

Townsendia aprica
(Last Chance townsendia)

**5-Year Review:
Summary and Evaluation**



Photo by Daniela Roth; USFWS.

U.S. Fish and Wildlife Service

Utah Field Office

Salt Lake City, Utah

August 22, 2013

5-YEAR REVIEW
Species reviewed: *Townsendia aprica* (Last Chance townsendia)

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5-YEAR REVIEW

***Townsendia aprica* (Last Chance townsendia)**

1. GENERAL INFORMATION

1.1. Purpose of 5-Year Reviews

The U.S. Fish and Wildlife Service (USFWS) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since the time it was listed or since the most recent 5-year review. Based on the outcome of the 5-year review, we recommend whether the species should: 1) be removed from the list of endangered and threatened species; 2) be changed in status from endangered to threatened; 3) be changed in status from threatened to endangered; or 4) remain unchanged in its current status. Our original decision to list a species as endangered or threatened is based on the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the five threat factors using the best available scientific and commercial data on the species, and we review new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process that includes public review and comment.

1.2. Reviewers

Lead Regional Office: Mountain-Prairie Region (Region 6)
Bridget Fahey, Chief of Endangered Species, 303-236-4258
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1.3. Methodology used to complete the review

On June 20, 2011, we published a Notice of Review in the Federal Register (76 FR 35906) soliciting any new information for Last Chance townsendia that may have a bearing on its classification as endangered or threatened. We did not receive any comments in response to the Federal Register notice. This 5-year review was primarily written by the Utah Field Office with review by the Mountain-Prairie Regional Office. It summarizes and evaluates information provided in the Recovery Plan, current scientific research, and surveys related to the species. All pertinent literature and documents on file at the Utah Field Office were used for this review (See References section below for a list

of cited documents). We interviewed individuals familiar with Last Chance townsendia as needed to clarify or obtain specific information.

1.4. Background

1.4.1. Federal Register Notice citation announcing initiation of this review

76 FR 35906; June 20, 2011

1.4.2. Listing history

Original Listing

Federal Register notice: 50 FR 33734; August 21, 1985

Entity listed: Species

Classification: Threatened range-wide

1.4.3. Review History

Since the Federal listing of Last Chance townsendia in 1985, we have not conducted a status review or a 5-year review. However, we considered the species status in the 1993 Recovery Plan (USFWS 1993).

1.4.4. Species' Recovery Priority Number at start of 5-year review

At the start of the 5-year review, the Recovery Priority Number for Last Chance townsendia was 5C. This number indicated that the species faces a high degree of threat and a low recovery potential that may be in conflict with economic activity.

Table 1. The below ranking system for determining Recovery Priority Numbers was established in 1983 (48 FR 43098, September 21, 1983 as corrected in 48 FR 51985, November 15, 1983).

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C
		Subspecies/DPS	3	3C
	Low	Monotypic Genus	4	4C
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	High	Monotypic Genus	7	7C
		Species	8	8C
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

1.4.5. Recovery Plan

Name of plan: Last Chance townsendia Recovery Plan (hereafter referred to as the "Recovery Plan").

Date approved: August 20, 1993

2. REVIEW ANALYSIS

2.1. Application of the 1996 Distinct Population Segment (DPS) policy

This section of the 5-year review is not applicable to this species because the Act precludes listing Distinct Population Segments (DPSs) for plants. For more information, see our 1996 DPS policy (61 FR 4722, February 7, 1996).

2.2. Recovery Planning and Implementation¹

2.2.1. Does the species have a final, approved Recovery Plan?

- Yes
 No

2.2.2. Adequacy of Recovery Plan?

The Recovery Plan has not been updated since 1993 and no longer represents the best available and up-to-date information on the species and its habitat. New research on the life history and habitat of the species is available and should be incorporated into the Recovery Plan.

Additionally, the recovery criteria are no longer believed adequate to gauge the status of the species relative to the Act's definition of threatened or endangered. For example, none of the threats that led to listing have corresponding criteria or objectives. Instead, the Recovery Plan includes only demographic-based recovery objectives. Such information does not allow us to determine long-term trends or determine whether population levels are likely to be maintained in the face of existing or projected threats (particularly after the Act's protections are removed should recovery be achieved and delisting occur). The Recovery Plan calls for the maintenance of viable Last Chance townsendia populations throughout the current range of the species. The Recovery Plan identifies a criterion of 20 populations of at least 500 individuals per occurrence which have been demonstrated to be at minimum viable population levels. This criterion was likely chosen because, at the time, it was believed 500 reproductive individuals in an area was a minimum viable population size (based upon science summarized in Schonewald-Cox *et al.* 1983). This standard minimum was used in the absence of a population viability analysis specific to Last Chance townsendia. A population viability analysis is typically based on basic information that includes how long seeds remain in a seed bank, percentage of germination and recruitment from the seedbank, and survival and mortality of individuals within different age or size classes. Much of this information is presently not available for this species. Thus, it is unclear

¹ Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species, and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

whether it was appropriate for the plan to use 500 individuals as the minimum viable population size. Finally, the Recovery Plan does not fully consider or address the five listing factors. In order to determine whether a species is endangered or threatened, or has improved to the point of reclassification or delisting, the Act requires an explicit analysis of the 5 listing factors.

Therefore, we believe the Recovery Plan should be revised (see section 4). Regardless, the species' status relative to these criteria are discussed below so as to show progress, or lack thereof, toward recovery.

2.2.3. Progress toward recovery

The recovery objective in the Recovery Plan states: “The listing of *Townsendia aprica* as threatened provides the recognition and protection necessary to ensure the species survival in the foreseeable future. Protection of all existing populations and their habitats is necessary to conserve the species and prevent its further decline. Recovery, and eventual delisting, of the species may be accomplished through the discovery and establishment, if feasible, of additional populations and the maintenance of the species total population at viable population levels.” The delisting criteria are identified below followed by the recovery actions.

Criterion 1: Maintain a documented total population of 30,000 Last Chance townsendia individuals for 5 consecutive years.

Status: This objective is **not met**. The total population estimate of 6,848 individuals is well below the total population criterion.

Criterion 2: Maintain 20 populations of at least 500 individuals each, which have been demonstrated to be at minimum viable population levels.

Status: This objective is **not met**. There are 23 populations of Last Chance townsendia and only 5 populations meet the criterion of at least 500 individuals. Furthermore, we do not know the minimum viable population levels for these populations. Populations of Last Chance townsendia are generally small and contain less than 100 individuals.

Criterion 3: Establish formal land management designations for these populations that provide long-term, undisturbed habitat for Last Chance townsendia.

Status: There are no established conservation areas or other land management designations that provide protection specifically for Last Chance townsendia on USFS and BLM lands. On BLM land, the species occurs within two Wilderness Study Areas (WSAs): Devils Canyon and Sids Mountain/Sids Cabin WSAs (BLM 2008a). The Sand Bench population and a portion of the Moore Cutoff population of Last Chance townsendia are within the two WSAs. The BLM

manages WSAs in accordance with their Interim Management Policy for lands Under Wilderness Review (BLM 1995). Historic grazing, mining and mineral lease uses in existence prior to October 21, 1976, are allowed to continue within WSAs. Currently, grazing is occurring within the two WSAs; however, mining is not (Truman 2013a). With the exception of 4 designated routes within the Sids Mountain/Sids Cabin WSA, all WSAs are closed to motorized vehicle use (including OHVs) (BLM 2008a). Last Chance townsendia also occurs within the Price BLM's Interstate 70 ACEC. However, the portion of the ACEC where Last Chance townsendia occurs overlaps with the Sid Mountain/Sid Cabin WSA, so the stricter management prescriptions of the WSA apply (BLM 2008a).

Existing laws, regulations, and policies within Capitol Reef (see section 2.3.2.4, below) provide protection for the species on their land from the threats that led to the original listing (see section 2.3.2, below). This recovery criterion is **partially met** because of the protections afforded to the species within Capitol Reef.

Recovery Plan Actions

In addition to the above criteria, the Recovery Plan includes recovery actions. In this section, we briefly review our progress for each action.

(1) Manage activities that affect Last Chance townsendia and its habitat through section 7 of the Act and other relevant laws and regulations. Manage mineral development activities, off-road vehicle use and recreational impacts, road building and maintenance, and activities associated with livestock management.

We completed several section 7 consultations since listing Last Chance townsendia (1985) and publishing the Recovery Plan (1993). We completed seven noteworthy programmatic section 7 consultations:

- BLM's Price Field Office's Resource Management Plan (RMP) (BLM 2008a),
- BLM's Richfield Field Office's RMP (BLM 2008b),
- BLM's Renewal of 17 Grazing Allotments in the San Rafael Swell (BLM 2009a),
- BLM and Capitol Reef's joint section 7 consultation for the Renewal of the Hartnet and Cathedral Grazing Allotments (BLM 2009b),
- Fishlake National Forest's Oil and Gas Leasing Program (USFS 2011),
- Fishlake National Forest's OHV Route Designation Project (USFS 2006a; USFS 2006b), and
- Dixie National Forest's Motorized Travel Plan (USFS 2009a; USFS 2009b).

These consultations included conservation measures designed to avoid and minimize impacts to Last Chance townsendia and its habitat from the implementation of projects funded, permitted, or carried out by Federal agencies across the range of the species.

As part of the RMP consultations with the Price and Richfield Field Offices, BLM developed a standardized lease notice for Last Chance townsendia (BLM 2008a; BLM 2008b). The lease notice applies to energy and mineral development activities (e.g. coal, oil and gas), requires plant surveys within suitable habitat, and establishes buffers around known Last Chance townsendia plants (300 feet minimum distance) from surface disturbance activities. When development occurs within occupied habitat, conservation measures for the species include a seasonal use restriction during the Last Chance townsendia flowering period from April 15th – June 30th, gravel roads to minimize dust generation, and three years of monitoring will be performed.

Conservation measures for the species within the San Rafael Swell, Hartnet and Cathedral grazing allotments include avoidance and minimization of surface disturbance within occupied habitat, surveys for the species prior to surface disturbance, and avoidance of key habitats during livestock herding and trailing (BLM 2009a; BLM 2009b). Additionally, the BLM committed to performing intensive surveys at four allotments and monitoring at one allotment over the term of the grazing permit to collect information on the potential impact of livestock to the species for one consultation (BLM 2009a), but was not specific about monitoring locations within the Hartnet and Cathedral allotments (BLM 2009b). We have not yet received from the BLM monitoring plans for Last Chance townsendia to assess the potential impact of livestock grazing on the species.

Conservation measures for the species on the Fishlake National Forest for oil and gas leasing include requiring plant surveys within suitable habitat and implementing a No Surface Occupancy (NSO) restriction within one mile of occupied habitat, and a 300 foot minimum buffer in areas where plant surveys are technically infeasible (USFS 2011). The one-mile buffer is large enough to eliminate direct and some indirect effects such as the trampling and/or destruction of individual plants, dust deposition, and erosion.

Conservation measures for the species on the Fishlake National Forest for their OHV Route Designation Project include the removal of OHV trails and use within occupied habitat. Designated motorized routes do not go within 1.5 miles of known populations (USFS 2006a; USFS 2006b). This buffer is large enough to eliminate direct and indirect effects such as the

trampling and/or destruction of individual plants, dust deposition, and erosion.

Conservation measures for the species on the Dixie National Forest for their motorized travel plan include road closures within occupied habitat, and a buffer of 500 feet between existing roads and Last Chance townsendia individuals to minimize dust impacts and avoid direct impacts to the species (USFS 2009a; USFS 2009b).

This recovery action is **ongoing** as projects are proposed that may affect Last Chance townsendia.

(2) **Inventory suitable habitat for Last Chance townsendia and determine with a reasonable degree of accuracy the population and distribution of the species.**

There is considerable progress to-date for this recovery action on Federal lands. The BLM, USFS and Capitol Reef have contributed resources toward Last Chance townsendia surveys within suitable habitat on their lands since 1998 (see section 2.3.1.2, below). These surveys have greatly expanded the known range of Last Chance townsendia. At the time the Recovery Plan was written, Last Chance Townsendia was only known to occur on BLM land with approximately 15 acres of occupied habitat. Now we estimate the species is distributed across 9,000 acres of habitat. Surveys for Last Chance townsendia on State and private land are uncommon. Unsurveyed, suitable habitat remains on Federal lands at higher elevations on Capitol Reef and remote areas on USFS land (Clark 2013; Tait 2013). A potential habitat model to identify additional locations for future surveys has not been developed for the species. This recovery action is **partially met**.

(3) **Establish and conduct minimum viable population studies on at least six different populations of Last Chance townsendia.**

A minimum population viability analysis has not been performed for the species, so we do not know what number constitutes a self-sustaining population size. We have 13 years of monitoring data for one Last Chance townsendia demography plot on BLM land. These data provide us with seedling recruitment, survival, and mortality of different size classes. However, we need additional information on seedbank dynamics and seed viability before an acceptable population viability analysis can be performed. Demography data should also be collected from additional populations. For more detail on the monitoring data, see sections 2.3.1.1 and 2.3.1.2. This recovery action is **not met**.

(4) **Conduct research on the biology and ecology of Last Chance townsendia.**

Survival, reproduction and recruitment were monitored at one demography plot. Last Chance townsendia is a short-lived species and reproduction is positively correlated with plant size. The species reproduces by seed and requires pollinators for successful seed production (Clark 2008; Tepedino *et al.* 2004). See section 2.3.1.1 for further information.

The genetics and habitat characteristics of Last Chance townsendia and a closely related taxon, Sigurd townsendia (*T. jonesii* var. *lutea*) were studied and the analysis indicated they are not the same taxon and should be considered separate taxa (Jennings 2005; Lipsen *et al.* 2013). See sections 2.3.1.3 and 2.3.1.4 for further information.

This recovery action is **partially met**. Future research on the seed bank dynamics, seed viability and production, drought tolerance, and trampling tolerance of Last Chance townsendia is warranted.

(5) **Determine the horticultural requirements and establish garden populations of Last Chance townsendia.**

Horticultural research and propagation of Last Chance townsendia were performed to a limited extent. Red Butte Garden curates a seed collection of Last Chance townsendia rather than a population of established plants in their greenhouse or botanic garden. Red Butte Garden and Arboretum collected seeds from 3–4 populations from 1988 to the present and 2,341 seeds are currently in long-term storage (Reisor 2013). The BLM paid the Center for Plant Conservation to sponsor the seed collection and long-term storage of Last Chance townsendia in 2006. This sponsorship covers Red Butte Garden's expenses to collect and store seeds in perpetuity and the sponsorship ensures future seed collection efforts for this species. Germination requirements of the species can be found on the internet, but have not been tested by an authorized individual or institution (see section 2.3.2.2).

This recovery action is **partially met**. Seed collection from additional sites is warranted to represent the majority of subpopulations of the species.

(6) **Evaluate the need for the introduction of artificial populations into suitable habitat.**

We have not evaluated the need for reintroducing Last Chance townsendia into suitable habitat. This recovery action is **not met**. An evaluation for

reintroduction is warranted for occupied habitat areas that have experienced dramatic declines and are threatened with extirpation.

(7) Document the presence of or, if necessary, establish formal land management designations that would provide for long-term protection for Last Chance townsendia and its habitat.

This recovery action is **not met**. There are very few Last Chance townsendia populations within formally designated areas that provide for long-term protection of the species (see Criterion 3 in this section). This recovery action is still warranted.

(8) Develop public awareness, appreciation, and support for the conservation of Last Chance townsendia.

Capitol Reef has an educational pamphlet at the visitor center on the Park's rare plants. This pamphlet is not specific to Last Chance townsendia, but it raises public awareness and appreciation for the rare plants at Capitol Reef. The species is neither on display at botanic gardens, nor are materials provided to school groups. This recovery action is **partially met**.

2.3. Updated Information and Current Species Status

2.3.1. Background on the Species

2.3.1.1. Biology and life history

Last Chance townsendia is a small, stemless, mound-forming perennial plant in the sunflower family (Cronquist *et al.* 1994; Welsh *et al.* 2008). There are approximately 25 species in the *Townsendia* genus, and Last Chance townsendia is distinguished from other members of the genus by its apricot flowers and the shortened pappus² of the ray flowers (Cronquist *et al.* 1994; Welsh *et al.* 2008). The species was first described in 1968 and is named for the apricot color of the flowers, hence the specific epithet, “aprica” (USFWS 1993; Welsh and Reveal 1968). Plants are 0.6–1 inch (1.5–2.5 centimeters (cm)) tall, with small leaves 0.28–0.52 of an inch (7–13 millimeters (mm)) long by 0.14 of an inch (3.5 mm) wide. Plants flower in the early spring from late-April through early-June. Each flower head (inflorescence) produces approximately 35 flowers (Tepedino *et al.* 2004). Fruits are achenes³ and are compressed and ribbed with one seed. This species and others in the *Townsendia* genus reproduce solely by seed. For a technical description of the species, see Welsh *et al.* (2008).

² A crown of bristles or scales at the top of the fruit or achene (see footnote #3).

³ A dry fruit containing one seed and the seed does not adhere to the fruit wall.

Last Chance townsendia appears to be a short-lived perennial that begins to flower in the second year of life when they achieve a size of approximately 0.6–0.8 of an inch (1.5–2.0 cm) in diameter. Reproduction is positively correlated with plant size so larger plants produce more flowers than small plants. However, few individuals survived and grew larger than 1.6 inches (4 cm) in diameter at the Ivie Creek study site, elevation 7,217 feet (2,200 meters) (Tepedino *et al.* 2004). Plant longevity of 232 individuals was also studied at one demography plot on BLM land in the Upper Last Chance Creek population since 1996, elevation 7,400 feet (2,256 meters). The majority of Last Chance townsendia individuals did not survive past 6 years of age and the three longest-lived individuals in the plot had a minimum known age of 13 years (Clark 2008). In the long-term plot, reproduction was positively correlated with the number of leaf rosettes. Over a ten year period, individuals with one leaf rosette flowered 35% of the time, individuals with four leaf rosettes flowered 80% of the time, and individuals with 16 or more leaf rosettes flowered 100% of the time (Clark 2008).

Seeds in the *Townsendia* genus are produced either sexually or asexually and several *Townsendia* species utilize both strategies and are comprised of separate sexual and asexual populations. Within the same species, chromosome numbers and geographic distributions are different depending upon the reproductive strategy of the population. Sexual populations of *Townsendia* are diploid and asexual populations are polyploid; asexual populations without exception occur at higher elevations and higher latitudes of the species' range (Beaman 1957). The maintenance of alternative reproductive strategies is presumed to involve a frequency-dependent selection or a condition-dependent selection based upon physiological or environmental circumstances (Goodwillie *et al.* 2005).

The breeding system of Last Chance townsendia was evaluated at a study site along Ivie Creek. Individuals produced the majority of their seeds by sexual means, whereby flowers require pollen from other Last Chance townsendia plants by a pollination vector. Seed production from two selfing (= asexual reproduction) treatments was very low and indicates that selfing is a rare occurrence at this site (Tepedino *et al.* 2004). Data from three other study sites were consistent with sexual, diploid populations of *Townsendia* based upon pollen and isozyme characteristics (Jennings 2005). These data confirm the species is sexual and diploid at study sites, but do not rule out the possibility that populations at higher elevations reproduce asexually.

Likely pollination vectors of Last Chance townsendia are insects, but wind pollination may also occur. The primary pollinators of Last Chance

townsendia at the Ivie Creek study site are native solitary bees. The early spring bee, *Synalonia fulvitaris*, was the most abundant bee species and is a ground nesting bee. Some of the other native bees nest in holes in wood. For a complete list of pollinators, see Tepedino *et al.* (2004).

Low seed production in Last Chance townsendia was reported by botanists and identified in the Recovery Plan (RMER 2012; USFWS 1993), yet we do not have data to document the extent and the frequency with which seed limitation occurs. Nor do we know what factors are limiting seed production, although possible factors include low pollinator numbers, inclement weather affecting pollinator flight activity, or small population size (Tepedino *et al.* 2004; USFWS 1993). While pollinators were not limiting seed production during the breeding system study, the presence of a more common plant species that flowers at the same time as Last Chance townsendia, *Phlox austromontana*, may have facilitated the pollination of Last Chance townsendia (Tepedino *et al.* 2004). Further study is required to assess pollinator limitation throughout the range of the species.

Last Chance townsendia occurs over a wide elevation gradient and on a variety of soil substrates. The published elevation range of the species is 6,102–8,005 feet (1,860–2,440 meters) (Welsh *et al.* 2008), but new populations of Last Chance townsendia have increased the upper elevation limit to 9,100 feet (2,773 meters) (Clark 2011). The species occurs on a variety of geologic substrates and the majority of populations are found on soils within the Moenkopi Formation, Morrison Formation, Mancos Shale Group, and the San Rafael Group. However, the species appears to be restricted to fine-textured shale soils within each formation (Clark 2011).

Last Chance townsendia occurs in a number of plant communities because of the wide, elevational range it occupies. It is found in the Castle Valley saltbush (*Atriplex gardneri* var. *cuneata*) plant community in the San Rafael Swell, openings of pinyon-juniper woodlands within the Fishlake Plateau, and in ponderosa pine woodlands in the upper Deep Creek mountains (Fertig and Beer 2005; Welsh *et al.* 2008). The presence of a well-developed cryptobiotic crust⁴ was documented at Last Chance townsendia populations in Sevier and Emery Counties (Armstrong and Thorne 1991). Commonly associated plant species include galleta grass (*Hilaria jamesii*), Utah Juniper (*Juniperus osteosperma*), blue grama grass (*Bouteloua gracilis*) and shadscale (*Atriplex confertifolia*) (Clark 2002). Several other rare, endemic species also occur in the same habitat as Last Chance townsendia and include *Pediocactus despainii*, *Sclerocactus wrightiae*, and *Gilia tenuis* (Armstrong and Thorne 1991). For a detailed list of associated plant species, see Clark (2005) and Rocky Mountain Environmental Research (RMER) (2009).

⁴ Composed of cyanobacteria, green and brown algae, fungi, lichens, and/or mosses; an important component of desert ecosystems that stabilizes soil, promotes water retention and fixes atmospheric nitrogen (Wikipedia 2013).

2.3.1.2. Distribution, Abundance, and trends

Last Chance townsendia is a narrow endemic to south-central Utah in Emery, Sevier, and Wayne counties. In the Recovery Plan, the known range of the species was limited to a linear, narrow band less than 5 miles (8 km) wide and 30 miles (48.3 km) long, bordering Interstate 70, with a few additional isolated populations outside of this area (USFWS 1993). Surveys for the species since the Recovery Plan was written have greatly expanded the distribution of the species (see Figure 1, below). We now know the species is distributed across 9,000 acres of habitat compared to the 15 acres documented in the Recovery Plan.

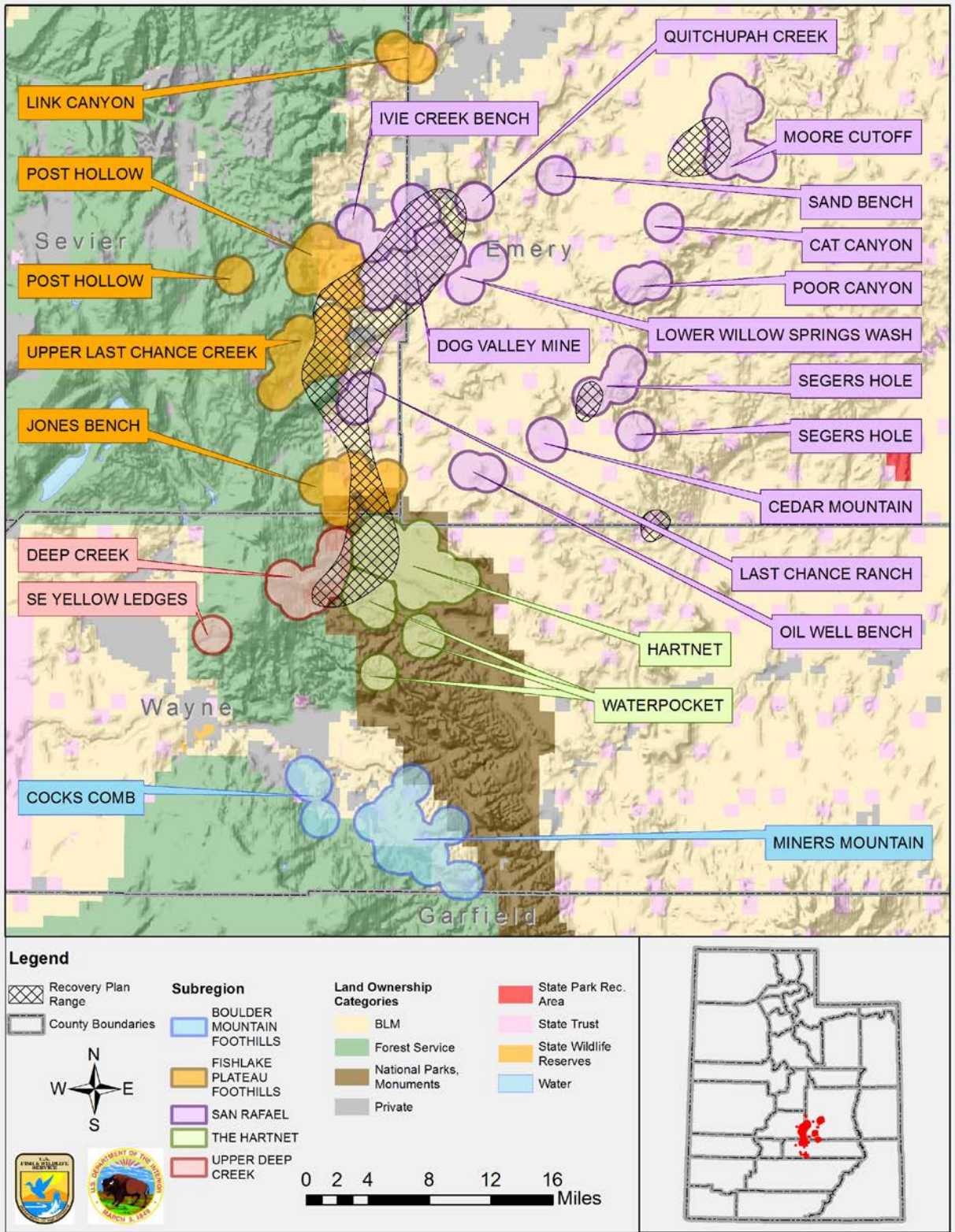


Figure 1. Present and Historic Last Chance townsendia range. Historic range is the shaded area.

The range of the species extends across Capitol Reef, Fishlake National Forest, Dixie National Forest, and BLM land managed by the Price and Richfield Field Offices. The BLM land contains the most occupied habitat for Last Chance townsendia with approximately 4,830 acres, followed by the USFS with 2,620 acres and Capitol Reef with 2,390 acres.

Landownership as a percent of the known population areas is depicted in Figure 2. The BLM consistently surveys for Last Chance townsendia within previously unsurveyed, potential habitat on an annual basis (Robinson 2013). Additional potential habitat yet to be surveyed exists at higher elevations on Capitol Reef and remote locations on USFS land (Clark 2013; Tait 2013).

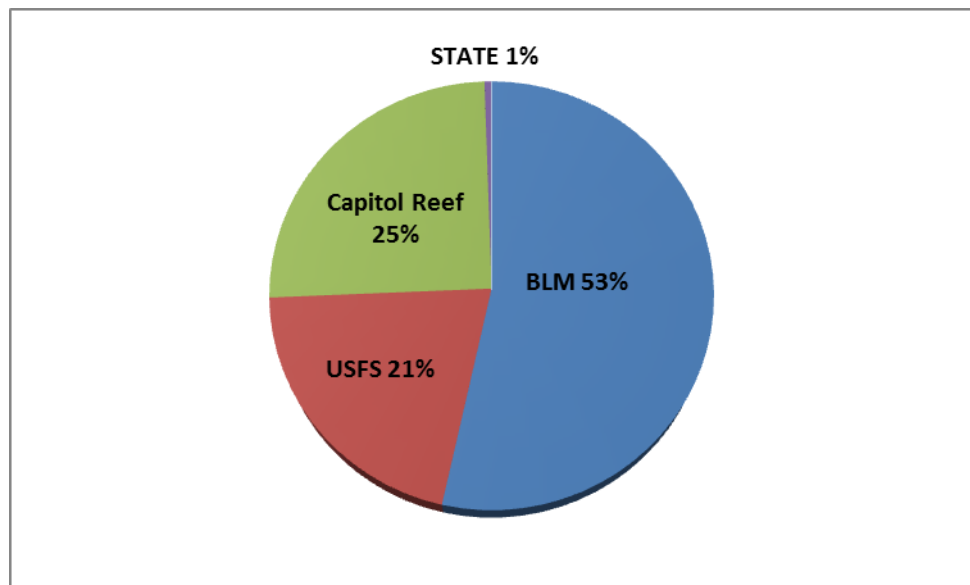


Figure 2. Percent of Last Chance townsendia populations by land owner.

There are 23 populations of Last Chance townsendia as determined by our analysis. We did not use the element occurrence data from the Utah Natural Heritage Program (UNHP) because their records are not up-to-date. Our populations differ slightly from the NatureServe protocol the UNHP uses for delineating element occurrences in a few instances so we use the term population rather than element occurrence. The populations are organized by the 5 subregions identified in Fertig and Beer (2005) in **Error! Reference source not found.** For this review, we use survey and monitoring data since 1998 for our summary and analysis.

Table 2. Table 2. Populations of Last Chance townsendia by Subregion

Subregion	Population	No. Sites	Population Size	Percent of Total Population
San Rafael	MOORE CUTOFF	12	74	
	QUITCHUPAH CREEK	1	0	
	SAND BENCH	1	0	
	DOG VALLEY MINE	9	6	
	CAT CANYON	1	35	
	POOR CANYON	2	30	
	LOWER WILLOW SPRINGS WASH	2	32	
	SEGERS HOLE	6	83	
	OIL WELL BENCH	2	83	
	CEDAR MOUNTAIN	3	36	
	LAST CHANCE RANCH	2	34	
	JONES BENCH	8	49	
	IVIE CREEK BENCH	6	4	
	Total:		55	466
The Hartnet	HARTNET	29	736	
	WATERPOCKET	8	381	
	Total:	37	1117	16%
Fishlake Plateau Foothills	POST HOLLOW	18	534	
	UPPER LAST CHANCE CREEK	17	1620	
	JONES BENCH	8	49	
	LINK CANYON	8	0	
	Total:	51	2203	32%
Upper Deep Creek	DEEP CREEK	13	1547	
	SE YELLOW LEDGES	1	45	
	Total:	14	1592	24%
Boulder Mountain Foothills	COCKS COMB	4	151	
	MINERS MOUNTAIN	26	1319	
	Total:	30	1470	21%

Our best range-wide estimate for the total population of Last Chance townsendia is 6,848 individuals. This estimate uses the latest plant count data for each population. We determine the actual plant count data is the best indicator of total population size at this time because it is consistent with total population estimates from 2008 (7,215 individuals) and 2009 (4,000 – 4,500 individuals) (Clark 2009). We recognize the actual plant count likely underrepresents the total population size for the species because of the difficulty of detecting seedlings and non-flowering individuals in the field, and may be considered a conservative estimate of abundance (Clark 2013).

The 1993 population estimate in the Recovery Plan was 6,000 individuals (USFWS 1993). While we have greatly expanded the range of the species since that time, our current total population size of 6,848 individuals is only slightly greater than the 1993 estimate.

Overall abundance of Last Chance townsendia has declined over the last thirteen years and climate conditions are believed to be the primary cause of the decline (Clark 2008; RMER 2012). Precipitation data from 1997 until 2011 show below average annual precipitation from 1997 to 2009, with 2002 and 2009 recording the lowest precipitation amounts during that time period (RMER 2011; USGS 2003).

Sharp declines in abundance were documented during the 1999 – 2004 period at a number of populations on BLM land and at Capitol Reef. The decline appeared to be more severe at lower elevations on BLM land and at Capitol Reef compared to higher elevations on USFS land (Clark 2002; Clark 2009; RMER 2004). Survey and monitoring results since 2000 indicate sharp declines at many monitoring sites, with 80 – 90% mortality of mature plants in Capitol Reef in 2001 (Clark 2002). On USFS land, the population trend of Last Chance townsendia is less apparent because of infrequent monitoring; however, these populations appear to be stable (Tait 2013).

Annual monitoring efforts on BLM land provide the best documentation of the decline in abundance for the species. A long-term demography plot established in 1996 documents the decline from 232 individuals to 33 plants in 2009 (Clark 2009). Mortality was equal to or greater than recruitment every year during the study period except for 2004 which was the only year with high recruitment. Mortality was greatest from 2000–2002, and in 2009. Additionally, the BLM has performed annual monitoring since 2002 and currently has 114 monitoring sites within 14 populations (RMER 2011). Total abundance for all monitoring sites is reported in Table 3. The monitoring results document two periods of decline: 2002–2004 and 2009–2011. During these two time periods, abundance at many monitoring sites declined to zero. On BLM land, 26

monitoring sites containing plants in 2002 no longer had plants in 2004 (RMER 2004). By 2011, only 59 of the known 114 BLM sites (52%) were occupied (RMER 2011). Many plants were considered to be in poor condition during 2009 and 2010 (RMER 2010).

Table 3. Total abundance for BLM monitoring sites 1991–2007 (RMER 2011).

Survey Year	Total Abundance
1991	447–1,930
2002	794
2003	536
2004	834
2005	1,098
2006	1,233
2007	1,613
2008	1,342
2009	788
2010	546
2011	614

The BLM annual monitoring data indicate the lower elevation populations of the species are sensitive to drought conditions. There are concerns that the species may now be extirpated at many of the unoccupied monitoring sites, particularly at sites which supported less than 10 individuals in favorable years. Further study is required to document if there is a sufficiently large and long-lived seedbank such that the species can persist during long periods of drought conditions. A detailed look at the BLM annual monitoring data does show the species was dormant and not detectable for one to seven consecutive years at 11 monitoring sites (Robinson 2013). Thus, multiple years of monitoring may be necessary for a site to be considered extirpated. Furthermore, multiple years of surveys may be necessary to determine if Last Chance townsendia is present within suitable habitat.

2.3.1.3. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)

A genetic analysis of 13 populations⁵ of Last Chance townsendia showed higher levels of genetic diversity than expected for endemic taxa, and the total genetic diversity for the species was similar to mean estimates for widespread species (as reported in Hamrick and Godt (1989); see Jennings 2005). However, these results should be used with caution due to the limited sample size of the study. Genotype frequencies were in Hardy-Weinberg Equilibrium and within the expected range for sexual, outcrossed species.

⁵ The populations we defined for the species were not those used for this study.

Genetic divergence among populations was low and inbreeding depression was not a concern within the study populations even for small populations. Geographic isolation appeared to have a greater influence on genetic diversity patterns than population size, and there was a positive and significant relationship between genetic isolation and geographic distance. The three southern populations of Last Chance townsendia in the study appear to be geographically isolated from each other as well as isolated from the northern populations. Possible explanations for the high genetic diversity within the small populations of Last Chance townsendia include: (1) a recent reduction in the populations may have occurred and not enough time has passed for a corresponding reduction in genetic diversity, or (2) Last Chance townsendia is a species of hybrid origin and past hybridization events have contributed to the high genetic diversity within Last Chance townsendia populations (Jennings 2005).

2.3.1.4. Taxonomic classification or changes in nomenclature

Last Chance townsendia is similar in appearance to another taxon of *Townsendia*, the Sigurd townsendia (*T. jonesii* var. *lutea*) (Welsh 1983), and their identification can be confused because both taxa have ray flowers that range from yellow to cream (Armstrong and Thorne 1991) and even sometimes white, and all measureable morphological characters overlap (Jennings 2005). Based upon a review of herbarium specimens, the key morphological difference between the two taxa is their habit; the Sigurd townsendia has a “less densely pulvinate habit, with a more open and spreading growth form, and larger heads with peduncles” than Last Chance townsendia (Lipsen *et al.* 2013). The two taxa also occupy different geologic substrates and their distributions do not seem to overlap (Armstrong and Thorne 1991; Jennings 2005).

Based upon morphological characteristics alone, both taxa are presently recognized as Last Chance townsendia in the Flora of North America (Barkley *et al.* 2006), Intermountain Flora (Cronquist *et al.* 1994), and the online databases, Integrated Taxonomic Information System database (ITIS 2013) and the USDA PLANTS database (USDA PLANTS Database 2013). The results of a genetic and ecological comparison of the two taxa are currently in-press to be published in the peer-reviewed journal, Botany (Lipsen *et al.* 2013). This study combines the genetic and ecological research from Jennings (2005) with an ecological niche modeling effort using climatic variables. The genetic comparison of the two taxa found more genetic differences between the two taxa than within populations of each taxon, and the niche profiles of the two taxa were distinct from each other and did not overlap. Thus, there is adequate support for Last Chance townsendia and Sigurd townsendia to be recognized as separate taxa. This study supports the opinion of other Utah botanists who consider them to be separate taxa (Clark 2013; Tait 2013). The suggestion that Last Chance

townsendia may be an asexual form of Sigurd townsendia has been disproven based upon breeding system and genetic analysis, and both taxa are considered to be sexual diploids (Jennings 2005; Lispen *et al.* in press; Tepedino *et al.* 2004).

We believe the peer-reviewed genetic study will resolve the taxonomic status of Last Chance townsendia and Sigurd townsendia. Since this study provides the best available data on the two taxa, we recommend that taxonomy experts review the published study and update the taxonomy of Last Chance townsendia.

2.3.2. Five-Factor Analysis - threats, conservation measures, and regulatory mechanisms

The final rule and the Recovery Plan cite mineral and energy development, road building, livestock grazing and off-highway vehicle (OHV) use as threats to the species. To help identify new threats in addition to assessing the threats we identified when we listed the species, we systematically examined what we know about Last Chance townsendia's life history in the context of the same five factors we considered when we listed the species. In order to better understand how any given threat actually affects the species, each identified threat was partitioned into **stressors**, which are processes or events that negatively impact the species. Through this threats assessment process, we evaluated each stressor for its **scope**, **immediacy**, and **intensity**, as a way to identify the true magnitude of the potential threat to Last Chance townsendia. We then characterized the **exposure** of Last Chance townsendia to the stressors and the **response** we would expect from the species if exposed to the stressor. Using this approach, we are able to integrate the scope, immediacy, intensity, exposure, response at the species level, and our professional interpretation, into an **overall threat level** (see Table 4 and APPENDIX A). The threats presented in the table are ranked according to our "Draft Guidance for Conducting Threats Assessment under the Act" (USFWS 2006).

Table 4. Key to overall threat level ranking components.

<p><i>Scope</i> (geographic extent of the stressor)</p>	Localized- extent sums to 1 population or less per subregion
	Moderate – extent sums to more than 1 population per subregion
	Rangewide – stressor is present throughout the range
<p><i>Immediacy</i> (timeframe of the stressor)</p>	Imminent – is the stressor present and acting on the target now
	Future – anticipated in the future
	Historic – the impact already occurred
<p><i>Intensity</i> (the strength of the stressor itself)</p>	Low
	Moderate
	High
<p><i>Exposure</i> (the extent to which a target resource & stressor actually overlap in space and/or time given the scope)</p>	Small (<10% of total population exposed)
	Moderate (11-50% of total population exposed)
	High (>51% of total population exposed)
<p><i>Response</i> (level of physiological/behavioral response due to a specific stress considering growth, fecundity, and mortality rates)</p>	Basic need inhibited–basic plant needs for growth & development
	Basic need supported–basic plant needs for growth & development
	Injury – direct physical injury
	Mortality – identifiable reduction in growth rate or survival
<p><i>Overall Threat Level</i> (integration of the scope, immediacy, intensity, exposure, and response at the species level)</p>	Beneficial (no action is needed)
	Potential (at this point in time, we lack scientific information regarding this factor to determine the overall threat level)
	Low (at this point in time, no action is needed)
	Moderate (action is needed)
	High (immediate action necessary)

2.3.2.1. Present or threatened destruction, modification or curtailment of its habitat or range

Mineral and Energy Development

Coal:

At the time of listing, most of the known Last Chance townsendia occurrences were on Federal land managed by the BLM and were under lease for coal or oil and gas development. Coal mining development and production was a significant potential threat to the species, especially strip mining along the exposed coal seams in the Emery coal field. The majority of known populations at the time of listing and the Recovery Plan were underlain by coals seams, and coal mining had the potential of impacting and possibly eradicating 95% of the total population of Last Chance townsendia (50 FR 33734; August 21, 1985).

The range of Last Chance townsendia has expanded since it was listed and coal mining is now a threat to a smaller portion of the species range. Current coal leases partially overlap with three populations (Dog Valley Mine, Ivie Creek Bench and Post Hollow) that represent 8% of the total population size. The potential of future coal development was assessed by the area of mineable coal (with 4-foot (1.2 meters) thick coal seams). Five populations of Last Chance townsendia sites occur within this area (Dog Valley Mine, Ivie Creek Bench, Link Canyon, Post Hollow, Upper Last Chance Creek) and represent 32% of the total population size.

Current coal leases within Emery County cover 354,708 acres of land in the BLM Price Field Office (BLM 2008c). Coal is mined using underground methods in the majority of leases within the Emery Coal Field and the adjacent Wasatch Plateau coal field because the coal seams are too deep below the surface to consider surface mining. Therefore, surface disturbance is limited to access points where companies horizontally drill to the coal seam. These access points are generally located where coal seams intersect the ground surface (Falk 2013).

Surface disturbance for underground mining is estimated to be less than 20 acres, and includes the truck/train loadouts, offices and maintenance facilities, change house, electrical substations and roads (USFWS 2008a). Surface coal mining operations involve the use of draglines, shovels, haul trucks, and results in large areas of surface disturbance from topsoil and overburden removal, stockpiling of materials, and road construction (USFWS 2008a). Coal development and related activities may result in increased surface disturbance, increased foot and vehicle traffic, vegetation disturbance, removal of top soil and overburden, and localized ground subsidence.

There is one location with surface mining potential in the range of Last Chance townsendia and that is a 60 acre parcel within the floodplain of Ivie Creek. Surface mining at this location has the potential to impact the Ivie Creek Bench population if mining operations commence. Another location within the range of the species the BLM determined to be unsuitable for surface coal mining, but the State of Utah has expressed an interest in a land exchange to mine for coal, is a parcel known as Walker Flat (BLM 2008a). The land exchange has not occurred (Truman 2013a), and the BLM would consult with us if the land exchange is discretionary. Surface mining on the Walker Flat parcel has the potential to impact the Ivie Creek Bench population and a portion of the Post Hollow population of Last Chance townsendia.

Potential impacts to Last Chance townsendia include mortality of individuals, habitat loss, degradation and fragmentation, increased soil erosion, increased dust generation, reductions in pollinator populations, reductions in plant reproductive potential, reductions in seed bank quantity and quality, and increasing invasive plant occurrences (Brock and Green 2003). For surface coal mining operations, there is the potential for the extirpation of a portion of Ivie Creek Bench and Post Hollow populations.

Conservation measures for Last Chance townsendia on BLM land include buffers around known Last Chance townsendia plants (300 feet minimum distance) from surface disturbance activities, and a seasonal use restriction is enforced in occupied habitat during the Last Chance townsendia flowering period from April 15th – June 30th. Additionally, roads will be graveled to minimize dust generation.

Most of the coal mines on USFS lands are on the Manti La Sal National Forest, which is outside of the species' range. There are no active coal leases or proposed coal leases on Fishlake National Forest within Last Chance townsendia habitat (Rodriguez 2013). There are currently no coal leases on Dixie National Forest, and there is a low potential for coal leases in the near future (Baughman 2013).

While conservation measures will avoid direct effects to Last Chance townsendia, indirect effects to the species (habitat fragmentation, dust deposition, plant-pollinator interactions) are discussed in this section. Development is and will occur in unoccupied, suitable habitat thereby limiting potential expansion and recovery of the species. Furthermore, development is and will occur in habitats immediately adjacent to occupied habitats. While steps have been taken to avoid direct effects and minimize indirect effects, it is unknown if this adjacent development is or will adversely impact the viability of Last Chance townsendia populations.

Habitat fragmentation and degradation are frequent threats to plant populations. Changes in land use can directly alter plant habitats in terms of area, stability, connectivity, and quality that the viability of plant populations can be significantly reduced (Brigham and Schwartz 2003). Changes in habitat connectivity have shown to reduce gene flow between plant subpopulations (Ellstrand and Elam 1993; Young *et al.* 1996). Endemic plant species, such as Last Chance townsendia, are considered geographically restricted due to habitat specificity and were likely historically rare species. These endemics face a high risk of extinction due to their rarity (Soulé *et al.* 1992; Menges 2002; Lienert 2004), and their present survival may be explained by low levels of environmental stochasticity within their habitat (Medial and Verlaque 1997). The best strategy for conservation of endemic species appears to be maintaining optimal ecological conditions and natural disturbance regimes by keeping their natural habitat as free as possible from any form of abnormal disturbance (Oostermeijer 2003).

Some of the negative effects of habitat fragmentation to plants are due to effects on plant-pollinator interactions (Aizen *et al.* 2002; Debinski and Holt 2000; Gathmann and Tschardtke 2002; Kolb 2008; Lennartsson 2002; Moody-Weis and Heywood 2001). Fragmented plant populations appear to be less attractive to insect pollinators, which spend more time in larger, unfragmented plant habitats (Aizen *et al.* 2002; Goverde *et al.* 2002; Kolb 2008; Lennartsson 2002). Furthermore, insect pollinator diversity increases in larger populations (Mustajarvi *et al.* 2001) and decreases in isolated habitats with smaller plant populations (Steffan-Dewenter and Tschardtke 1999). Lower pollinator visitation rates are associated with reduced reproductive success in fragmented sites compared to intact sites (Jennersten 1988). Last Chance townsendia pollinators are ground nesting and wood nesting bees (Tepedino *et al.* 2004). Ground nesting bee species sometimes have specific nest site requirements, and human-caused habitat fragmentation changes native bee populations and species' composition due to alterations in nesting sites (Cane 2001). Pollinator nest sites are more often a limiting factor than pollen or nectar (Gathmann and Tschardtke 2002), and surface disturbance from energy development is likely to disturb nest sites for ground nesting bee species.

Roads associated with energy exploration and development can cause a high level of habitat fragmentation. Increased energy development within will result in more roads developed near Last Chance townsendia habitat. Ecological effects of roads to plants can extend more than 328 feet (100 meters) from the road (Angold 1997; Forman 2000; Forman and Deblinger 2000). Disturbance can occur directly from construction or indirectly from road dust, discussed further below (Angold 1997; Farmer 1993; Trombulak and Frissel 2000). There is a strong correlation between

vegetation composition and health with distance from a road, although it may take decades for the full effects of road development to be realized (Auerbach *et al.* 1997; Myers-Smith *et al.* 2006).

Road traffic mobilizes and spreads dust on unpaved roads (Farmer 1993; Trombulak and Frissell 2000), and dust accumulation within nearby habitat can negatively affect plant growth and physiology (Eller 1977; Farmer 1993; Hobbs 2001; Spatt and Miller 1981; Sharifi *et al.* 1997; Thompson *et al.* 1984; Trombulak and Frissell 2000). Dust deposition tends to be highest near the road and decreases with increasing distance from the road (Everett 1980; Myers-Smith *et al.* 2006; Santelmann and Gorham 1988; Spatt and Miller 1981; Walker and Everett 1987). The distance from a road at which dust can affect vegetation varies (see McCrea 1984; Myers-Smith *et al.* 2006), but negative impacts can occur up to 984 feet (300 meters) away from the road (Everett 1980). Furthermore, soil characteristics and plant community composition can remain significantly different up to 28 years after road development (Myers-Smith *et al.* 2006).

Last Chance townsendia may be impacted by the indirect effects of coal development, seismic activities for oil and gas exploration, and other activities associated with mineral exploration and extraction. Habitat fragmentation triggers other adverse effects mentioned above such as the disruption of plant-pollinator interactions and increased road dust. These effects in combination may exert a synergistic influence or a strong interaction on the vulnerability and extinction risk of Last Chance townsendia (Richardson *et al.* 1996). We do not know Last Chance townsendia's or their pollinator's ability to tolerate and adapt to habitat modification and fragmentation. Nor do we know if dust accumulation within occupied habitat is occurring and if dust is impacting growth and reproduction of Last Chance townsendia. Without monitoring, we do not know what habitat changes are occurring and how vulnerable the species is to those changes.

We assign coal development a **low** threat at this time, based upon the present localized scope of underground coal mining, conservation measures protecting the species from direct impacts, and the non-imminent threat of strip mining within the range of Last Chance Townsendia. This threat may increase to moderate if coal development expands within the range of the species. We will re-evaluate this threat level when we have more information regarding indirect effects of coal mining to Last Chance townsendia and future plans to strip mine within Last Chance townsendia habitat.

Oil and Gas:

Natural gas exploration and development is on the rise on lands managed by the BLM Price Field Office, and 489,125 acres are open for oil and gas leasing in the BLM Price Field Office (BLM 2008a; USFWS 2008a).

Currently one population (Oil Well Bench) is entirely within oil and gas lease parcels and three additional populations (Link Canyon, Ivie Creek Bench, Cedar Mountain) partially overlap with oil and gas lease parcels. These four populations represent 2% of the total population size. There are no oil and gas leases within the range of the species in the Richfield Field Office.

Oil and gas development has the potential to occur on the majority of land managed by the Price Field Office with the exception of WSAs. Thus, there is the potential for oil and gas lease parcels to overlap with 15 Last Chance townsendia populations (Cat Canyon, Cedar Mountain, Dog Valley Mine, Ivie Creek Bench, Link Canyon, Lower Willow Springs Wash, Last Chance Ranch, Moore Cutoff, Oil Well Bench, Poor Canyon, Quitcupah Creek, Segers Hole, and portions of Jones Bench, Post Hollow, and Upper Last Chance Creek) that represent 8% of the total population size.

Conservation measures within the BLM lease notice would apply to protect the species and are the same measures described in the coal subsection. Conservation measures for Last Chance townsendia include buffers around known Last Chance townsendia plants (300 feet minimum distance) from surface disturbance activities, and a seasonal use restriction is enforced in occupied habitat during the Last Chance townsendia flowering period from April 15th – June 30th. Additionally, roads will be graveled to minimize dust generation.

Fishlake National Forest is planning to lease lands for oil and gas development, and the Record of Decision (ROD) for the project will be finalized sometime in 2013 after the completion of this review (Tait 2013). There is known geologic potential for oil and gas occurrence within Fishlake National Forest based upon past exploration and development activity (USFS 2011). The reasonably foreseeable development scenario anticipates 334 and 379 acres of surface disturbance from seismic exploration, exploratory drilling, roads and developed oil and gas fields over the next 15 years within the two Ranger Districts (Richfield and Fremont River Ranger Districts, respectively) where Last Chance townsendia occurs (USFS 2011).

Seismic exploration activities, using helicopters, heli-portable drills and vibroseis trucks will be allowed in areas where the species may occur. Seismic activities involve a high level of human activity over a short time period (less than 3 months) (USFS 2011), and are considered a temporary

impact not a permanent impact to the habitat (USFWS 2012). The exact locations of seismic activities are not known but there is the potential to disturb 3 populations (Deep Creek, SE Yellow Ledges, Upper Last Chance Creek) and portions of 3 populations (Jones Bench, Post Hollow, Miners Mountain) on USFS land (representing approximately 64% of the total population size). Seismic activities may occur within occupied and suitable Last Chance townsendia habitat after a survey is performed. The conservation measure for seismic activities is to maintain a 50-foot buffer from Last Chance townsendia individuals (USFS 2011).

Oil and gas related development activities may result in increased surface disturbance, increased foot and vehicle traffic, increased dust generation, vegetation disturbance, and removal of top soil and overburden. Surface disturbance per well pad within Fishlake National Forest is estimated to be 14.9 acres, and includes the well pad footprint and road widening and construction (USFWS 2012). Potential impacts include mortality of individuals, habitat loss, degradation and fragmentation of habitat, increased soil erosion, reductions in pollinator populations, reductions in plant reproductive potential, reductions in seed bank quantity and quality, and increasing invasive plant occurrences (Brock and Green 2003).

Conservation measures for oil and gas development activities include a No Surface Occupancy (NSO) restriction within one mile of occupied habitat, and a 300 foot minimum buffer in areas where plant surveys are technically infeasible (USFS 2011). The one-mile buffer is large enough to eliminate direct and most indirect effects such as the trampling and/or destruction of individual plants, dust deposition, and erosion to known locations of the species. As mentioned above in the coal section, the indirect effect to the species from habitat fragmentation is not known. Development is and will occur in unoccupied, suitable habitat thereby limiting potential expansion and recovery of the species.

Coal and Coal Bed Natural Gas (CBNG) were identified to have the highest potential for future development in the Price BLM Resource Management Plan (RMP) (BLM 2008a), but exploratory studies have not found sufficient CBNG within the Emery and Wasatch Plateau coal fields to warrant development (Falk 2013). Thus, there is a low potential for CBNG development on BLM lands within Last Chance townsendia's range.

Oil and gas development is a **moderate** threat based upon the imminent and future immediacy of development activities, the moderate scope, and moderate to high exposure of the activities within Last Chance townsendia's range. While conservation measures are in place to avoid directly impacting individual plants, oil and gas development is still considered a threat because of indirect impacts such as habitat degradation and loss, and the loss of unoccupied, suitable habitat that could limit potential expansion and recovery of the species.

Uranium:

There are four uranium districts within the range of Last Chance townsendia (West San Rafael Swell, Tomsich Butte, Delta, and Fremont). Five populations of Last Chance townsendia (Sand Bench, Poor Canyon, Segers Hole, Waterpocket, and Miners Mountain) occur within these uranium districts. An additional population (Lower Willow Springs Wash) occurs in an area with uranium and/or vanadium deposits. These populations represent 27% of the total population size.

There is currently no active uranium mining within these districts; however, there are a few current mining claims (Gochnour 2013; Rooks 2013). Uranium mining fluctuates with the commercial value of uranium ore. The three uranium districts within the Price Field Office (West San Rafael Swell, Tomsich Butte, Delta) have fairly large deposits of quality uranium ore (Gochnour 2013) while the Fremont uranium district in the Price Field Office is considered a marginal uranium deposit (Jackson 2013; Reay 2013).

Currently there are no active uranium mining claims on Fishlake National Forest (Baughman 2013), and there are no requests for uranium claims within Fishlake and Dixie National Forests (Rodriguez 2013).

Mining related activities may result in increased surface disturbance, increased foot and vehicle traffic, vegetation disturbance, and removal of top soil and overburden. Surface disturbance per claim is estimated to be 5 – 15 acres from uranium extraction (USFWS 2009). This footprint includes processing plants, evaporation ponds, equipment maintenance buildings and other support facilities. Potential impacts include mortality of individuals, localized population mortality, habitat loss, degradation and fragmentation, increased soil erosion, reductions in pollinator populations, reductions in plant vigor and reproductive potential, reductions in seed bank quantity and quality, and increasing invasive plant occurrences (Brock and Green 2003; BLM 2008b). There is also the potential for release or exposure to toxic chemicals and wastes.

The overall threat of uranium mining to the species is **moderate** at this time. The threat is not imminent but alteration and destruction of the

habitat from historic mining use needs to be assessed. There is also future potential for mining if uranium prices climb to levels that make mining of these deposits economically favorable. There is also the threat of exploratory mining and casual use activities that are not regulated by the BLM. We will re-evaluate this threat level when we have more information regarding historic mining impacts to Last Chance townsendia habitat.

Other Minerals:

There is the potential for additional mineral development on BLM lands managed by the Price Field Office including gypsum, clay, sand and gravel, and humate (BLM 2008a). The same minerals were considered on BLM lands managed by the Richfield Field Office as well as the additional minerals stone, tar sands, and geothermal energy (BLM 2008b). However, tar sands and geothermal energy have potential outside of the known Last Chance townsendia range (Falk 2013). These other mineral resources are not considered to have development potential within Last Chance townsendia occupied or suitable habitat and do not appear to pose a threat to the species on BLM or USFS land (Falk 2013; Reay 2013; Tait 2013). Therefore, we do not consider other mineral development to be a threat to the species.

Summary

Energy and mineral related development is occurring throughout the range of Last Chance townsendia with the exception of Capitol Reef. Conservation measures for the species on BLM and USFS reduce the threat of direct impacts to the species, so we assign an overall **moderate** threat for energy and mineral related development at this time. Updated survey data are needed for populations near current mining activities. Indirect impacts to the species need to be quantified before we can assign a lower threat level to energy and mineral development.

Livestock Grazing

Grazing by cattle occurs across the entire range of Last Chance townsendia on BLM and USFS land and across the majority of the species range in Capitol Reef. In Capitol Reef, two active allotments remain in the Park, and ninety-five percent of the Last Chance townsendia individuals within the park occur within the Hartnet grazing allotment (Borthwick 2013).

Cattle trampling and compaction of the soil and trampling of individual plants is a threat because Last Chance townsendia, like many small herbaceous plants, can be severely damaged in heavily travelled areas, such as around watering areas, fences, and along trails (Fleishner 1994; Krausman *et al.* 2009). The deleterious effects of livestock on western arid ecosystems are well-documented (Jones 2000; Milchunas *et al.* 1992).

Trampling by livestock can disturb the soil cryptobiotic crust layer (Belnap and Gillette 1997) which can result in increased erosion and reductions in soil fertility and soil moisture (Belnap *et al.* 1999; Belnap *et al.* 2009; Kuske *et al.* 2012; Rosentreter *et al.* 2007; Schwinning *et al.* 2008). Cryptobiotic crusts are beneficial for plant establishment and growth (Belnap *et al.* 2001), and may take hundreds of years to recover from disturbance (Belnap 2003). Soil compaction by livestock trampling can affect water infiltration, soil porosity, and root development (Castellano 2007; Sharrow 2007). Additional adverse effects from livestock include changes to insect communities (Debano 2006; Kearns and Inouye 1997), damage to ground-nesting pollinators and their nests (Sugden 1985), changes in water infiltration due to soil compaction (Jones 2000), subsequent nonnative invasive plant invasions (Parker *et al.* 2006), and changes in the timing and availability of pollinator food plants (Kearns and Inouye 1997). This last adverse effect is specifically mentioned as a concern for Last Chance townsendia because the grazing of palatable forbs that flower at the same time as Last Chance townsendia, such as *Phlox austromontana*, may indirectly affect Last Chance townsendia pollinator abundance and the species' seed production (Tepedino *et al.* 2004).

Our understanding of actual grazing impacts on Last Chance townsendia is mostly observational in nature with documentation of whether or not livestock grazing is occurring within occupied habitat. Livestock grazing and trampling were a reported threat at 15 populations of Last Chance townsendia populations (representing 90% of the total population size). It is important to mention that while we used the latest threats assessment for each population, some assessments are dated and may not adequately reflect the current livestock use within the populations. Additionally, surveys may not adequately reflect the intensity of livestock use if sufficient time has elapsed such that rain events obscure livestock prints. Furthermore, we do not have documented criteria with which to assign a level of impact to the habitat or species from livestock grazing and trampling.

On BLM land, 58 Last Chance townsendia monitoring sites were visited in 2012 and the level of grazing impacts was assessed at each monitoring site (see Table 5). No Last Chance townsendia individuals were directly trampled and no monitoring sites were assessed as having a high level of impact from livestock grazing that year (Robinson 2013). In 2011, significant livestock trampling was documented at one monitoring site next to a fence line on BLM land where cattle were concentrated (RMER 2011).

Table 5. Level of grazing impacts assessed at 58 BLM annual monitoring sites (Robinson 2013).

Impacts to Site	Percentage of Sites
No Impacts	19%
Low Impacts	57%
Moderate Impacts	24%
High Impacts	0%

We have mortality data on Last Chance townsendia individuals that were trampled by cattle within the BLM demography plot. Cattle trampled 13 of the 394 plants within the plot. Six of the 13 plants died within two years of the trampling event (Clark 2008) providing us with a mortality rate of 46% for trampled plants. Since trampling was only documented once during the 12-year study, we consider this to be a lightly-travelled route with a low intensity of livestock use. This limited data set suggests the species is vulnerable to trampling, but the two year time frame also suggests that mortality may be attributed to other factors such as climate or life span. At this time, we do not have monitoring plots to compare mortality and population trends of grazed and un-grazed Last Chance townsendia populations.

The only additional data documenting grazing impacts to Last Chance townsendia individuals was an evaluation performed within the Capitol Reef portion of the Hartnet grazing allotment. The report assessed grazing as having a moderate to low impact to Last Chance townsendia and other rare plant species at that time (Heil 1994). The major impact from grazing was due to the degradation and destruction of suitable habitat through soil compaction, trailing, and loss of vegetation. Direct trampling of individuals was not considered a major impact to the species since only one trampled Last Chance townsendia individual was recorded (Heil 1994). Presently, the Hartnet grazing allotment in Capitol Reef is now fully managed by Capitol Reef (BLM 2009b). Livestock trailing also occurs within the Park between allotments, but no stock trails pass within 0.5 miles of known Last Chance townsendia populations (Borthwick 2013). Additionally, the large distance between Last Chance townsendia populations and water sources indicates that only a portion of the Last Chance townsendia populations in Capitol Reef may be impacted by livestock (Borthwick 2013). However, we do not have current monitoring data within Capitol Reef to document current impacts to the species from livestock grazing and trampling. Grazing permittees use horses to round up livestock in Capitol Reef, so there is the potential for impacts to Last Chance townsendia associated with this activity (Borthwick 2013).

On USFS land, Last Chance townsendia populations are within grazing allotments. We do not have up-to-date monitoring data within USFS land to document current impacts to the species from livestock grazing and trampling. Livestock do not appear to spend much time grazing within the

habitat, but do travel through the habitat so trampling is a threat (Tait 2013).

We assign a **moderate** overall threat level for livestock grazing based upon the rangewide scope, the immediacy of the threat, and the small exposure of the threat. The BLM and Capitol Reef committed to performing intensive surveys and monitoring activities within occupied and potential habitats that occur within grazing allotments in order to assess the impact grazing activities have on the species (see section 2.2.3, above). We will re-evaluate this threat level when we have more information regarding the extent of livestock trampling within populations and the species' vulnerability to trampling.

Range Improvements

The BLM grazing permits allow for range improvements that involve surface disturbance, such as fence construction and livestock pond construction, to be performed within grazing allotments. The BLM committed to performing plant surveys before these activities take place and avoiding or minimizing grazing impacts to the Last Chance townsendia; however, no specific buffer area was established to protect individual plants or occupied habitat from these activities (BLM 2009a; BLM 2009b). Impacts to Last Chance townsendia include the loss of individuals and the modification or degradation of occupied and suitable habitat.

Range improvement from an existing fence line was identified to be a threat to Last Chance townsendia at one monitoring site within the Post Hollow population on BLM land (RMER 2011). Significant cattle trampling was occurring along the fence line and within the monitoring plot. This population represents 8% of the total population size.

Range improvements have not been identified as a threat to the species at other populations. Therefore, we consider range improvements a **low** threat to the species. We will re-evaluate this threat level when we have more information regarding range improvements and impacts to Last Chance townsendia.

Wild Horses and Burros

Wild Horses and Burros occur within a portion of Last Chance townsendia's range within the BLM Price Field Office planning area (RMER 2005). The BLM Price RMP designates 283,000 acres for wild horses in the Muddy Creek Herd Management Area (HMA) where Last Chance townsendia occurs. Herds are managed under the Federal Land Policy and Management Act of 1976. The BLM monitors the herd size at a minimum of every three years and adjusts the herd size based upon available forage to comply with their Standards for Rangeland Health

(BLM 2013). Aircraft and motorized vehicles are used in round-up activities.

Six populations of Last Chance townsendia (Cat Canyon, Lower Willow Springs Wash, Moore Cutoff, Poor Canyon, Sand Bench, and Segers Hole) occur within the Muddy Creek HMA representing 4% of the total population size. Wild horses were specifically identified as threats at two of these populations (Cat Canyon, Poor Canyon) representing 1% of the total population size. Horse trampling was associated with regular horse migration rather than from round-up activities (RMER 2005). We believe impacts to Last Chance townsendia by horse trampling are similar to impacts by livestock trampling (see Livestock Grazing section, above).

We consider wild horses and burros a **moderate** threat to the species. While the exposure of the threat is small, the intensity of the threat is equivalent to that of livestock grazing and trampling. We will re-evaluate this threat level when we have more information regarding wild horses trampling impacts to Last Chance townsendia.

Off-Highway Vehicles

Off-Highway Vehicle (OHV) use was identified in the listing document and the Recovery Plan as a threat to Last Chance townsendia because OHV use was predicted to increase within the species' occupied habitat from the greater accessibility provided by new road development (USFWS 1993). There has been rapid growth in OHV use both nationally and in Utah on public lands (USFS 2006; Jakus *et al.* 2008), a trend that is reflected in the 233% increase in the number of OHV registrations in Utah from 1998 to 2006 (Smith *et al.* 2009).

OHV use is now restricted to designated routes on BLM and USFS land, and prohibited on Capitol Reef. On BLM land, the Price Field Office restricted OHVs to designated routes in 2003 (BLM 2003; BLM 2008a). The Richfield Field Office restricted OHVs to designated routes in 2008 (BLM 2008b). OHV use was restricted to designated routes in Fishlake and Dixie National Forests as of 2006 and 2009, respectively (Tait 2013; USFS 2006a; USFS 2009b). No designated routes pass through occupied or known, suitable habitat for the species in Fishlake National Forest (USFS 2006b), and 1.5 miles of roads were removed to improve protection of occupied habitat for Last Chance townsendia (USFS 2006a). Dixie National Forest closed all motorized travel within occupied and potentially suitable habitat (USFS 2009b).

The level of OHV traffic was recently assessed on the roads and trails adjacent to 58 BLM monitoring sites in 2012 (see Table 6). The majority of OHV use kept to designated routes. Unauthorized traffic through

occupied habitat was observed at only one Last Chance townsendia monitoring site.

Table 6. Level of OHV traffic assessed near 58 BLM annual monitoring sites (Robinson 2013).

OHV Traffic	Percentage of Sites
No OHV Traffic	23%
Recent OHV Traffic	61%
Past OHV Traffic	14%
Unauthorized Traffic	2%

Unimproved roads provide access to populations of Last Chance townsendia, and vegetation cover within Last Chance townsendia habitat is generally sparse and therefore presents few barriers to OHVs. Direct impacts from OHV use include destruction of individuals and habitat modification. Indirect impacts include soil erosion, and facilitation of nonnative plant invasions. Unimproved roads also provide a barrier to pollinators and seed dispersal (Spellerberg 1998). Road networks contribute to nonnative plant invasions via introduced road fill, vehicle transport of plant parts, and road maintenance activities (Forman and Alexander 1998; Gelbard and Belnap 2003). Many of these invasive species are not limited to roadsides, but also encroach into surrounding habitats (Forman and Alexander 1998; Forman 2000; Gelbard and Belnap 2003).

The overall threat of OHV use to the species is **low** at this time. The current threat of direct impacts to the species is not imminent now that vehicles are restricted to designated routes throughout a moderate portion of the species range. Inadequate enforcement of illegal OHV activity is a concern on both USFS and BLM land. Future road construction from oil and gas development within Fishlake National Forest may provide greater accessibility for illegal OHV use within the species' occupied habitat. Indirect impacts to the species will need to be monitored. Since many Last Chance townsendia populations were surveyed before the current OHV restrictions were in place, the threat assessment at these sites is out-of-date. We will re-evaluate the degree of threat OHV use poses to the species as we receive new data.

Summary

We conclude that livestock grazing poses a high threat to Last Chance townsendia at the present time because of the rangewide scope of the threat and the apparent vulnerability of the species to low frequency trampling events. We conclude energy and mineral related development (coal, oil and gas, uranium) as well as wild horses and burros pose a moderate threat to the species. We conclude OHV use and range improvements are low threats to the species.

The number of threats identified in this section was summed for each population of Last Chance townsendia, and depicted in Figure 3. Every population has at least one threat. Twenty-two of the twenty-three populations have two or more threats. Twelve of the twenty-three populations have three or four threats. The overall threat level for all factors considered in this section is **high**.

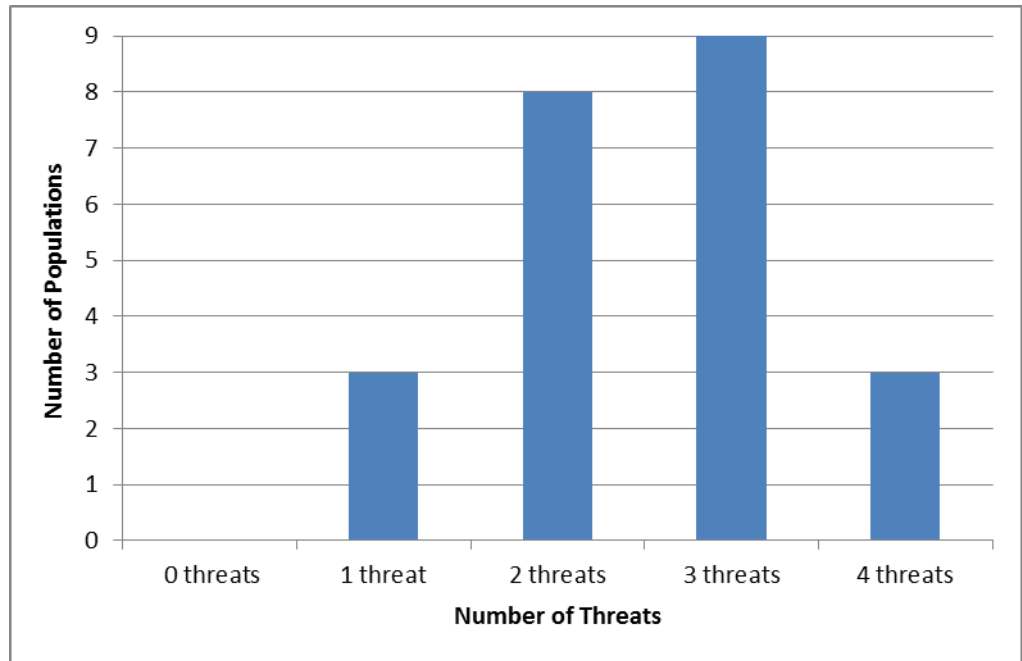


Figure 3. Combined number of threats for each Last Chance townsendia population.

2.3.2.2. Overutilization for commercial, recreational, scientific, or educational purposes

At the time of listing and the Recovery Plan, this factor was not considered a threat to the species. The reason for not proposing critical habitat for Last Chance townsendia at the time of listing was due to concerns of wanton vandalism from OHV use within the critical habitat boundary if such a boundary was established rather than a concern from overutilization (50 FR 33734; August 21, 1985).

Last Chance townsendia is an attractive plant that would be appealing to rock garden enthusiasts, and therefore may have commercial value. Rock garden enthusiasts are interested in the genus *Townsendia* as is documented by the numerous photographs on the North American Rock Garden Society (NARGS) website (NARGS 2013). Last Chance townsendia is likely a highly desirable *Townsendia* species due to its unusual flower petal color and rarity. The species was considered an “outstanding *Townsendia* species” in a NARGS newsletter (NARGS

2010). A photograph of a cultivated Last Chance townsendia plant growing in a rock garden trough can be found in the *Townsendia* photo gallery on the NARGS website (NARGS 2013) and germination protocols for the species are identified on one website (Rock Garden Plants Database 2013).

We did not find seeds of Last Chance townsendia for sale on the internet and in popular rock garden seed catalogs. However, commercial activity and recreational utilization of Last Chance townsendia may occur through other channels not readily discernible. Since Last Chance townsendia is listed as threatened rather than endangered, seeds from cultivated specimens of threatened plant species are exempt from commercial prohibitions of the Act, under certain circumstances. Collection of specimens for scientific purposes is regulated by our scientific permits and we have not authorized the collection of Last Chance townsendia for scientific voucher specimens. We are not aware that illegal collections for scientific purposes have occurred.

Overall, the scope of commercial and recreational overutilization appears to be localized and the intensity appears to be low, so we assign a **low** threat at this time. We will re-evaluate the degree of threat this poses to the species when we receive new information.

2.3.2.3. Disease or predation

Disease and insect predation were not considered threats to Last Chance townsendia in the listing decision or in the Recovery Plan. We have no new information to suggest they are present or future threats to the species. We conclude this is not a threat to Last Chance townsendia because it is not known to occur; however, if we receive new information regarding disease or predation, we will re-evaluate the degree of threat this poses to the species.

2.3.2.4. Inadequacy of existing regulatory mechanisms

Prior to listing of the Last Chance townsendia as federally threatened, the species was not protected by state or Federal regulations. Once listed, some Federal protections became effective. Below we analyze the current situation (i.e., the situation with the Act's protections in place) and, in order to gauge the adequacy of regulatory mechanism, what would happen in the absence of the Act's protections.

Federal Laws and Regulations

With the listing of Last Chance townsendia as federally threatened, multiple protections became available. The National Environmental Policy Act (NEPA) (42 U.S.C. 4371 et seq.) provides some protections for listed species that may be affected by activities undertaken, authorized, or

funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, the NEPA requires an agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where the analysis reveals significant environmental effects, the Federal agency must discuss mitigation that could offset those effects (40 CFR 1502.16). These mitigations usually provide some protections for listed species. However, the NEPA does not require that adverse impacts be mitigated, only that impacts be assessed and the analysis disclosed to the public. In the absence of the Act's protections, it is unclear what level of consideration and protection Federal agencies would provide through the NEPA process.

The Act is the primary Federal law protecting Last Chance townsendia since its listing in 1985. Section 7(a) (1) states that Federal agencies, in consultation with us, shall carry out programs for the conservation of endangered species and threatened species. Section 7(a) (2) requires Federal agencies to consult with us to ensure any project they fund, authorize, or carry out is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Jeopardy includes engaging in any action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Measures specifically addressing the protection of Last Chance townsendia were included in Section 7 consultations for the BLM Price Field Office RMP (BLM 2008a), the BLM Richfield Field Office RMP (BLM 2008b), the Renewal of 17 Grazing Allotments in the San Rafael Swell (BLM 2009a), the Renewal of the Hartnet and Cathedral Grazing Allotments (BLM 2009b), the Fishlake National Forest OHV Route Designation Project (USFS 2006b), the Dixie National Forest Motorized Travel Plan (USFS 2009b), and the oil and gas leasing project on the Fishlake National Forest (USFS 2011). Without the Act, we would neither have completed these Section 7 consultations, nor developed species-specific conservation measures. As stated under section 2.3.2.1 (livestock grazing) above, the BLM committed to conducting intensive surveys and monitoring activities for applicable listed species over the term of the renewed grazing permits (BLM 2009a; BLM 2009b). However, no intensive monitoring efforts to assess livestock trampling impacts are occurring at this time. Without monitoring data, we have no information to base management decisions designed to protect the species on. Therefore, regulatory mechanisms are inadequate to protect the species.

The Price and Richfield BLM RMPs provide some general habitat protection mechanisms for Last Chance townsendia in oil and gas lease

notices. The two Last Chance townsendia populations within WSAs are protected from new mining activity. The BLM did not commit to closing occupied habitat to OHV use or recreation use if they are threats to Last Chance townsendia, but stated they would consider protective measures for the species from OHV use. The BLM stated they will encourage the avoidance of occupied habitat during livestock herding and trailing activities. No systematic monitoring efforts have been conducted to determine if surface disturbances (trampling by livestock, coal development, uranium mining) are affecting Last Chance townsendia. We recommend that the BLM monitor to determine the level of intensity and level of impact these activities have on Last Chance townsendia individuals and populations (see section 4). BLM land supporting Last Chance townsendia that are discretionary and considered for exchange or sale would be reviewed to determine if the action would threaten the survival and recovery of the species.

Through the Federal Land Policy and Management Act of 1976 (FLPMA) and BLM Policy Manual 6840 – Special Status Species Management, the BLM would have authority to manage lands for sensitive (special status) species including species of concern, should the species be considered for delisting.

Prior to listing, Last Chance townsendia was not known to occur on USFS land. Consequently, it was not considered in the analysis for the current land use plans of Fishlake and Dixie National Forests (USFS 1986a; USFS 1986b) and the Dixie National Forest Timber Management Plan (USFS 1997). The species will be included in the Biological Assessment for the update land use plans but the planning process is stalled due to litigation (Tait 2013). Presently, Last Chance townsendia is not protected by any formal land management designations on USFS lands.

Both the Fishlake and Dixie National Forests provide protection to Last Chance townsendia from OHV use and Fishlake National Forest provides protection from oil and gas development. However, we have not yet consulted with the USFS on grazing activities for this species.

If the species is removed from the Federal list of threatened and endangered species, it is likely to be listed as a USFS sensitive species as per the National Forest Management Act (NFMA) (Title 2600, Chapter 2670.3(2)). The NFMA requires that the USFS prepare a Biological Evaluation for USFS sensitive species for any activity that triggers NEPA analysis. Within the Biological Evaluation, the USFS must analyze the effects of any action that may impact a sensitive species and minimize the adverse effects.

The National Park Service (NPS) lands are administered under the provisions of the Organic Act of 1916 (16 U.S.C. 1, 2, 3, and 4), as amended and supplemented. The Organic Act specifies that the NPS will “promote and regulate the use of the Federal areas known as national parks, monuments, and reservations which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.”

The 1976 Mining in the Parks Act (16 U.S.C. 1901 et seq.), the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.), and the Clean Air Act of 1977, as amended, (42 U.S.C. 7401 et seq.) provided tools for parks to remove and prevent mining and drilling ventures (NPS 2006). There are no valid mineral rights or mining claims in Capitol Reef, no private or state inholdings within the Park boundary, and OHV use is prohibited throughout the Park (Borthwick 2013). Capitol Reef’s General Management Plan (GMP) designates Management Zones within the park and the species is located within Primitive and Semi-Primitive Zones (Capitol Reef 1998). Protection of the wilderness qualities within these Zones is one of the highest priorities of the GMP. No facilities or services are provided within these Zones, and no development is currently proposed within these Zones (Borthwick 2013).

While some threats to Last Chance townsendia were removed in Capitol Reef (i.e., mining and OHV use), grazing is permitted within the Park and is a high threat to the species. Livestock grazing is allowed within Capitol Reef as per their enabling legislation (FR 69-899; Jan. 21, 1969). Capitol Reef committed to conducting intensive surveys and monitoring activities within their grazing allotments to assess the impact of livestock, recreational, or other uses on the long-term viability of Last Chance townsendia when they assumed control of the allotments in 2010 (Capitol Reef 2010). However, no intensive monitoring efforts to assess livestock trampling impacts are occurring at this time. Without data from monitoring activities, we have no information to base adaptive management decision on. Therefore, regulatory mechanisms are inadequate to protect the species.

The Clean Air Act of 1970 does not adequately address the effects of global climate change such that the threat to Last Chance townsendia would be ameliorated in the foreseeable future. The Clean Air Act of 1970 (42 U.S.C. 7401 et seq.), as amended, required the Environmental Protection Agency (EPA) to develop and enforce regulations to protect the general public from exposure to airborne contaminants that are known to be hazardous to human health. In 2007, the Supreme Court ruled that gases that cause global warming are pollutants under the Clean Air Act, and the EPA has the authority to regulate carbon dioxide and other heat-trapping gases (Massachusetts *et al.* v. EPA 2007 [Case No. 05-1120]).

The EPA published a regulation to require reporting of greenhouse gas emissions from fossil fuel suppliers and industrial gas suppliers, direct greenhouse gas emitters, and manufacturers of heavy-duty and off-road vehicles and engines (74 FR 56260; October 30, 2009). The rule does not require control of greenhouse gases; rather it requires only that sources above certain threshold levels monitor and report emissions. At this time, it is not known what regulatory mechanisms will be developed by the EPA.

Removal of Last Chance townsendia from Federal protection under the Act would remove current Federal conservation mechanisms to protect and enhance these vulnerable populations. Habitat protection and other conservation actions on Federal land would likely decline as funds were shifted to protection and conservation of other resources. Without the protection of the Act, management and research to benefit the species may still occur, but available funding would likely be used for species with higher conservation priority.

State Laws and Regulations

Utah has no State laws or regulations that protect Last Chance townsendia.

Local or Other Laws and Regulations

There are no county or local laws or regulations protecting Last Chance townsendia.

Summary

In the absence of the Act's protection, we believe the existing regulatory mechanisms would not provide Last Chance townsendia with adequate protection from threats. Under the Act's protection, a review of Federal actions potentially impacting the species can be performed. Because the species occurs on Federal land, threats to the species can be addressed by regulatory mechanisms, and some threats (OHV use, energy and mineral development) have been addressed. However, one high threat to the species (livestock grazing) is not adequately being addressed. The BLM and Capitol Reef have not initiated the monitoring and surveying applicant committed measures included in the programmatic grazing consultation (BLM 2009a; BLM 2009b) and the USFS is delayed in processing their grazing permit renewals and their consultation with us due to litigation. Climate change is a high threat to the species that can be addressed by regulatory mechanisms, but the Clean Air Act of 1970 presently does not regulate greenhouse gas emission levels. We assign an overall threat level to this factor as **high** because livestock grazing and climate change are high threats to the species and are not adequately addressed by the existing Federal regulatory mechanisms.

2.3.2.5. Other natural or manmade factors affecting its continued existence

Vulnerability due to Small Population Sizes

The listing decision stated that the small population and limited distribution of Last Chance townsendia contribute to the vulnerability of the species to natural and human-caused stresses. Population size is likely the best predictor of extinction rate for isolated populations (Fischer and Stöcklin 1997; Pimm *et al.* 1988). Small plant populations are at an increased risk of extinction due to the potential for inbreeding depression, loss of genetic diversity, and lower sexual reproduction rates (Ellstrand and Elam 1993; Wilcock and Neiland 2002), and are more likely to succumb to natural catastrophes (e.g., drought, fire, and flood) and environmental stochasticity. In addition, extinction is significantly more likely for populations undergoing large fluctuations in population size (Fisher and Stöcklin 1997).

The increase in the range and the number of Last Chance townsendia populations should reduce the risk of extirpation or extinction from stochastic events. However, as noted above (section 2.3.1.2), 57% (13) of the populations contain less than 50 individuals. Only 22% (5) of the populations are larger than 500 individuals. Additionally, we lack information on the minimum viable population size for this species.

Small population size in and of itself is not considered a threat; however, we consider small population size to increase the species' vulnerability to the threats discussed under sections 2.3.2.1, 2.3.2.2, 2.3.2.3, 2.3.2.4, and 2.3.2.5.

Lack of Scientific Knowledge/Monitoring

The lack of scientific knowledge to identify the meaningful threats may be contributing to decline in abundance of Last Chance townsendia populations and potential extirpation. While not a threat in and of itself, lack of scientific knowledge and monitoring information affects our ability to effectively manage and recover the species. We acknowledge the complexity of biotic interactions directly and indirectly affecting Last Chance townsendia. We could promote population growth if we could better quantify the threats the species faces and better understand how to alleviate those threats.

We consider this factor to have a **moderate** level of impact to the species because of the moderate scope and intensity of the threat.

Climate Change

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). The term

“climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions. (For these and other examples, see IPCC 2007a; and Solomon *et al.* 2007). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is “very likely” (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007a; Solomon *et al.* 2007). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011), who concluded it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (Meehl *et al.* 2007; Ganguly *et al.* 2009; Prinn *et al.* 2011). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007a; Meehl *et al.* 2007; Ganguly *et al.* 2009; Prinn *et al.* 2011). (See IPCC 2007b, for a summary of other global projections of climate-related changes, such as frequency of heat waves and changes in precipitation. Also, see IPCC 2011 for a summary of observations and projections of extreme climate events.)

Although many species already listed as endangered or threatened may be particularly vulnerable to negative effects related to changes in climate, we also recognize that, for some listed species, the likely effects may be positive or neutral. In any case, the identification of effective recovery strategies and actions for recovery plans, as well as assessment of their results in 5-year reviews, should include consideration of climate-related changes and interactions of climate and other variables. These analyses also may contribute to evaluating whether an endangered species can be reclassified as threatened, or whether a threatened species can be delisted.

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (IPCC 2007a). Therefore, we use “downscaled” projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al.* 2011, for a discussion of downscaling). With regard to our analysis for Last Chance townsendia, downscaled projections are not available.

At the time of listing and in the Recovery Plan, climate change was not specifically mentioned as a threat to Last Chance townsendia. Considered an endemic species, the present narrow range of Last Chance townsendia is thought to be restricted by soil substrate specificity rather than by climatic variables. Thus, while climate may not directly influence the availability of suitable habitat for Last Chance townsendia, the species may be sensitive to future precipitation levels if the drought tolerance threshold of Last Chance townsendia is exceeded by insufficient precipitation and prolonged drought conditions or if future precipitation levels negatively affect the pattern and amount of recruitment into the population.

In the southwestern United States, including Utah, average temperatures have increased ~1.5°F (0.8°C) compared to a 1960 – 1979 baseline (Karl *et al.* 2009). By the end of this century, temperatures are expected to warm a total of 4 to 10°F (2 to 5°C) in the southwest (Karl *et al.* 2009). Much of the Southwest remains in a drought, recently assessed as the most severe western drought of the last 110 years (Karl *et al.* 2009). Water resources in the western United States are predicted to be sensitive to climate change (Karl *et al.* 2009). The levels of aridity of recent drought conditions are predicted to become the new climatology for the southwestern United States (Seager *et al.* 2007). Utah is expected to see longer periods between precipitation events, while those precipitation events become more intense (Steenburgh *et al.* 2007).

Severe climate conditions have the potential to profoundly impact individuals, populations, and plant communities (Levine and Paige 2004). Drought conditions can directly affect Last Chance townsendia through declines in survival, plant vigor, and reproductive output, which have been documented for other rare plants in the Southwest during the drought years of 2001 through 2004 (Anderton 2002; Clark and Clark 2007; Van Buren and Harper 2003). While we may be able to assume that Last Chance townsendia has some level of drought tolerance given the arid habitat it occupies, the recent drought conditions are implicated in substantial population declines at sites in Capitol Reef and on BLM land (see section 2.3.1.2).

Indirect effects to Last Chance townsendia from climate change include biotic interactions with other plants and with pollinators and herbivores, which should also be considered when assessing how a plant species will respond to climate change (Fox *et al.* 1999). Shifts in seasonal temperature and moisture regimes may indirectly affect Last Chance townsendia by influencing pollinator behavior and abundance during the flowering period (Gordo and Sanz 2005; Schweiger *et al.* 2008) and future distributional overlap of plants and pollinators (Schweiger *et al.* 2008). Herbivory and small mammal foraging may intensify under drought conditions (Fox *et al.* 1999; Levine and Paige 2004), and extreme water limitation will diminish a plant's capacity to tolerate herbivory (Levine and Paige 2004). The indirect effects of livestock trampling within Last Chance townsendia habitat such as reduced water infiltration (Castellano and Valone 2007) and soil compaction (Allington and Valone 2011) may further diminish soil water availability during drought conditions. While we are uncertain how these climate-related interactions will affect Last Chance townsendia, they should be mentioned here, and considered in future research of climate-related effects to the species.

Last Chance townsendia has not been able to maintain a large range or robust population at lower elevations under the current drought conditions, and therefore does not appear to have the adaptive capacity (Glick *et al.* 2011; Dawson *et al.* 2011) to retain its current range under a future climate change scenario of prolonged arid conditions. The ability of Last Chance townsendia to maintain a portion of its range at the mid-to-high elevations of its current range and potentially expand into higher elevations if suitable habitat exists is unknown and we are not confidently able to predict the foreseeable consequences of this threat. Extinction risk from climate change is predicted to be higher for species such as Last Chance townsendia with small ranges (Schwartz *et al.* 2006).

We conclude that Last Chance townsendia is vulnerable to drought conditions, and that the threat of climate change to the species is **high**,

mainly due to the rangewide scope, the imminent and future immediacy, and the species apparent sensitivity to the threat. There are uncertainties in our threat evaluation since downscaled climate projections are not available for our specific location, and a vulnerability assessment has not been performed for Last Chance townsendia. We will re-assess the degree of threat climate change poses on Last Chance townsendia when more information becomes available.

2.4. Synthesis

At the time of listing and the Recovery Plan, we concluded that Last Chance townsendia was threatened (i.e., likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range) due to mineral and energy development, road building, livestock grazing and off-highway vehicle (OHV) use.

We examined the same five factors we considered when we listed the species and identified any potential new threats we have not previously considered. Once these potential threats were identified, we systematically analyzed the impacts using the rankings components presented in Table 4. This allowed us to assess the factors in relation to the species' exposure and evaluate the relative importance of each potential threat to the species' persistence and recovery, allowing us to rank the threats in order of importance (USFWS 2006; Appendix A).

We assessed the factors of climate change, and inadequacy of regulatory mechanisms and determined these factors pose a high threat to the species, exacerbated by the vulnerability due to small population size and our lack of scientific understanding of the species' needs. The overall threat level is high for the combined threats considered in section 2.3.2.1 (mineral and energy development, livestock grazing, wild horses and burros, OHV use, and range improvements).

We assessed the factors of oil and gas development, uranium mining, livestock grazing, wild horses and burros, the lack of scientific knowledge and monitoring and determined these factors pose a moderate threat to the species.

We assessed the factors related to coal mining, OHV use, range improvements, overutilization, deleterious effects of research efforts (includes scientific voucher specimen collecting) and determined these factors pose a low threat to the species.

We assessed the factors related to disease and insect predation and determined this factor is not considered a threat to the species.

The species has not achieved recovery and remains threatened. Over the past 20 years since the Recovery Plan was finalized, one recovery criteria is partially met and the remaining two recovery criteria are not met. Of the eight Recovery Plan actions, three actions are not met, four actions are partially met, and one action is ongoing:

Recovery Actions Not Initiated

- We have not established and conducted minimum viable population studies on at least six different Last Chance townsendia populations.
- We have not evaluated the need for reintroducing Last Chance townsendia into suitable habitat.
- We have not established conservation areas or other land management designations that provide protection specifically for Last Chance townsendia for any of the known populations; however, there are existing laws, regulations, and policies that afford the species some protection (see section 2.3.2.4 above).

Recovery Actions Partially Met

- Comprehensive surveys within suitable habitat throughout the range of the species have occurred, but are not complete for higher elevation areas within Capitol Reef and remote locations on USFS land. A potential habitat model to identify additional locations for future surveys has not been developed for the species.
- Research on the biology and ecology of the species was conducted; however, additional research on the seed bank dynamics, seed viability and production, drought tolerance, and trampling tolerance of Last Chance townsendia is warranted.
- A “garden” population of Last Chance townsendia, consisting of a seed bank in long-term storage, is maintained by Red Butte Garden. Germination requirements of the species can be found on the internet, but have not been tested by an authorized individual or institution (see section 2.3.2.2). Further research on the germination requirements and additional seed collections are warranted.
- Capitol Reef is developing awareness, appreciation, and support for Last Chance townsendia by educating visitor on the importance of rare plants in the Park. However, the species is not on display at botanic gardens and no educational materials are provided to school groups.

Recovery Actions that are Ongoing

- We will work with BLM, USFS, and Capitol Reef to incorporate conservation measures to provide protection for the species through Section 7 consultation; however, not all of these conservation measures are being implemented.

3. RESULTS

3.1. Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist** (Indicate reasons for delisting per 50 CFR 424.11):
 - Extinction
 - Recovery
 - Original data for classification in error
- No change is needed

3.2. New Recovery Priority Number

We do not recommend a change in the recovery priority number.

4. RECOMMENDATIONS FOR FUTURE ACTIONS

4.1. Surveys and Monitoring

- We recommend the BLM, USFS, Capitol Reef develop a reliable, comprehensive population estimate every 5 years. Populations that are accessible by foot should be resurveyed routinely unless human trampling is considered a high threat. General estimates may be used for inaccessible areas.
- We will work with the BLM, USFS, and Capitol Reef to establish long-term demographic monitoring plots for Last Chance townsendia. We will review available information and coordinate with experts to identify appropriate monitoring plots. Data on survival, recruitment, reproduction, seed viability, and habitat condition for the species can be used to determine a minimum viable population size for the species and will help us identify trends, threats, and whether conservation measures incorporated thus far are effective.
- We will work with the BLM, USFS, and Capitol Reef to establish monitoring plots that assess the impact of specific threats to the species and its habitat, including the effects of livestock trampling, recreational activities, oil and gas development, and mining activities.
- We recommend the BLM, USFS, Capitol Reef, and USFWS fund the development of a geographic information systems (GIS) based research project to spatially model the potential habitat of Last Chance townsendia. We recommend this because the species occurs on many different geologic formations and botanists continue to find new subpopulations, some of which came as a complete surprise because of the different geology and habitat conditions. Improved habitat mapping should be considered in land use decisions to minimize impacts to the species.

4.2. Research

- We recommend the BLM, USFS, and Capitol Reef initiate research projects to better understand threats to the species, its habitat, and biological requirements, including:
 - * Assess seed production and viability rangewide. Incorporate data collection of these two variables into the periodic monitoring protocols. For those populations with poor viability or production, determine if seed production is limited by pollinators or genetics.
 - * Assess seedbank dynamics, including seed longevity and germination requirements. This research should be performed at multiple sites in the field. Germination requirements can be performed in both the field and in a laboratory or greenhouse.

- * Determine the species' vulnerability to prolonged drought and the potential impacts of climate change.
- * Determine if the species is extirpated at formerly occupied sites, and assess the threats at each site that may have contributed to the extirpation.
- Once habitat requirements are better understood and reliable suitable habitat maps are developed, we recommend the USFWS, BLM, USFS, and Capitol Reef in consultation with scientific experts study the feasibility of introducing Last Chance townsendia into new areas of unoccupied habitat near existing populations as well as formerly occupied sites.

4.3. Ex-situ Conservation

- Red Butte Garden, or another qualified and permitted botanical garden, should collect seeds from all or the majority of populations to develop ex-situ populations of the species.
- Red Butte Garden, or another qualified and permitted entity (i.e., Utah State University or U.S. Forest Service Shrub Lab), should research techniques needed to successfully propagate the species should we determine reestablishing populations in the wild is a viable recovery action.

4.4. Education

- We recommend Capitol Reef continue develop educational materials regarding rare plants, their unique relationship to the local geology, and their conservation.
- We recommend Red Butte Garden develop educational materials regarding rare plants, their conservation, and conservation efforts performed by their institution.
- We, the BLM, and USFS should develop fact sheets and educational materials in schools, agency offices, and visitor centers to facilitate appreciation of and respect for sensitive areas which may contain habitat for threatened or endangered plants.

4.5. Threat Abatement

- On Federal lands, the BLM, USFS, and Capitol Reef should continue to avoid development in Last Chance townsendia populations and suitable, unoccupied habitat to the extent possible, until we can complete research showing what level of development in Last Chance townsendia habitat is tolerable. We should ensure that developers follow established conservation measures when disturbance occurs and that habitat fragmentation is reduced to the extent possible.
- We should identify and establish core conservation areas in minimally-disturbed habitat (both occupied and unoccupied) for long-term protection of Last Chance townsendia. We should work with the BLM and USFS to adopt these conservation areas under a long-term conservation agreement.
- We should use conservation area information to identify and establish an Area of Critical Environmental Concern (ACEC) on BLM land to protect Last Chance townsendia and its habitat. The ACEC should include no surface occupancy stipulations for those areas where mineral rights are not yet leased, and adequate conservation measures for livestock grazing. The ACEC can be formally recommended to the BLM and incorporated during their resource management planning process.
- We should develop a habitat management plan in coordination with the BLM and USFS to incorporate into their RMP and land use plan, respectively. Ensure that all Last Chance townsendia occurrences on public lands are within management areas where maintenance of the species is a primary management goal.
- We should develop conservation agreements in coordination with the BLM and USFS with those federal mineral leaseholders whose leases are not subject to the terms of federal management plans protecting the plants (leases that predate the RMP/habitat management plan). Through implementation of these conservation agreements, companies or individuals would implement conservation measures necessary to protect the species from mineral extraction activities.

4.6. Administrative Actions

- The Utah Natural Heritage Program should update their Last Chance townsendia records.
- Once we have new survey and research data, we should revise the Recovery Plan to explicitly address the relevant listing factors. The number of plants and populations referenced in the current Recovery Plan that are required for long-term viability of the species are unsupported by our current

understanding of the species' population status and needs revision. The revised Recovery Plan should include objective, measurable criteria which, when met, will result in a determination that the species be removed from the Federal List of Endangered and Threatened Plants. The Recovery Plan also should estimate the time required and the cost to carry out those measures needed to achieve the goal for recovery and delisting. The Recovery Plan should include updated range and population numbers and should provide recognition for new and/or increased threats since the time of listing, such as the effects of increased drought conditions caused by global climate change.

- The USFWS, BLM, USFS, and Capitol Reef should support Last Chance townsendia recovery by providing personnel and fiscal resources yearly to implement recovery actions.
- The USFWS should request the taxonomic review and update of taxonomic status of Last Chance townsendia and *T. jonesii* var. *lutea* by an acceptable *Townsendia* authority.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF SPECIES X**

Current Classification: Threatened rangewide

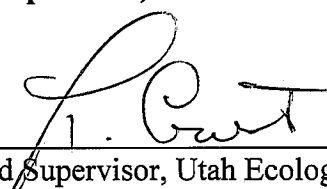
Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Review Conducted By:

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 8/22/12
Field Supervisor, Utah Ecological Services Field Office

APPENDIX A

Last Chance townsendia (*Townsendia aprica*)

Threats, Stressors, and Their Associated Scope, Immediacy, Intensity, Exposure, Response, and Overall Threat Level

Threat ⁶ / Potential Threat ⁷		Stressor ⁸	Factor ⁹	Scope ¹⁰	Immediacy ¹¹	Intensity ¹²	Exposure ¹³	Response ¹⁴	Overall Threat Level ¹⁵
1	Coal mining (Surface)	direct physical injury / mortality to individuals	A	Localized	Future	High	Moderate	Mortality	Low
2	Coal mining (underground)	direct physical injury / mortality to individuals	A	Localized	Historic / Imminent / Future	Low	Small	Mortality	Low
3		vegetation disturbance	A	Localized	Historic / Imminent / Future	Low	Small	Basic need inhibited	Low
4		soil removal / disturbance	A	Localized	Historic / Imminent / Future	Low	Small	Basic need inhibited & Mortality	Low
5		increased erosion	A	Localized	Historic / Imminent / Future	Low	Small	Basic need inhibited	Low
6		disturbance to pollinators	A	Localized	Historic / Imminent / Future	Moderate	Small	Basic need inhibited	Low
7		Oil and Gas	direct physical injury / mortality to individuals	A	Moderate	Imminent / Future	High	Moderate	Mortality
8	vegetation disturbance		A	Moderate	Imminent / Future	Moderate	High	Basic need inhibited	Moderate

Threat ⁶ / Potential Threat ⁷		Stressor ⁸	Factor ⁹	Scope ¹⁰	Immediacy ¹¹	Intensity ¹²	Exposure ¹³	Response ¹⁴	Overall Threat Level ¹⁵
9	Oil and Gas	soil removal / disturbance	A	Moderate	Imminent / Future	Moderate	High	Basic need inhibited & Mortality	Moderate
10		increased erosion	A	Moderate	Imminent / Future	Moderate	High	Basic need inhibited	Moderate
11		disturbance to pollinators	A	Moderate	Imminent / Future	Moderate	High	Basic need inhibited	Moderate
12	Uranium mining	direct physical injury / mortality to individuals	A	Moderate	Historic / Future	High	Small	Mortality	Moderate
13		vegetation disturbance	A	Moderate	Historic / Future	High	Small	Basic need inhibited	Low
14		soil removal / disturbance	A	Moderate	Historic / Future	High	Small	Basic need inhibited & Mortality	Moderate
15		increased erosion	A	Moderate	Historic / Future	High	Small	Basic need inhibited	Low
16		disturbance to pollinators	A	Moderate	Historic / Future	High	Small	Basic need inhibited & Mortality	Moderate
17	Grazing	direct physical injury / mortality to individuals	A	Rangewide	Historic / Imminent / Future	High	Small	Basic need inhibited & Mortality	Moderate

Threat ⁶ / Potential Threat ⁷		Stressor ⁸	Factor ⁹	Scope ¹⁰	Immediacy ¹¹	Intensity ¹²	Exposure ¹³	Response ¹⁴	Overall Threat Level ¹⁵
18	Grazing	soil removal / disturbance	A	Rangewide	Historic / Imminent / Future	Moderate	Small	Basic need inhibited & Mortality	Moderate
19		vegetation disturbance	A	Rangewide	Historic / Imminent / Future	High	Small	Basic need inhibited	Moderate
20		disturbance to pollinators	A	Rangewide	Historic / Imminent / Future	Moderate	Small	Basic need inhibited	Moderate
21	Range Improvements	direct physical injury / mortality to individuals	A	Rangewide	Historic / Future	Low	Small	Basic need inhibited & Mortality	Low
22	Wild Horses	direct physical injury / mortality to individuals	A	Moderate	Historic / Imminent / Future	High	Small	Mortality	Moderate
23		soil removal / disturbance	A	Moderate	Historic / Imminent / Future	Moderate	Small	Basic need inhibited & Mortality	Moderate
24	Wild Horses	vegetation disturbance	A	Moderate	Historic / Imminent / Future	High	Small	Basic need inhibited	Moderate
25		disturbance to pollinators	A	Moderate	Historic / Imminent / Future	Moderate	Small	Basic need inhibited	Moderate
26	OHV Use	direct physical injury / mortality to individuals	A	Moderate	Historic	Low	Small	Mortality	Low

Threat ⁶ / Potential Threat ⁷		Stressor ⁸	Factor ⁹	Scope ¹⁰	Immediacy ¹¹	Intensity ¹²	Exposure ¹³	Response ¹⁴	Overall Threat Level ¹⁵
27	OHV Use	vegetation disturbance	A	Moderate	Historic	Low	Small	Basic need inhibited	Low
28		soil removal / disturbance - soil compaction	A	Moderate	Historic	Low	Small	Basic need inhibited & Mortality	Low
29		increased erosion	A	Moderate	Historic / Imminent / Future	Low	Small	Basic need inhibited	Low
30		disturbance to pollinators	A	Moderate	Historic	Low	Small	Basic need inhibited	Low
31	Lack of (or inefficiency of) existing regulatory mechanisms independent of Act	Insufficient protective measures	D	Rangewide	Imminent / Future	Moderate	High	Basic need inhibited & Mortality	High
32	Overutilization	direct physical injury / mortality to individuals	B	Localized	Not known to occur	Low	Small	Basic need inhibited & Mortality	Low
33	Personal / commercial uses	Reduction in population numbers	B	Localized	Imminent / Future	Low	Small	Basic need inhibited & Mortality	Low
34	Deleterious effects of research efforts	Reduction in population numbers/ seedbank	B	Localized	Historic/ Imminent/ Future	Low	Small	Basic need inhibited & Mortality	Low

Threat ⁶ / Potential Threat ⁷		Stressor ⁸	Factor ⁹	Scope ¹⁰	Immediacy ¹¹	Intensity ¹²	Exposure ¹³	Response ¹⁴	Overall Threat Level ¹⁵
35	Disease	direct physical injury / mortality to individuals	C	Localized	Not known to occur	Low	Small	Basic need inhibited & Mortality	Not a Threat
36	Insect predation	direct physical injury / mortality to individuals	C	Localized	Not known to occur	Low	Small	Basic need inhibited & Mortality	Not a Threat
37	Small Populations	Loss of genetic diversity and resiliency	E	Rangewide	Historic / Imminent / Future	High	High	Basic need inhibited & Mortality	High ¹⁶
38	Climate Change	Changes in hydrological conditions, habitat conditions	E	Rangewide	Imminent / Future	Moderate	High	Basic need inhibited & Mortality	High
39	Lack of scientific knowledge	Potentially inadequate management of species	E	Rangewide	Historic / Imminent / Future	Moderate	Moderate	Basic need inhibited & Mortality	Moderate ¹⁷
40	Lack of monitoring	Potential failure to detect meaningful changes in population trends	E	Rangewide	Historic / Imminent / Future	Moderate	Moderate	Basic need inhibited & Mortality	Moderate ¹⁷

⁶Any circumstance or event that is causing or will cause harm to the resource.

⁷Any circumstance or event with the potential to cause harm to the resource.

⁸A process or event with negative impact on target species.

⁹ Same factors used when making a listing decision: A – The present or threatened destruction, modification, or curtailment of its habitat or range; B – Overutilization for commercial, recreational, scientific, or educational purposes, C – Disease or predation; D – The inadequacy of existing regulatory mechanisms; or E – Other.

¹⁰ Geographic extent of the stressor: Localized – less than one population; Moderate – one population; or Rangewide – stressor is acting on species rangewide.

¹¹ Timeframe of the stressor: Imminent – is the stressor present and acting on the target now; Future – anticipated in the future; or Historic – or has the impact already occurred.

¹² The strength of the stressor itself: Low, Moderate, or High.

¹³ The extent to which a target resource and stressor actually overlap in space and/or time given the scope: Small, Moderate, or High.

¹⁴ Level of physiological / behavioral response due to a specific stress considering growth, fecundity, and mortality rates: Basic need inhibited – basic plant needs for growth & development; or Mortality – identifiable reduction in growth rate or survival.

¹⁵ Integration of the scope, immediacy, intensity, exposure, and response at the species level: Potential, Low, Moderate, or High.

¹⁶ Small population size in and of itself is not considered a threat; however, it may increase the species' vulnerability if other threats are impacting the species.

¹⁷ While not a threat in and of itself, this factor affects our ability to manage and recover the species.