Updated Status Report on

Green River greenthread

(*Thelesperma caespitosum*)

in Southwestern Wyoming

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

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Abstract

The Green River greenthread (*Thelesperma caespitosum*) was first discovered in 1947, but was not described as a new species until 1990 (Dorn 1990). It is closely related to *Thelesperma pubescens* and other taxa in the "*T. subnudum*" complex, differing primarily in having glabrate leaf blades and rayless flower heads. *T. caespitosum* is known from 2 locations near the city of Green River, Wyoming (Sweetwater County) and 2 main sites south of Duchesne, Utah (Duchesne County). Recently, 3 additional colonies have been discovered in southern Duchesne County consisting of *T. caespitosum, T. pubescens,* and morphologically intermediate plants. Biosystematic studies by Hansen (1998) suggest that *T. caespitosum* should be considered a variety of *T. pubescens*. In Wyoming, *T. caespitosum* is restricted to sparsely vegetated cushion plant and bunchgrass communities with low shrub cover on ridgetops and upper slopes of bleached, limey-slate derived from the Wilkins Peak member of the Green River Formation. Utah populations occur on similar outcrops of the Uinta or Green River formations in openings within pinyon pine and mountain mahogany. Surveys in Wyoming in 1997-1998 resulted in the discovery of 3 additional subpopulations on the west side of the Green River. The total state population is currently estimated at 26,500-31,500, a figure that is comparable to estimates made in 1994 (Fertig 1995). Most populations in Utah have not been resurveyed in recent years, although at least one "mixed" *T. pubescens-T. caespitosum* contained thousands to tens of thousands of plants in 1995 (S. Goodrich, personal communication). Green River greenthread is threatened by habitat damage from off-road vehicle recreation, disturbance associated with mineral exploration and development, and urban expansion. Most known populations are on public or tribal lands managed for multiple use and recreation and none currently receive formal protection. Populations on BLM lands in Wyoming could be eligible for designation as a "Special Status Plant" ACEC and the species should be managed as “Sensitive” on public lands. Listing as Threatened or Endangered may be warranted in the future if current public land management fails to prevent significant population declines.

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INTRODUCTION

The Green River greenthread (*Thelesperma caespitosum*) was first discovered by H. Dwight Ripley and Rupert Barneby south of Duchesne, Utah in 1947, but remained undescribed until Robert Dorn located a second population near Green River, Wyoming in 1988 and recognized the taxon as a new species (Dorn 1990). Due to its limited distribution and apparent rarity, the species was designated a Category 2 candidate for listing under the Endangered Species Act by the US Fish and Wildlife Service (USFWS) in 1993. *T. caespitosum* ceased to be a candidate in 1996, following a major revision of the Service's candidate list (US Fish and Wildlife Service 1996). The species is still considered a "special status" plant by the Bureau of Land Management (BLM) Rock Springs Field Office and is a possible candidate for statewide BLM Sensitive designation.

In 1994, the BLM contracted with the Wyoming Natural Diversity Database (WYNDD) to assess the status, habitat requirements, and potential management needs of this species on public lands in southwest Wyoming. That study (Fertig 1995) resulted in the discovery of one additional population (consisting of 6 subpopulations) in the Green River area and in the collection of baseline data on the abundance and distribution of *T. caespitosum*. A follow-up survey was recommended to determine population trends and better assess management strategies. With funding from the BLM, WYNDD conducted additional surveys and monitoring in the summers of 1997 and 1998. The results are contained in this report.

METHODS

Information on the habitat and distribution of *Thelesperma caespitosum* was obtained from secondary sources, including WYNDD and Utah Natural Heritage Program files and computer databases, specimens from the Rocky Mountain (RM) and Central Wyoming College (CWC) herbaria, scientific literature, and knowledgeable individuals. USGS topographic maps, geologic maps (Love and Christiansen 1985), and BLM land status maps were used to identify areas of potential habitat for ground survey.

Field surveys were conducted in early June 1997 and early July 1998 (survey routes and collection sites are indicated in Appendix B). Data on the biology, habitat, population size, and management needs of this species were collected using WYNDD plant survey forms. Locations of occurrences were mapped on 7.5 minute USGS topographic maps and digitized as an arcview theme. Color photographs were taken of plants and their habitat at each site. Information gathered in the field was entered into the computerized Element Occurrence database at WYNDD.

A permanent demographic monitoring transect was established at WY Occurrence # 001 in 1994 following the protocol of Lesica (1987). This transect consisted of a single belt 1 meter x 30 meters long divided into 30 1 x 1 meter plots. Within each plot, individual plants were counted and assigned to one of four classes: flowering, fruiting, vegetative, and dead. The number of flowering and fruiting heads per plant and the percentage of vegetative cover in each plot was

also recorded. This transect was resurveyed in 1998 and results from 1994-1998 are included in Appendix C.

SPECIES INFORMATION

Classification:

Scientific Name: *Thelesperma caespitosum* Dorn (Dorn 1990).

Holotype: USA: Wyoming: Sweetwater County: T18N R106W S31 SE4 of SE4 & S32 SW4 of SW4, 5 km southeast of Green River, barren white shale ridge, 1890 m., 22 June 1988. Dorn 4948 (RM).

Common Name: Green River greenthread (Fertig et al. 1994), Duchesne greenthread (Welsh *et al*. 1993).

Family: Asteraceae or Compositae (Sunflower family).

Synonyms: Welsh *et al*. (1993) reduced *Thelesperma caespitosum* to a variety of *T. subnudum*, creating the new combination *T. subnudum* Gray var. *caespitosum* (Dorn) Welsh. Cronquist (1994) considered *T. caespitosum* and *T. subnudum* var. *alpinum* to be synonyms of *Thelesperma pubescens* Dorn. Hansen (1998) has proposed reducing *T. caespitosum* to a variety of *T. pubescens* (*T. pubescens* Dorn var. *caespitosum* (Dorn) Hansen in ed.).

Phylogenetic Relationships: Cronquist (1994) recognized about a dozen species in the genus *Thelesperma,* all native to central and western North America and warm-temperate regions of South America. *T. caespitosum* is one of five or six taxa in the "*Thelesperma subnudum*" complex (Dorn 1990; Hansen 1998). Dorn has hypothesized that *T. subnudum* is the ancestral species in the complex due to its wide distribution and relatively unspecialized habitat requirements. *T. caespitosum* and *T. pubescens* are thought to be recent derivatives of *T. subnudum* adapted to more specialized and restricted environments. Although morphologically distinct and allopatric in Wyoming, mixed populations of *T. pubescens*, *T. caespitosum,* and intermediate plants occur in southern Duchesne County, Utah. Recent biosystematic studies by Hansen (1998) indicate a strong genetic similarity between *T. pubescens* and *T. caespitosum* (both diploids), suggesting that the taxa should be recognized as varieties of the same species. These taxa, along with *T. subnudum* var. *alpinum*, form a separate clade that is distinct from *T. subnudum* var. *subnudum, T. marginatum,* and *T. longipes* (Hansen 1998).

Legal Status: *Thelesperma caespitosum* was formerly a Category 2 (C2) candidate for listing under the Endangered Species Act (US Fish and Wildlife Service 1993). The C2 list included species that might have warranted listing as Threatened or Endangered, but for which the USFWS lacked sufficient biological data to support a listing proposal. In February 1996, the USFWS revised its candidate policy and eliminated the C2 designation (US Fish and Wildlife Service 1996). As a result, *T. caespitosum* currently has no status under the Endangered Species Act. The taxon is designated a "special status" species by the BLM Rock Springs Field Office and is listed as Sensitive by US Forest Service Region 4 (Amidon 1994; Intermountain Region) (Joslin 1994). It is not protected under state law in Wyoming or Utah.

Natural Heritage Rank: The network of Natural Heritage programs gives *Thelesperma caespitosum* a rank of G1, indicating that the species is "critically imperiled because of extreme rarity" throughout its range and is known from 5 or fewer extant locations (Fertig and Beauvais 1999). Given the recent taxonomic questions surrounding the species, this rank may need to be changed to G1Q. Green River greenthread is ranked S1 in both Wyoming and Utah, indicating that it is imperiled in both states.

Description: Green River greenthread is a tap-rooted perennial herb with glabrous flowering stems 1.5-7.5 inches high (4-19 cm) (Figures 1-2). The mostly basal leaves are pinnately compound with 3-5 short, narrow leaflets. Leaves are glabrous except for the ciliate margins of the petiole (although some specimens in Utah may have sparsely pubescent leaf blades). Flower heads occur singly or in pairs on each stem and contain only reddish-yellow disk flowers. The involucre consists of two distinct rows of connate bracts, with the inner bracts conspicuously larger than the reflexed outer ones. Individual flowers lack a pappus but are subtended by a membranous receptacle bract (Dorn 1990, 1992; Fertig *et al*. 1994; Fertig 1995).

Similar Species: *Thelesperma pubescens* differs in having grayish leaf blades that are pubescent throughout. *T. marginatum* has leaves that are completely glabrous (including the petiole), numerous flower heads per stem, and a more northerly distribution. *Hymenopappus filifolius* has multiple flowering heads per stem and ashy-gray, woolly-pubescent leaves. Rayless specimens of *Erigeron compositus* differ in having thin pappus bristles and involucre bracts in a single, uniform series (Dorn 1990, 1992; Fertig 1995).

In Utah, *T. caespitosum* may be confused with varieties of *T. subnudum*. Variety *subnudum* differs in having long, broad leaf segments, glabrous leaves, somewhat creeping rootstalks, and ray flowers (although rayless specimens are occasionally found). *T. subnudum* var. *alpinum,* an endemic of Wayne County, has shorter stems, smaller heads, and pubescent leaves and stems (Dorn 1990; Welsh *et al.* 1993).

Figure 1. Line drawing of *Thelesperma caespitosum* from Fertig et al. (1994). Clockwise from upper left: single head of disk flowers; individual disk flower with subtending bract; growth habit; single leaf with glabrate surface and ciliate pubescence on petiole margins. Illustration by Isobel Nichols.

Figure 2 (Page 9). Photograph of *Thelesperma caespitosum* from FMC Park on the east side of the Green River, ca 2 miles east of the city of Green River (WY Occurrence # 001). Plants are growing on barren outcrops of the Eocene age Green River shale. WYNDD photograph by W. Fertig, June 1994.

Geographic Range: *Thelesperma caespitosum* is a regional endemic of southwestern Sweetwater County, Wyoming and southern Duchesne County, Utah (Figure 3). In Wyoming, *T. caespitosum* is restricted to two small populations (consisting of 12 subpopulations) on the east and west sides of the Green River about 2 air miles southeast of the city of Green River. The entire state population is restricted to less than 25 acres of habitat in an area of approximately 2.5 square miles. In Utah, two main populations (consisting of at least 4 subpopulations) occur in the vicinity of Indian and Coyote canyons, 3-4 miles south of Duchesne. Two or three additional occurrences consisting of mixed populations of *T. caespitosum* and *T. pubescens* have recently been discovered in the Bad Land Cliffs of southern Duchesne County near Anthro Mountain and the head of the Left Fork Antelope Canyon. The presence of intermediate plants in these latter populations has prompted Hansen (1998) to reclassify *T. caespitosum* as a variety of *T. pubescens*. The Utah populations occupy an area of less than 25 square miles.

Locations of extant populations of Green River greenthread are listed in Table 1. More detailed information is provided in Element Occurrence Records and maps in Appendix A.

Habitat: In Wyoming, Green River greenthread occurs in sparsely vegetated cushion plant communities dominated by Hooker's sandwort (*Arenaria hookeri*), Thrift goldenweed (*Haplopappus armerioides*), and Nuttall's goldenweed (*Haplopappus nuttallii*) on bleached, white or brownish, limey-slate ridgetops and upper slopes of the Eocene-age Green River Formation (Wilkins Peak Member) (Figures 4-6). Vegetative cover is typically 2-15%, while bare soil and rock account for 50-75% of total cover. Soils are dry, weakly developed inceptisols or carbonate-rich aridisols with a shallow lithic contact. Average annual precipitation in the Green River area is 7.71 inches (196 mm), with peak levels in May. Mean annual temperature is 42.7° F (5.9° C), with mean maximum and minimum temperatures in January of 32.1° and 4.9° F (0° and - 15° C) and mean maximum and minimum temperatures in July of 86.9° and 49.4° F (30.5° and 9.7° C) (Martner 1986). Common associated species include Tufted cryptantha (*Cryptantha caespitosa*), Shortstem wild-buckwheat (*Eriogonum brevicaule*), Moss phlox (*Phlox muscoides*), Condensed bladderpod (*Lesquerella alpina* var. *condensata*), and Shadscale (*Atriplex confertifolia*). *T. caespitosum* is absent from sites with dense shrub or graminoid cover or areas with sparse rock cover.

Utah populations of *T. caespitosum* occur on white shale or marl limestone benches, cliffs, and slopes of the Green River (Parachute Creek Member) or Uinta formations (Ben Franklin and Sherel Goodrich, personal communication). As in Wyoming, Utah occurrences are mostly on benches, gentle slopes, and concave ridges rather than steep slopes. These populations are often found in openings within communities of *Pinus edulis* and *Cercocarpus montanus.* Populations in Indian Canyon co-occur with two other local endemics, *Lepidium barnebyanum* and *Parthenium ligulatum*.

Figure 3. Global distribution of *Thelesperma caespitosum*.

Table 1. Location information for known populations of *Thelesperma caespitosum* in Wyoming and Utah

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I. Wyoming

A. Green River

Occurrence # 001
County: Sweetwater.
Legal Description: **T18N R106W S31** (SE4 of SE4); **S32** (SW4SW4); **T17N R106W S6** (NE4 of NW4 of NE4 of NE4).
Latitude: 41° 29' 24" N (centrum).
North: 41° 29' 30" N.
South: 41° 29' 18" N.
Longitude: 109° 24' 29" W (centrum).
East: 109° 24' 10" W.
West: 109° 24' 35" W.
Elevation: 6300-6330 ft (1920-1930 m).
USGS 7.5' Quad: Whalen Butte.
Location: Green River Basin, ca 0.75 miles north of Cordwood Bottom on the east side of the Green River, ca 2 air miles southeast of the city of Green River.

Occurrence # 002
County: Sweetwater.
Legal Description: **T17N R106W S7** (center of SW4); **S8** (SE4 of NW4 of SW4); **T17N R107W S12** (S2 of NE4).
Latitude: 41° 27' 57" N (centrum).
North: 41° 28' 09" N.
South: 41° 27' 44" N.
Longitude: 109° 25' 27" W (centrum).
East: 109° 25' 27" W.
West: 109° 25' 27" W.
Elevation: 6440-6520 ft (1960-1990 m).
USGS 7.5' Quad: Whalen Butte.
Location: Green River Basin, ridge system on south side of Logan Draw, from vicinity of old drill hole east of Whalen Butte Road east ca 1.5 miles to west side of Point 6465, ca 2.5-4 miles southeast of the city of Green River on the west bank of the Green River.

II. Utah

A. Indian Canyon

Occurrence # 001
County: Duchesne.
Legal Description: **T4S R5W S15** (NW4), **S16, S17**.
Elevation: 6000-6600 ft (1830-2010 m).
USGS 7.5' Quad: Duchesne.
Location: 1 mile north of Indian Canyon along main ridge, 3.5 miles southwest of Duchesne.

Occurrence # 003
County: Duchesne.
Legal Description: **T4S R5W S22** (NW4).
Elevation: 6000 ft (1830 m).
USGS 7.5' Quad: Duchesne.
Location: 3-4 miles southwest of Duchesne along Highway 33 in Indian Canyon.

B. Coyote Canyon

Occurrence # 002
County: Duchesne.
Legal Description: **T4S R5W S23, S24** (SW4 of NW4NW4), **S25** (W2 of NW4), **S26** (W2 of NW4, E2 of NW4, NE4 of NW4, NW4NW4 of NE4).
Elevation: 5900 ft (1800 m).
USGS 7.5' Quad: Duchesne SW.
Location: About 3.5 miles south of

Duchesne [ridges on north side of Coyote Canyon].

Occurrence # 004
County: Duchesne.
Legal Description: **T4S R4W S19** (SW4 of NE4)**.**
Elevation: 6000-6200 ft (1830-1890 m).
USGS 7.5' Quad: Duchesne SW.
Location: About 3.5 miles south of Duchesne [vicinity of Coyote Canyon].

C. Bad Land Cliffs
[These populations consist of a mix of pubescent and glabrate forms that bridge the gap between true *T. caespitosum* and *T. pubescens*].

Occurrence A.
County: Duchesne.
Legal Description: **T7S R4W S17**, **S18**.
Elevation: 8100-8400 ft (2470-2560 m).
USGS Quad: Anthro Mountain NE.
Location: West Tavaputs Plateau, head of Left Fork Antelope Canyon near Bad Lands Cliffs.

Occurrence B.
County: Duchesne.
Legal Description: **T11S R13E S12** (SW4 of SE4); **S13** (NW4 of NE4); **T11S R14E S8** (NE4).
Elevation: 8000 ft (2440 m).
USGS Quad: Wood Canyon.
Location: West Tavaputs Plateau, Bad Lands Cliffs, Argyle Escarpment [near head of Wood Canyon].

Occurrence C.
County: Duchesne.
Legal Description: **T10S R13E S33** (SW4); **T11S R13E S3** (SW4); **S5** (SE4).
Elevation: 8350-9000 ft (2545-2740 m).
USGS Quad: Anthro Mountain.
Location: Side of Anthro Mountain and Bad Lands Cliffs 1.4 miles southeast of Anthro Mountain.

Population Size and Trends: In 1994, the Wyoming population of *Thelesperma caespitosum* was estimated at 22,000-28,000 individuals, based on surveys of 9 known subpopulations (Fertig 1995). With the discovery of 3 additional subpopulations in 1997-1998 and more thorough sampling, the state population is currently estimated at 26,500-31,500 (Fertig *et al.* 1998). These population estimates may be overly conservative, however, due to difficulties in reliably distinguishing individual plants within dense clusters. The multi-branched caudices of *T. caespitosum* may become intertwined with neighboring plants and can only be differentiated through destructive sampling. As a rule, plants were considered separate individuals during 1997-98 surveys if they were isolated from other clumps by a minimum distance of 3-5 cm. Wyoming populations appear to be stable to slightly increasing since 1994, possibly due to improved recruitment following several wet springs.

Census data are lacking for most Utah colonies, although one population in the Bad Lands Cliffs area has been estimated in the "thousands and likely tens of thousands" (Sherel Goodrich, personal communication). Many of these plants,

Figure 4. Topographic position of *Thelesperma caespitosum* on the landscape, based on the Logan Draw population (WY Occurrence # 002 shown in Figure 5). Illustration by W. Fertig.

X = *Thelesperma caespitosum*

A. Bleached shale gravel and flakes completely cover the surface. *T. caespitosum* present, but scattered. Occurs with *Cryptantha caespitosa* and *Haplopappus nuttallii.*

B. Northwest-facing slope with low vegetative cover (15-20%). *T. caespitosum* present, but widely scattered. Soil dry, fine-textured, and covered by shale slabs and small rocks.

C. Slopes of fine-textured gravel and dark brown rock flakes dominated by *Artemisia tridentata* var. *wyomingensis, Chrysothamnus* spp., and *Atriplex confertifolia*. *T. caespitosum* absent.

D. Gentle slopes dominated by *Artemisia tridentata* var. *wyomingensis* and scattered *Sarcobatus vermiculatus*. Little gravel on surface. *T. caespitosum* absent.

E. Barren, flat bench with high cover of bleached shale rock and slabs. *T. caespitosum* locally common, occurring with *Eriogonum brevicaule, Phlox muscoides,* and *Lesquerella alpina* var. *condensata*.

F. Slopes of fine-textured soils with little surface gravel dominated by grasses and low shrubs. *T. caespitosum* absent.

G. Scree slopes of whitish-gray, flaky shale. *T. caespitosum* absent.

Figure 5 (Page 15). Habitat of *Thelesperma caespitosum* on the south side of Logan Draw (WY Occurrence # 002), about 2 miles south of the city of Green River. Plants occur on whitish limey-shale outcrops of the Green River Formation on the flats in the foreground and on bare northwest-facing slopes below the caprock in the background. WYNDD photo by W. Fertig, June 1994.

however, may represent *T. pubescens* or intermediate plants. Due to access problems, the populations south of Duchesne have not been surveyed since 1989 (Ben Franklin, personal communication).

Population Biology and Ecology: Green River greenthread is a diploid perennial that reproduces sexually by seed. Flowering occurs from late May to mid July, depending on spring moisture and temperature conditions. During the drought year of 1994, flowering was nearly complete by June 20-28 (Fertig 1995), while in the cold, wet spring of 1998, plants were still in bud or early flower on July 2. Fruits typically mature from late June through July. Unlike several other taxa in the genus *Thelesperma*, *T. caespitosum* does not spread vegetatively by rhizomes (Dorn 1990), as I erroneously reported in 1994 (Fertig 1995).

Several pollinators were observed during 1998, including hairy black bees with yellow abdomens, large robber flies, and mottled orange and white butterflies. These species visited *Thelesperma* flowers primarily from mid-morning to early afternoon.

The achenes of *Thelesperma caespitosum* lack a pappus or other specialized structures for dispersal by animals or the wind. Most fruits probably drop close to the parent plant, accounting for the clumped distribution pattern observed at known sites (Fertig 1995). Wind gusts may be adequate to carry fruits short distances downwind of the parent plant.

Individual colonies of Green River greenthread in Wyoming may be locally abundant, with average densities of 3.8-5.7 plants per square meter in occupied habitat (Table 2; Appendix C). Plants are distributed in a non-random, clumped pattern. Populations typically consist of 50-60% reproductive plants and 40-60% vegetative plants. Seedlings have been rarely observed, suggesting that establishment rates are low and probably episodic. *T. caespitosum* is intolerant of shade and is consistently absent from sites dominated by taller forbs, shrubs, or graminoids.

In Wyoming, populations of *Thelesperma caespitosum* are reproductively isolated from populations of related taxa, and no morphological evidence of hybridization has been detected. Hybridization is suspected in several populations in southern Duchesne County, Utah, where *T. caespitosum* and *T. pubescens* grow in sympatry.

Figure 6 (Page 17). Habitat of *Thelesperma caespitosum* on rim of bleached, whitish Green River slate near boundary of FMC Park and Flaming Gorge National Recreation Area (WY Occurrence # 001). Community of widely scattered cushion plants and occasional shrubs. WYNDD photo by W. Fertig, July 1998.

Table 2. Demographic information for Wyoming populations of *Thelesperma caespitosum.*

Occurrence # 001 Area: 7 acres (3 subpopulations). Number of Plants: Population estimated at 6500 individuals on 28 June 1998. Density: 5.7 plants per square meter observed in demographic monitoring plot in 1998. 3.83 plants observed in same plots in June 1994. Evidence of Reproduction: 60-65% of all plants in flowering or fruiting condition on 28 June 1998. Evidence of Expansion/Contraction: A slightly larger area of occupied habitat was observed in 1998, indicating expansion or a more intensive survey effort.	Occurrence # 002 Area: 15 acres (9 subpopulations). Number of Plants: 10,100-15,150 plants observed at 8 of 9 known subpopulations on 5 June 1997. Ca 10,000 plants estimated at ninth colony in 1994. Density: Density of 3.63 plants per square meter observed at one colony in 1994. Higher densities (11-25) have been observed in especially favorable microsites. Evidence of Reproduction: Plants observed in bud, flower, fruiting, or vegetative conditions in 1994, 1996, 1997, and 1998. Evidence of Expansion/Contraction: Additional colonies have been located since this site was first discovered in 1994 (probably as a result of more thorough survey rather than range expansion).

low rates of herbivory have been detected in demographic monitoring plots in Wyoming (Fertig 1995). In most cases, herbivory is restricted to flowering and fruiting heads. Mature leaves are rarely grazed, probably due to their leathery texture or the presence of anti-herbivory compounds. Grazing is probably restricted to insects, rodents, and pronghorn. No evidence of grazing by domestic livestock has been detected.

ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Existing and Potential Threats: Habitat damage from off-road vehicle recreation is probably the single greatest threat to Wyoming populations of Green River greenthread (Fertig 1995; Fertig *et al.* 1998; Refsdal 1996). Due to its proximity to the city of Green River, *Thelesperma caespitosum* habitat on BLM and FMC Park lands receive heavy recreational use. Graded roads and unimproved two-tracks bisect at least two large subpopulations and provide ready access to all other known colonies. Plants are notably absent from the ruts of these roads, although they may persist along the road edge where lighter traffic has removed competing vegetative cover. Vehicles can cause plant mortality directly by dislodging individuals, or indirectly by compacting soils or removing rock cover to facilitate erosion. Road widening, resulting from vehicles driving on the edge of the road to avoid ruts, can lead to further mortality of plants and reduction

of habitat quality (Fertig 1995). Under the Green River Resource Management Plan (USDI Bureau of Land Management 1997), off-road vehicle travel within the known habitat of listed Threatened, Endangered, Candidate, or Sensitive species is technically restricted to existing roads and trails, although enforcement is limited.

Mineral development is a potential threat to populations near Green River, Wyoming, and Duchesne, Utah. Exploration for oil has taken place within 0.25 miles of 7 *Thelesperma caespitosum* subpopulations on the west side of the Green River (WY Occurrence # 002) (Fertig 1995) and has occurred in the vicinity of several colonies south of Duchesne (Utah Natural Heritage Program records). The flat benches inhabited by this species are well suited for the placement of well pads and associated structures if minerals are discovered. These populations could also be vulnerable to disturbances associated with seismic exploration. Commercially significant deposits of trona and oil shale may also be present in the surrounding area. In Wyoming, the habitat of *T. caespitosum* could be protected from surface disturbing activities under language in the Green River Resource Management Plan (USDI Bureau of Land Management 1997, p. 205), although no withdrawals have been proposed to date.

Two *T. caespitosum* colonies on the west bank of the Green River are within 0.2 miles of an existing communications right-of-way in which new fiber optic lines are being placed. Construction associated with these lines could pose a threat if equipment is parked or stored on the gravelly benches occupied by this species.

Expansion of the city of Green River is a potential threat if public lands occupied by *T. caespitosum* are made available for residential development. A growing urban population will result in greater demands for off-road or other recreational opportunities within this plant's habitat. As the city encroaches, *T. caespitosum* habitat may become more vulnerable to invasion by exotic weeds.

Grazing by cattle, sheep, or horses does not appear to be detrimental to Wyoming populations of Green River greenthread due to the plants low stature and poor palatability. Attempts to increase livestock use through supplemental water tanks or salt blocks should be discouraged within occupied habitat.

Current Management: Wyoming populations of *Thelesperma caespitosum* occur on lands managed by the city of Green River (FMC Park), BLM Rock Springs Field Office, and Ashley National Forest (Flaming Gorge National Recreation Area). FMC Park is managed primarily for motorized recreation, day use, and shooting sports, and affords no protection for this species (Fertig *et al.* 1998). *T. caespitosum* habitat on BLM and Forest Service lands is currently managed for multiple use, including oil and gas development, recreation, and livestock grazing. No habitat on BLM land has been designated as a "Special Status Plant Area of Critical Environmental Concern" under provisions of the 1997 Green River Resource Area Resource Management Plan (USDI Bureau of Land Management 1997). Utah populations occur on private and tribal lands within the Uintah and Ouray Indian

Reservation and on Ashley National Forest. No Utah populations are found in designated special management areas.

Conservation Recommendations:

1. Road Construction and Maintenance: New roads should not be constructed within the occupied habitat of *Thelesperma caespitosum* in Wyoming. Existing major roads should be maintained in good condition to prevent the inevitable widening of the roadbed by drivers trying to avoid ruts. Off-road vehicle trails leading from established roads in occupied *T. caespitosum* habitat should be closed by physical barriers and the establishment of new trails should be discouraged.

2. Other Development: Surface disturbing activities associated with mineral development and exploration should be routed around occupied habitat of *T. caespitosum* or the immediate area inhabited by these plants should be withdrawn from mineral leasing. Pipeline and communication line routes should avoid occupied habitat.

3. Notification of Land Managers: BLM and Forest Service land managers need to be aware of the exact locations of known *T. caespitosum* populations to reduce management conflicts with mineral development and recreation during the planning process.

4. Establish Off-Site Seed Banks and Populations in Arboreta: Populations of *T. caespitosum* should be established in botanic gardens specializing in the propagation of endangered species (Nebraska Arboretum, Denver Botanic Garden, Red Buttes Garden) to safeguard against unforeseen extinction in the wild and to provide seed for potential reintroductions.

5. ACEC status for Logan Draw area: Provisions in the Green River Resource Management Plan allow for the designation of "Special Status Plant Areas of Critical Environmental Concern" for species that are current or likely candidates for listing under the Endangered Species Act. The management objective for candidate plants in these ACECs is to "provide sufficient protection to prevent listing as threatened and endangered species" (USDI Bureau of Land Management 1997, p. 34). Special status plant ACECs are closed to direct surface disturbing activities, location of new mining claims, and off-road vehicle travel, and are subject to no-surface occupancy stipulations for existing leases. High quality *T. caespitosum* habitat on BLM surface-managed lands in the Logan Draw area (WY Occurrence # 002 in part) would qualify for potential ACEC status.

Legal Status: Green River greenthread was formerly a C2 candidate for listing under the Endangered Species Act, but was dropped in 1996 when the entire C2 program was eliminated. Fertig (1995) recommended that additional surveys and monitoring be conducted (especially in non-drought years) to assess population trends and threats before a decision on listing was made. Since 1995, 3 new subpopulations have been discovered in the Green River area of Wyoming, and at least 3 large colonies have been identified in

southern Duchesne County, Utah. Monitoring studies in Wyoming from 1994-1998 indicate that the state population is currently stable to slightly increasing, despite significant potential threats. Some Taxonomic questions have arisen about the status of *T. caespitosum* as a full species since the discovery of mixed populations of *T. caespitosum* and *T. pubescens* in Duchesne County (Hansen 1998), but these concerns are not sufficient to disqualify Green River greenthread as a candidate for listing. The taxonomic status of these populations needs to be resolved, however, especially if the larger occurrences consist primarily of *T. pubescens*. Threats remain high at most locations (especially in Wyoming), where expansion of urban areas, growth of motorized recreation, and impacts from mineral exploration and pipeline construction are only likely to increase in the future. Existing management guidelines are probably sufficient to protect the habitat of this plant on BLM lands, but implementation and enforcement to date have been spotty. The small geographic range and degree of potential threats are sufficiently high that *T. caespitosum* should continue to be managed as a Sensitive species by the US Forest Service and listed as Sensitive by the BLM. Listing as Threatened or Endangered may be warranted, especially if management actions by federal agencies fail to prevent significant population declines in the near future.

SUMMARY

The Green River greenthread (*Thelesperma caespitosum*) was first discovered in 1947, but was not described as a new species until 1990 (Dorn 1990). It is closely related to *Thelesperma pubescens* and other taxa in the "*T. subnudum*" complex, differing primarily in having glabrate leaf blades and rayless flower heads. *T. caespitosum* is known from 2 locations near the city of Green River, Wyoming (Sweetwater County) and 2 main sites south of Duchesne, Utah (Duchesne County). Recently, 3 additional colonies have been discovered in southern Duchesne County consisting of *T. caespitosum, T. pubescens,* and morphologically intermediate plants. Biosystematic studies by Hansen (1998) suggest that *T. caespitosum* should be considered a variety of *T. pubescens*. In Wyoming, *T. caespitosum* is restricted to sparsely vegetated cushion plant and bunchgrass communities with low shrub cover on ridgetops and upper slopes of bleached, limey-slate derived from the Wilkins Peak member of the Green River Formation. Utah populations occur on similar outcrops of the Uinta or Green River formations in openings within pinyon pine and mountain mahogany communities. Surveys in Wyoming in 1997-1998 resulted in the discovery of 3 additional subpopulations on the west side of the Green River. The total state population is currently estimated at 26,500-31,500, a figure that is comparable to estimates made in 1994 (Fertig 1995). Most populations in Utah have not been resurveyed in recent years, although at least one "mixed" *T. pubescens-T. caespitosum* contained thousands to tens of thousands of plants in 1995 (S. Goodrich, personal communication). Green River greenthread is threatened by habitat damage from off-road vehicle recreation, disturbance associated with mineral exploration and development, and urban expansion. Most known populations are on public or tribal lands managed for multiple use and recreation and none currently receive formal protection. Populations on BLM lands in Wyoming could be eligible for designation as a "Special Status Plant" ACEC and the species should be managed as “Sensitive” on public lands. Listing as Threatened or Endangered may be warranted in the future if current public land management fails to prevent significant population declines.

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Appendix A.

Element Occurrence Records and Population Maps

for *Thelesperma caespitosum*

Utah Occurrences

Indian Canyon

Occurrence # 001
County: Duchesne.
Legal Description: **T4S R5W S15** (NW4), **S16, S17**.
Elevation: 6000-6600 ft (1830-2010 m).
USGS 7.5' Quad: Duchesne.
Location: 1 mile north of Indian Canyon along main ridge, 3.5 miles southwest of Duchesne.
Collector/Collection Number/Date: Reported in Coors Energy T & E survey.

Occurrence # 003
County: Duchesne.
Legal Description: **T4S R5W S22** (NW4).
Elevation: 6000 ft (1830 m).
USGS 7.5' Quad: Duchesne.
Location: 3-4 miles southwest of Duchesne along Highway 33 in Indian Canyon.
Collector/Collection Number/Date: Goodrich, S. (5519, 5524). 2 June 1976.

Coyote Canyon

Occurrence # 002
County: Duchesne.
Legal Description: **T4S R5W S23, S24** (SW4 of NW4NW4), **S25** (W2 of NW4), **S26** (W2 of NW4, E2 of NW4, NE4 of NW4, NW4NW4 of NE4).
Elevation: 5900 ft (1800 m).
USGS 7.5' Quad: Duchesne SW.
Location: About 3.5 miles south of Duchesne [ridges on north side of Coyote Canyon].
Collector/Collection Number/Date: Ripley, H.D. and R. Barneby (8700). 15 June 1947.

Occurrence # 004
County: Duchesne.
Legal Description: **T4S R4W S19** (SW4 of NE4)**.**
Elevation: 6000-6200 ft (1830-1890 m).
USGS 7.5' Quad: Duchesne SW.
Location: About 3.5 miles south of Duchesne [vicinity of Coyote Canyon].
Collector/Collection Number/Date: Reported in Coors Energy T & E survey.

Bad Land Cliffs

[These populations consist of a mix of pubescent and glabrate forms that bridge the gap between true *T. caespitosum* and *T. pubescens*. Some locations may contain only *T. pubescens*].

Occurrence A.
County: Duchesne.
Legal Description: **T7S R4W S17**, **S18** (W2).
Elevation: 8100-8400 ft (2470-2560 m).
USGS Quad: Anthro Mountain NE.
Location: West Tavaputs Plateau, head of Left Fork Antelope Canyon near Bad Lands Cliffs.
Collector/Collection Number/Date: Goodrich, S. and A. Huber (25170) 14 July 1995; Goodrich and Huber (25174) 14 July 1995; Goodrich and Huber (25297).
Note: Goodrich and Huber collection 25170 appears to be good *Thelesperma caespitosum,* # 25174 appears to be intermediate, and # 25297 is *T. pubescens.*

Occurrence B.
County: Duchesne.
Legal Description: **T11S R13E S12** (SW4 of SE4); **S13** (NW4 of NE4); **T11S R14E S8** (NE4).
Elevation: 8000 ft (2440 m).
USGS Quad: Wood Canyon.
Location: West Tavaputs Plateau, Bad Lands Cliffs, Argyle Escarpment [near head of Wood Canyon].
Collector/Collection Number/Date: Goodrich, S. and A. Huber (25293). 1995-08-08; Huber, A., B. Adams, and J. St. Clair (2605). 25 July 1995; Goodrich, S. and A. Huber (25155, 25159) 14 July 1995; Goodrich, S. (6130) 5 July 1976.
Note: Goodrich notes on his specimen label (# 25159) that "pubescence of leaves of this and other recent collections from the West Tavaputs Plateau shows variation that crosses the concepts of *Thelesperma pubescens* Dorn and *Thelesperma caespitosum* Dorn. Variation within populations and across populations in this area indicates a single taxon for these plants".

Occurrence C.
County: Duchesne.
Legal Description: **T10S R13E S33** (SW4); **T11S R13E S3** (SW4); **S5** (SE4).
Elevation: 8350-9000 ft (2545-2740 m).
USGS Quad: Anthro Mountain.
Location: Side of Anthro Mountain and Bad Lands Cliffs 1.4 miles southwest of Anthro Mountain.
Collector/Collection Number/Date: S. Goodrich (25137) 1995-07-12; Franklin, M.A. and J. Chandler (6256). 1988-07-02.

Appendix B.

1997-1998 Survey Routes

Appendix C.

Monitoring Data, 1994-1998
Thelesperma caespitosum (Green River greenthread)
Demographic Monitoring Data

Date: 28 June 1998 Surveyor: Walter Fertig

Transect Location

County: Sweetwater.
Occurrence: EO 001 (east side of Green River).
Legal Description: T18N R106W S31 SE4SE4 (FMC Park)
Orientation: 250° magnetic North.
Latitude: 41° 29.3536 N.
Longitude: 109° 24.5135 W.
USGS Quad: Whalen Butte.
Directions: From the city of Green River, proceed to the FMC Park. Cross the bridge over the Green River and continue on main dirt road for about 2.5 miles to the boundary marker of Flaming Gorge National Recreation Area. The demographic plot is located on the west side of the road near the rim of a wide, flat bench (Figure 7).

Sampling Method: A 30 x 1 meter belt transect was established with starting points indicated by orange re-bar 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 at the origin (at the northwest end of the belt) and continuing southwest. Locations of individual rosettes were mapped and given X, Y coordinates. The number of rosettes per plant was recorded on the map. One of three age classes was assigned to each plant: R (reproductive, in flower or bud), F (fruiting), and V (vegetative). The number of flowering and fruiting heads present and the estimated percent cover per plot was also recorded.

Habitat: Barren cushion plant community on flat bench of fine-textured soil covered by bleached whitish shale or sandstone flakes and gravel of the Green River Formation. Associated species include: *Cryptantha caespitosa, Eriogonum brevicaule, Atriplex confertifolia, Arenaria hookeri, Haplopappus nuttallii, Chaenactis douglasii, Lesquerella alpina* var. *condensata,* and *Linum lewisii.*

Summary of Results: Baseline studies in 1994 indicated a density of 3.83 plants per square meter, with 50.4% in flower and fruit and 49.6% vegetative (Fertig 1995). In 1998, density was measured at 5.73 plants per square meter, with 61% in flower and fruit and 39% in vegetative condition. The total population showed a 49.5% increase between 1994 and 1998, with the largest increase in the reproductive population. This increase probably reflects improved sampling due to recognition of individuals as any tight cluster of rosettes separated from other clusters by 3-5 cm (in 1994, individual clumps were recognized at a coarser scale).

Implications: The 1998 survey incorporated a number of improvements in sampling which may negate the 1994 dataset as a true baseline. Additional plots should be established in Occurrence # 001 and 002 to create a more robust dataset. Populations are small enough that complete censuses could be conducted with proper griding of the habitat. Smaller plots could be randomly located within these populations to assess demographic relationships and density patterns. All sampling techniques involve habitat trampling and may need to be conducted on 2-3 year cycles to minimize habitat damage.

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Figure 7 (Page 45). Location of Monitoring Transect # 1 on shale bench adjacent to 2-track road in WY Occurrence # 001. View is from the origin of the transect. WYNDD photograph by W. Fertig, 28 June 1998.

Thelesperma caespitosum
Transect # 1 Census Data

Codes: R = reproductive (plants with mature flowers or buds), F = fruiting (plants with heads bearing mature or ripening fruit), V = vegetative (plants or stems lacking flowers, buds, or fruits), Fl = flowering, Fr = fruiting.
Date: 20 June 1994
Surveyor: W. Fertig

Plot #	Total #	#R	#F	#V	#Fl heads	#Fr heads	%Cover	Notes
1	8	2	3	3	3	4	50	Atypically high cover
2	5	3	1	1	5	1	10	
3	7	0	1	6	0	1	10	
4	5	1	1	3	1	1	10	
5	5	0	1	4	0	1	5	*T. caespitosum* only plant present
6	8	2	1	5	2	3	15	
7	4	0	1	3	0	5	15	
8	4	0	1	3	0	3	10	
9	6	0	1	5	0	3	25	2 plants heavily grazed
10	3	1	1	1	5	2	15	
11	1	0	0	1	0	0	20	
12	3	0	3	0	0	6	10	
13	4	0	3	1	0	11	25	
14	8	1	5	2	1	14	30	Floral herbivory observed
15	2	2	0	0	6	12	15	Floral herbivory observed
16	2	1	1	0	1	2	5	Floral herbivory observed
17	2	0	0	2	0	0	10	
18	4	2	0	2	8	8	5	
19	0	0	0	0	0	0	2	
20	5	1	2	2	2	7	30	
21	7	1	1	5	3	5	25	
22	4	0	3	1	0	7	15	
23	4	0	3	1	0	14	45	All fruit aborted
24	1	0	0	1	0	0	10	
25	1	1	0	0	1	10	5	
26	1	1	0	0	2	2	3	
27	0	0	0	0	0	0	0	Plot completely barren
28	1	1	0	0	2	0	18	Flowers all aborted
29	3	1	1	1	1	1	20	
30	7	2	1	4	2	3	25	One flower aborted
Tot.	115	23	35	57	45	126		

# of plants per square meter = 3.83
# of flowering heads per square meter = 1.5
# of fruiting heads per square meter = 4.2
% of plants in flower and fruit = 50.4%

Thelesperma caespitosum
Transect # 1 Census Data

Codes: R = reproductive (plants with mature flowers or buds), F = fruiting (plants with heads bearing mature or ripening fruit), V = vegetative (plants or stems lacking flowers, buds, or fruits), Fl = flowering, Fr = fruiting.
Date: 28 June 1998
Surveyor: W. Fertig

Plot #	Total #	#R	#F	#V	#Fl heads	#Fr heads	%Cover	Notes
1	11	5	0	6	8	0	50	Some herbivory of veg. rosettes
2	10	3	0	7	9	0	15	
3	10	3	0	7	4	0	7	
4	10	3	0	7	8	0	5	
5	8	4	0	4	9	0	5	
6	12	6	0	6	6	0	10	
7	8	7	0	1	14	0	5	
8	5	3	0	2	18	0	10	
9	9	6	0	3	39	0	25	
10	5	2	0	3	22	0	5	
11	1	1	0	0	10	0	5	
12	6	4	0	2	10	0	5	
13	5	2	0	3	15	0	30	Some plants heavily grazed
14	8	6	0	2	22	0	35	Floral herbivory observed
15	2	2	0	0	20	0	5	Floral herbivory observed
16	2	2	0	0	9	0	5	
17	3	1	0	2	8	0	5	
18	4	1	1	2	32	1	5	
19	1	0	0	1	0	0	2	
20	8	7	0	1	31	0	25	
21	10	6	0	4	29	0	25	
22	6	4	0	2	57	0	10	
23	8	8	0	0	46	0	20	
24	1	1	0	0	6	0	2	
25	2	2	0	0	5	0	2	
26	1	1	0	0	38	0	3	One huge plant in plot
27	0	0	0	0	0	0	0	Plot completely barren
28	3	2	1	0	6	3	20	
29	5	4	0	1	25	0	10	
30	8	7	0	1	31	0	25	
Tot.	172	103	2	67	537	4		

# of plants per square meter = 5.73
# of flowering heads per square meter = 17.9
# of fruiting heads per square meter = 0.13
% of plants in flower and fruit = 61.0%

Appendix D

Slides