Status of *Sphaeromeria simplex* (Laramie False Sagebrush), South-central Wyoming

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

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ABSTRACT

Sphaeromeria simplex (Laramie false sagebrush), a Wyoming endemic, was surveyed for 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. Specific location, population distribution, and habitat data were gathered for many occurrences that were only known from specimen collections. Six new occurrences were found, establishing that the species is more extensive than previously known within its limited distribution and verifying the potential distribution model. Species information, status assessment, and management recommendations are provided based on prior knowledge, current and future land uses, and new understanding gained from these surveys.

ACKNOWLEDGEMENTS

Collections and taxonomic work by the founder of Rocky Mountain Herbarium (RM), Aven Nelson, remains central to understanding current taxonomy and status. Collections by more recent graduate students and personnel have contributed greatly to current understanding. The facilities and resources of RM were fundamental to this study.

Robert Dorn rediscovered *Sphaeromeria simplex* and prepared its first status report. Walter Fertig expanded on surveys, prepared status updates, and worked with Rob Thurston to develop and refine a potential distribution model for it through Wyoming Natural Diversity Database (WYNDD).

Considerable work has been directed toward recognizing, protecting and monitoring the type locality of *Sphaeromeria simplex* by employees of WYNDD and The Nature Conservancy (TNC).

The permission of all private landowners to access public lands for 2010 surveys was crucial. The essential coordination with private landowners and lease holders, original support for this project, and critical review of report drafts were provided by Frank Blomquist, Bureau of Land Management (BLM) Rawlins Field Office. This project was conducted as a challenge cost-share project between the BLM and WYNDD.

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Cover photo by Bonnie Heidel

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INTRODUCTION

Sphaeromeria simplex (Laramie false sagebrush) is endemic to Wyoming. The status of *S. simplex* was previously addressed in two reports (Fertig 1993, Mountain West Environmental Consulting 1996) and in a state species abstract (Fertig 2000). Need for an expanded baseline survey of *Sphaeromeria simplex* and updated status information was identified based on three main considerations:

1. The most current *Sphaeromeria simplex* status report (Mountain West Environmental Services 1996) was prepared when there were three known occurrences. Twelve new occurrences were subsequently discovered, which modified status information and had not been addressed. The majority of these occurrences were based on specimen data without benefit of mapping and surveys, and were located on BLM-administered lands.

2. A potential distribution model had been developed for *Sphaeromeria simplex* (Fertig and Thurston 2003) that identified additional areas of potential habitat not addressed in prior surveys, and digital orthophotographs became readily available for use in aerial photointerpretation of habitat.

3. Wind energy developments were recently proposed over large areas of Wyoming, including known and potential habitat for *Sphaeromeria simplex*. These proposals raised the needs for additional information on species' distribution extent and patterns, habitat specificity, and re-evaluation of threats.

The primary objectives of this study were to make detailed surveys of the *Sphaeromeria simplex* occurrences based only on specimen data, conduct *de novo* surveys using both the potential distribution model and aerial photointerpretation, and update rangewide status information.

METHODS

At the start of this project, information on the habitat, distribution, and potential distribution model of *Sphaeromeria simplex* was compiled and reviewed (Fertig 1993, Fertig and Thurston 2003, Mountain West Services 1996, Roderick et al. 1999). Specimens from the Rocky Mountain Herbarium were examined and label information utilized to ensure that *S. simplex* records in the Wyoming Natural Diversity Database (WYNDD) were complete and up to date.

A two-pronged approach was taken in conducting 2009 field surveys of *Sphaeromeria simplex*. Unsurveyed specimen collection points were surveyed to map precise *S. simplex* distribution and

extent in the immediately surrounding landscape while gathering information on the species and its habitat. In addition, the potential distribution model that had been developed for *S. simplex* (Fertig and Thurston 2003) was tested. It identified polygons having high, medium or low probabilities of suitable habitat. Sites of varying probabilities, both close to and far from known occurrences of *S. simplex*, were deliberately chosen for surveys.

In preparation for fieldwork, GIS layers of the known *Sphaeromeria simplex* distribution, potential distribution polygons, and public land layer were overlain on digital orthophotos in ArcMap to ascertain habitat and public land access. The results were printed out at a quarter-quad scale that corresponded closely to that of USGS topographic maps (7.5'), for reference in the field. USGS topographic maps, BLM land status maps, and geologic maps (Love and Christiansen 1985) were also used to access survey areas and conduct surveys. The selection of potential habitat polygons to survey was also tempered by photointerpretation, using digital orthophotographs.

The potential distribution model that had been developed for *Sphaeromeria simplex* (Fertig and Thurston 2003) was also used in setting the geographic scope of the study. Most of the high and medium probability areas of potential habitat were in Albany and Carbon counties, along the western foothills of the Laramie Range and in the Shirley Basin. Lands administered by the BLM Rawlins Field Office in these two areas were the highest priority for survey. The secondary priorities included other immediately-adjoining public lands, and BLM lands outside of the Laramie Range and Shirley Basin, within the Rawlins Field Office.

Surveys of *Sphaeromeria simplex* were performed by the authors between 27 May and 29 August 2009, when the species was flowering and fruiting. When *S. simplex* was found in a survey area, plant numbers were estimated, field maps were marked, and coordinates were recorded from GPS units for georeferencing population boundaries that were later digitized as polygons into the Biotics program. Information on habitat, phenology, and plant associates were documented on WYNDD survey forms and later entered into the Biotics program as permanent electronic spatial database records.

RESULTS – SPECIES INFORMATION

Classification

Scientific name: *Sphaeromeria simplex* (A. Nelson) A. Heller

Synonym: *Tanacetum simplex* A. Nelson

Common name: Laramie false sagebrush; Laramie chickensage

Family, Tribe, Subtribe, and Genus: Asteraceae or Compositae (Sunflower family) is comprised of 14 tribes (Barkley et al. 2006). Anthemideae is one of the smaller tribes, and the subtribe Artemisiinae includes the large, cosmopolitan, and closely related genus *Artemisia* (Watson et al. 2002). The genus *Sphaeromeria* includes 9 species, all western North American, 8 species that occur north of Mexico (Lowrey and Shultz 2006).

History of the Species:

Sphaeromeria simplex was first described by Aven Nelson as *Tanacetum simplex*:

Nelson, A. 1899. *Tanacetum simplex* In: New plants from Wyoming X. Bulletin Torrey Botanical Club 26: 484.

Aven Nelson's type specimen (*4325*) is deposited at the Rocky Mountain Herbarium (RM), and was collected in Albany County, Wyoming in the Laramie Hills (probably in T15N R72W, T15N R73W, or T14N R72W), at 7300-7600 ft, stony slopes in the foothills, 30 May 1898. Isotypes are at NY, GH, and US.

The newly discovered species was reported as "certainly rare and far from abundant even in type locality" (Nelson 1899). In 1900, Amos Heller placed it in *Sphaeromeria* based on Thomas Nuttall's published description of that genus (Heller 1900, Nuttall 1841). Nelson collected it several times from the vicinity of the type locality between 1898 and 1907. *Sphaeromeria simplex* was not collected again until 1978 when Robert Dorn relocated the type area. In 1984 and 1985, Dorn found two additional populations in the Shirley Mountains in Carbon County; and in the foothills of the northern Laramie Range at the convergence of Albany, Converse, and Natrona counties (Mountain West Environmental Services 1996, Dorn 1998, 1992), although the locations of these populations was not reported until 1993. In 1993, expanded surveys were conducted in the BLM Casper Field Office by Walter Fertig, surveying the Rattlesnake Mountains, northern Laramie Range, and Casper/Muddy Mountain areas for *S. simplex* without success but greatly expanding available information on the Shirley Mountains site first collected by Dorn (Fertig 1993). Walter Fertig, Ronald Hartman, and Amy Roderick found nine more locations in Albany and Carbon counties, in Shirley Basin and the foothills of the Laramie Range, during floristic inventories in 1997 and 1998 (Roderick et al. 1999). In 2003, Walter Fertig and Robert Thurston used known population locations, together with known negative points, to develop potential distribution models based on the correlation between a species' distribution with selected environmental variables for 44 rare Wyoming plants, including *S. simplex* (Fertig and Thurston 2003). Also in 2003, while conducting vegetation sampling of cushion plant communities, George Jones and Cathy Cooper found three additional locations in the Shirley Basin in Carbon County (Jones 2005).

Phylogenetic Relationships

Thomas Nuttall first described the genus *Sphaeromeria* in 1841, when he published his discovery of *S. argentea* and *S. capitata*. In 1843, Torrey and Gray reduced *Sphaeromeria* to a section of the genus *Tanacetum* (Holmgren et al. 1976). When Aven Nelson first described *S. simplex* in 1899, he placed it in the genus *Tanacetum*. In 1900, Heller, who continued to accept *Sphaeromeria* at the generic level, made the nomenclatural change to *Sphaeromeria simplex*. Rydberg (1916) returned *Sphaeromeria* to generic rank and proposed two other genera, *Vesicarpa* and *Chamartemisia*, for two species (*S. potentilloides* and *S. compacta*, respectively) that are presently accepted by most authors as members of *Sphaeromeria* (Holmgren et al. 1976, Lowrey and Shultz 2006). Several studies have shown *Sphaeromeria* to be more closely related to *Artemisia* than to *Tanacetum* based on morphological and anatomical characters, DNA markers, and palynological features (Holmgren et al. 1976, McArthur et al. 1998, Vallès et al. 2003, Martín et al. 2003).

Sphaeromeria simplex has a more highly-reduced growth form than other members of the genus. It is a caespitose perennial rather than subshrub, has one involucre rather than multiple involucres, and no pappus (Lowrey and Shultz 2006). In Arctic lineages of *Artemisia*, reduced height and enlarged flower heads may be adaptive to cold climates. Enlarged heads in the *Artemisia* genus are thought to confer better pollinator attraction, a strategy to enhance outcrossing and therefore heterozygosity, which could be a substitute for polyploidy (Tkach et al. 2008). If this same pattern applies in the *Sphaeromeria* genus, then *S. simplex* may be more highly-evolved rather than ancestral.

Legal Status

U.S. Fish and Wildlife Service status: *Sphaeromeria simplex* was proposed as Threatened in the first list of species prepared by the Smithsonian Institute in 1975, and published in the Federal Register 40(127): 27887 of July 15, 1975. It was designated a Category 2 candidate Endangered or Threatened species in the Federal Register 45(242): 82479 of Dec. 15, 1980. Category 2 species are taxa for which proposing to list as Endangered or Threatened is possibly appropriate, but for which persuasive evidence on biological vulnerability and threat are not currently available to support proposed rules. The Category 2 list was discontinued in 1996, and *S. simplex* has no current status under the Endangered Species Act.

BLM status: Sensitive – Wyoming BLM (USDI Bureau of Land Management 2001, 2002, 2010).

Global Heritage rank: G2 – imperiled. Current global rank information was reviewed in the NatureServe (2009) Rank Calculator and it was determined that rank changed is unwarranted unless potential threats diminish.

State Legal status: none.

State Heritage rank: S2 – imperiled (Heidel 2007).

Description

General non-technical description: Laramie false sagebrush is a perennial herb with a branched woody caudex and stems less than 12 cm tall. The silvery-hairy linear leaves are crowded at the base of the plant and are entire or narrowly 2-3 lobed. Flowering stems have 2-3 small, linear leaves and a single, terminal flower head of 30-50+ yellow disk flowers (ray flowers absent). The involucre is composed of two series of green bracts with membranous margins (Figures 1 and 2). The achenes are ribbed and have no pappus (Fertig et al. 1994, Fertig 2000, Lowrey and Shultz 2006).

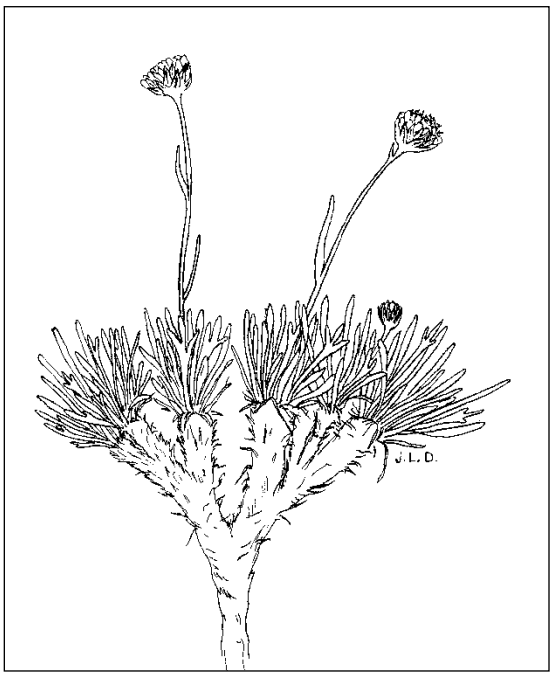


Figure 1. *Sphaeromeria simplex*
Illustration by Jane Dorn (from Dorn and Dorn 1980)

Figure 2. *Sphaeromeria simplex* individual plant clump
Photo by Bonnie Heidel

Sphaeromeria simplex has previously been described as mat-forming (Fertig et al. 1994, Fertig 2000). However, *S. simplex* seems to have less of a tendency to form continuous vegetation cover and radial growth patterns than the two other species of *Sphaeromeria* in Wyoming, *S.*

argentea and *S. capitata* (B. Heidel pers. obs.) Alternatively, it is possible that recent drought conditions have exacerbated the "break up" of mats. In any case, it was not possible in 2009 to distinguish belowground connectivity with certainty from viewing plants above ground. Herbarium specimens at RM have 1-many (30+) shoots per plant, with usually only 1-few flowering stems and the rest of the shoots in vegetative condition (this may be a result of collecting or mounting procedures).

Technical description: Perennials with a woody caudex of crowded branches and crowns scarcely above the surface of the ground, covered with dead leaf bases. Stems few, erect, rising singly from the crowns, 2.5-12.5 cm high. sericeous. Leaves mostly basal; blades (15-30 x 1.5-8 mm) pinnipalmately lobed (lobes 2-3, linear, 1-2 mm wide) or linear, faces silvery canescent with dolabriform hairs. Heads borne singly. Involucres 4.5-7 mm. Phyllaries ovate to obovate, in two rows, (12-)14-20+, with slightly thickened greenish midribs canescent or glabrous, margins scarious. Pistillate flowers in one series. Cypselae light brown, 1.8-2.5 mm, face finely striate (Mountain West Environmental Services 1996, Dorn 2001, Coulter and Nelson 1909, Lowrey and Shultz 2006).

Local field characters: *Sphaeromeria simplex* can be recognized by its single flowering head (involucre) comprised of only disc flowers, and its linear, silvery, sage-like leaves (Figures 3 and 4). The flowering stalk and involucral phyllaries persist even after seeds are shed.

Figure 3. *Sphaeromeria simplex* flowering heads
Photo by Bonnie Heidel

Figure 4. Stems and silvery, sage-like leaves
Photo by Bonnie Heidel

Similar species: *Sphaeromeria capitata* has a spherical, compound terminal inflorescence composed of two or more separate, sessile flower heads (recognizable by the presence of more than one involucre). *Sphaeromeria argentea* has several distinct, short-stalked heads in a loose

inflorescence (Table 1). Herbaceous and low shrubby species of *Artemisia* have numerous flowering heads arranged in spikes, racemes, or panicles. Vegetative and rayless specimens of *Tetraneuris acaulis* differ in having tufts of white hairs at the base of the sessile, entire basal leaves. Rayless individuals of *Erigeron compositus* have usually twice- to thrice-ternately lobed or dissected leaves with short, rough hairs, not silvery (Fertig 2000).

Table 1. Comparison of the three species of *Sphaeromeria* in Wyoming (Lowrey and Shultz 2006, RM 2010).

Species	**Leaves**	**Flower heads**	**Wyoming distribution** (Figure 5)
Sphaeromeria simplex	mostly basal; linear, 2-3 lobed or entire, faces silvery-canescent	borne singly	south-central Wyoming: Albany, northeastern Carbon, southeastern Natrona, and southwestern Converse counties
Sphaeromeria argentea	mostly basal; 3-5 lobed or entire or lobed, faces silvery-canescent	usually 2–7 in subcapitate to corymbiform arrays	southwestern Wyoming: Sweetwater, Lincoln, Uinta, southern Fremont, and western Carbon counties
Sphaeromeria capitata	mostly basal; linear, usually 1–2 lobed, faces ± tomentose	usually 8–20 in tight, spherical, compound arrays	north-central and south-central Wyoming: Big Horn, Johnson, Fremont, Natrona, Converse, Sweetwater, Carbon, and Albany counties

Sphaeromeria simplex overlaps in phenology and habitat with *S. capitata* and other yellow-flowered, rayless and rayed, composites of similar stature.

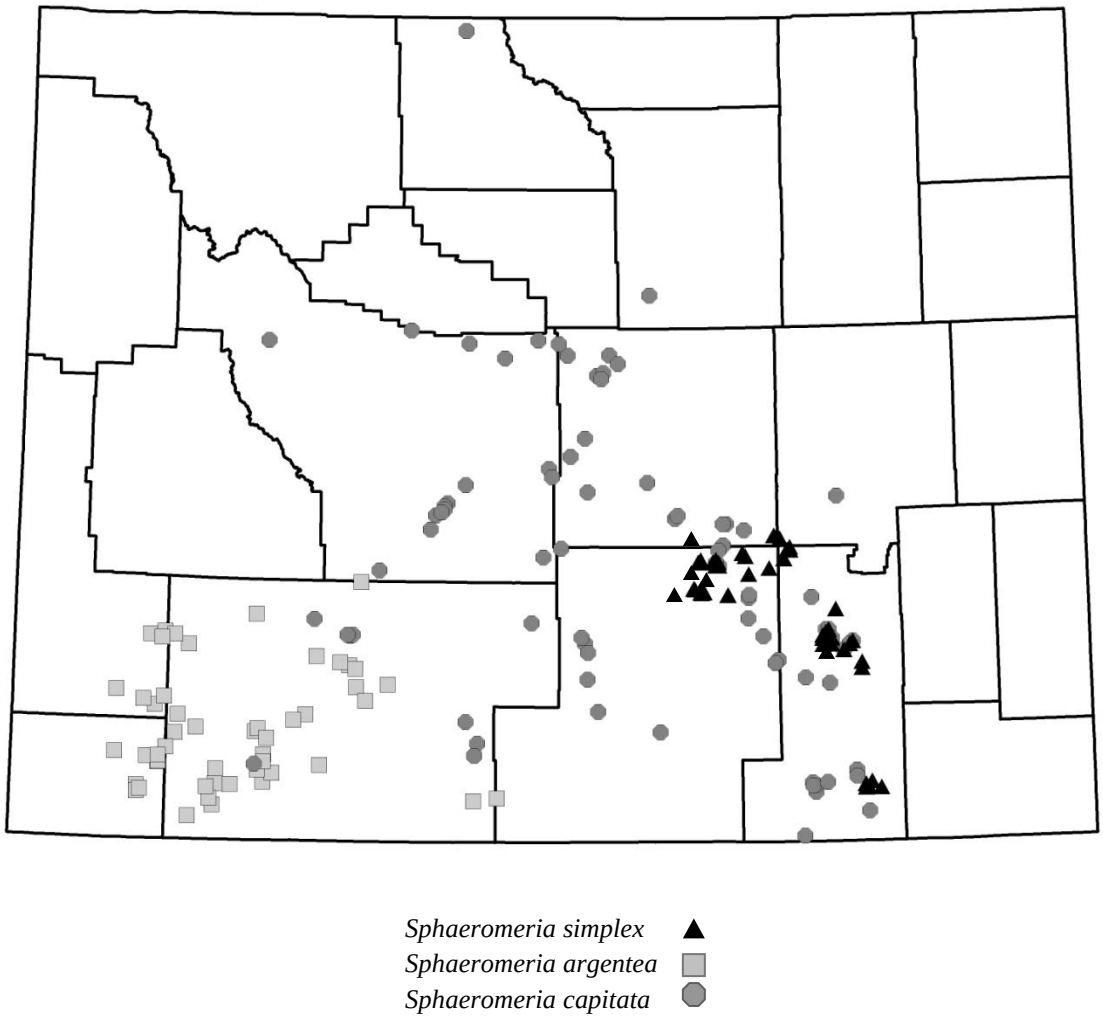
Geographical Distribution

Range: *Sphaeromeria simplex* is endemic to the Shirley Mountains, Shirley Basin, and western foothills of the Laramie Range in Carbon, Natrona, Converse, and Albany counties in south-central Wyoming (Figure 5).

Extant sites: There are 22 extant occurrences of *Sphaeromeria simplex* based on the 2009 surveys, including six new occurrences (Table 2, Appendix C). All six of the new occurrences were identified using the potential distribution model (Appendix A) and aerial photointerpretation. One of the new sites represents the first documented occurrence on lands managed by the BLM Casper Field Office (North Fork Canyon Creek, #22). The discovery of some subpopulations between previously known populations provided justification for combining these records as representing one population complex. Thus, the Sevenmile Creek (#8) population is a consolidation of three formerly separate occurrences. The Little Medicine (#3) and Deer Creek (#25) occurrences were once represented by one occurrence, but the distance and geological differences provided rationale for dividing them. The Deer Creek occurrence (#25) is also in the BLM Casper Field Office but on public lands managed by the State of Wyoming. All known populations were visited in 2009 with the exception of the

Laramie quarry (#1), Little Medicine (#3), Twentytwo Mile Draw (#12), and Deer Creek (#25) populations. The Laramie quarry area was last surveyed in 2006, and the others were last seen in 1996 or 1997.

Figure 5. Wyoming distribution of *Sphaeromeria* species[1]



Historical sites: None known. Some historic collections included vague location description, such as "Tie City" (*Hinkston 3*), but all are thought to correspond with the Laramie quarry site (#1).

Unverified/Undocumented reports: None known.

[1] Herbarium specimen data provided by the Rocky Mountain Herbarium (Accessed through RM Herbarium web site, http://www.rmh.uwyo.edu, 2009-12-16)

Sites where present status not known: *Sphaeromeria simplex* at Twentytwo Mile Draw (#12) was apparently collected on private land and could not be surveyed.

Table 2. Location information for known occurrences of *Sphaeromeria simplex*

EO#	Site Name	County	Legal Description	Elevation Range (ft)	USGS 7.5' Quad	Location
001	Laramie quarry	Albany	T14N R72W Sec 6 T15N R72W Sec 18, 19 T15N R73W Sec 13, 24	7350-7600	Red Buttes, Laramie	Laramie Basin; edge of foothills ca 2.5 - 6.5 air miles southeast of Laramie.
002	Grinnell Creek	Carbon	T26N R81W Sec 18, 19, 20	8360-8760	The Q Ranch	Shirley Mountains; slopes on west side of steep north-south running ridge above head of Grinnell Creek and on flats adjacent to BLM Road 3115, near radio/microwave tower, ca 2.5 air miles south of County Road 102.
003	Little Medicine	Albany	T28N R76W Sec 6, 7, 18 T28N R77W Sec 12, 13, 23, 26	7200-7700	Squaw Spring, Rock Creek, Chalk Hills	Northern Laramie Mountains; foothills in the vicinity of County Road 62 (Little Medicine Road) on ridge between South Fork and North Fork of Little Medicine Bow River and from Medicine Peak east to Burnett Creek, ca 32-36 miles south-southeast of Casper.
004	Moss Agate Ridge	Carbon	T28N R79W Sec 16, 22, 23	7200-7340	Mud Springs	Shirley Basin; southeast rim of Bates Hole, 2 locations: (1) along "rim road", a 2-track that parallels the rim of Bates Hole just north of where Wyoming Highway 487 drops over the rim. (2) Along Moss Agate Ridge, 0.1-0.2 miles south of Wyoming Highway 487, ca 8 air miles northwest of the townsite of Shirley Basin.
005	Chalk Mountain	Carbon	T27 R80W Sec 6 T27 R81W Sec 1 T28N R80W Sec 31 T28N R81W Sec 25, 26, 35, 36	7700-7980	Wild Irish Reservoir, Fourmile Point	West rim of the Shirley Basin; Chalk Mountain, south of Elk Creek and east rim in saddle between 2 knolls, ca 2-4.25 miles south of Horse Peak.
006	Dodge Peak	Albany	T23N R73W Sec 20	7200-7542	Dodge Ranch	West slope Laramie Range; Laramie Basin, Dodge Peak, south of Garrett Road, ca 2.7 road miles northeast of Rock River, ca 4 air miles north of north end of Wheatland Reservoir # 2.

008	Sevenmile Creek	Albany	T23N R74W Sec 4, 6, 8, 10, 14, 20 T23N R75W Sec 2, 11, 23 T24N R74W Sec 30 T24N R75W Sec 36	6900-7400	Ayres Spring, Sevenmile Spring, Pinto Creek, Boot Heel SE	Western foothills of the Laramie Range; from the Fetterman Road and along Sevenmile Creek to the head of Box Canyon, ca 3.2-9.2 miles north of Wheatland Reservoir, ca 17-22 miles northeast of Rock River.
009	Petrified Forest	Carbon	T27N R77W Sec 5, 6 T27N R78W Sec 12 T28N R77W Sec 31, 32	7150-7250	Chalk Hills, Moss Agate Reservoir	Shirley Basin; Petrified Forest Area, off County Road 2, on southeast side of the Little Medicine Bow River, east of the Shirley Basin uranium mines.
010	Sand Creek tributaries	Carbon	T27N R79W Sec 23	7130-7170	Measel Spring Reservoir	Shirley Basin; drainage ca 1.2 air miles north of BLM Road 3136, ca 2 air miles west of Wyoming Highway 487, ca 4 air miles west of the Shirley Basin townsite.
012	Twentytwo Mile Draw	Albany	T25N R74W Sec 22	7000	Pinto Creek, Cottonwood Creek	West foothills of the Laramie Range; "ca 4.5 air miles west of Garrett" [east-west trending ridge, east of the North Laramie River, ca 2.5 miles east of Fort Fetterman Road].
014	Bluegrass	Albany	T22N R73W Sec 24, 36	7040-7208	Bluegrass Wells	Laramie Range; (1) extreme west end of Bluegrass Ridge, and (2) ca 1.5-2 miles north of West Bluegrass Creek, 2-4 miles east of Wheatland Reservoir No. 2.
015	Kite Ranch Road	Albany	T23N R74W Sec 36	7000-7060	Ayres Spring	Laramie Range; Laramie Basin, south of Garrett Road immediately east of junction with Kite Ranch Road, ca 3 miles northeast of the north end of Wheatland Reservoir No. 3, ca 2 miles west of Laramie River, ca 23.5 road miles northeast of Rock River.
016	Dry Creek Rim	Carbon	T28N R81W Sec 30 T28N R82W Sec 25, 36	7200-7500	Fourmile Point	Shirley Basin; Dry Creek Rim and slopes below, ca 1 mile north of Dry Creek, ca 1.3 miles west of Bolton Creek Road, ca 2 miles northwest of Meer Ranch.

017	Cave Creek	Carbon	T26N R82W Sec 10, 11, 14	7820-8035	The Q Ranch, Beaver Creek	Shirley Basin; ridge west of Cave Creek, ca 1-2 miles southwest of Cave Creek Ranch, ca 4.2-5 miles west of Grinnell Lake, ca 24 miles south of Alcova.
018	Pine Hill	Carbon	T26N R80W Sec 26, 27, 35	7300-7750	Pine Hill	Shirley Basin; north slopes leading up to Pine Hill, ca 1.8-2.9 miles south of Point of Rocks, ca 2.5 miles east of First Ranch Creek, ca 20 miles north-northwest of Medicine Bow.
019	Spring Creek	Albany	T23N R75W Sec 36	6880-6900	Sevenmile Spring	Laramie Valley; south side of Spring Creek, on west side of Fetterman Road, ca 0.5 mile west of Boswell Spring, ca 21.5 road miles northeast of Rock River.
020	Teton Camp	Carbon	T27N R78W Sec 3	7130	Moss Agate Reservoir	Shirley Basin; off County Road 2, ca 1.5 miles west of the Little Medicine Bow River, ca 2.5 miles east of Heward Reservoir, ca 3 miles north of Shirley Basin townsite.
021	Shirley Basin Rim	Carbon	T26N R81W Sec 5 T27N R81W Sec 32, 33, 34	7540-7720	Fourmile Point	Shirley Basin; rim north of Muddy Creek, ca 2.4 miles north of Grinnell Lake, ca 22 miles south of Alcova.
022	North Fork Canyon Creek tributaries	Natrona	T29N R82W Sec 34	7000	Bear Spring	Sweetwater River Valley; slopes between tributaries of North Fork Canyon Creek, ca 1.7 mile south east of Bear Spring, ca 5 miles east of Kortes Road on BLM Road 3121, ca 10 air miles southeast of Alcova.
023	Fourmile Point	Carbon	T27N R81W Sec 19 T27N R82W Sec 13, 23, 24	7260-7610	Fourmile Point, Fourmile Ridge	Shirley Basin; Fourmile Ridge and west side of Fourmile Creek, ca 3-4 miles north of Cave Creek Ranch, ca 20 air miles south of Alcova.
024	Bunker Draw	Carbon	T26N R83W Sec 21, 22	6900-7047	Seminoe Dam NE	Shirley Mountains; knoll and ridges between Bunker and Big draws, ca 1.3-1.9 miles north of site of the former Lost Creek School, ca 5-6 mi northeast of Kortes Dam, ca 25 miles south of Alcova.

025	Deer Creek	Converse and Natrona	T29N R77W Sec 16, 17, 22	7300-7800	Squaw Spring	Northern Laramie Mountains; foothills at the base of ridge system south of Deer Creek and west of Curry Creek along the Natrona/Converse County line bordering Forest Service Road 660 (Balsh Road) off the old Casper-Medicine Bow Road, ca 2-3 miles north of Dugway Rim, ca 27-28 miles south-southeast of Casper.

Areas surveyed but species not located: USGS topographic map quadrangle quarters in which surveys were conducted and no *Sphaeromeria simplex* was found include: Bear Spring NE4, Cameron Creek NW4 and SW4, Chalk Hills NE4 and SE4, Difficulty SE4, Dodge Ranch NW4, Four Mile Ridge SW4, Jelm Mountain SW4, King Mountain SW4, Laramie NE4, Medicine Bow NE4 and NW4, Pilot Hill SW4, Pine Hill NE4 and SW4, Rendle Hill SW4, Rogers Creek NE4 and SE4, Seminoe Dam NE NE4, Sybille Springs SE4, TB Ranch NW4, The Q Ranch SE4, and White Rock Canyon NE4 (Appendix B).

Habitat

Sphaeromeria simplex occurs on windswept ridges, rims, buttes, and barren slopes of rocky or gravelly limestone-sandstone, dominated by cushion plant communities or occasionally by low sagebrush. The sparsely vegetated habitat is found from open plains to lower montane settings within more densely vegetated big sagebrush, mountain mahogany, juniper, or limber pine stands (Figures 6 and 7).

Figure 6. Cushion plant habitat with scattered limber pine
Photo by Bonnie Heidel

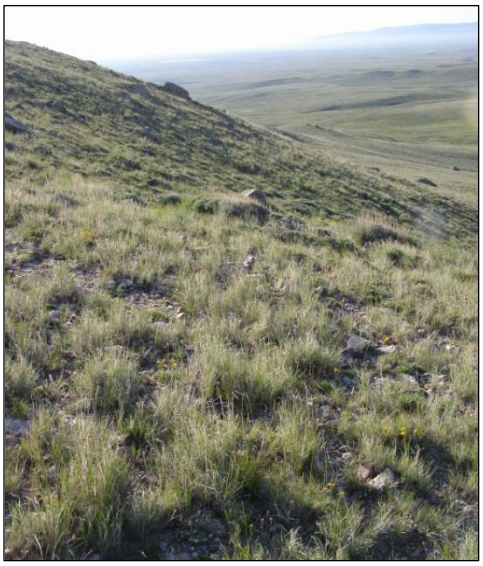


Figure 7. Big sagebrush/grassland habitat
Photo by Bonnie Heidel

Table 3. Species frequently associated with *Sphaeromeria simplex*

Scientific name	**Common name**
Artemisia frigida	prairie sagewort
Artemisia nova	black sagebrush
Artemisia pedatifida	birdfoot sagebrush
Artemisia tridentata ssp. *wyomingensis*	Wyoming big sagebrush
Astragalus spatulatus	tufted milkvetch
Cercocarpus montanus	alderleaf mountain mahogany
Comandra umbellata	bastard toadflax
Cryptantha caespitosa	tufted cryptantha
Cryptantha cana	mountain cryptantha
Draba oligosperma	fewseed draba
Elymus spicatus	bluebunch wheatgrass
Eremogone hookeri	Hooker's sandwort
Erigeron compositus	cutleaf daisy
Erigeron nematophyllus	needleleaf fleabane
Erigeron ochroleucus var. *scribneri*	buff fleabane
Eriogonum acaule	singlestem buckwheat
Eriogonum flavum	alpine golden buckwheat
Gutierrezia sarothrae	broom snakeweed
Koeleria macrantha	Junegrass
Krascheninnikovia lanata	winterfat
Lesquerella alpina	alpine bladderpod
Lesquerella ludoviciana	foothill bladderpod
Linum lewisii	prairie flax
Machaeranthera grindelioides	rayless tansyaster
Minuartia nuttallii	Nuttall's sandwort
Musineon divaricatum	leafy wildparsley
Musineon tenuifolium	slender wildparsley
Packera cana	woolly groundsel
Paronychia depressa	spreading nailwort
Paronychia sessiliflora	creeping nailwort
Penstemon eriantherus	fuzzytongue penstemon
Phlox hoodii	carpet phlox
Phlox muscoides	musk phlox
Poa secunda	Sandberg's bluegrass
Sedum lanceolatum	spearleaf stonecrop
Sphaeromeria capitata	rock tansy
Stenotus acaulis	stemless mock goldenweed
Tetradymia canescens	spineless horsebrush
Tetraneuris acaulis	stemless four-nerve daisy
Tetraneuris torreyana	Torrey's four-nerve daisy

Associated vegetation: *Sphaeromeria simplex* is found in two general vegetation types: sparse steppe usually dominated by *Artemisia nova* (black sagebrush) or *A. tridentata* ssp. *wyomingensis* (Wyoming big sagebrush); and more often in cushion plant communities usually dominated by *Phlox muscoides* (musk phlox), often co-dominated by *Stenotus acaulis* (stemless mock goldenweed), *Tetraneuris acaulis* (stemless four-nerve daisy), or *Eremogone hookeri* (Hooker's sandwort) (Table 3). *Elymus spicatus* (bluebunch wheatgrass) and other bunchgrasses are co-dominant in both types.

The northern, Shirley Basin-area occurrences of *Sphaeromeria simplex* often have a few more cushion plant species in and adjoining occupied habitat - including species such as *Eriogonum acaule* (singlestem buckwheat), *Sphaeromeria capitata*, and *Parthenium alpinum* (alpine feverfew) - than the southern, Laramie Basin-area occurrences, though there are no major composition differences between occurrences.

Associated species of concern: *Sphaeromeria simplex* was found in or adjoining the same habitat as *Parthenium alpinum*, another regional endemic plant in the Asteraceae. Though the *P. alpinum* is no longer tracked as a Wyoming species of concern, collections and location information were also recorded for it, expanding its known distribution in and north of the Shirley Mountains.

Topography: *Sphaeromeria simplex* occurs on rolling hills and adjoining breaks, often with rims and slopes of exposed calcareous rock or gravel. It is also found on relatively level areas of extensive calcareous buttes or mesas. These topographic features are found in basin, foothills and lower montane zones. The settings often follow butte or escarpment rims, but are not restricted to any aspects and topographic positions, varying with the particular landform and outcrop planes. Occupied habitat often corresponds to highly restricted microtopography in the landscape, though widely scattered and recurring. The elevation ranges from 6880-8760 ft (2097-2670 m).

Soil relationships: *Sphaeromeria simplex* is found on well drained soils classified as frigid or cryic (mean annual soil temperature 0-8˚ C). Surface texture classes are: loam, fine sandy loam, and gravelly sandy clay loam. Most of these soils have some calcareous content and are formed in alluvium, colluvium, or residuum of limestone, sandstone, shale, or igneous rocks, often on ridges or slopes. Many of the soils are classified as ustic, indicating water may be deficient but is usually available during the growing season. Some *S. simplex* soils have clay content, and are described as smectitic (clay that swells when wet) or agric (clay below the surface layer). A few of the soils inhabited by *S. simplex* have enough sodium to be described as sodic or nitric. Most of the soils are Aridisols, with many Mollisols and some Entisols (Soil Survey Staff 2010).

Sphaeromeria simplex is most commonly found on the tuffaceous claystone and sandstone, and arkosic conglomerate of the Oligocene White River Formation; the Carboniferous interbedded sandstone and limestone of the Casper Formation and the limestone and dolomite of the Madison Limestone; and the claystone and sandstone, and conglomerate of the Eocene Wind River Formation. Other bedrock types that occur with *Sphaeromeria simplex* include: Carboniferous sandstone, limestone, and dolomite of the Tensleep Sandstone and the shale, dolomite, and sandstone of the Amsden Formation; Triassic shale, siltstone, and sandstone of the Chugwater Group; the Carboniferous limestone and dolomite of the Madison Limestone Group; the Eocene tuffaceous bentonitic claystone, sandstone, and conglomerate of the Wagonbed Formation; and the Jurassic and Cretaceous sandstone, bentonitic claystone, chert-pebble conglomerate of the Cloverly, claystone, limestone, silty sandstone of the Morrison, and sandstones and shales of the Sundance formations. At some sites it may extend onto 2,600 million year old Archean granitic rocks or Quaternary alluvium and colluviums (Love and Christiansen 1985).

Table 4. Local Climate Data Summary for Lookout 14 NE, Wyoming (485720)
Monthly Climate Summary Period of Record : 2/ 1/1933 to 7/31/1965 (Western Regional Climate Center 2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	28.7	32.1	37.8	50.5	61.4	72.1	80.6	79.0	69.6	58.0	41.5	33.2	53.7
Average Min. Temperature (F)	6.0	8.9	15.5	25.2	34.5	43.3	49.8	48.0	38.7	28.7	16.2	11.0	27.2
Average Total Precipitation (in.)	0.68	0.76	0.98	1.55	1.81	1.47	1.57	0.96	0.91	0.69	0.53	0.47	12.38
Average Total SnowFall (in.)	8.2	8.7	12.8	11.7	2.4	0.4	0.0	0.0	0.8	3.2	6.5	6.1	60.8
Average Snow Depth (in.)	4	4	4	1	0	0	0	0	0	0	1	2	1

Percent of possible observations for period of record.
Max. Temp.: 85.1% Min. Temp.: 85% Precipitation: 86.5% Snowfall: 86% Snow Depth: 81.9%

Table 5. Local Climate Data Summary for Shirley Basin Stn, Wyoming (488192)
Monthly Climate Summary Period of Record : 1/ 1/1978 to 5/31/2009 (Western Regional Climate Center 2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	28.1	30.9	39.9	49.6	60.4	72.0	80.1	78.2	68.1	54.0	38.6	29.1	52.4
Average Min. Temperature (F)	2.0	4.3	15.0	22.5	31.1	39.0	44.9	43.0	33.8	23.7	13.9	3.5	23.1
Average Total Precipitation (in.)	0.38	0.45	0.63	1.02	1.62	1.32	1.43	1.02	0.96	0.81	0.43	0.40	10.48
Average Total SnowFall (in.)	7.5	9.7	7.8	8.8	3.9	0.4	0.0	0.0	1.2	5.0	7.4	7.7	59.4
Average Snow Depth (in.)	6	8	5	1	0	0	0	0	0	0	2	4	2

Percent of possible observations for period of record.
Max. Temp.: 94.9% Min. Temp.: 95.2% Precipitation: 96.8% Snowfall: 97.1% Snow Depth: 96%

Regional climate: The Laramie Basin and Shirley Basin areas have average annual precipitations of less than 11 inches, and very similar precipitation and temperature conditions (Western Regional Climate Center 2010) (Tables 4, 5). The month of highest precipitation is usually May. The average monthly minimum temperatures are above freezing only from May through September.

Local microclimate: The low cover, windy settings, and often shallow rocky soil signify harsh microclimate conditions in *Sphaeromeria simplex* habitat. Many of these exposed areas probably do not hold snow cover well in the winter, leaving little melt water to recharge the ground in the spring. Low humidity and the high elevation summer sun increase the evapotranspiration rate. However, being low to the ground, *S. simplex* is somewhat shielded from the wind and changes in air temperature.

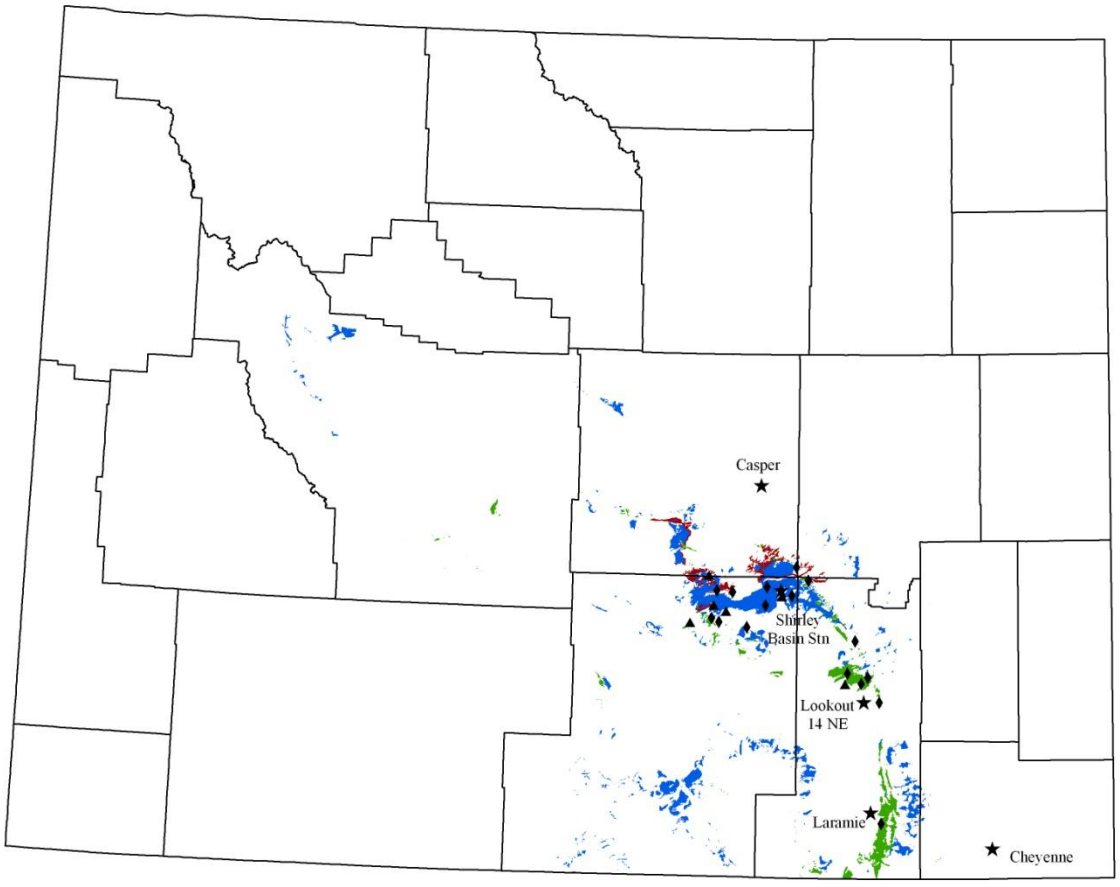
There has been debate over what constitutes suitable habitat. Dorn (1978), in describing local patterns of distribution at the type locality, noted that: "…The limestone formation goes on for many miles with no perceptible difference, but both *Sphaeromeria simplex* and *Phlox bryoides* [*P. muscoides*] drop out for no perceptible reason. There may be a chemical change in the rock. Gypsum may be the constituent which is required, as the *Phlox* is often found in gypsum-limestone areas." When *Sphaeromeria simplex* was still only known from one occurrence, its distribution was called an "enigma" by Walter Fertig, who said: "There are a lot of places around here [the Laramie Basin] where you'd think it would grow. We know it likes exposed limestone outcrops, but it may have other requirements, too, that we don't know about yet" (Winner 1993).

The distribution of *Sphaeromeria simplex* has been expanded significantly since 1993, but challenges remain in determining what constitutes "good habitat." Over the course of 2009 survey work, two hypotheses were developed to account for the breaks in its distribution and local limits in its extent. First, it is possible that the distribution of *S. simplex* represents a relict pattern reflecting ancient climates or conditions rather than current conditions. Second, it is also possible that the distribution of *S. simplex* represents a species with distribution curtailed by disturbance events such as fire, with limited capacity for dispersal and colonization. The hypothesis presented by Robert Dorn (above), that it has subtle environmental requirement such as gypsum concentration, is also a possibility, though no commonality has been found. These three hypotheses, alone or together, would explain distribution gaps over apparently suitable habitat and abrupt population boundaries that do not seem to correlate with the discerned environmental conditions.

The potential distribution model for *Sphaeromeria simplex* predicted high, medium and low probability potential habitat, based mainly on soils and geologic characteristics, in addition to relief, land cover, and spring and fall temperature values (Fertig and Thurston 2003, Appendix A). Two of the three *S. simplex* occurrences that were discovered in ecological studies (Jones

2005) overlapped with polygons of potential habitat predicted by the potential distribution model, and the third was in the same quarter-section. Five of the six of the new *S. simplex* occurrences documented in the course of 2009 surveys overlapped with polygons of potential habitat predicted by the potential distribution model. The other new occurrence is approximately 1,000 m from high probability potential habitat and borders the private land that the model encompasses. The 2009 survey results found that the potential distribution model worked well, especially in proximity to known occurrences (Figure 8).

Figure 8. Distribution of *Sphaeromeria simplex* and potential species distribution model



Population biology and demography

Phenology: Flowering – mid May to early July, Fruiting – late May to mid Aug (RM 2010)

Peak flowering is in the last week of May and early June for most populations, but there is variation. Walter Fertig noted: "This population [Grinnell Creek in Shirley Mountains] typically flowers 1-2 months after the Laramie population" in a letter of 30 June 1996 to Jim Locklear. The Grinnell Creek occurrence (#2) is the highest elevation occurrence and the Laramie quarry occurrence (#1) is the southernmost.

Table 6. Size and extent of *Sphaeromeria simplex* populations

Site name	**Population size**	**Extent**	**Occurrence rank**
Laramie quarry	3000-7000 in densest subpopulation	ca 130 acres	B – Good estimated viability
Grinnell Creek	ca 18,100	ca 140 acres	A – Excellent estimated viability
Little Medicine	ca 41,830	ca 100 acres	A – Excellent estimated viability
Moss Agate Ridge	500+	ca 8 acres	B – Good estimated viability
Chalk Mountain	100,000s	ca 250 acres	AB – Excellent or good estimated viability
Dodge Peak	450+	ca 10 acres	B – Good estimated viability
Sevenmile Creek	10,000-22,200	ca 435 acres	A – Excellent estimated viability
Petrified Forest	2500-6000	ca 235 acres	B – Good estimated viability
Sand Creek tributaries	700+	ca 10 acres	BC – Good or fair estimated viability
Twentytwo Mile Draw (private land)	unknown	unknown	E – Verified extant (viability not assessed)
Bluegrass	950+	ca 40 acres	B – Good estimated viability
Kite Ranch Road	150-300+	ca 15 acres	BC – Good or fair estimated viability
Dry Creek Rim	220+	ca 5 acres	BC – Good or fair estimated viability
Cave Creek	1,500,000	ca 130 acres	A – Excellent estimated viability
Pine Hill	2000+	ca 70 acres	AB – Excellent or good estimated viability
Spring Creek	1000-2000	ca 3 acres	B – Good estimated viability new 2009
Teton Camp	ca 7	less than 1 acre	D – Poor estimated viability new 2009
Shirley Basin Rim	10,000+	ca 50 acres	AB – Excellent or good estimated viability new 2009
North Fork Canyon Creek tributaries	500-1000	ca 5 acres	E – Verified extant (viability not assessed) new 2009
Fourmile Point	1500-4500	ca 145 acres	B – Good estimated viability new 2009
Bunker Draw	5000-10,000	ca 40 acres	B – Good estimated viability new 2009
Deer Creek	ca 26,760	ca 235 acres	A – Excellent estimated viability formerly part of Little Medicine

Population size and condition: Based on 2009 surveys and prior work, the total numbers of *Sphaeromeria simplex* in Wyoming are over 1.6 million plants, in an occupied area of over 2000 acres (over three square miles). These numbers are low in light of estimates with over 86,000 plants when it was only known from three occurrences (Mountain West Environmental Services

1996). At least part of the difference is thought to be due to differences in interpreting what is called an individual plant. At present, there are seven populations that number over 10,000 plants (Table 6).

Population numbers may be determined differently depending on what is interpreted as constituting an individual (Figure 9). Interpretation differences may explain differences between estimates of 1500-2000 plants and counts of 185,856 plants at the Laramie quarry (#1), at least as more important as trend differences (discussed in Heidel and Handley 2007). Stromberg and Lichvar (1982) ascribed the differences to the fact that they had conducted rigorous quantitative sampling as compared to prior imprecise estimates. This is a valid point, but they did not discuss differing conventions for delimiting individuals as another possible explanation for the discrepancies. Closer examination of the underground branching pattern and surface patterns of shoot distribution led to a more conservative approach in 2007 monitoring, using a convention of treating any shoots less than 15 cm apart as representing the same individuals (Heidel and Handley 2007). This means that any given individual can have 1-many shoots (ramets). It appears that there is decay in the underground woody caudex of old plants, so that clusters of shoots can function entirely independently whether or not they were once connected and represent the same genotype. The estimates in Table 6 are conservative ones that could be low by at least a magnitude if every shoot were tallied rather than every loose aggregate of shoots.

Figure 9. High density, in particular, creates difficulty in delimiting individuals
Photo by Bonnie Heidel

Reproductive biology: *Sphaeromeria simplex* reproduces sexually; the fruits are achenes. The woody base of *Sphaeromeria simplex* branches, which may provide the species with a means of vegetative reproduction. Over time these branches may separate, making it difficult to determine clones (genets).

Figure 10. Vegetative clumps of *Sphaeromeria simplex*

There have been no studies of achene production in *Sphaeromeria simplex*, but it has been noted: "I was a little surprised by the low level of fruit production in this species [*S. simplex*]. With each head averaging about 10 fruit, and individual plants rarely producing more than 3-5 flowering stems, it would seem that annual fruit production is pretty low, at least relative to a lot of other plants in the same habitat. I suppose it must compensate through longevity or vegetative spread." (Walter Fertig in letter of 30 June 1996 to Jim Locklear). During the 2009 surveys, it was noted that some occurrences had a high proportion of vegetative plants (Figure 10).

Pollination biology: Flower heads of *Sphaeromeria simplex* may be protandrous, meaning the male flowers appear to mature before the female flower, thus reducing the likelihood of self-pollination. During the 2009 surveys, possible pollinators were observed: small flies were noted on flowers in a couple instances, and ants were observed moving up and down flowering stalks.

Seed dispersal and biology: The achenes of *Sphaeromeria simplex* do not have a pappus, therefore it is unlikely that they travel far from the plant via wind or externally on animals. Unless they are cached by animals, most achenes probably stay close to the parent plant when they drop.

Population ecology

General summary: *Sphaeromeria simplex* appears to be a long-lived perennial. No signs of seedlings were found in the 2009 surveys but seedlings were noted as numerous in the 1983 and 1984 monitoring of *S. simplex* at the Laramie quarry occurrence (#1) (Mountain West Environmental Services 1996). Due to the branched, woody base there is no clear way to characterize the age or life history stage of individuals.

In 1899, Nelson reported it as "certainly rare and far from abundant even in the type locality."

Trend data are not available for any sites apart from monitoring at the Laramie quarry (#1), and even those have proven impossible to replicate due to different estimation methods. At this site, a monitoring program with permanent markers and coordinates recorded with a GPS unit, detailed record of methods, and photopoints was established during the most recent survey (Heidel and Handley 2007). It is recommended that any new, long-term monitoring also evaluate methods of measuring cover devised for mat-forming plants (Lesica 1993, Lesica and Steele 1996) as an alternative to recording individuals. Further discussion of monitoring considerations is available upon request.

Competition: *Sphaeromeria simplex* seems to thrive in areas of low plant cover. There is some evidence of disturbance from burrowing mammals in the vicinity, but it has not been observed on fresh burrows or any other recently disturbed places, such as roadcuts.

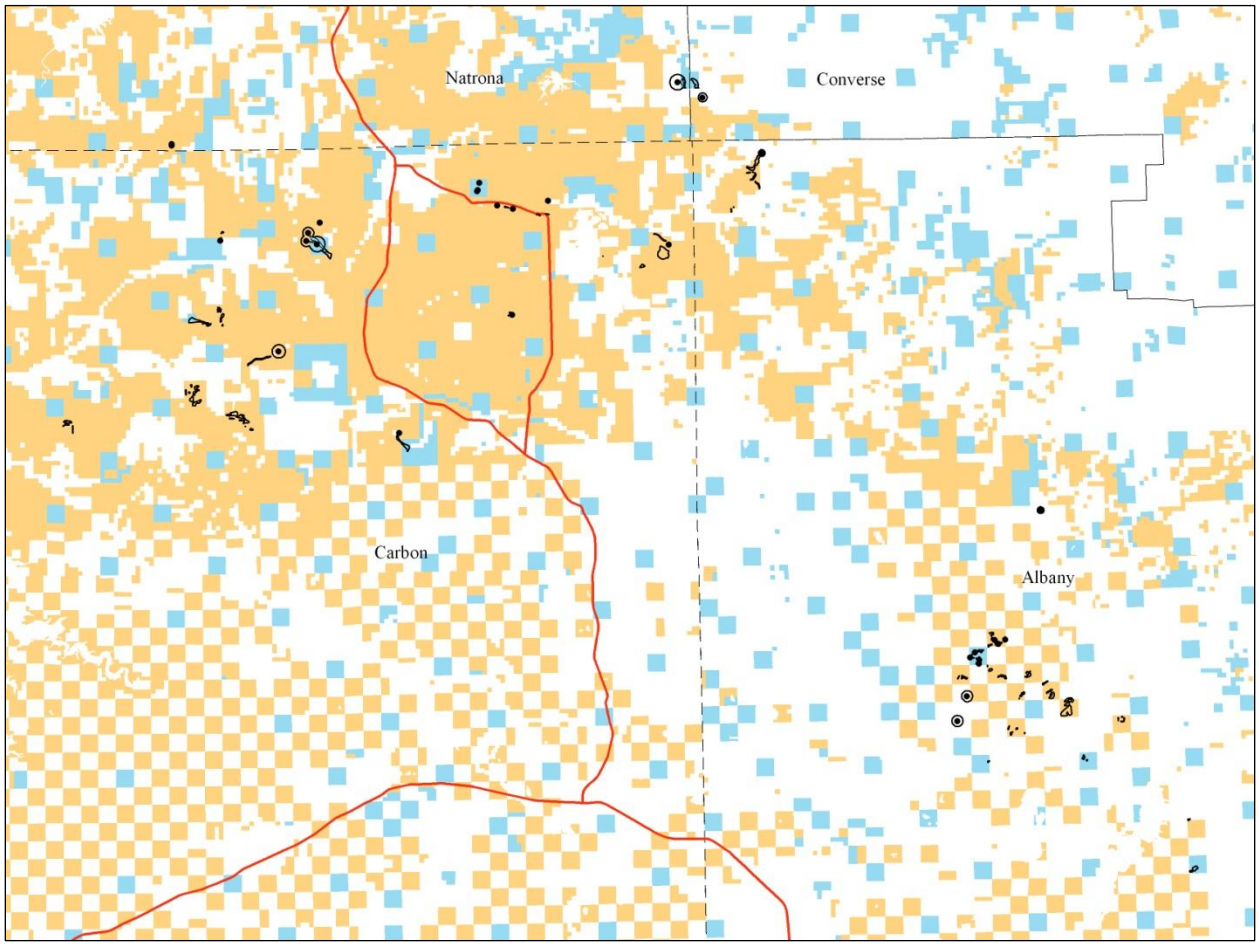
Herbivory: None observed.

Hybridization: *Sphaeromeria capitata* is often found along with *S. simplex* but they are not known to hybridize. There is no evidence of *S. simplex* hybridizing with any of its congeners.

Land ownership

The majority of known populations are on lands administered by the Rawlins Field Office of the Bureau of Land Management and the State of Wyoming (Figure 11). The North Fork Canyon Creek tributaries (#22) occurrence is on lands administered by the Casper Field Office of the Bureau of Land Management. The Nature Conservancy has a 20 acre easement at the Laramie quarry site (#1). The Twentytwo Mile Draw population (#12) is from a collection on private land, and some of the other occurrences may extend onto adjacent private lands.

Figure 11. Land ownership of *Sphaeromeria simplex* occurrences (except Laramie quarry, #1)



Sphaeromeria simplex occurrences represented by black dots and polygons

Roads County lines BLM lands Wyoming state lands

ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Potential threats to currently known populations

Grazing: The prevailing land use in *Sphaeromeria simplex* habitat is ranching. All occurrences, except for one, are on public lands that are part of large grazing allotments. The species is often found on the rockiest places in the landscape, which have shallow soils and zones of low forage production. Some settings are close to water sources or above drainages, so livestock grazing and travel occur in these areas, but are not concentrated in *S. simplex* habitat. The level of grazing did not appear to modify occupied habitat. Increaser species and exotics are sparse or absent.

The majority of allotments are cattle allotments. One sheep allotment was surveyed during the time of grazing and no signs of grazing or trampling were noted (part of Petrified Forest, #9). Sheep grazing and sheep bedding were not found to be threats (part of Deer Creek, #25). One horse pasture was surveyed prior to grazing, but *Sphaeromeria simplex* appeared to be present in very low numbers due to habitat suitability constraints, so no inferences were drawn (part of Laramie quarry, #1).

Range improvements are generally limited in the landscape and include stock ponds, windmills, rubbing posts, corrals and fencing. Water developments were generally at a distance from *Sphaeromeria simplex* habitat. Fencelines usually skirted the species' habitat.

No signs of grazing or browsing were observed on individual *Sphaeromeria simplex* plants. There has not been research on the *Sphaeromeria* genus as to whether it contains the terpenoids and sesquiterpene lactones of the closely-related *Artemisia* genus that deter herbivory. However, the *Sphaeromeria* genus has glandular leaves and flowers, and a fragrance of crushed leaves that resembles the fragrance of *Artemisia*, suggesting chemical similarities that render it unpalatable.

Wind energy development: *Sphaeromeria simplex* distribution overlaps with the largest area of Class 7 wind energy potential in the state (Elliott et al. 1986), the category having the highest potential for development. The species often occupies the windiest landforms within this area. Meteorological testing towers for wind energy development have been erected on private land near one occurrence (Sevenmile Creek, #8) and proposed at others.

The platform area for an individual wind turbine is approximately 35,000 sq ft. With the access roads and associated facilities there is a large amount of disturbance associated with wind turbines (F. Blomquist 2010 pers. comm.). The potential influence on *Sphaeromeria simplex* is greatly increased by the possibility that the placement of multiple towers may follow rims and ridges as topographic features that correspond with species' distribution. Wind energy development may also potentially affect the species in the wind-churning affects of the turbines by causing desiccation of the surrounding vegetation (Baidya Roy et al. 2004).

Mining and extractive energy development: There are three classes of mining and energy resource extraction activities on BLM administered lands: salable minerals, locatable minerals, and leasable minerals. All three are present in or adjoin *Sphaeromeria simplex* habitat.

1) Salable minerals include materials such as sand, gravel, and rock that are used for many construction purposes. They are bulky and needed in large volumes, so their sheer weight makes transportation costs high. BLM policy is to make these materials available to the public and local governmental agencies whenever possible and wherever environmentally acceptable. The presence of a sensitive species on a site allows BLM

discretion not to issue a permit (F. Blomquist 2010 pers. comm.). BLM sells mineral materials to the public at fair market value, but gives them free to states, counties, or other government entities for public projects (USDI Bureau of Land Management 2009).

The gravelly limestone that is often found in *Sphaeromeria simplex* habitat is suitable for road surfacing material. There is a small, inactive quarry on BLM lands at Moss Agate Ridge (#4), which is now used by the Wyoming Department of Transportation as a stockpile area, in or adjoining *Sphaeromeria simplex* habitat (F. Blomquist 2010 pers. comm.).

The type locality of *Sphaeromeria simplex* in hills above Laramie is on private property where limestone bedrock members of the Casper Formation are quarried for cement production (Laramie quarry, #1). A mining permit was pending at a time when this was the only known population, raising concerns that it could be threatened with extinction. A 20 acre segment of the population with highest numbers was put into conservation easement while a directly adjoining tract lying downslope that had lower numbers was quarried, refilled, and revegetated.

2) Locatable minerals include metallic and nonmetallic minerals such as gold, silver, copper and uranium. These are subject to the provisions of the 1872 Mining Law. Uranium mining is in the reclamation phase in the Shirley Basin, including the Moss Agate Ridge occurrence (#4) where *Sphaeromeria simplex* was documented on a rim setting that, from topographic maps, appears to extend into central areas of the mine. The Teton Camp occurrence (#20) is also near this mine.

3) Leasable minerals are subject to lease by the Federal Government and include energy resources as well as potash, sodium and phosphate. Test holes for coalbed methane were noted in part of occupied habitat at Fourmile Point (#23). Pipelines run through at least the Sevenmile Creek (#8) occurrence. Supplementary roads and other facilities are also potential developments associated with leasable minerals.

Roads: The habitat occupied by *Sphaeromeria simplex* is often conducive to motorized travel because the often rocky, shallow soils are passable in most weather conditions, the exposed positions reduce snow accumulation, and the habitat often follows outcrop planes and landforms along gentle contours. The largest road development in occupied habitat to date is at Moss Agate Ridge (#4). The original roadway followed very close to the rim, built on and adjoining to *S. simplex* habitat. When U.S. Highway 487 was constructed, it was set back from the rim to provide broad, gentle right-of-ways. A spur road from the highway follows the rim in the opposite direction, a broad road with bladed margins totaling nearly 30 ft (10 m) width that was developed for use by heavy machinery access to a uranium mine. The Little Medicine

occurrence (# 3) is crossed by Little Medicine Road. Grinnell Creek (#2) and Chalk Mountain (#5) have dirt recreational and utility roads that seem to get significant use. In other settings, two-tracks cross *S. simplex* habitat where the limited level of use and general confinement of travel to the tracks suggest limited affect (Figure 12) (other parts of Little Medicine, #3, and Moss Agate Ridge, #4; Sevenmile Creek, #8; Petrified Forest, #9; Sand Creek tributaries, #10; Bluegrass, #14; Dry Creek Rim, #16; Pine Hill, #18; Shirley Basin Rim, #21; Fourmile Point, #24; Bunker Draw, #24; Deer Creek, #25).

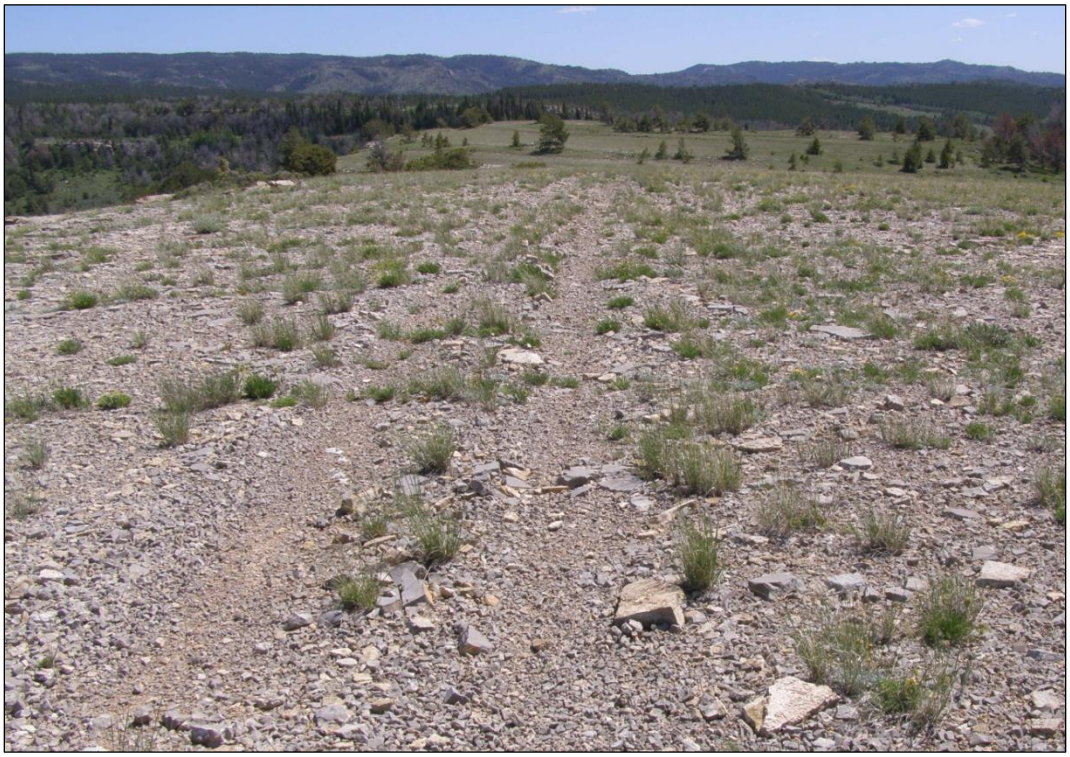


Figure 12. Two-track crossing *Sphaeromeria simplex* habitat
Photo by Bonnie Heidel

Tire tracks sometimes cross cushion plant habitats such as those occupied by *Sphaeromeria simplex*. It was noted in earlier ecological studies of cushion plant vegetation that tracks lay in ruts noticeably lower than the undisturbed ground surface, whether due to compaction or wind deflation, or both (Jones 2004, 2005). Unvegetated tire tracks demonstrated narrow strips of impact. This interpretation was qualified by the statement that the presence of tire tracks without ruts extending into undisturbed habitat would be more worrisome, as indication of indiscriminate off-road use (Jones 2004, 2005).

Quarrying of *S. simplex* habitat for road construction is more likely to be a threat to the species than new road development, as discussed above in salable minerals.

Recreation: Recreational uses in *Sphaeromeria simplex* habitat are limited to hunting and other forms of dispersed recreation. There are no recreational developments directly adjoining *S. simplex* habitat at present.

Weeds: No noxious weeds were found in association with *Sphaeromeria simplex*. The absence of weed species was noteworthy among cushion plant communities in general (Jones 2004, 2005). The only noxious weeds in the landscape were along public access roads, where herbicide spraying in some cases targeted unwanted natives. In general, there were few exotic species at all. The only occurrence with more than a trace of exotic species is at Laramie quarry (#1) where *Malcolmia africana* (African mustard) appears to be expanding from directly adjoining habitat that had been quarried and revegetated.

Other: There is no known commercial collecting of *Sphaeromeria*. Members of the genus have been studied for anti-tumor compounds (Owen Asplund 1990 pers. comm. to Stephen Williams) but there are no published reports of cancer research value.

The *Sphaeromeria simplex* habitat is often at summits and high points in the landscape. The prominent locations are suitable tower construction sites for telecommunications, radio, microwave, and beacons. One of the largest *S. simplex* populations is at Chalk Mountain (#5), which also has the largest tower installation among *S. simplex* occurrences. The tower is in a portion of *S. simplex* habitat. There is also a microwave tower in the *S. simplex* habitat at Grinnell Creek (#2). The towers were approved for construction before it was known that *S. simplex* was present at these sites.

Sphaeromeria simplex populations occupy prominent landforms that may have cultural features directly associated with them. Teepee rings, cairns, and possible grave sites were noted at several occurrences.

Burrowing activity by small mammals has been noted as common in cushion plant vegetation and in the adjoining vegetation types of the Rawlins Field Office (Jones 2005). Mammal burrows (in most cases, probably made by pocket gophers, *Thomomys* sp.) were noted at some of the plots along rims and on outcrops, and in even more of the plots away from rims and outcrops (Jones 2005). There were no observations to indicate that *Sphaeromeria simplex* requires successional conditions associated with burrowing, although it may have adaptations that confer resilience to burrowing activity.

Management practices and response

There have been no studies of management practices and associated responses involving *Sphaeromeria simplex.* At least one of the occurrences appears to have had lightning strikes

within population boundaries as evidenced by fire scars on limber pine (*Pinus flexilis*). The sparse vegetation at this particular site (Cave Creek, #17) would not be likely to conduct a wildfire and tree cover is low. However, Cave Creek, Grinnell Creek (#2), and Chalk Mountain (#5) might be affected by fire if a large crown fire started in surrounding timber. Elsewhere, wildfires or prescribed burns could impact *S. simplex* where found in gently rolling habitat continuous with well vegetated terrain. It might be expected that *S. simplex* is as flammable as members of the *Artemisia* genus. The terminal bud is at the surface, and the dead, persisting leaves on the root crown are like tinder.

Sphaeromeria simplex habitat directly adjoined *Artemisia tridentata* ssp. *wyomingensis* in notably high density at Bunker Draw (#24). Otherwise, *A. tridentata* ssp. *wyomingensis* is often present in the landscape, albeit at greater distances. At the Bunker Draw occurrence, if not others, any prospects of prescribed burn could impact *S. simplex*. It is possible that fire history and limited ability for recolonization may account for some of the current gaps in *S. simplex* distribution.

Conservation recommendations

Recommendations regarding present or anticipated activities: Based on the results of this project, the potential distribution model that was developed for *Sphaeromeria simplex* (Fertig and Thurston 2003, Appendix A) is recommended for continued use in project reviews. It has utility in identifying potential habitat, particularly among the high probability polygons. The high probability polygons were generally much more extensive than *S. simplex* distribution, and sometimes omitted significant areas of distribution one to two miles away. For this reason, unsurveyed areas may warrant surveys on the ground if they lie in polygons predicted as high probability habitat, or within about two miles of them. Priorities can be drawn, and likelihood further evaluated, by studying aerial photographs for indication of rocky, calcareous habitat.

Notification of BLM personnel of locations on BLM lands: To prevent inadvertent impacts to known populations, all appropriate BLM personnel involved in planning and on-the-ground land management activities, including oversight of mineral material quarrying and wind energy developments, should be provided with location data for *Sphaeromeria simplex*. Toward this end, the updated state species abstract (Appendix D) and GIS files of all currently known occurrences are provided with this report.

Areas recommended for protection: Fertig (1999) identified eight occurrences of *Sphaeromeria simplex,* nearly all those known at that time, as priorities for conservation action. The species' habitat is addressed as part of the sensitive species policy in the Rawlins Resource Management Plan (USDI Bureau of Land Management 2008). Cushion plant communities have not been treated as conservation targets. However, the overlap of *S. simplex* distribution with these

unique communities, as well as their overlap with other Wyoming Basin local or regional endemics, elevate their significance and may present a case for protection if not adequately protected under current policy. The largest populations (Cave Creek, #17 and Chalk Mountain, #5), the most extensive population (Sevenmile Creek #8) and the other three populations of at least 10,000 plants on BLM-administered lands warrant special consideration.

It is noteworthy that one of the most extensive *Sphaeromeria simplex* populations (Sevenmile Creek, #8) is in a checkerboard land ownership area. There are other large populations that may have significant extensions onto unsurveyed private land. Species information may be appropriate to consider in any real estate transactions adjoining known occurrences.
Two easements encompass portions of the Laramie quarry (#1) on private property, including the largest and one of the smaller known subpopulations. The first easement in particular remains highly significant as it represents the type locality and the largest population segment at Laramie quarry (#1). The Laramie quarry site is separated from all other more northern occurrences by over 30 miles (48 km). There are also isolated BLM parcels of up to 120 ac (50 ha) within 0.5 mile (0.8 km) of the Laramie quarry occurrence that were not addressed in prior local *S. simplex* surveys (Fertig 1995). The current Rawlins Resource Management Plan (USDI Bureau of Land Management Plan 2008) identifies these parcels and others that may have potential *S. simplex* habitat as lands for potential disposal. Most parcels were not addressed in 2009 surveys because this information was not brought into project planning discussions. BLM policy is to screen parcels for the presence of sensitive plants before finalizing land exchanges. Any parcels containing sensitive plants would be dropped from consideration (F. Blomquist 2010 pers. comm.).

Sphaeromeria simplex is included in the Center for Plant Conservation - National Collection of Endangered Plants, with seed material collected by Jim Locklear in 1988. Propagation may be the last resort for a slow-growing perennial.

Status recommendations

Wyoming BLM continues to recognize *Sphaeromeria simplex* as a 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 2010). The new occurrences and greatly expanded documentation of previously known occurrences reduce the endangerment of this species on one hand, but the numerous proposals for wind energy developments signify major potential threats.

Summary

Concerted 2009 surveys produced much new information about *Sphaeromeria simplex* distribution patterns, habitat, population estimates, and area of occupancy. However, there are almost no expansions in range extent and only modest increases in numbers of occurrences. Thus, it is recommended that known distribution continue to be referenced for management and planning purposes.

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