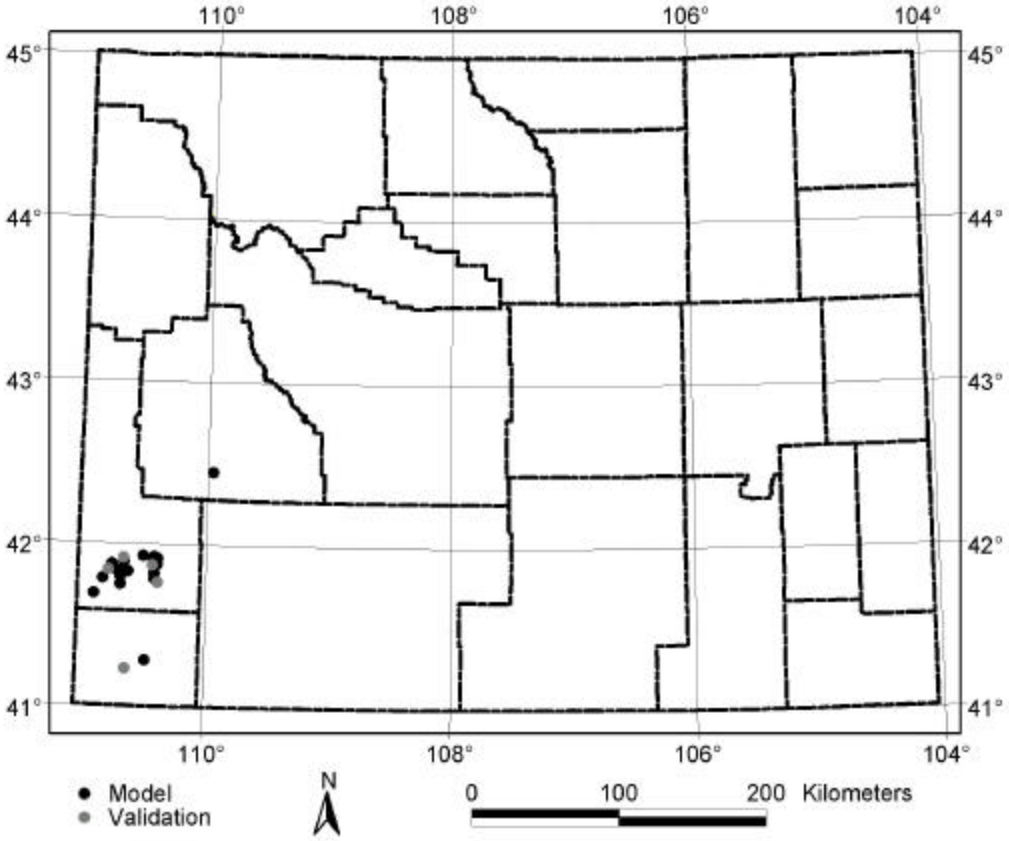
		Coordinates		**species found**
10 June 1997	Fertig	T15N R117W S4 N2 of NW4	Uinta	
17 June 1997	Fertig	T23N R119W S25 S2 of SE4 of SW4	Lincoln	*P. dornii* *P. integrifolia*
17 June 1997	Fertig	T23N R119W S24 SW4 of NE4 & SE4; T23N R118W S19 W2 of SW4	Lincoln	*P. dornii* *P. integrifolia*
17 June 1997	Fertig	T24N R118W S31 NW4 of SW4	Lincoln	*P. dornii*
18 June 1997	Fertig	T22N R119W S26 SE4 of NE4 of SW4	Lincoln	*P. dornii*
18 June 1997	Fertig	T17N R116W S2 NE4 of SW4	Uinta	*P. acutifolia*
18 June 1997	Fertig	T15N R117W S18	Uinta	
18 June 1997	Fertig	T14N R118W S6 SW4 of NW4	Uinta	
18 June 1997	Fertig	T15N R119W S14	Uinta	
18 June 1997	Fertig	T15N R118W S18	Uinta	
19 June 1997	Fertig	T15N R118W S28 SE4 of SW4 & SW4 of SE4	Uinta	*P. dornii*
12 June 1998	Fertig	T17N R106W S32 NE4 of NW4	Sweetwater	*P. acutifolia*
30 June 1998	Fertig	T28N R111W S9 N2 of SW4SW4	Sublette	
30 June 1998	Fertig	T28N R111W S2 Sw4, S3 E2 of SE4	Sublette	
30 June 1998	Fertig	T28N R110W S5 SW4, S6 SE4, S7 NE4	Sublette	
30 June 1998	Fertig	T27N R111W S10 S2 of SW4	Sublette	
30 June 1998	Fertig	T25N R112W S22 SE4 of NW4	Sublette	
1 July 1998	Fertig	T25N R110W S21 NW4 of SE4	Sweetwater	
1 July 1998	Fertig	T25N R109W S30 NW4	Sweetwater	*P. acutifolia*
29 June 1999	Walford	T15N R118W S28	Uinta	
29 June 1999	Walford	T15N R118W S32	Uinta	
30 June 1999	Walford	T14N R117W S6 SE4 of NE4NE4	Uinta	*P. condensata*
1 July 1999	Walford	T14N R118W S30	Uinta	
1 July 1999	Walford	T14N R119W S28	Uinta	
3 July 1999	Walford	T14N R117W S26	Uinta	
3 July 1999	Walford	T14N R117W S24	Uinta	
3 July 1999	Walford	T14N R117W S12	Uinta	
14 July 2000	Fertig & Kyte	T22N R118W S23 S2 of NW4; S24 SE4of SW4SW4; S25 NE4NE4 of NW4	Lincoln	*P. condensata*

Appendix C.
Potential Habitat Model of Tufted twinpod

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

Physaria condensata Rollins

Known Distribution of *Physaria condensata* in Wyoming
Black dots represent known present points for *P. condensata* 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	18	5	23
Known Absent	960	175	1135
Total	978	180	1158

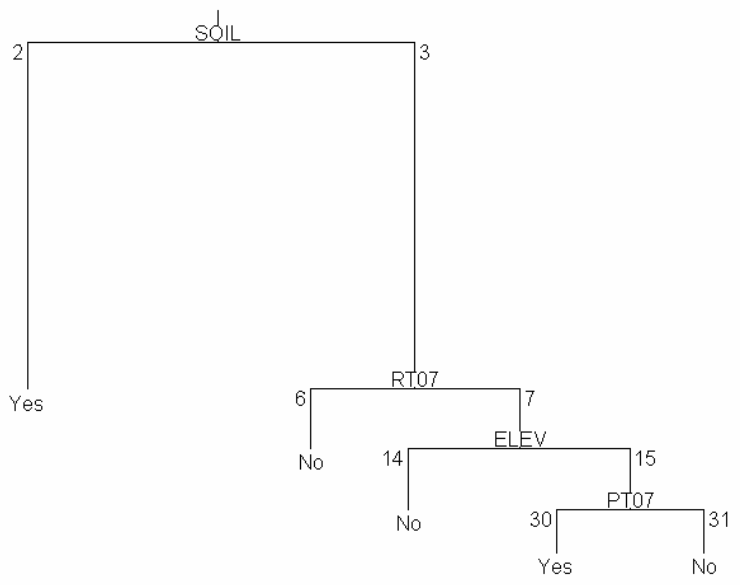
Data Source (Records):
This table lists the sources used for location data and the number of present points derived from each source.

Wyoming Natural Diversity Database (23)

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: 0.8
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 *P. condensata* 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 page for the specific values or categories of each variable used for splitting nodes along with 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 (960 and 18, 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 (960,18) (100,100) Yes
  2) SOIL:WY41 22 (8,14) (0.8,77.8) **Yes ***
  3) SOIL:WY01,WY06C,WY07C,WY08C,WY10,WY11,WY14, WY15,WY16C,WY17C,
     WY18,WY20,WY23,WY27,WY31C,WY34,WY35,WY36,WY38C,WY40C, WY42,
     WY44,WY45 956 (952,4) (99.2,22.2) No
    6) RT07<25.505 842 (842,0) (87.7,0) No *
    7) RT07>25.505 114 (110,4) (11.5,22.2) Yes
     14) ELEV<2230 99 (99,0) (10.3,0) No *
     15) ELEV>2230 15 (11,4) (1.1,22.2) Yes
       30) PT07<2.39 5 (1,4) (0.1,22.2) **Yes ***
       31) PT07>2.39 10 (10,0) (1,0) No *

Path Composition and Likelihood

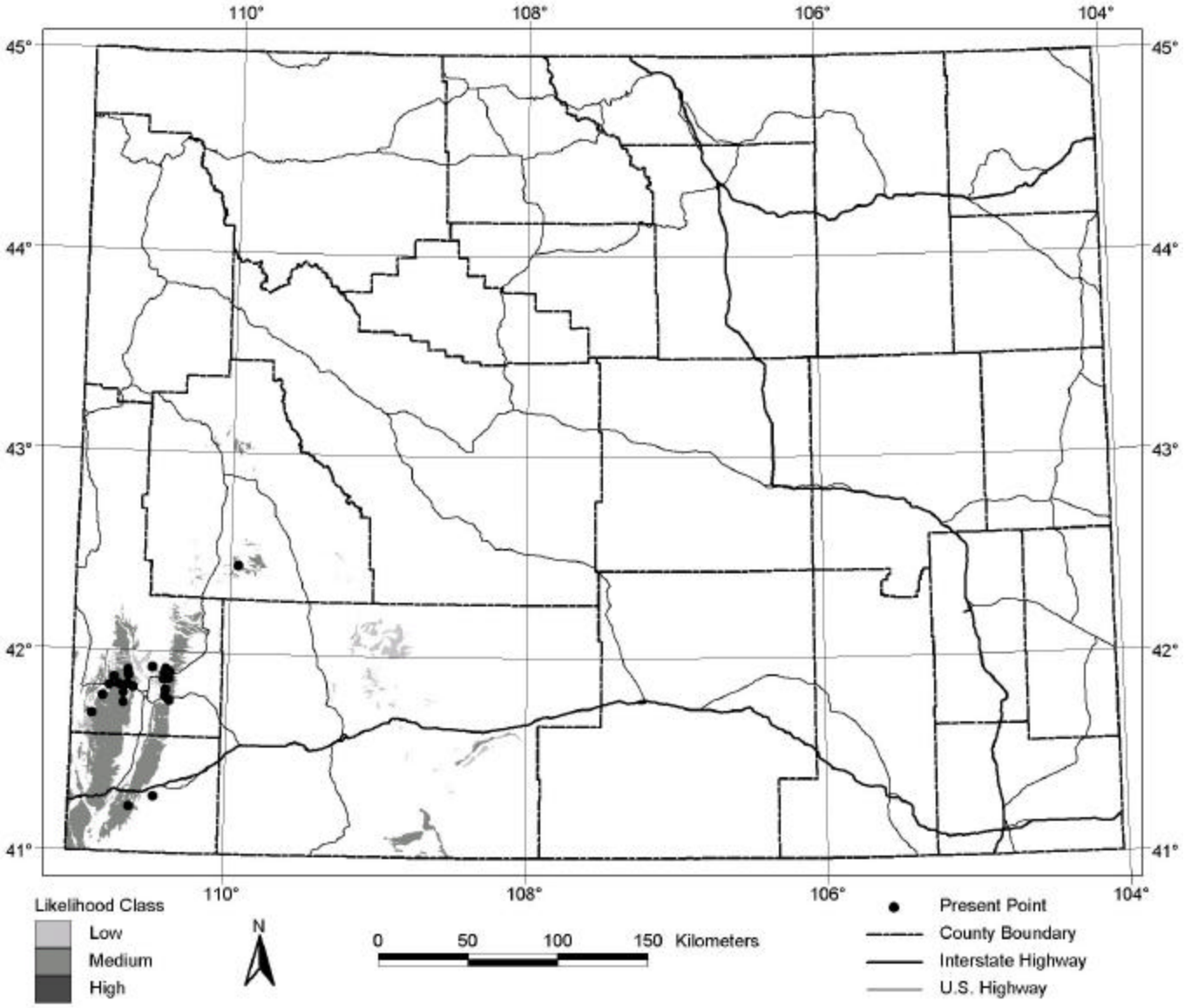
This table lists the nodes that comprise each of the two "yes" (predicted present) paths for the model shown above. The percentage of present points in the terminal "Yes" node for each path is indicated, as is the likelihood of points falling within the path based on a three-part scoring system (Low,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

Yes Path	Node List	% of Present Points	Likelihood Class
a	2	77.8	Medium
b	30, 15, 7, 3	22.2	Low

Predicted Distribution of *Physaria condensata* 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 2 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 (next page). 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.

Predicted Distribution of *Physaria condensata* in Wyoming



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 *P. condensata* 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	18/18 (100.0%)	0/18 (0.0%)
Known Absent	9/960 (0.9%)	951/960 (99.1%)

Total Correct: 969/978 (99.1%)
Total Incorrect: 9/978 (0.9%)

Validation Points

	Model Present	**Model Absent**
Known Present	4/5 (80.0%)	1/5 (20.0%)
Known Absent	1/175 (0.6%)	174/175 (99.4%)

Total Correct: 178/180 (98.9%)
Total Incorrect: 2/180 (1.1%)

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

4,012 km^2 (1.6% of WY)