

**Status and monitoring of *Townsendia microcephala*
(smallheaded Townsend daisy), southwestern Wyoming**



Prepared for Bureau of Land Management
Rock Springs Field Office and Wyoming State Office

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ABSTRACT

During the 2016 and 2017 field seasons, *Townsendia microcephala* (smallheaded Townsend daisy) a Wyoming endemic, was surveyed for and monitored to gather detailed information about known occurrences and to locate possible new occurrences. A potential distribution model and aerial photointerpretation of habitat were used to identify areas for new surveys. Potential habitat on Cedar Mountain and Sage Creek Mountain, as well as Bald Range and areas ca 5 mi southwest of Lonetree were surveyed. More extensive mapping and data were gathered for all three known occurrences on Sage Creek Mountain and Cedar Mountain. Results indicate that *T. microcephala* extends farther north and east on Cedar Mountain and farther north on Sage Creek Mountain than previously documented. High numbers were observed in some locales at peak flowering. However, a monitoring plot established in 1994 was reread in 2016 and exhibited a decline of 93%. Species information, status assessment, and conservation considerations are provided based on prior knowledge, current and future land uses, and better understanding gained from these surveys.

ACKNOWLEDGEMENTS

Collections and taxonomic work by Robert Dorn, discoverer and publisher of *Townsendia microcephala* remains central to understanding current taxonomy and status. Consultation with Charmaine Delmatier and Ron Hartman was useful and enjoyable. The facilities and resources of the Rocky Mountain Herbarium (RM) were fundamental to this study.

Walter Fertig surveyed and addressed the species status in a previous report, established the original monitoring transect, and worked with Rob Thurston to develop a potential distribution model for *Townsendia microcephala* through Wyoming Natural Diversity Database (WYNDD).

Mark Andersen and Gary Beauvais (WYNDD) also developed a potential distribution model.

Tanya Skurski, BLM Wyoming State Office, and Jim Glennon, BLM High Desert District Office, provided project coordination. This project was conducted as a challenge cost-share between BLM and WYNDD.

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Cover photo by Bonnie Heidel

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INTRODUCTION

Townsendia microcephala (smallheaded Townsend daisy) is endemic to the southern Green River Basin of southwestern Wyoming and is a Bureau of Land Management (BLM) Sensitive Species (USDI BLM 2010). The status of *T. microcephala* was previously addressed in a report (Fertig 1995) and in a state species abstract (Markow and Fertig 2001). Need for surveys in the BLM Rock Springs Field Office and updated status information were identified based on: a lack of surveys since 1994 and the potential distribution models developed since the original survey (Fertig and Thurston 2003, Andersen et al. 2016; Appendix A) that identified areas of potential habitat in the BLM Rock Springs Field Office. The main objectives of this study were to: make detailed surveys of the three *T. microcephala* occurrences in the BLM Rock Springs Field Office (especially the subpopulations known only from specimen data); replicate monitoring; conduct surveys in new areas of the BLM Rock Springs Field Office using the potential distribution models and photointerpretation; and update rangewide status information.

METHODS

At the start of this project, information on the habitat, distribution, and a potential distribution model of *Townsendia microcephala* was compiled and reviewed (Dorn 1992; Fertig 1995; Markow and Fertig 2001; Fertig and Thurston 2003; Andersen et al. 2016). Wyoming Natural Diversity Database (WYNDD) spatial database (Biotics) records were compared with Rocky Mountain Herbarium (RM) specimens for completeness. National Agriculture Imagery Program (NAIP) 2012 aerial imagery was overlain with the Fertig and Thurston (2003) and Andersen et al. (2016) potential distribution models in the BLM Rock Springs Field Office area, together with private land boundaries and known *T. microcephala* collection sites and mapped distribution, in ArcMap for aerial photo interpretation of potential habitat and producing maps. The NAIP imagery maps were printed out by 7.5-minute topographic quarter-quadrangle, along with half-quadrangle digital raster graphic (DRG) maps with the same layers, for use in the field.

Surveys of *T. microcephala* were conducted 2 to 9 July 2016 and 28 to 30 June 2017, when the species was flowering and beginning to fruit. Monitoring and continued surveys were done on 15 and 16 July 2016, but effectiveness had declined because many plants had finished flowering. When *T. microcephala* was found in a survey area, plant numbers were estimated and coordinates were recorded from Global Positioning System (GPS) receivers for georeferencing population boundaries that were later digitized as polygons into Biotics. Information on habitat, phenology, and plant associates were documented on WYNDD plant species of concern survey forms and later entered into Biotics as permanent electronic spatial database records.

Monitoring of *T. microcephala* at Cedar Mountain was first conducted during the 1994 surveys. The monitoring establishment record and first-year results were presented in an appendix of Fertig (1995). The initiator recommended that monitoring be replicated by BLM at least every three years, with the option of consecutive annual monitoring, in order to provide valuable demographic data on reproductive success, seedling establishment, and longevity of individual plants. There have been no known revisits until the time of this study. The full monitoring methods and results are addressed in a separate section (i.e., Monitoring Results) following Species Information, with supporting documentation in Appendix B.

RESULTS – SPECIES INFORMATION

Classification

Scientific name: *Townsendia microcephala* Dorn.

Synonyms: None.

Common names: Cedar Mountain Easter-daisy, smallheaded Townsend daisy.

Family: Asteraceae or Compositae (Sunflower or Daisy family).

Tribe: Astereae (Aster tribe).

Genus: According to Strother (2006) and Lee (2015), *Townsendia* has 27 known species. Apomixis (asexual production of seeds) is well-known in some members of the genus *Townsendia* (J.H. Beaman 1954, 1957). In particular, hybrids and polyploids between sexual diploid plants in the genus may be apomicts. A single taxonomic species in *Townsendia* may include apomictic populations as well as sexually reproducing plants (Strother 2006; Lee 2015). *Townsendia* is restricted to Mexico, the western United States, and western Canada. Of the *Townsendia* species recognized by Strother (2006) and Lee (2015), 12 are in Wyoming.

Relationship within the genus: The origin and closest relatives of *T. microcephala* have not been determined. Molecular phylogenetic studies in *Townsendia*, based on three different regions of plastic and nuclear ribosomal DNA, do not show consistent relations. It is hypothesized that this reflects rapid divergence of species in the genus, resulting from adaptive radiation and likely reflecting the ability of many *Townsendia* species to specialize in harsh habitats, often with unusual edaphic conditions (Lee 2015).

History of the species: *Townsendia microcephala* was first described by Robert Dorn:

Dorn, R.D. 1992. *Townsendia microcephala* (Asteraceae: Astereae): a new species from Wyoming. *Madroño* 39: 189-192.

Robert Dorn's type specimen (5034) is deposited at RM. The isotype is at NY (Dorn 1992). The label states:

Location: WYOMING, Sweetwater Co., Cedar Mtn.

T13N R112W Sec 22 W ½ W ½

Habitat: Rocky slope

Associates: *Thelesperma*, *Hymenoxys*

Flower Color: Rays white

Date: 19 July 1989 Elevation 8500 ft.

Collector: R. Dorn No. 5034

The holotype and isotype specimens were collected in the BLM Rock Springs Field Office, at the southern end of Cedar Mountain. After the published description, *T. microcephala* was collected by Charmaine Refsdal (Delmater) in 1994 (Delmater 1998). Also in 1994, Walter Fertig conducted surveys for *T. microcephala* (concurrent with surveys for *Thelesperma pubescens* [hairy greenthread]) and discovered more populations on the north-central section of Cedar Mountain and on Sage Creek Mountain (Fertig 1995). Robert Dorn has since collected *T. microcephala* at the southern end of Cedar Mountain (near the type collection) in 1999 and 2010. Bonnie Heidel collected *T. microcephala* from Sage Creek Mountain and north-central Cedar Mountain in 2003, incidental to *Thelesperma pubescens* surveys and monitoring (Heidel 2004).

2016 and 2017 surveys included revisiting and expanded mapping of all three previously known occurrences on Cedar Mountain and Sage Creek Mountain (EO#s 001, 002, and 003; Table 2).

Legal Status

U.S. Fish & Wildlife Service status: None. (Formerly a Category 2 candidate for listing under the Endangered Species Act. Category 2 applied to taxa for which proposing to list as Endangered or Threatened was appropriate, but for which persuasive evidence on biological vulnerability and threat were not currently available to support proposed rules. Category 2 was discontinued in 1996.)

BLM status: Sensitive – Wyoming BLM (USDI 2010).

Global Heritage rank: G1 (Critically Imperiled - At very high risk of extinction due to extreme rarity [often 5 or fewer populations], very steep declines, or other factors.) (NatureServe 2017).

State Heritage rank: S1 (Critically Imperiled).

State legal status: None.

Description



Figure 1. *Townsendia microcephala* in flower. By Joy Handley

General non-technical description: *Townsendia microcephala* is a rosette-forming, taprooted perennial herb. The leaves are spatulate to oblanceolate (usually folded), 1-2.5 mm wide, and moderately to densely pubescent with soft, shaggy hairs. Flower heads are mostly sessile with involucre 4-8 mm in diameter. Involucral bracts are mostly lanceolate, acute-tipped, and pubescent with stiff or shaggy hairs, and in a series of 3-4. Ray flowers are usually white, sometimes lavender and 5-8 mm long. The achenes are glabrous (Figures 1, 2, 3) (Fertig 1995; Fertig et al. 1994; Markow and Fertig 2001; Dorn 1992, 2001).

Technical description: Rosulate, taprooted perennial herb with a branched caudex; leaves spatulate to oblanceolate, moderately to densely villous, 3-18 mm long, 1-2.5 mm wide; heads sessile or nearly so. Involucre 4-8 mm in diameter; phyllaries in 3-4 series, mostly lanceolate, acute, more or less strigose to villous, 5-8 mm long, margins more or less scarious and lacerate-ciliate; ray florets 13-17, pistillate and fertile, white to lavender, 5-8 mm long; disk florets bisexual and fertile, yellow, about 4 mm long; pappus of ray and disk florets similar, of mostly 15-20 barbellate, flattened bristles, 3-5 mm long, deciduous; cypselae obovate to oblanceolate, compressed, glabrous or nearly so, epapillate, 3-4 mm long, about 1 mm wide (Figure 4) (Dorn 1992; Strother 2006; Fertig 1995).



Figure 2. *Townsendia microcephala* in flower. By Joy Handley



Figure 3. *Townsendia microcephala* in late flower/fruit, rays are browning and pappus bristles evident. By Bonnie Heidel.

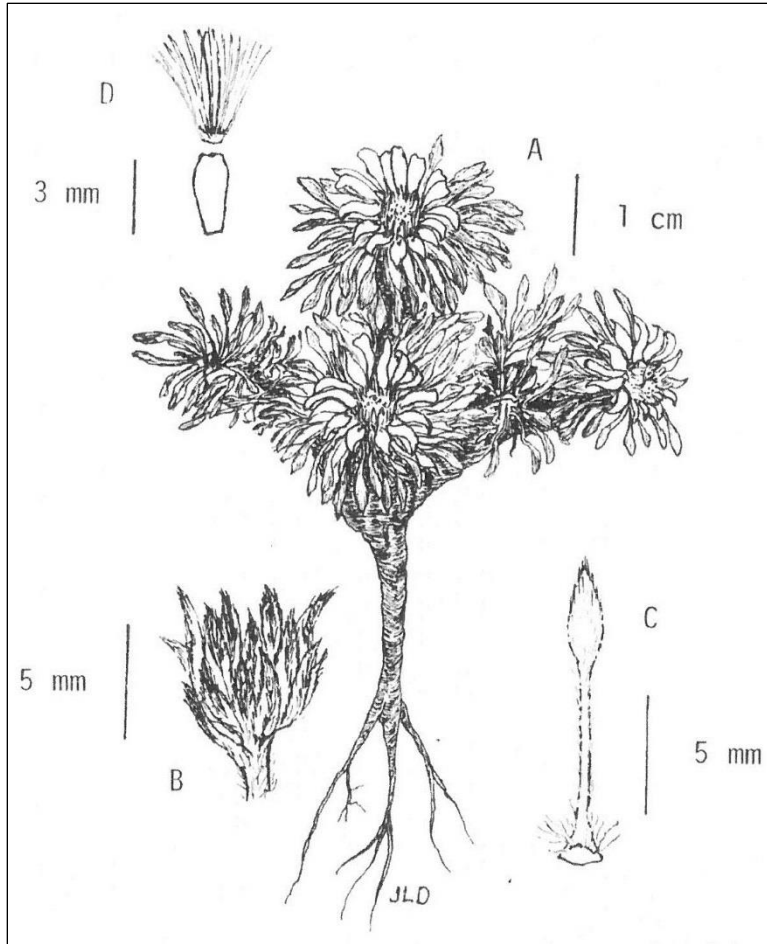


Figure 4. *Townsendia microcephala*

A. Habit. B. Involucre. C. Leaf. D. Achene and pappus

Illustration by Jane M. Dorn.

Reproduced with permission of the publisher from: Robert D. Dorn, *Townsendia microcephala* (Asteraceae: Astereae): a new species from Wyoming. *Madroño* 39(3): 191.

Similar species: *Townsendia spathulata* (sword Townsend daisy) and *T. condensata* (cushion Townsend daisy) differ in having larger flower heads (involucre mostly 8-40 mm wide), and hairy, papillate achenes. These species also tend to occur in different habitats and are geographically isolated (Fertig et al. 1994; Fertig 1995; Markow and Fertig 2001; Dorn 1992). *Townsendia microcephala* co-occurs with *T. nuttallii* (Nuttall's Townsend daisy) and *T. incana* (hoary Townsend daisy) (Table 1).

Geographical Distribution

Range: *Townsendia microcephala* is endemic to the northern foothills of the Uinta Range in southwestern Wyoming (Cedar and Sage Creek mountains). It occurs in Sweetwater and Uinta counties (Figure 5).

Table 1. Distinguishing characteristics of *Townsendia microcephala* from other *Townsendia* species

Species	Invol. diameter (mm)	Invol. bract series	Achene surface glabrous-glabrate	Ray color	Leaf shape	Leaf length (mm)	Leaf width (mm)	Leaf pubescence	Ray laminae length (mm)
<i>T. microcephala</i>	4-8 mm	3-4	glabrous - glabrate	white to lavender	spatulate - oblanceolate	3-8 (18)	1-2.5	strigose to villous	5-8
<i>T. condensata</i>	10 (12-) 16-30+	5-7	hairy	white, pink, lavender	obovate - broadly spatulate	(4) 6-12 (30)	1-3+	± villous to pilosulous	8-12 (-16+)
<i>T. hookeri</i>	8-18+	5-7	hairy	white	linear	5-25 (40)	1-1.5 (3)	sericeous-strigose	8-12+
<i>T. incana</i>	(6)10-15(20)	3-4(5)	hairy	white or pinkish	linear – linear lanceolate	3-12 (40+)	1-2(4+)	± strigose-scabrellous to strigillose	5-8(12+)
<i>T. nuttallii</i>	9-12 mm	5-7	hairy	white to pink or lavender	oblanceolate	5-20 mm	1-3	sericeous-strigose	ca 8
<i>T. spathulata</i>	(5) 6-12 (16)	3-4	hairy	white to pinkish lavender, brownish orange, coppery, bronze, yellowish green	spatulate	(3) 7-10 (22)	1.5-2 (5)	± villous or sericeous	3-12

Dorn 1992, 2001; Strothers 2006, Clark and Dorn 1979

Unverified/undocumented reports: None known.

Sites where present status not known: None known.

Table 2. Location information for known occurrences of *Townsendia microcephala*

EO #	Location	County	Legal Description	Elevation	USGS 7.5' Quad	Land Ownership
001	Western and southwestern rim of Cedar Mountain	Sweetwater, Uinta	T13N R112W Sec 10, 15, 16, 20, 21, 22, 27, 28, 29	8300-8600 ft (2530-2621 m)	Burntfork, Soap Holes Reservoir	BLM Rock Springs Field Office, State of Wyoming
002	Summit and west rim of Sage Creek Mountain	Uinta	T13N R113W Sec 3; T14N R113W Sec 34	8400-8440 ft (2560-2573 m)	Reed Reservoir	BLM Rock Springs Field Office
003	Cedar Mountain, east side of Middle and East canyons	Sweetwater	T13N R111W Sec 5, 6, 7; T13N R112W Sec 1, 12; T14N R111W Sec 31, 32	8160-8300 ft (2487-2530 m)	Horse Ranch, McKinnon	BLM Rock Springs Field Office

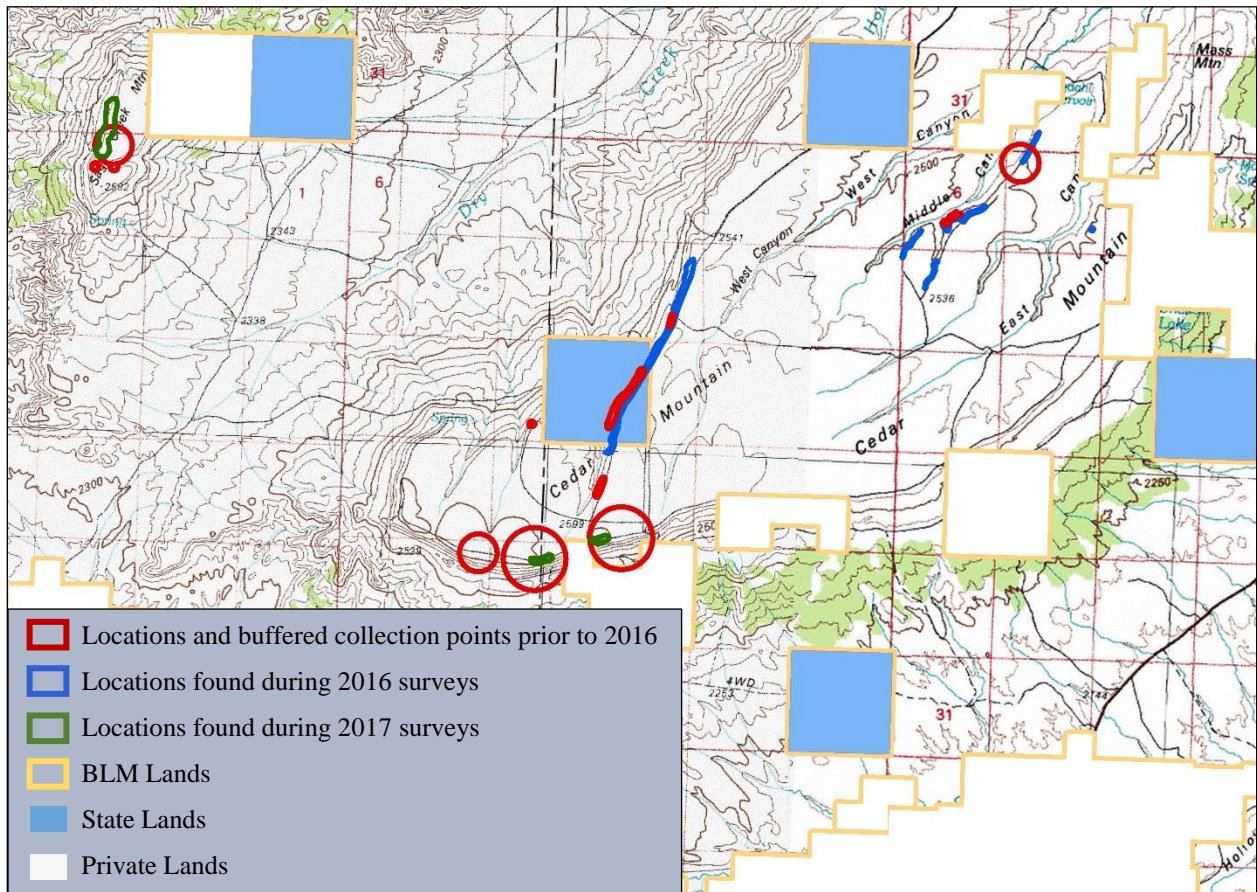


Figure 6. Land ownership of *Townsendia microcephala* populations.

Table 3. Areas surveyed in 2016 and 2017 but *Townsendia microcephala* not located

Location	County	Legal Description	USGS 7.5' Quad	Land Ownership
West rim of Cedar Mountain, ca 1 mile north of Hussman Reservoir	Sweetwater	T13N R112W Sec 3	Soap Holes Reservoir	BLM Rock Springs Field Office
Northwest rim of Cedar Mountain, northwest of Ringdahl Reservoir	Sweetwater	T14N R111W Sec 30	Horse Ranch	BLM Rock Springs Field Office
Northeast rim of Cedar Mountain, ca 0.5 mile south of Mass Mountain	Sweetwater	T14N R111W Sec 33	Horse Ranch	BLM Rock Springs Field Office
East rim of East Canyon of Cedar Mountain, ca 1.8 miles northeast of Phil Mass Reservoir	Sweetwater	T13N R111W Sec 4	Horse Ranch	BLM Rock Springs Field Office
West rim of East Canyon of Cedar Mountain, ca 1-2 miles north-northwest of Phil Mass Reservoir	Sweetwater	T13N R111W Sec 5	Horse Ranch	BLM Rock Springs Field Office
South rim of Cedar Mountain, ca 1.7 miles south and 2-2.5 miles southeast of Hussman Reservoir	Sweetwater	T13N R111W Sec 19 T13N R112W Sec 24, 23	Burntfork, McKinnon	BLM Rock Springs Field Office
South rim of Cedar Mountain, ca 0.1 mile east of Turtle Bluff BM	Uinta	T13N R112W Sec 29	Burntfork	BLM Rock Springs Field Office
West rim of Cedar Mountain at far southwestern corner, ca 0.1-1.2 miles southwest of Webb Spring	Uinta	T13N R112W Sec 17, 20	Burntfork	BLM Rock Springs Field Office
Bald Range, ca 0.25-1.5 miles east of Well Reservoir	Uinta	T12N R112W Sec 19, 30 T12N R113W Sec 24	Burntfork, Hoop Lake	BLM Rock Springs Field Office
Bald Range, ca 0.75-2.2 miles west of Well Reservoir, 3.25-4 miles south of Lonetree	Uinta	T12N R113W Sec 21, 22, 23	Burntfork, Lonetree, Hole In The Rock	BLM Rock Springs Field Office
Plains ca 2.5 miles south of The Butte	Uinta	T12N R114W Sec 14, Sec 23	Lonetree	BLM Rock Springs Field Office

Land ownership: Of the three known occurrences of *T. microcephala*, two of them are on BLM administered lands (Rock Springs Field Office), and one is on mixed BLM and State lands (Table 2; Figure 6).

Areas surveyed but species not located: The 2016 and 2017 surveys were conducted on public lands that fell within areas indicated as potential *T. microcephala* habitat by the Fertig and Thurston 2003 and Andersen et al. 2016 models or seemed to have suitable habitat

characteristics based on visual judgement. *Townsendia microcephala* was not found at many of the sites surveyed (Table 3; Appendix D).

Habitat



Figure 7. *Townsendia microcephala* habitat (EO #003)

Associated vegetation: Dominant plant species in *Townsendia microcephala* habitat are low forbs, cushion plants, grasses and *Cercocarpus montanus* (alderleaf mountain mahogany) (Figures 7, 8). Usually *T. microcephala* is most common with cushion plants and other low forbs, and scattered bunchgrasses, for example: *Astragalus spatulatus* (tufted milkvetch), *Carex filifolia* (threadleaf sedge), *Paronychia sessiliflora* (creeping nailwort), *Draba oligosperma* (fewseed draba), *Arenaria hookeri* (Hooker's sandwort), *Cryptantha caespitosa* (tufted cryptantha), *Cryptantha flavoculata* (roughseed cryptantha), *Tetraneuris acaulis* (stemless four-nerve daisy), *Eriogonum acaule* (singlestem buckwheat), *Eriogonum brevicale* (shortstem buckwheat), *Eriogonum caespitosum* (matted buckwheat), *Pseudoroegneria spicata* (bluebunch wheatgrass), *Stenotus armerioides* (thrift mock goldenweed), *Machaeranthera grindelioides* (rayless tansyaster), *Hymenopappus filifolius* (fineleaf hymenopappus), *Linum lewisii* (Lewis flax), *Packera cana* (woolly groundsel), *Thelesperma pubescens*, *Townsendia nuttallii* (Nuttall's Townsend daisy), *Trifolium andinum* (Intermountain clover), and *Oxytropis sericea* (white locoweed) (Fertig 1995).



Figure 8. *Townsendia microcephala* habitat (EO #003)

Associated species of concern: On Sage Creek Mountain and the west-facing slopes of Cedar Mountain, *T. microcephala* often shares habitat with *Thelesperma pubescens* (Fertig 1995). *Cryptantha stricta* (Yampa River cryptantha) also occurs on both Sage Creek and Cedar Mountains. *Ceanothus martinii* (Martin’s ceanothus) and *Physaria parvula* (*Lesquerella parvula*, *Lesquerella alpine* var. *parvula*, pygmy bladderpod) occur along the rims of Cedar Mountain, in the vicinity of *T. microcephala*. *Cryptantha rollinsii* (Rollins’ cryptantha) and *Arabis pendulina* var. *russeola* (russeola rockcress) have been collected at the northern end of Cedar Mountain. *Penstemon paysoniorum* (Payson’s beardtongue) has been collected off the southwestern end of Cedar Mountain (WYNDD 2016).

Topography: *Townsendia microcephala* is found primarily on open rims and upper slopes of mesa-like landforms (Fertig 1995) at 8160-8600 ft (2487-2621 m). The rims have gently-

rounded shoulder slopes more often than sharp breaks in topography. Most occupied habitat is on west-facing slopes, likely because it is a preferred aspect or because of topography or other environmental conditions associated with this aspect (Figure 9).

Soil and geology: Soils in *T. microcephala* habitat tend to be thin, rocky, loamy Inceptisols or Mollisols. Rocky outcrops, surface gravel, and shallow bedrock are common (Figures 7, 8). Bedrock includes: Bishop Conglomerate, Alluvium and Colluvium, and Bridger Formation.

Regional climate: There are two weather stations near Cedar and Sage Creek Mountains. Lonetree #1 (485703) is at 7550 ft (2301 m). Precipitation data at this station are from 1993-2010. Mean annual precipitation is 10.79 in. (27.41 cm), with the highest monthly mean precipitation in June at 1.27 in. (3.23 cm). Mountain View (486555) is at 6800 ft (2073 m). Data at this station are from 1966-2017. Mean annual precipitation is 9.75 in. (24.77 cm), with the highest monthly mean precipitation in May at 1.20 in. (3.05 cm). Mean annual temperature is 41.8° F (5.4° C), with a mean January temperature of 22.4° F (-5.3° C) and a mean July temperature of 64.5° F (18.1° C) (Western Regional Climate Center 2017).

Local microclimate: *Townsendia microcephala* is typically found in windswept areas with high solar radiation. These settings are conducive to early snowmelt and early start to the growing season compared to surrounding habitats on the mesas. However, because of their topographical relief, the mesas experience more late spring and early fall storms than the surrounding plains. The pale gravel that often covers much of the soil surface in areas occupied by *T. microcephala* has a high albedo (Figures 7, 8), which reduces evaporation from underlying soils, retaining subsurface moisture (Campbell and Norman 1998).

Unsurveyed Potential Habitat

The Fertig and Thurston 2003 potential distribution model indicated potential habitat on Cedar Mountain along the east rim of West Canyon and north rim of the southwest portion, near Webb Spring (Figure 9).

The model created by Andersen et al. (2016) has four levels of probability, with the upper two levels being of interest in the case of *Townsendia microcephala*. On Cedar Mountain the uppermost level (high probability) includes the southwest rim, the northwest rim just southeast of Webb Spring, also south of Hussman Reservoir (Figure 10).

For the most part, the second highest level (medium probability) of the 2016 model expands on the areas of Cedar Mountain in high probability: farther south on the lobes on the southwest end, farther east on the south rim. It also includes areas north, along the canyon rims that branch the

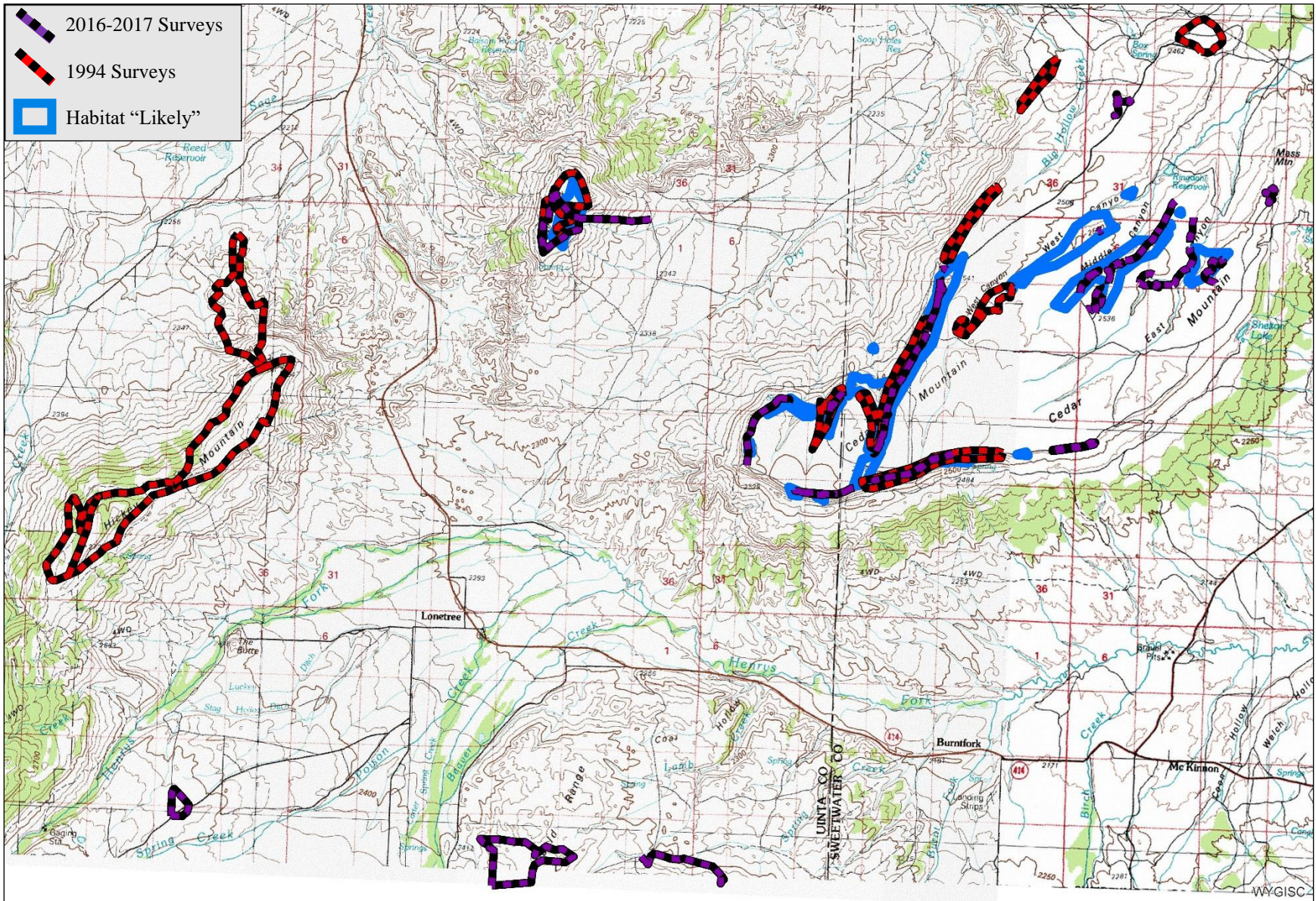


Figure 9. Fertig and Thurston 2003 potential distribution model

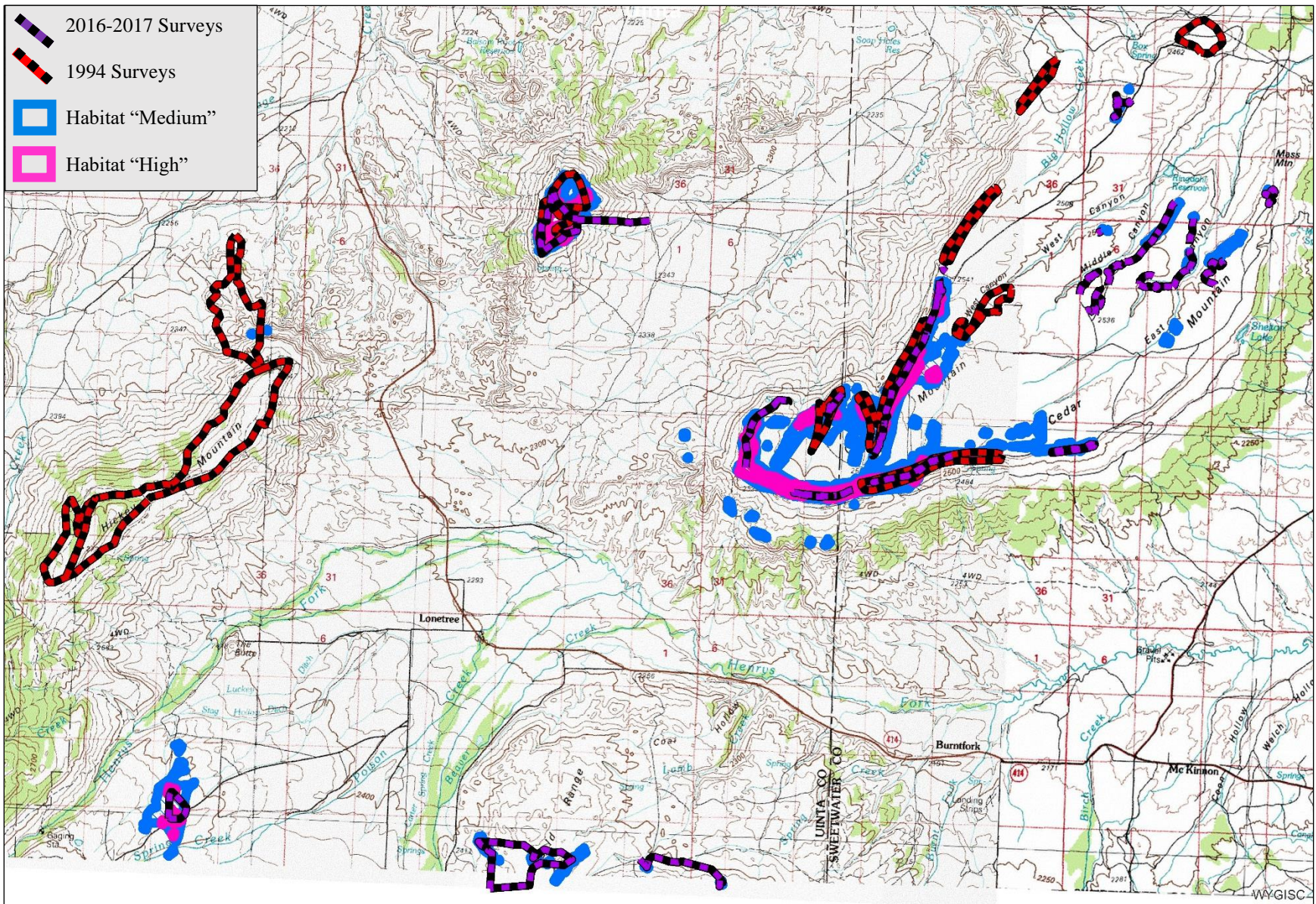


Figure 10. Andersen et al. 2016 potential distribution model

northern part of Cedar Mountain and a few small areas along the northwest rim and below the southwest corner (Figure 10).

Population Biology and Demography

Phenology: *Townsendia microcephala* flowers and fruits from May to July. Flowering probably depends on moisture conditions (Fertig 1995).

During the 2016 and 2017 surveys (2 to 9 July 2016 and 28 to 30 June 2017), most of the populations observed were in peak flower with some plants in early fruit (Figures 1 and 2). The proportion of vegetative plants was difficult to determine due to their resemblance to vegetative *Cryptantha caespitosa* (Appendix B). At the time of the 2016 monitoring (15 and 16 July), most reproductive plants had finished flowering but some produced a second later flower after the first flower finished or just had a later phenology.

Population size and condition: There are still currently three known populations of *T. microcephala*. We expanded the extent of all three populations. Subpopulations surveyed in 2016 and 2017 and ranged from 10 to over 2,000 individuals. Total estimates for subpopulations surveyed in 2016 and 2017 was over 3,500 plants. One subpopulation from past surveys had an estimated 1,000-2,000 individuals and estimated totals of 2,280-4,550 plants (Fertig 1995, Appendix C). The monitoring transect documented a decline in *T. microcephala* between 1994 and 2016 (Appendix B).

Reproductive biology: *Townsendia microcephala* reproduces sexually, by seed. Although the caudex is sometimes branched, there is no evidence of vegetative reproduction (Fertig 1995).

Pollination biology: Members of the genus *Townsendia* have fertile, pistillate ray florets and fertile, bisexual disc florets (Strother 2006; Tepedino et al. 2004). Another rare *Townsendia*, *T. aprica* (Last Chance Townsend daisy), is primarily pollinated by native solitary bees (Tepedino et al. 2004).

Seed dispersal and biology: The fruits of *T. microcephala* are achene-like cypselae. The pappi are flattened bristles, but these break off easily and may only provide limited benefit in aerial dispersal. One plant may have several flowering stalks, with each inflorescence producing pistillate ray florets and bisexual disc florets, both of which have the ability to produce fruit. Tepedino et al. (2004) found that *T. aprica* produced filled cypselae in 42.6% of ray florets and 45.5% of disc florets. Most likely, the small, dry fruits disperse by a combination of gravity and wind for short distances in exposed landscapes.

There is some evidence that south- and west-facing rim areas with off-road vehicle tracks are often inhabited with *T. microcephala*, in the tracks themselves, on the edges and between them (Handley pers. obs.). It's not known whether off-road vehicles spread the seeds, or provide a favorable amount of disturbance in some grassland areas.

Population Ecology

General summary: *Townsendia microcephala* is a polycarpic perennial, but little is known about its lifespan. Reproductive plants of different sizes were seen during 2016 and 2017 surveys, but it is difficult to determine age or lifespan (Figure 11). Trend data are only available for the monitoring transect, where seedlings were sought, but not found.

Competition: Vegetation cover in *T. microcephala* habitat is usually low, although it is found in a few grassy areas (Figure 11). This indicates the species favors low competition conditions.

Herbivory: None observed.

Pathogens: None observed.

Hybridization: There is no evidence of *T. microcephala* hybridizing with any related species, although production of allopolyploids and apomictic reproduction are documented in the genus (Beaman 1954, 1957). Lee (2015) considers hybridization in *Townsendia* to be of low importance to phylogenetic patterns in the genus and restricted to range edge populations.

MONITORING RESULTS

Establishment Report

Verbatim from Fertig (1995):

Townsendia microcephala (Cedar Mountain Easter daisy)

Demographic Monitoring Data

Date: 24 June 1994

Surveyor: Walter Fertig

Transection Location:

County: Sweetwater

Occurrence: 001 (West slope Cedar Mountain)

Legal Description: T13N R112W S22 W2W2

Orientation: 192° magnetic North

USFS Quad: Burntfork

Directions: From the junction of the Cedar Mountain Rim Road and the road leading off the west side of the mountain (eventually joining the highway north of Lonetree), proceed southeast ca 1.5 miles. The road will make an abrupt left, following a fence line due south for ca 1.5 miles. At the break in the fence (just before reaching the south rim) turn right and proceed west for ca 0.5 miles. Follow an obscure two-track north 0.4 miles. The transect is to the west along the rim and is marked by two orange rebars and a small pile of cobbles.

Sampling Method: A 30 x 1 m belt transect was established with starting points indicated by orange rebar and a low rock pile. The meter tape formed the baseline and meter sticks framed each 1 x 1 meter subdivision. 30 contiguous plots were read following the left side of the tape, beginning from the origin (at the north end of the belt) and continuing south-southwest.

Locations of individual rosettes were mapped and given X, Y coordinates. The number of stems per plant was recorded on the map. One of four age classes was assigned to each plant: R (reproductive, in flower or bud), F (fruiting in current season), P (post-reproductive, bearing old fruiting heads from previous season), and V (vegetative). The number of flowering and fruiting heads per plot was also recorded.

Habitat: Cushion community of gravelly sand on mesa-like summit 5.5-7.6 meters (18-25 ft) from the rim. Adjacent area has been burned to control sagebrush in recent years, but sample site itself is unburned. Occurs with *Trifolium andinum*, *Thelesperma pubescens*, *Cryptantha caespitosa*, *Paronychia sessiliflora*, *Draba oligosperma*, *Senecio canus* and *Arenaria hookeri*.

Summary of Results: Since monitoring was only initiated in 1994, no information on population trends is available at this time. The accompanying data sheets summarize baseline data collected this year. Because of drought conditions in 1994, production may have been adversely affected.

Discussion and Recommendations: Follow-up monitoring should be conducted at this site every 1-3 years. Monitoring yearly would provide valuable data on reproductive success, seedling establishment, and longevity of individual plants. Periodic monitoring (every 2-3 years) would provide population trend data for this site only, but could provide inferences to overall trends of the species. Additional monitoring sites should be located in the future to create a larger data set and more accurately indicate population size and trends. Existing monitoring plots for *Thelesperma pubescens* established by Marriott (1988) could be modified for use with *Townsendia microcephala*.

Establishment Report Results: Appendix B

2016 Monitoring Replication

Plot relocation: The directions and field map provided by Fertig (1995, as represented above) proved to be highly accurate. The transect seemed to be located at least 0.5 mi north on the two-track rather than 0.4 mi north, but odometers are not necessarily accurate to 0.1 mi. GPS coordinates were taken to document the location and endpoints of the transect (Figure 11). Origin (N end): Lat. 41.093344, Long. -110.037985. End (S end): Lat. 41.093094, Long. -110.038141 (NAD83).

The spray-painted rebar was no longer upright, but lying on the ground. When the first rebar was found, a tape measure was stretched to determine whether it corresponded to the northern or southern transect end. A second rebar was found lying on the surface exactly 30 m away, and both were beside subtle rock piles. It is inferred that they mark the transect at approximate original placement, if not the precise place. The two rebar were pounded in with a mallet and rock piles re-built around them (Figures 12, 13).



Figure 11. Location of *Townsendia microcephala* transect (EO #001) by Bonnie Heidel
The southern pair of points mark the transect. The northern point marks a break in the species' distribution.

There was one photographic slide on file, taken in 1994, showing the south end of the transect, but it was not in the report, or its existence known in time for use as reference in 2016 fieldwork. There was concern that the rebar could have been pulled and tossed or kicked by a passerby, and shell casings were noted in the vicinity. It was also noted that a portion of the tape line as re-established in 2016 crossed less suitable habitat toward the south end (i.e. habitat with high cover of *Pseudoroegneria spicata*). Upon return from the field and comparison of the 1994 slide with 2016 photographs, it appeared that there was the same distinctive set of rocks near the south end to verify location, although there was no high grass cover at the south end apparent in the 1994 slide compared to what was found in 2016. However, Fertig noted species composition in every plot, and presence of *P. spicata* was recorded in plots 8, 9 and 11-30 (with plot 30 corresponding to the south end).

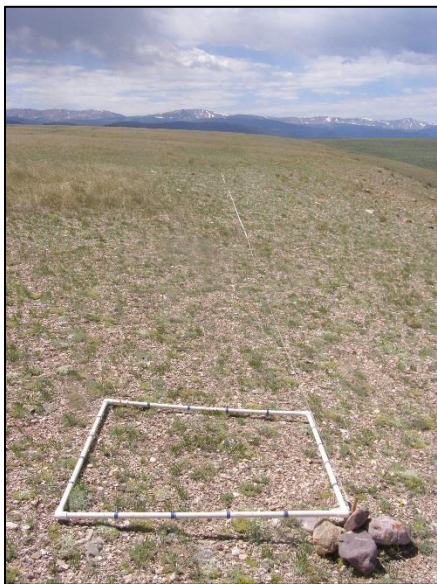


Figure 12. *Townsendia microcephala* belt transect, from origin looking south (Note: The transect is read on the left/east side).



Figure 13. First plot along the *T. microcephala* transect (origin in the lower left corner, looking east). Both by Bonnie Heidel

Data recording: The original transect data, collected in 1994, was recorded in great detail on lined legal paper and later transcribed into tables and maps. A copy of the 1994 raw data was carried into the field in 2016, along with the earlier tables and maps. The 2016 replication of transect data collection was done using graph paper as the simplest representation of map coordinates, with any field notes made onto the same paper. A meter frame was used, rather than meter sticks, for consistency and ease. Results are represented in tables and maps that are consistent with originals. In addition to mapping *Townsendia microcephala* plants, a tally of *Thelesperma pubescens* individuals was made in each plot.

The convention of recording individual plant categories and number of flowering and fruiting heads produced was replicated as originally outlined. In the future, it may be better to lump

plants in the current year's flowering vs fruiting stages, treat plants as vegetative if they have nothing besides vestiges of last year's flower heads, while keeping a tally of this year's flower heads.

The practice of preparing complete species list for each of the 30 plots as used by Fertig (1995) was started but not completed in 2016.

Conventions for distinguishing *Townsendia microcephala*: In the course of setting up the transect, no *T. microcephala* were noticed. It was only after getting onto knees and scrutinizing every sector of each 1 x 1 m plot area that the species was found. These notes address the conventions for making a positive determination, and the challenges.

Plants of *T. microcephala* with any flowers or vestiges of flowers were readily identifiable. There are no other stemless composites present in the study area, except for *T. nuttallii*, which has a larger flower. Vegetative *T. microcephala* closely resemble *Cryptantha caespitosa*, but the latter has silky, appressed hairs and a generally lighter leaf color. *Cryptantha caespitosa* leaves form a cushion-like growth form, generally more tightly spaced and numerous than *T. microcephala* leaves, except in small (young?) plants of *C. caespitosa*. Their leaf shapes overlap and slight differences are obscured by the in-rolling of leaves. Some of the close-up flowering photographs of *T. microcephala* show the above-mentioned leaf characteristics with spreading hairs and slightly greyish green leaf color (Figures 14, 15).

The ease of spotting *T. microcephala* is greatest when it is in full flower, but even this is confounded where it grows underneath other vegetation, where the substrate has white gravel that is almost as white as the ray petals, or under dim light and low-angle light conditions that produce low contrasts or shadows. The flowers close overnight, and possibly under strong winds, likely in response to temperature, light levels, or stress. The 2016 monitoring was conducted under conditions that were ideal most of the afternoon, and conducted entirely from a kneeling position.

Results: A total of nine *T. microcephala* plants were present in the transect in 2016. This signifies a big decline from the 133 plants that were present in 1994 (Appendix B). In 1994, 29 of the 30 plots along the 30 m transect were occupied. In 2016, only six of the 30 plots were occupied and they were all in the northern half. Plots with high grass cover were all at the southern end. By comparison, a total of 261 *Thelesperma pubescens* plants were tallied in the same transect. *Thelesperma pubescens* was present in all plots except the three at the southernmost end of the transect.



Figure 14. A rosette in flower and fruit. The small size of *Townsendia microcephala* is such that effective survey fieldwork is tied to flowering phenology. Monitoring on hands and knees is not as phenology sensitive.



Figure 15. *Townsendia microcephala* and *Thelesperma pubescens* often grow side-by-side. Dual-purpose monitoring transects warrant consideration. Both by Bonnie Heidel.

Discussion: In the process of searching the area to relocate the *T. microcephala* transect, and after reading the transect, the surroundings were scoured. While we cannot be certain that the 2016 transect was placed within 10 cm of the original 1994 transect, it is clear that no alignment in the vicinity would capture species density of 1 plant/m², much less the 4.3 plants/m² documented in 1994. It is interesting, and consistent with the idea that the transect is correctly placed, to note that the three plots with more than one plant in 2016 were also the plots that had high numbers in 1994. The presence of *Thelesperma pubescens* in most of the *T. microcephala* transect would seem to indicate that there is some level of rim habitat condition that has been retained.

Two possible explanations for results to date include:

1. Local trends as documented in the transect to date may not reflect prevailing trends. Fertig (1995) used transect plant density figures that he documented in the transect as the basis for estimating total population numbers, though he raised the possibility that the transect may not be representative of populations as a whole.
2. Trends as documented in the transect reflect serious population-wide decline, for an unknown reason that may warrant closer examination. Drought conditions were noted in 2003 when *Thelesperma pubescens* was monitored (Heidel 2004). It is not known if

drought, fire in adjoining habitat, or the apparent encroachment of grassland into parts of occupied habitat in the past could influence trends.

Alternate explanations were sought in the details of methodology. Very few of the plants in the transect had more than one rosette, so it is not possible that tight clusters of individuals were mistakenly counted as one individual when they represented multiple individuals. Only two of the plants in the transect were vegetative, and while that is the easiest stage to overlook, hundreds of *Cryptantha caespitosa* plants were examined closely to ensure vegetative plants of *T. microcephala* were not overlooked.

To further evaluate results, a constructive action might be to assemble digital imagery going back to at least the 1990s and determine whether or not there is a measurable change in the extent of rim habitat (i.e., width of sparse vegetation at the locations where the species is present) between then and the present, in the transect vicinity, and across occupied habitat. Another constructive measure might be to monitor *T. microcephala* where it is currently in high density (i.e., evaluating the ubiquity of trends). It is possible that the *Thelesperma pubescens* transects established by Marriott (1988) reflect high densities of *T. microcephala* and that they could serve multiple purposes.

CONSERVATION CONSIDERATIONS

Potential Threats to Currently Known Populations

Grazing: No signs of livestock grazing or trampling of *Townsendia microcephala* plants were observed during either 1994 (Fertig 1995) or 2016-2017 surveys. Major segments of occupied habitat are fenced off close to the south and west rims. This may concentrate trailing at the rim, but it also separates the upland pastures from rim habitat, curtailing loitering by livestock. It seems as though the current level of trailing has generally not affected the species or stability of its habitat.

There are no stock dams or impoundments close to occupied habitat. Salt blocks were noted close to the south rim at least once, but their proximity to *T. microcephala* is unknown because occupied habitat on the south rim has not been precisely mapped.

Roads: The Cedar Rim Road (BLM Road 4314) crosses Cedar Mountain, located beside several *T. microcephala* subpopulations. There are branch roads as well as unauthorized travel off of them. Road maintenance, changes in road margins, and recreational use of adjacent habitat could affect the species.

Recreation: The rim habitat occupied by the species on Cedar Mountain offers panoramic views of the surrounding countryside in all directions, and the most direct evidence of off-road recreational use was seen in many fresh off-road vehicle tracks to the rim. Other occasional signs of recreational use included waste products such as old bottles and cans, in addition to cigarette butts and shell casings.

Roadside RV camping was noted on the north side of Cedar Mountain below the rim. Maintaining a road system and fencing design that deter off-road uses may be more effective than adding regulations or practices, and require the collaboration of lease holders and communication with owners of private land inholdings.

Weeds: Non-native species are rarely present in occupied habitat. *Bromus tectorum* (cheatgrass) was noted in 2003 along BLM Road 4314 as it crosses Cedar Mountain, a year when it appeared that the road had been widened. Since then, it appears as though *B. tectorum* has spread little into adjoining rangeland and has not become continuous along the roadside. *Hyoscyamus niger* (black henbane) has invaded along BLM Road 4314 since 2003, and appeared to have been sprayed with herbicides. In general, the ridges, outcrops, and cushion plant communities that make up much of *T. microcephala* habitat seem to be too harsh for weedy species, as found by Jones (2004, 2005) in southern Wyoming at elevations of 6931-8966 ft (2057-2660 m).

Fire: Many *T. microcephala* subpopulations are in sparsely vegetated habitats with low probability of carrying fire. However, the flat top of Cedar Mountain and Sage Creek Mountain are well-vegetated sagebrush steppe. Fire was one of the management tools used locally to clear sagebrush on top of Cedar Mountain beside *T. microcephala* habitat Fertig (1995). *Bromus tectorum* is now in the same landscape, and could foster the spread of fire.

Oil and Gas: There is only one feature marked as a Drill Hole beside Cedar Mountain in T13N R112W Sec 10 (Burntfork USGS Quadrangle, 1964). Oil and gas permit applications across Cedar Mountain are currently under review. While well construction is not possible in most or all occupied habitat, development might be associated with expansions of the road system, weed distribution, and recreational use. Activities associated with oil and gas development may influence occupied habitat, as with road construction and seismic testing across landscape grids.

Other: Rangeland in an adjoining township has been disked to increase forage production, but there is no sign of disking on Cedar Mountain, nor was any observed on Sage Creek Mountain in 2003 (Heidel pers. obs.). Any activities or practices that lower the water table potentially affect the species. The influence of roads and fires might warrant consideration in this regard.

A human-made hole, approximately 4 ft in diameter, is along the western edge of the southwest lobe of Cedar Mountain, on the T13N R112W Sec 17 and 20 line, in Uinta County (Figure 14).

Quarrying was identified as a potential threat for *Thelesperma pubescens* (Heidel 2004, based on Dorn 1989), but there were no observed signs of quarrying activity.

The prominent landforms occupied by *T. microcephala* and *Thelesperma pubescens* make them desirable for communication tower construction, as found on Hickey Mountain, but there is no sign of this activity on Cedar or Sage Creek Mountains.



Figure 14. Human-made hole on Cedar Mountain, in Uinta County.

Management Practices and Response

There have been no studies of management practices and associated responses involving *Townsendia microcephala*.

Fertig (1995) noted that:

“ *T. microcephala* was observed to be minimally impacted by current grazing activities, but potentially affected by oil, gas, and hard-rock-mining development, road

construction, and trampling from off-road vehicles.” He indicated that placement of developments is possible so as to avoid occupied habitat. He also identified encroachment of occupied habitat by *Cercocarpus montanus* as a potential long-term threat.

Fertig (1995) also stated:

“If populations are in decline or threats increase, *T. microcephala* should be considered for listing as Threatened.”

The 2016 monitoring fieldwork to date provides evidence of local decline in *T. microcephala* numbers at the 1994 transect. We are not in a position to evaluate cause and effect but at least part of the transect has become marginally-suitable with increased cover of *Pseudoroegneria spicata*. It is possible that upland habitats and dominants have expanded into the rim setting, including species such as *P. spicata*, and that this has as great or greater long-term quantitative or qualitative reduction in suitable habitat as increase of *C. montanus* encroachment on rim habitat.

The potential threats that were identified in the 1990s still exist to the best of our understanding (i.e., oil, gas, and hard-rock-mining development; road construction; and off-road vehicles). Road construction, in particular, has been accompanied by the spread of weeds, which have not spread beyond the road corridor to date.

Notes Regarding Present or Anticipated Activities

Recommendations regarding present or anticipated activities: Monitoring trend would greatly add to knowledge of the species. Information on locations of known populations and potential habitat near roads should be provided to weed management personnel, including County Weed and Pest districts and other contractors.

Populations of *Thelesperma pubescens* were proposed for designation as Areas of Critical Environmental Concern (ACECs) in the Green River Resource Management Plan (1997), and populations of this species encompass much of the *Townsendia microcephala* occupied habitat. ACECs are special management areas designated by BLM to protect significant historic, cultural, or scenic values; fish and wildlife resources; natural process or systems; and/or to protect human life and safety from natural hazards. Information on the status of ACECs at either of the two landforms where *Thelesperma pubescens* overlaps with *T. microcephala* (Cedar Mountain, Sage Creek Mountain) could not be located. A data interpretation study was conducted by Fertig et al. (1998) identifying Cedar, Sage Creek, and Hickey Mountains as potential conservation sites among other sites in southwestern Wyoming, based on plant species of special concern data. We are not aware of this information having been cited in any planning documents.

As a conservation measure of last resort, storage of *T. microcephala* seeds in a conservation seedbank may be warranted. We do not have an estimate of seed numbers per flower head, or know viability levels, but seed production is likely in the range of 20-50 seeds per flower head. Therefore, to get 2000 seeds, at least 40-100 flower heads would need to be collected from across the species' known distribution.

Notification of BLM personnel of locations on BLM lands: To prevent inadvertent impacts to known populations, all appropriate BLM personnel involved in planning and on-the-ground management activities, including: travel planning, grazing, fire management, and weed control should be provided with location data for *Townsendia microcephala*. Toward this end, the updated state species abstract (Appendix E) and GIS files of all currently known occurrences are provided with this report.

Status summary: Wyoming BLM continues to recognize *T. microcephala* as a designated BLM Sensitive Species to ensure that agency actions do not contribute to the further endangerment of the species and the subsequent need for listing under the Endangered Species Act (USDI BLM 2001, 2010). The BLM may want more complete survey and additional monitoring information to inform the Special Status Species (SSS) program and status review process. Expanded documentation of previously known occurrences reduce the endangerment of this species.

Summary

2016 and 2017 surveys produced new information about *Townsendia microcephala* distribution patterns, habitat, population estimates, threats, and area of occupancy. The expanded documentation of previously known occurrences increases knowledge and management awareness of the species. Travel management, weed management, and expansion of grasses into occupied areas may have bearing on the status of *T. microcephala*. Population boundaries were expanded, particularly to the north and east on Cedar Mountain. Decreasing population trends are documented at least on a small scale within the 30 m² area marked by the baseline transect. 2016 results and evaluations underscore the results and evaluation presented in original 1994 survey and monitoring work. Habitat remains in good condition to date throughout the scope of Cedar Mountain surveys.

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