U.S. FISH AND WILDLIFE SERVICE

Species Report for *Eriogonum diatomaceum* (Churchill Narrows buckwheat)

Nevada Fish and Wildlife Office
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EXECUTIVE SUMMARY

Eriogonum diatomaceum is a member of the Polygonaceae (buckwheat family). It is a low, matted, herbaceous perennial forb densely hair leaves and head-like clusters of creamy-white flowers. Flowering typically occurs between the months of June and September. *Eriogonum diatomaceum* was elevated to candidate status under the Endangered Species Act on May 4, 2004. We recognize four populations of this species that are restricted to approximately 3 square miles (7.8 square kilometers) in the Churchill Narrows area of the Pine Nut Mountains in Lyon County, Nevada. These four populations occupy approximately 18 acres (ac) (7.3 hectares (ha)) on lands managed entirely by BLM.

BLM began a pilot monitoring program for *Eriogonum diatomaceum* by establishing permanent, fixed monitoring plots at 16 discrete locations across the range of the species. This represents the best available information on abundance and population trend for this species.

Eriogonum diatomaceum occurs on diatomaceous soil deposits, which is an economically valuable mineral that is in increasing demand. Mineral exploration and development has impacted *E. diatomaceum* habitat, resulting in the loss of individual plants and habitat at one population corresponding to 5 ac (1.67 ha) or 22 percent of habitat for the species. No portion of the species' range has been withdrawn to mineral entry; two placer claims (for gold) filed in 2004, located one-quarter mile from occupied habitat, remain active (meaning the claims are still open) but without ongoing activity.

Other factors affecting the species evaluated in this document include livestock grazing; herbivory; off-highway vehicles (OHV) activity and other road corridors; nonnative, invasive plant species; disease; and climate change. Livestock grazing may result in direct impacts to established *Eriogonum diatomaceum* plants due to trampling. Livestock grazing, OHV activity, and road corridors create patterns of soil disturbance alters habitat function, reduces the likelihood of population recruitment, and creates conditions conducive to the invasion of nonnative plant species. Once nonnative, invasive plant species are established, these species tend to spread well beyond the footprint of mineral development and exploration or OHV or road corridors, further deteriorating otherwise intact habitat and native vegetation, including *E. diatomaceum*. Herbivory when combined with climate change and altered precipitation and temperature regimes, may interfere with seedling recruitment and persistence of the species on the landscape. A rust pathogen was observed on *Eriogonum diatomaceum* individuals during survey work in the late 1990s, however the identity of the pathogen, its origin, and its ultimate effect on this plant species are unknown.

BIOLOGICAL INFORMATION

Legal or Formal Status

Endangered Species Act

Eriogonum diatomaceum Reveal, J. Reynolds & Picciani (Churchill Narrows buckwheat) was elevated to candidate status under the Endangered Species Act (ESA) on May 4, 2004, and it has been evaluated as a candidate in the Candidate Notice of Review (CNOR) each year since 2004. Candidate species are plants and animals for which the U.S. Fish and Wildlife Service (USFWS) has sufficient information on the biological status and threats to propose those species as endangered or threatened under the ESA, but for which development of a proposed listing regulation has been precluded by other higher-priority listing activities.

State of Nevada

Eriogonum diatomaceum has been declared by the Nevada Division of Forestry (NDF) to be threatened with extinction pursuant to Nevada Revised Statutes (N.R.S.) 527.260–.300 and was added to the State list of fully protected species of native flora (Nevada Administrative Code 527.010) in 2004. Removing or destroying plants on the State's fully protected list is prohibited except under special permit issued by NDF (N.R.S. 527.270).

Bureau of Land Management

Eriogonum diatomaceum is a Bureau of Land Management (BLM) sensitive species. Populations of *E. diatomaceum* on BLM land are managed under BLM 6840 Manual, Release 6–125, revised as of December 12, 2008 (BLM 2008a, pp. 1–48). BLM policy is to manage candidate species (as designated under the ESA) as sensitive species, defined as "species that require special management or considerations to avoid potential future listing" (BLM 2008a, Glossary, p. 5). The stated objective for sensitive species is to initiate proactive conservation measures that reduce or eliminate threats to minimize the likelihood of and need for listing (BLM 2008a, 6840.02). Conservation, as it applies to BLM sensitive species, is defined as "the use of programs, plans, and management practices to reduce or eliminate threats affecting the status of the species, or improve the condition of the species' habitat on BLM-administered lands" (BLM 2008a, Glossary, p. 2).

Species Description

Eriogonum diatomaceum is a member of the Polygonaceae (buckwheat family). It is a low, matted, herbaceous perennial forb that is 2–9.8 inches (in) (5–25 centimeters (cm)) across and 2–8 in (5–20 cm) tall. This species grows from a branched, woody caudex and has elliptic, densely gray-tomentose (covered by short, matted, or tangled, soft, wooly hairs) leaves that sheath up the stem (Figure 1). Capitate (i.e., head-like or in a head-shaped cluster) inflorescences arise from a leafless, tomentose stem. Rigid involucres (a whorl of bracts subtending a flower or flower cluster) are 0.11–0.18 in (3–4.5 millimeters (mm)) long, densely crowded, and turbinate (i.e., top-shaped). The perianth (a term that encompasses both the sepals and petals of a flower, especially when similar in appearance) is creamy-white, glabrous, and 0.08–0.1 in (2–2.5 mm) long (Reveal *et al.* 2002, pp. 87-88; Reveal pp. 292–293 in Holmgren *et al.* 2012).

Taxonomy

Eriogonum diatomaceum was discovered in 1997 during surveys conducted for a proposed mining project and was described by Reveal *et al.* in 2002 (pp. 87–89). Within the genus, *E. diatomaceum* is placed in the subgenus *Eucycla*, a complex group with many narrow endemics throughout the interior western United States, many of which specialize on volcanic ash, clay, or calcareous habitats (Morefield 1996, p. 10). *Eriogonum diatomaceum* is similar in appearance to a species known from the Great Plains, *Eriogonum pauciflorum* Pursh (fewflower buckwheat), but is allied to species of the *Eriogonum ochrocephalum* S. Watson (whitewoolly buckwheat) complex, characterized as matted perennials with leafless stems and capitate inflorescences, and specifically those that have a rigid, usually turbinate involucre (Reveal *et al.* 2002, p. 89). We have carefully reviewed the available taxonomic information to reach the conclusion that *E. diatomaceum* is a valid taxon.

FIGURE 1—*Eriogonum diatomaceum*, Churchill Narrows buckwheat (Photo credit: USFWS).

Phenology and Life History

The phenology and life history of *Eriogonum diatomaceum* have not been well studied. The species breaks dormancy in early spring, and new leaves and flowering stems appear in April or May, depending on the annual timing of temperature changes and precipitation events. Plants were observed in full flower in the second week of June for two consecutive years and continued to flower into September (Reynolds 2001, p. 100; BLM 2006, p. 11). The fruits or achenes, which are small, glabrous, and taper to a 3-angled beak, are likely mature within a month of flowering, between the end of June and mid-November (Reynolds 2001, p. 4; Reveal *et al.* 2002, p. 88).

The reproductive strategies of *Eriogonum diatomaceum* have not been well studied. Floral visitors of *E. diatomaceum* were collected in the field in 1998, including a white spider, a small red ant, a reddish colored wasp, a small dark beetle, and a native bee. However, these potential pollinators have not yet been identified (Reynolds 2001, p. 2). There are no studies on the reproductive strategy and dispersal mechanisms for *E. diatomaceum*. Wind and water transportation of seeds is likely the primary dispersal agent. Seeds are enclosed by light, papery floral parts that are presumably easily transported, potentially for several miles, in the prevalent, high winds that characterize the landscape in which this species occurs (Reynolds 2001, p. 10). Plants are most often found growing in channelized areas, suggesting that water and gravity may transport seeds downhill and along drainage channels (Reynolds 2001, p. 10; D. Tonenna, BLM, *in litt.* 2012, entire).

Habitat

Eriogonum diatomaceum occurs between 4,300 and 4,560 feet (ft) (1,311 and 1,390 meters (m)) in elevation on diatomaceous outcrops. These outcrops are on rounded or convex knolls, low ridgelines, and drainages with 0–25° slopes (Reveal *et al.* 2002, p. 88; Reynolds 2001, p. 8). *E. diatomaceum* occurs on all aspects; however, the species is found in the highest densities on south-facing aspects (Tonenna, BLM, *in litt.* 2012, entire; Tonenna, *in litt.* 2013, entire). The occupied sites are all composed of white, exposed diatomaceous soils developed from the Coal Valley Formation and have variable volcanic cobble-rock cover. The Coal Valley Formation is part of the series of Tertiary diatomite that filled the subsidiary basins within the Basin and Range extensional tectonic system of Nevada (Reynolds 2001, p. 8). The major components of this diatomaceous soil are fossil diatoms (amorphous silica), calcium montmorillonite, feldspar, and gypsum (Reynolds 2001, p. 8; Reveal *et al.* 2002, pp. 88-89).

All populations of *Eriogonum diatomaceum* occur on the Celeton soil series (S. Kulpa, unpubl. survey notes, 2013). This series consists of very shallow and shallow, well drained soils that formed in colluvium (i.e., a deposit of soil material accumulated at the base of steep slopes as a result of gravitational actions) derived from volcanic rocks over residuum weathered from diatomite. Effective rooting depth is estimated at 4–14 in (10–36 cm) (Soil Survey Staff 2012, entire). Soils are usually moist in some part of the soil profile for short periods during winter and early spring and dry in all parts of the soil profile during late spring, summer, and fall (Soil Survey Staff 2012, entire). Available water holding capacity is very low (i.e., ranging from 0.3–

0.7 in (0.8–1.8 cm) within 40 in (101.6 cm) of the soil surface) for this soil; water held in the surface horizon does not decrease as rapidly as water held in the subsurface horizons due to the influence of volcanic parent material (National Cooperative Soil Survey, accessed online at *http://ncsslabdatamart.sc.egov.usda.gov* on September 6, 2013). Lack of soil organic matter in the soil profile contributes to reduced soil fertility, infiltration, and water holding capacity (U.S. Department of Agriculture (USDA) and U.S. Department of the Interior (USDI) 2001, entire). Additionally, some of the soils are flocculated or form lumpy or fluffy masses of small soil particles that settle out of suspension quickly (Gardiner and Miller 2004, p. 614). *Eriogonum diatomaceum* individuals occur on both flocculated and non-flocculated soils; however, plants occur more frequently in non-flocculated soils (Tonenna, *in litt.* 2012, entire).

Data from BLM (Tonenna *in litt*. 2013, entire) and our own analyses of BLM's data (S. Kulpa, USFWS, *in litt*. 2013, entire) indicate that *Eriogonum diatomaceum* is more abundant in channelized areas as opposed to areas that experience overland flow. By contrast, these data indicate that seedlings are randomly distributed across the landscape. Reynolds (2001, p. 8) notes that the channels found within *E. diatomaceum* habitat provide an area for moisture accumulation. In the harsh environment in which *E. diatomaceum* occurs, incident precipitation and soil moisture retention represent limiting factors for seed germination, recruitment, and survival. The observation that mature plants are more abundant in channelized areas suggests a higher rate of survival in these areas; it also seems reasonable to attribute this pattern to increased moisture availability in these microhabitats.

The diatomaceous, exposed soil habitats are sparsely vegetated and typically dominated or co-dominated by *Eriogonum diatomaceum,* which lies within a larger plant community type, maintained within the *Atriplex confertifolia* (Torr. & Frém.) S. Watson (shadscale) series (Reynolds 2001, p. 9). BLM (Tonenna, *in litt.* 2012, entire) demonstrated that the density of *E. diatomaceum* decreases as the cover of associated species increases, seemingly illustrating the effect of competition upon this species. Species most often associated with *E. diatomaceum* include: *Atriplex confertifolia* (shadscale), *Eriastrum sparsiflorum* (Eastw.) H. Mason (Great Basin woollystar), *Eriogonum deflexum* Torr. (flatcrown buckwheat), *Eriogonum lemmonii* S. Watson (volcanic buckwheat), *Mentzelia albicaulis* (Hook.) Torr. & A. Gray (whitestem blazingstar), *Stanleya pinnata* (Pursh) Britton (desert princesplume), and *Tetradymia glabrata* Torr. & A. Gray (littleleaf horsebrush) (Tonenna, *in litt.* 2013, entire).

Range and Distribution

Eriogonum diatomaceum is a narrow endemic of the Lahontan Basin section of the western Great Basin, an area of broad, irregularly shaped valleys interspersed among low mountain ranges of relatively short length, with a mean annual precipitation of about 4.5 in (11.4 cm) (Holmgren 1972, p. 87). All known locations of this species are restricted to approximately 3 square miles (mi^2) (7.8 square kilometers (km^2)) in the Churchill Narrows area of the Pine Nut Mountains in Lyon County, Nevada (Figure 2 and Table 1; Reynolds 2001, p. 6). *Eriogonum diatomaceum* occupies approximately 18 ac (7.3 ha) of habitat, on lands managed entirely by BLM (Table 1).

Most written accounts of the geographic range and distribution of *Eriogonum diatomaceum* use the terms “site,” “location,” “occurrence” (often, but not always, in reference to Natural Heritage Program Element Occurrence (EO) records), “population,” and “subpopulation” interchangeably. In most cases where the term “population” has been used, the criteria for aggregating smaller sites into populations are not explicitly defined. This generates discrepancies among sources with respect to reporting abundance and distribution of the species, with the net result being that different sources (and even different surveys by the same source) are usually not comparable. The tendency to treat each spatially discrete *E. diatomaceum* location as a separate population can also suggest more populations than may actually exist. For the purposes of this document, the USFWS has applied spatial mapping standards devised by NatureServe and its network of Natural Heritage Programs (NatureServe 2004, entire) to organize known location data for *E. diatomaceum* into spatially discrete mapping units which we herein treat as “populations” of the species. Because the population genetic structure and dispersal distances (of pollinators and seed) are not known for *E. diatomaceum*, our delineation of presumed populations primarily reflects the degree of spatial separation among known locations, the existence of (or potential for) intervening patches of seemingly suitable habitat, and the presence of known or presumed barriers to dispersal. Based upon these factors, we have aggregated 15 known, spatially discrete locations of the species into four populations (Table 1, column 1).

The best available data for *Eriogonum diatomaceum* comes from a multi-year monitoring effort conducted by BLM (Tonenna, *in litt.* 2012, entire and Tonenna *in litt.* 2013, entire). This monitoring is conducted throughout the known distribution of the species, at 16 discrete locations (Table 1, column 2; Figure 1). We describe this data collection effort in the next section (*Abundance and Population Trend*).

The databases of the Nevada Natural Heritage Program (NNHP) also contain information on the distribution and status of *Eriogonum diatomaceum* locations. Although we make only sparing mention of these NNHP EO numbers in this species report, for ease of discussion we have cross-referenced our four “populations” to their corresponding Nevada NHP EO numbers in column 3 of Table 1.

TABLE 1—Summary of Extant Populations of *Eriogonum diatomaceum*.

USFWS Population	BLM monitoring location[1]	NNHP EO number[2]	Estimated acres (hectares)[3]	Land owner
1	1	1	1.33 (0.54)	BLM
2	2A	2	4.71 (1.91)	BLM
	2B		0.2 (0.08)	BLM
3	4	4	2.52 (1.02)	BLM
	5	5	1.8 (0.73)	BLM
	6		0.17 (0.07)	BLM
	7	6	1.83 (0.74)	BLM
	8	8	0.57 (0.23)	BLM
	9		0.36 (0.15)	BLM
	10		0.07 (0.03)	BLM
	11	9	2.62 (1.06)	BLM
	12	10	0.22 (0.09)	BLM
	13		0.09 (0.04)	BLM
4	14	12	0.5 (0.2)	BLM
	15[4]	7	0.85 (0.34)	BLM
	15B		0.02 (0.01)	BLM
Total			17.87 (7.23)	

[1] BLM monitoring location = Each BLM monitoring location is referred to by the number assigned to the single "macroplot" established by BLM at this location (e.g., Tonenna, *in litt*. 2012 and Tonenna *in litt*. 2013).
[2] EO number = Natural Heritage Program (NHP) element occurrence (EO) number, as assigned by the Nevada NHP. The assigned numbers are not consecutive due to iterative data management by the Nevada NHP, which entails merging and splitting database records.
[3] Estimated acres (hectares) = The extent of occupied habitat, as last estimated by BLM in 2011 (BLM, Geospatial Data 2011).
[4] BLM refers to this monitoring location as merely "15", not "15A", in their monitoring dataset and accompanying documentation (Tonenna, *in litt*. 2012 and Tonenna *in litt*. 2013).

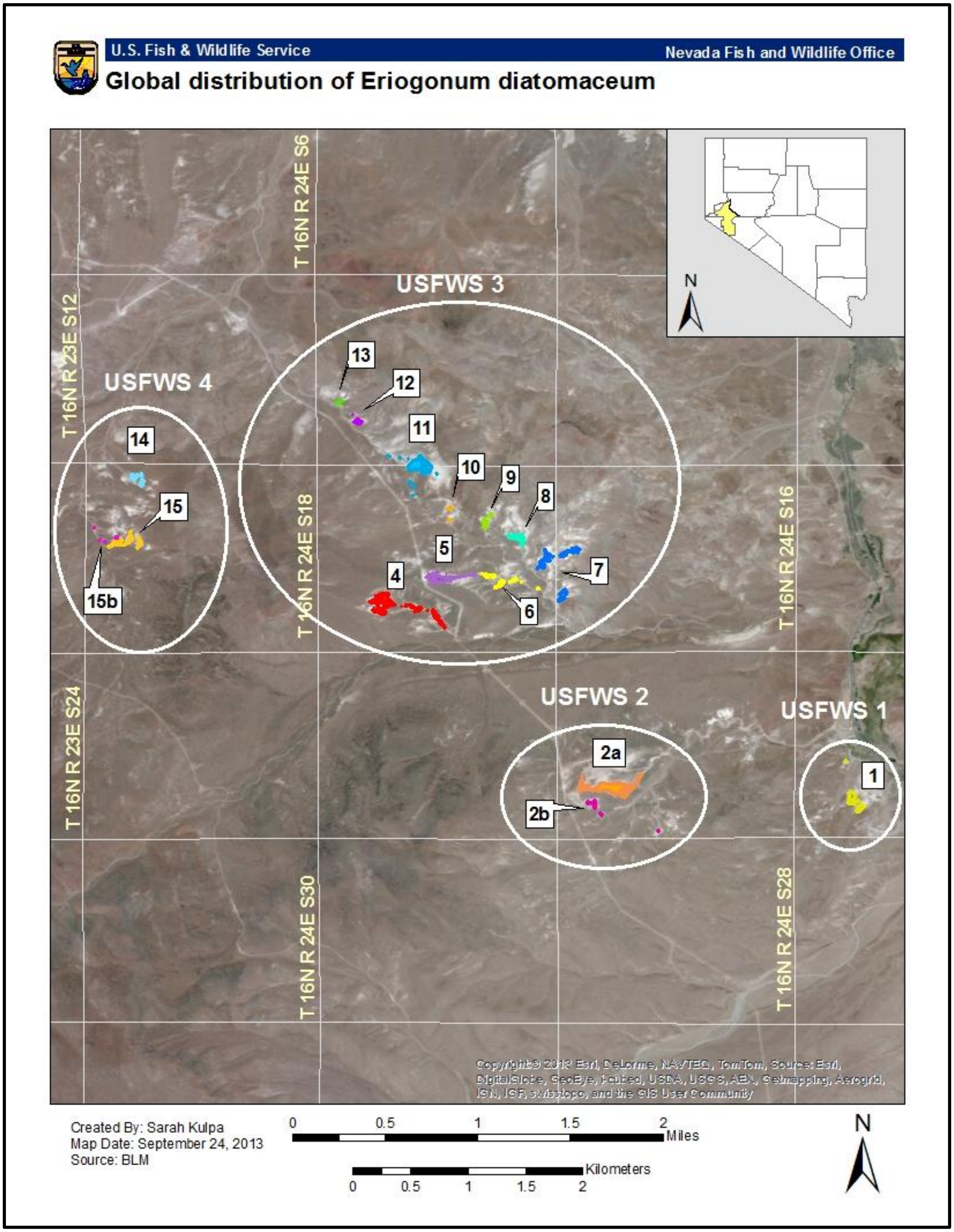

FIGURE 2—Global distribution of *Eriogonum diatomaceum;* depicting USFWS populations (white ovals) and BLM monitoring locations (square call-out boxes).

The current distribution of *Eriogonum diatomaceum* remains unchanged from when the taxon was first described in 2002 (Reveal *et al*. 2002, pp. 87–89), thus the historical and current ranges are synonymous. In 1997 and 1999, over 5,000 ac (2,023 ha) of potentially suitable habitat were surveyed for this species in the Pine Nut Mountains, Virginia Range, and Desert Mountains, in areas with diatomaceous soil deposits and within the Vylack-Weena soil series (soil series originally mapped at Churchill Narrows, but now it is known to be the Celeton soil series) (Reynolds 2001, p. 7), and no new occurrences of the species were found. Since 2006, BLM has systematically surveyed diatomaceous earth deposits located up to 100 mi (161 km) from the perimeter of known *E. diatomaceum* populations (BLM, Geospatial Data 2011), and again, no new occurrences of the species were found.

Abundance and Population Trend

At the time of discovery in 1997, the distribution of *Eriogonum diatomaceum* was mapped as 15 occurrences, collectively estimated to support 47,251 individuals (Reynolds 2001, p. 6). The total number of individuals was estimated by performing a census (complete count) of all individuals within the boundaries of each of the smallest occurrences. For larger occurrences, average densities were calculated by counting plants within quadrats and extrapolating to obtain a total based on the entire area (i.e., acreage) of the occurrence (Reynolds 2001, p. 6). Since this initial discovery in 1997, the best available estimates of *E. diatomaceum* abundance result from BLM's multi-year monitoring effort (Tonenna *in litt.* 2006; Tonenna *in litt.* 2013). We describe this monitoring effort and the current state of available data below.

BLM Monitoring: 2005–2007 and 2012

In 2005, BLM began a pilot monitoring program for *Eriogonum diatomaceum* by establishing permanent, fixed monitoring plots at 16 discrete locations across the range of the species (Table 1, column 1; Figure 2). At each of these 16 locations, BLM collected quantitative and qualitative data in a nested array of sampling units often referred to (by BLM) as a "macroplot." In 2011, BLM also delineated the extent of occupied habitat across a larger area encompassing each macroplot (BLM, Geospatial Data 2011). To reinforce the distinction between these "macroplots" and the larger area of occupied habitat in which they are established, we use the term "macroplot" to describe the nested array of fixed sampling units, and the term "monitoring location" in reference to the larger area encompassing each macroplot. The geographic locations and spatial extent of BLM's 16 monitoring locations are depicted in Figure 2; the basic configuration of each macroplot is depicted in Figure 3, based upon written BLM protocols and accompanying schematic illustrations (Kulpa *et al.* 2006, Appendix 3 pp. 36–46).

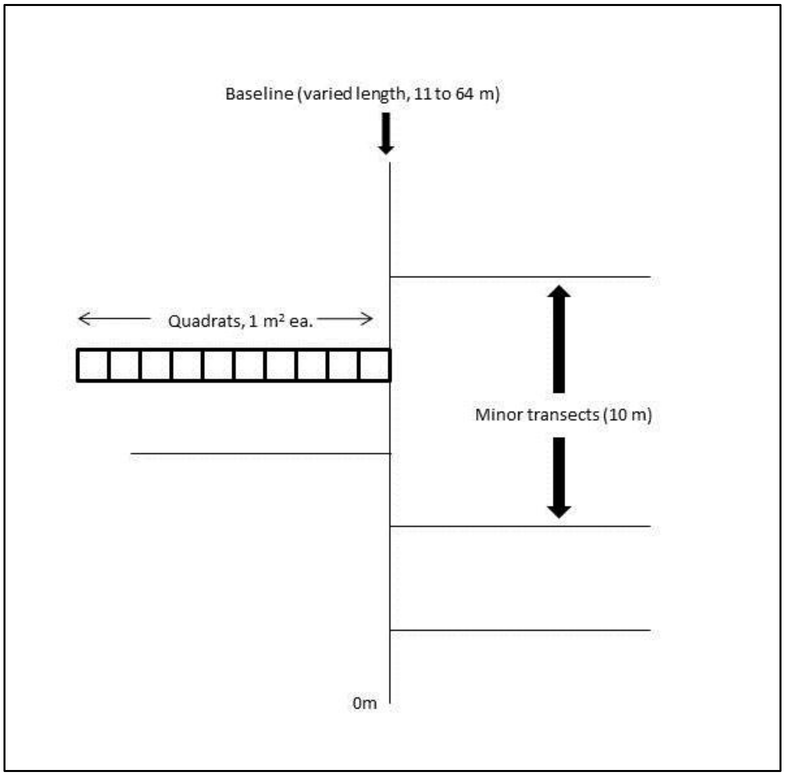

FIGURE 3—BLM's sampling scheme for *Eriogonum diatomaceum*, depicting a single macroplot and the array of sampling units (minor transects and quadrats) established within each macroplot. Modified from Kulpa *et al.* 2006, Appendix 3 pp. 36–46.

At each of the 16 monitoring locations, BLM established a single, permanent main transect (i.e., a baseline) within occupied habitat. Each baseline transect was established with the intent of controlling for slope and aspect (two habitat variables of interest), by first locating an area of constant (or nearly so) slope and aspect within occupied habitat, and then placing the baseline through the center of occupied habitat at that location, spanning the length of occupied habitat. The total length of the baseline therefore varied depending upon the amount of occupied habitat at each monitoring location, and ranged from 11 to 64 m (36 to 210 ft). At five randomly-selected points along the baseline, minor transects (each 10 m (33 ft) in length) were established perpendicular to and along either side of the baseline. The orientation of each minor transect from the baseline was also random: minor transects randomly assigned to an even-numbered starting position along the baseline were oriented to the right (of the baseline), those randomly assigned to odd-numbered starting positions along the baseline were placed to the left. BLM then established a series of $1m^2$ quadrats contiguously along each minor transect, for its entire length. In its entirety, this sampling scheme consists of a total of 16 macroplots, each consisting of a single baseline transect (of varied length, ranging from 11 to 64 m), five minor transects (each 10 m in length), and a total of 50 quadrats per macroplot.

Within each $1m^2$ quadrat, BLM recorded all *Eriogonum diatomaceum* individuals present, according to the age class of each individual. Age classes are defined as: seedling (up to 1 year old), juvenile (small plants with at least two sets of leaves and no flowering stems), mature (larger plants with or without flowering stems), senescent (over 50% of the plant evidently dead or dying), and dead. BLM collected data from all 16 monitoring plots (and all quadrats (n=50) in each plot) in 2005, 2006, 2007, and 2012. With the exception of a very cursory, preliminary analysis (Tonenna *in litt.* 2012, entire), these data have never been subjected to formal analysis or interpretation.

In August 2013, BLM provided the USFWS with a Microsoft Access database containing unanalyzed data associated with this monitoring effort (Tonenna *in litt.* 2013, entire). We conducted cursory summary analyses of these data to inform our preparation of this species report (Kulpa *in litt*. 2013, entire). Our analyses consisted of simple tabulations of the total number of plants recorded in each year, within each of BLM's 16 macroplots (i.e., aggregated across the 50 quadrats in each monitoring plot, with separate tallies for each plot), and among all macroplots (i.e., aggregated across all 16 monitoring locations).

We summarize preliminary analyses provided by BLM (per Tonenna *in litt.* 2012, entire) along with our own inferences from these data (Kulpa *in litt*. 2013, entire) below.

Table 2 depicts the total number of *Eriogonum diatomaceum* individuals recorded in BLM's quadrats, aggregated across all 16 BLM macroplots in each year of data collection. This table conveys both the total number of plants recorded across BLM's monitoring effort in any given year, and the relative proportion of individuals in any age class in each of the four years of data collection. These data illustrate that, in any given year, the majority of live plants recorded consisted of mature individuals, as opposed to younger (seedling or juvenile) age classes. The data also indicate that half (or more) of all plants recorded in a given year were senescent or dead; and in most cases, the number of senescent and dead plants is far greater than the number of seedlings and juveniles. Unfortunately, BLM did not tag and follow the fate of individual plants over time, therefore we are unable to use these data to determine the rates of survivorship and transition among age classes, or make projections about population viability.

TABLE 2—Total abundance of *Eriogonum diatomaceum* individuals sampled in each year of BLM's monitoring, aggregated across all of BLM's monitoring plots (n=16).

Year	Seedlings	Juvenile	Mature	Senescent	Dead	Total plants	Total live plants[1]
2005	55	174	702	63	484	1,478	994
2006	182	77	707	28	610	1,604	994
2007	26	52	469	91	466	1,104	638
2012	110	148	422	238	347	1,265	918

[1] Excluding dead plants but including all other age classes (seedlings, juveniles, mature, and senescent plants).

Table 3 provides an extrapolated estimate of abundance for the larger area of occupied habitat encompassing each of BLM's 16 macroplots. BLM delineated the amount of occupied habitat encompassing each macroplot in 2011 (Table 1, column 4; BLM, Geospatial Data 2011). We derived the estimates presented in Table 3 by first calculating the mean number of *E.*

diatomaceum plants in each macroplot (including senescent, but excluding dead plants) (i.e., the mean number of plants/m^2 for each macroplot) and then multiplying by the total amount of occupied area (m^2) delineated at each monitoring location. Because the locations of the macroplots were not selected at random, these extrapolations must be interpreted with caution; however, they represent the only available estimates of abundance at these locations.

TABLE 3—Estimated abundance of *Eriogonum diatomaceum*[1] in each monitoring location extrapolated from data collected in BLM monitoring macroplots, for each year of data collection.

USFWS population	BLM monitoring location[2]	2005	2006	2007	2012
1	1	5,490	2,045	3,014	4,951
2	2A	8,038	3,445	3,062	3,445
	2B	543	214	279	411
3	4	1,428	1,428	1,428	1,836
	5	11,781	9,017	7,563	8,581
	6	1,708	1,834	812	1,330
	7	592	296	296	296
	8	3,830	4,983	2,815	3,414
	9	2,127	2,040	729	1,661
	10	119	91	68	68
	11	14,208	12,936	8,907	17,389
	12	635	1,288	564	1,217
	13	415	965	262	546
4	14	5,300	3,682	3,925	3,682
	15	2,880	2,948	2,057	3,291
	15B	215	213	170	237
Total		**59,307**	**47,424**	**35,950**	**52,355**

[1] Excluding dead plants but including all other age classes (seedlings, juveniles, mature, and senescent plants).
[2] BLM monitoring location = Each BLM monitoring location is referred to by the number assigned to the single "macroplot" established by BLM at this location (e.g., Tonenna, *in litt*. 2012 and Tonenna *in litt*. 2013).

Current Status of Populations and Habitat

In this section, we summarize the four populations of *Eriogonum diatomaceum* in terms of land ownership, estimated acreage, estimated number of plants, land use patterns (i.e., mining claims, grazing allotments, and off road vehicle (OHV) trails), and other site-specific considerations such as the presence of non-native, invasive plant species.

Because all four populations of *Eriogonum diatomaceum* occur entirely on lands managed by BLM, we do not repeat this information in the descriptions that follow. Estimates of acreage reported in the following accounts are based upon a single delineation of occupied habitat performed by BLM in 2011 (BLM, Geospatial Data 2011), unless otherwise noted. Estimates of the number of plants are derived from BLM's monitoring dataset (Tonenna *in litt.* 2013, entire), unless otherwise noted.

Site Accounts

Population USFWS 1

Population USFWS 1 encompasses only one of BLM's 16 macroplot locations (Figure 2). BLM delineated 1.33 ac (0.54 ha) of occupied habitat (Table 1, column 4) at this location, corresponding to 7.4 percent of the total amount of occupied habitat mapped for *Eriogonum diatomaceum*. The first recorded survey at this location occurred in the late 1990s; this survey reported an estimated 4,846 plants (Reynolds 2001, Appendix 1, p. 1). BLM monitored *E. diatomaceum* at this location (along with all of the agency's 16 monitoring locations) from 2005–2007, and again in 2012; estimates of abundance derived from BLM's monitoring effort are presented in Table 3. Collectively, these prior surveys suggest that this population has contained (and may still contain) somewhere between 2,000 to 5,500 plants.

In terms of land use, eight closed mining claims occur within the legal section (Section 22, Township 16 North, Range 24 East) in which this population occurs (BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013). Population USFWS 1 is also located within the Fort Churchill grazing allotment, which is actively grazed by cattle. An annual off-highway vehicle (OHV) event occurs within 1 mi (1.6 km) of this population. *Bromus tectorum* L. (cheatgrass) and *Halogeton glomeratus* (M. Bieb) C.A. May (saltlover) were the most frequent nonnative, invasive species present within BLM macroplot established within this population (Tonenna *in litt.* 2013).

Population USFWS 2

Population USFWS 2 encompasses two of BLM's macroplots and monitoring locations (Figure 2). BLM delineated 4.91 ac (1.99 ha) of occupied habitat (Table 1, column 4) at this location, corresponding to 27.5 percent of the total amount of occupied habitat mapped for *Eriogonum diatomaceum*. The first recorded survey at this location occurred in the late 1990s; this survey reported an estimated 9,053 plants (Reynolds 2001, Appendix 1, p. 1). BLM monitored *E. diatomaceum* at these locations (along with all of the agency's 16 monitoring locations) from 2005–2007 and again in 2012; estimates of abundance derived from BLM's monitoring effort are presented in Table 3. Collectively, these prior surveys suggest that this population has contained (and may still contain) somewhere between 3,300 and 8,600 plants.

Mining occurred within this population in the late 1990s; this mining activity impacted approximately 5 ac (1.67 ha) of occupied habitat, and an unknown number of *Eriogonum diatomaceum* plants were lost (USFWS 2003, p. 1). Two active (an administrative term, meaning open and able to be worked, but conveying nothing as to whether surface disturbance is occurring) mining claims and 47 closed claims occur within the legal section (Section 21, Township 16 North, Range 24 East) in which this population occurs (BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013). *Eriogonum diatomaceum* occurs in the southwest corner of section 21 (Figure 2); the two active claims in this section are located in the northeast ¼ of this section, approximately ¼ mile from the *E. diatomaceum* population (BLM 2014, p.1). According to BLM, to date no written notices or plans of operations (documents that demonstrate an intent to explore or develop a mining claim) have been filed for these claims. However, access roads and parking areas associated with past mining activity border this population. This population is grazed by cattle and is part of the Adriance Valley allotment. An annual off-highway vehicle (OHV) event occurs within 1 mi (1.6 km) of this population (Reynolds 2001, p. 12). *Bromus tectorum* and *Halogeton glomeratus* were the most frequent nonnative, invasive species present within the two BLM macroplots located within this population (Tonenna *in litt.* 2013).

Population USFWS 3

Population USFWS 3 encompasses 10 of BLM's 16 macroplot locations (Figure 2). The BLM delineated 10.3 ac (4.17 ha) of occupied habitat (Table 1, column 4) at this location, corresponding to 57.4 percent of the total amount of occupied habitat mapped for *Eriogonum diatomaceum*. The first recorded survey at this location occurred in the late 1990s; this survey reported an estimated 26,457 plants (Reynolds 2001, Appendix 1, p. 1). BLM monitored *E. diatomaceum* at these locations (along with all of the agency's 16 monitoring locations) from 2005–2007 and again in 2012; estimates of abundance derived from BLM's monitoring effort are presented in Table 3. Collectively, these prior surveys suggest that this population has contained (and may still contain) somewhere between 23,400 and 36,900 plants.

In terms of land use, 40 closed mining claims occur in the 3 legal sections (Sections 8, 16, and 17, Township 16 North, Range 24 East) in which this population occurs (BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013). This population is grazed by cattle and is part of the Fort Churchill and Clifton Flat allotments. A vehicle testing operation has a permit to test vehicles on the road adjacent to a portion of this population (BLM 2003, p. 5). *Bromus tectorum* and *Halogeton glomeratus* were the most frequent nonnative, invasive species present within the 10 BLM macroplots located within this population (Tonenna *in litt.* 2013).

Population USFWS 4

Population USFWS 4 encompasses three of BLM's 16 macroplot locations (Figure 2). BLM delineated 1.37 ac (0.55 ha) of occupied habitat (Table 1, column 4) at this location, corresponding to 7.7 percent of the total amount of occupied habitat mapped for *Eriogonum diatomaceum*. The first recorded survey at this location occurred in the late 1990s; this survey reported an estimated 6,895 plants (Reynolds 2001, Appendix 1, p. 1). BLM monitored *E. diatomaceum* at these locations (along with all of the agency's 16 monitoring locations) from 2005–2007 and again in 2012; estimates of abundance derived from BLM's monitoring effort are presented in Table 3. Collectively, these prior surveys suggest that this population has contained (and may still contain) somewhere between 6,100 and 8,400 plants.

There are no closed or active mining claims in the legal section (Section 18, Township 16 North, Range 24 East) in which this population occurs (BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013). This population is grazed by cattle and is part of the Clifton Flat allotment. *Bromus tectorum* was the most frequent nonnative, invasive species present within the three BLM macroplots located within this population (Tonenna *in litt.* 2013).

CONSERVATION ACTIONS AND EFFORTS

Bureau of Land Management

As stated above, *Eriogonum diatomaceum* is a BLM sensitive species, which means that BLM's management objective is to initiate proactive conservation measures that reduce or eliminate threats to minimize the likelihood of and need for listing. However, with the exception of long-term monitoring of the species, we are not aware of BLM having implemented proactive measures in support of this species' conservation. Occupied and potential habitat for this species was first nominated as an Area of Critical Environmental Concern (ACEC) in an amendment to the Pine Nut Mountain Land Use Plan in 2008 (BLM 2008b, pp. 2–17). However, BLM has postponed finalizing this ACEC designation pending the completion of an amendment to the Carson City District Resource Management Plan (RMP) (BLM 2010, p. 1; BLM 2012, p. 1; BLM 2014, p.2). A decision for the RMP is not expected until 2016. During the preparation of this species report, the USFWS met with BLM managers to discuss the status of *E. diatomaceum,* and BLM's ongoing management of the species. During those conversations, the BLM affirmed its intent to continue managing the species as a BLM sensitive species, regardless of the species' ESA status, and avoid impacts to the species or its habitat, particularly in the context of mining activity (BLM 2014, entire).

FACTORS AFFECTING THE SPECIES

The fact that the distribution of *Eriogonum diatomaceum* is restricted to one location (consisting of four populations) in the Churchill Narrows area of Lyon County, Nevada (Figure 2), suggests that the species has specialized habitat requirements and/or a limited capacity for dispersal. Within this landscape, several factors are, or have the potential to, alter the structure and composition of habitat conditions favored by this species. These include: (1) mineral exploration and development, (2) livestock grazing, (3) herbivory, (4) OHV activity and roads, (5) nonnative, invasive species, and (6) disease. Climate change may further influence the degree to which these factors, individually or collectively, may affect *E. diatomaceum*. In the paragraphs below, we describe each of these factors and then present a categorical ranking to illustrate the relative scope, severity, and timing of each factor.

In the following discussion, we conclude the discussion of each factor with an indication of the timing, scope, and severity of each factor. *Timing* refers to the immediacy of the factor, and is categorized as ongoing, near-term future, long-term future, or past/historical. *Scope* is the percentage of the species' distribution (i.e., the percentage of the total rangewide population) that is expected to be affected by the factor within a specified, foreseeable amount of time, given continuation of current circumstances and trends. Because the lifespan and generation time of *Eriogonum diatomaceum* is not known, we define the timeframe for our analysis in terms of that length of time over which we are reasonably confident in assumptions of anticipated future trends in factors identified as affecting this species. Our ability to project future trends in the various factors identified as relevant to *Eriogonum diatomaceum* differs for each factor, with some factors (such as grazing) better assessed in terms of relatively short time periods (such as the 10-15 year longevity of a grazing allotment permit), whereas others (such as climate change) are more appropriately assessed in terms of longer time horizons (such as 50 years for most climate models).

Our evaluation of factors includes both existing and potential new factors affecting the species. Within the scope of each factor, *severity* is the level of damage to the species' population that can reasonably be expected to be affected by the factor, given our assessment of timing and scope, assuming the continuation of current circumstances and trends. In the paragraphs below, we describe each of these potential factors in detail and explain our rationale for each of the scope and severity conclusions.

At the end of this section, we present a tabular summary of the timing, scope, and severity of each factor to *Eriogonum diatomaceum*, using the best available scientific and commercial information (Table 4).

Mineral Exploration and Development

A review of USFWS files indicates that when *Eriogonum diatomaceum* was elevated to candidate status in 2004, our primary concern regarding the species' status was threats due to mining activities, which had the potential to impact three of the four range-wide populations recognized here (populations USFWS 1, 2, and 3) (Reynolds 2001, p. 11). Our files indicate that diatomaceous earth and gold deposits exist within habitats occupied by *E. diatomaceum*. Gold is a valuable precious metal that is used in three principal ways—as a manufactured product in industry and the arts (i.e., jewelry, decorative items, electronics, dental and medical uses, etc.), as an investment good, or as a monetary metal (Butterman and Amey III 2005, pp. 27–39). In 2011, Nevada produced 172,000 kg of gold and was the lead gold-producing state in the U.S. (George 2013, p. 31.3). Diatomaceous earth, which composes the outcrops where *E. diatomaceum* is found, is an economically valuable mineral with many commercial and industrial uses including filtration aid, insulation material, paint whitener, abrasive in polishes, silica additive in cement, and absorbent for industrial spills and pet litter (Reynolds 2001, p. 6; Dolley and Moyle 2003, p. 7; Wallace *et al*. 2006, p. 1). In 2001, the United States was the largest producer and consumer of diatomaceous earth in the world, producing about 644,000 metric tons, or about 33 percent of the global production (Dolley and Moyle 2003, p. 1). California and Nevada accounted for about 86 percent of the diatomaceous earth production in the United States in 2001, with the demand for this material increasing since that time as more applications for its use have been developed (Reynolds 2001, p. 11; Dolley 2003 as cited in Dolley and Moyle 2003, p. 5).

Regulation of Mining Activity

In the United States, mining activity is authorized under an array of statutes primarily administered by the BLM, both on federally-managed lands as well as other lands where mineral rights have been reserved to the U.S. (so-called split-estate lands). Statutory authority for mining essentially originates with The General Mining Law of 1872, as amended (30 USC 22-54 and 43 CFR 3809); subsequent statutes have provided additional standards and processes for administrative (Federal) oversight for specific classes of mineral deposits. In 1976, the Federal Land Policy and Management Act (FLPMA), as amended (43 USC 1701–1784) authorized the promulgation of regulations for the administration of applicable mining statutes, in order to ensure that mining operators and claimants prevent the "unnecessary or undue degradation of public lands", by adherence to performance standards, reclamation of disturbed areas, and complying with all applicable Federal and state laws related to environmental protection and the protection of cultural resources.

The BLM published implementing regulations for the various mining statutes in 1981. The BLM's statutory and regulatory authority thus depends upon the nature of the mineral deposit, which can be thought of in terms of three categories – leasable, salable or locatable. *Leasable* deposits refer to substances such as coal (43 CFR 3400), oil and gas (43 CFR 3100), and other leasable materials such as potassium and potash (43 CFR 3500); these are administered under the Mineral Leasing Act of 1920 (30 USC 181 et seq.). *Salable* deposits include common-variety substances such as sand, gravel, pumice, stone, soil and clay; these are regulated under the Materials Act of 1947, as amended (30 USC 601 et seq. and 43 CFR 3600). *Locatable* refers to metallic minerals (e.g., gold, silver, lead) and uncommon varieties of clays and building stone; these continue to be regulated under the General Mining Law of 1872, as amended (cited above, see also the regulations at 43 CFR 3809).

The General Mining Law of 1872 calls for "all valuable mineral deposits in lands belonging to the United States… to be free and open to exploration and purchase". Accordingly, this statute allows citizens of the United Sates the opportunity to explore for, discover, and purchase certain valuable mineral deposits on Federal lands that are open for mining claim location and patent (i.e., open to mineral entry) (BLM 2011, p.1–7). Only areas that have been "withdrawn" to mineral entry by a special act of Congress, regulation, or public land order are truly closed to mineral entry. No areas occupied by *Eriogonum diatomaceum* have been withdrawn from mineral entry.

Diatomaceous earth (from which *Eriogonum diatomaceum* derives its specific epithet), can be treated as either a saleable or locatable mineral, depending upon the quality of the deposit. In the Churchill Narrows area, the Carson City BLM treats diatomaceous earth as a saleable mineral (BLM 2014, p. 2). Mining operations involving saleable minerals are discretionary, meaning that BLM has broad discretion to impose terms upon or even deny authorization of a mining operation, particularly if a sensitive resource, such as a BLM sensitive species, is present (BLM 2014, p. 2).

Gold (also present in the Churchill Narrows area) is a locatable mineral. Although locatable mineral activities, claimants and operators are subject to the FLPMA standard of preventing “unnecessary or undue degradation”, the BLM generally does not have the discretion to deny mining operations for locatable mineral resources (this contrasts with salable or leasable mineral activities, which BLM has the discretion to deny). These regulations recognize three levels of operation, with increasing requirements:

1. Casual use by an operator who does negligible disturbance and does not use mechanized earth-moving equipment (43 CFR 3809.5 and 3809.10). These activities may be conducted without notifying the administering agency.
2. Notice-level operations, involving surface alteration of 5 ac (1.67 ha) or fewer during any calendar year (43 CFR 3809.10, 3809.21, and 3809.301). These operations require a written notice to be filed with the administering agency within 15 days prior to conducting work; if BLM does not respond within this time period, activities may commence.
3. Plan-level operations, involving surface disturbance of more than 5 ac (1.67 ha), bulk sampling of 1,000 tons of material or more, <u>or</u> operations proposed in special category lands, such as Areas of Critical Environmental Concern (ACECs), areas designated as “closed” to off road vehicle use, or lands containing federally proposed or listed threatened or endangered species or their proposed or designated critical habitat (43 CFR 3809.11). These operations require a Plan of Operations to be filed with the administering agency, and approved by that agency before work begins.

In 2001, BLM revised its regulations for locatable minerals to require that notice-level activities comply with the same performance standards as activities conducted under Plans of Operations (43 CFR 3809.320 and 3809.420).

Past Mining Activity (in the Churchill Narrows Area)

Eriogonum diatomaceum was described as a new taxon following sensitive plant surveys conducted to inform an Environmental Assessment (EA) of proposed mining activity in the Churchill Narrows area. Some time prior to 1997 (the exact date is unknown), the American Colloid Company filed a Notice of Operations to explore and mine 4.5 ac (1.8 ha) in the Churchill Narrows Area. This apparently triggered a rare plant survey in 1997, when an “unidentified wild buckwheat” (later described as *Eriogonum diatomaceum*; Reveal *et al.* 2002 pp. 87–89), was discovered (Picciani and Reynolds 1997 in American Colloid Company 1997, Appendix H, entire; BLM 1999, pp. 13 and 17). On December 16, 1997, this company filed a Plan of Operations for their Silver Springs Project (James, *in litt*, 2004, p. 1).

American Colloid Company’s 1997 proposed Silver Springs Project included a diatomaceous earth/bentonite clay mining operation on 45.2 acres of BLM-administered lands and an additional 1.7 acres of private lands in portions of Sections 10, 11, 12, 15, 20, 21, 22, 27, 28, and 29, Township 16 North, Range 24 East (i.e., an area encompassing present-day *Eriogonum diatomaceum* populations USFWS 1 and 2; Figure 2) (American Colloid Company 1997, p. 3; BLM 1999, p. 1). The proposed action was to mine known deposits and to explore for additional deposits (BLM 1999, p. 1). Proposed actions entailed the surface disturbance of approximately 47 ac (19 ha), including: (1) upgrading an existing access road (18.0 ac (7.3 ha) of disturbance), (2) constructing a portion of a new access road (0.9 ac (0.4 ha) of disturbance), (3) developing three new open pits (22.0 ac (8.9 ha) of disturbance), and (4) continuing exploration activities (6.0 ac (2.4 ha) of disturbance) (American Colloid Company 1997, pp. BLM 1999, p. 2). Additionally, proposed mining operations would remove and stockpile topsoil and overburden to be used in reclamation activities (BLM 1999, p. 2). A site visit by BLM and USFWS personnel to review the project's potential impacts to the as-of-yet unnamed buckwheat (now known as *Eriogonum diatomaceum*) occurred on January 23, 1998 (BLM *in litt*., 1998, pp. 1–4). These surveys estimated that the proposed project would impact about 530 plants on 1 ac (0.4 ha), representing about 1.2 percent of all known plants as of that time (BLM *in litt*., 1998, p. 2; BLM 1999, pp. 13 and 17).

In 1999, BLM approved the Silver Springs Project (BLM 1999, entire). Environmental protection measures for the project included the following specific actions to protect *Eriogonum diatomaceum*: avoiding all buckwheat plants found on the proposed mining project site; reclaiming areas disturbed by mining and exploring operations; and monitoring disturbed areas for noxious weed infestations (BLM 1999, p. 4). Topsoil was to be reapplied and disturbed areas were to be broadcast-seeded with a reclamation seed mix at a rate developed and approved by BLM (BLM 1999, p. 6). Reclaimed areas were to be inspected by BLM at a minimum of twice a year with additional reclamation efforts implemented as necessary (BLM 1999, p. 7). Subsequent to the completion of Phase I, American Colloid Company discontinued mining activities at this site (Reynolds 2001, p. 9). Meanwhile, subsequent surveys by BLM staff have revealed that re-seeding of areas disturbed by mining activities has proven unsuccessful – the non-native plant, *Halogeton glomeratus*, has invaded disturbed (even re-seeded) areas, and *E. diatomaceum* has not recolonized areas of formerly occupied habitat (Tonenna, pers. comm. 2013).

In 2003, USFWS notified BLM in writing of its concerns regarding historical and ongoing mining-related impacts to *Eriogonum diatomaceum*, and noted that emergency listing could become warranted if ongoing losses of individuals and habitat were not avoided or minimized (USFWS 2003, entire). These USFWS concerns were prompted by the (at the time) recent filing of a Notice of Operations by W.R. Byrd Minerals, Inc., which proposed additional mining activities within the largest occurrence of the species (USFWS 2003, p.2). The USFWS's February 24, 2003, memo references surveys conducted on February 5 (of that year) as providing further evidence of the destruction of about 5 ac (1.67 ha) of occupied and potentially-suitable *E. diatomaceum* habitat in the northern portion of the largest occurrence (corresponding to present-day population USFWS 2; Figure 2) (USFWS 2003, p. 1). The USFWS memo asserts that while reclamation (presumably re-seeding, although this is not explicitly stated) was conducted, there was no apparent mitigation for the loss of plants or habitat, nor any attempt to quantify the number of individuals lost.

The Notice of Operation filed by W.R. Byrd Minerals, Inc. in January 2003 (W.R. Byrd Minerals, Inc. 2003a, entire) was followed by a Plan of Operations filed in November (of that same year) (W.R. Byrd Minerals, Inc. 2003b, p. 1). These documents outlined proposals to conduct mining activity within Sections 20 and 21, Township 16 North, Range 24 East (again corresponding to population USFWS 2; Figure 2). More specifically, the proposed action included mining of about 1,000 tons of diatomaceous earth for field tests as a soil amendment and as an industrial absorbent (W.R. Byrd Minerals, Inc. 2003a, pp. 1–2). If field testing proved successful, an additional 50,000 tons of diatomaceous earth was expected to be removed from these locations (W.R. Byrd Minerals, Inc. 2003b, p. 6). The initial field tests were projected to impact 1.5 ac (0.6 ha) of *Eriogonum diatomaceum* habitat; excavation of the anticipated 50,000 tons of diatomaceous earth (if field tests were successful) was projected to impact 90 percent of occupied *Eriogonum diatomaceum* habitat at this location (USFWS 2003, p. 2). The initial exploratory work was performed (D. Erbes, BLM, pers. comm., 2008), but subsequent mining was not initiated and the claim is currently "closed," meaning that a proposed operation is completed or has ended without any action (BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013; D. Erbes, BLM, pers. comm., 2013).

It is unclear from USFWS files whether this historical diatomaceous earth mining was administered as locatable mineral activity (over which BLM has little discretion) or salable mineral activity (over which BLM has greater discretion). This distinction is important, because whereas BLM has little discretion regarding locatable mineral activity, the regulations for salable minerals state that BLM "will not dispose of mineral materials [i.e., allow them to be explored and developed] if we [BLM] determine that the aggregate damage to public lands and resources would exceed the public benefits that BLM expects from the proposed disposition" (43 CFR 3601.11). During our preparation of this species report, the Carson City BLM informed the USFWS that diatomaceous earth deposits in the lands encompassing known *Eriogonum diatomaceum* populations (i.e., Figure 2) are treated as salable materials. The BLM also affirmed that protecting *E. diatomaceum* and its habitat from impacts is clearly within the BLM's discretion when it comes to mineral material sales (J. Schroeder, BLM, pers. comm., 2014), and expressed its intent to continue managing the species as a Special Status Species, avoid impacts to the species and its habitat, and otherwise coordinate with USFWS to develop effective mitigation measures (BLM 2014, entire).

Present Mining Activity

In 2013, we reviewed the status of all locatable mineral claims within the six legal sections containing the species (i.e., all sections shown as occupied in Figure 2; BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013) and discussed the status of current mining activity in this area with BLM managers and staff. According to this review, there are 95 "closed" locatable mineral claims (an administrative term that indicates a prior claim that is no longer current) and two "active" claims (meaning paperwork and fees filed with the BLM in support of the claim are current) within the six sections occupied by this species (BLM, Land and Mineral Legacy Rehost 2000 System - LR2000, 2013). The two active claims are located in the northeast corner of the section containing *E. diatomaceum* population USFWS 2 (BLM 2014, p.1). These claims were filed in 2004 and are placer claims (i.e. valuable minerals contained in loose material) for gold – a locatable mineral. The *E. diatomaceum* population USFWS 2 is approximately one quarter mile from these claims (BLM 2014, p. 1), however these claims are within potentially suitable habitat for the species (i.e., adjacent, unoccupied diatomaceous earth outcrops). New claims could be filed anywhere within the occupied and potential habitat for *E. diatomaceum* or these two existing claims could be developed, because these lands are open to mineral entry. If an operator filed a Plan of Operations for mining activity in this area, the BLM would analyze the project under the National Environmental Policy Act (NEPA), however, a NEPA analysis is not required for Notice level activity (5 ac or less) (BLM 2014, p. 1). Under 43 CFR 3809 regulations, BLM can require a claimant to modify a Notice to prevent unnecessary or undue degradation. However, if the Notice modification results in no alternative that would avoid impacts to the plant or its habitat, the BLM would have to rely on its requirement that the operation comply with State law and permits (BLM 2014, p .1). In this case, since *E. diatomaceum* is listed threatened by the State, the BLM would require that a claimant be in compliance with this State law (BLM 2014, entire).

Summary of Mining Activity

In summary, mining has impacted *Eriogonum diatomaceum* habitat and resulted in the loss of individual plants and habitat at population USFWS 2, and two active but currently unworked mining claims still remain in the vicinity. The BLM is not aware of any ongoing or planned salable mineral activity in the area; however this activity is difficult to predict, as it is heavily influenced by the overall state of the economy, and the valuation of mineral deposits.

The timing of mining activities is historical, because mining has occurred within the boundary of population USFWS 2, but is not known to be occurring at present. All four *Eriogonum diatomaceum* populations are located on diatomaceous earth deposits in areas that remain open to mining activities and some 95 "closed" claims exist throughout this area, serving as evidence of past mining interest within these population boundaries. Therefore, we assess the scope of mining activities to be 100% (affecting all known populations). We estimate that continuation of current trends could result in loss or degradation of populations or subpopulations; we regard this risk as likely to be greatest at population USFWS 2. With regard to severity, 5 ac (1.67 ha) or 22 percent of historically-occupied habitat for this species has already been lost to mining activities (17.87 ac (7.23 ha) of occupied habitat remains). In the absence of active oversight of mining activities by BLM in the future, we anticipate that the severity of mining-related impacts in the future could be equal to or higher than historical levels, equating to or exceeding 22 percent.

Livestock Grazing

Livestock grazing has the potential to result in negative effects to *Eriogonum diatomaceum*, depending on factors such as stocking rate and season of use. It is not known whether *E. diatomaceum* is palatable to livestock (Reynolds 2001, p. 12). Regardless, trampling by cattle typically results in broken stems and leaves of plants, and also creates various forms of soil disturbance, including soil compaction. Grazing within *E. diatomaceum* habitat has been shown to compact soils anywhere from 3.9 to 5.9 in (10–15 cm), at rates of use observed throughout occupied habitat (Reynolds 2001, p. 12; BLM 2006, p. 11). Soil compaction can adversely affect *E. diatomaceum* (and other native plant species) due to its potential to alter site hydrology and other microhabitat (including micro topography) conditions necessary to sustain already-established plants, retain native plant seeds on-site, and encourage seed germination – all of these are pre-requisites for population persistence and recruitment (germination of seed and survival of seedlings) (NRCS 2001, entire). Livestock use has also been suggested as a contributing factor to the spread of nonnative, invasive plant species (Young *et al*. 1972, entire; Hobbs and

Huenneke 1992, p. 329; Loeser *et al*. 2007, pp. 94–95).

Livestock grazing occurs within all *E. diatomaceum* populations (USFWS 1, 2, 3, and 4) in three contiguous BLM allotments—Adriance Valley (USFWS 1 and 2), Clifton Flats (portions of USFWS 3 and all of USFWS 4), and Fort Churchill (portions of USFWS 3). There are no grazing exclosures within any of these three BLM allotments; therefore all of the *E. diatomaceum* populations found within these allotments are exposed to the effects of livestock grazing. Both the Adriance Valley and Clifton Flat allotments have year-round grazing use, while the Fort Churchill allotment is grazed from April to the end of July (BLM, Rangeland Administration System (RAS), 2013c). Grazing on these lands is regulated under FLPMA, which is the same multiple-use mandate that allows for mining and other activities on BLM land. Under FLPMA, BLM has the ability to establish and implement special management areas such as ACECs to reduce or eliminate actions that adversely affect species of concern, such as *Eriogonum diatomaceum*. However, there are no special management designations for this species on any BLM lands, and no other restrictions regarding livestock use within the allotments where this species occurs.

The timing of livestock grazing is ongoing. Livestock grazing is occurring within all four populations of *Eriogonum diatomaceum*, therefore the scope of this factor is 100%. The severity of this factor, however, is unknown because we have no knowledge of data indicating (qualitatively or quantitatively) the numbers (or percentages) of individuals or habitat acreage lost as a result of this threat.

Herbivory

Many observers have noted the clipping and apparent consumption of *Eriogonum diatomaceum* flower stems and the tunneling of an unknown rodent into *E. diatomaceum* roots (BLM 2003, p. 5; Longland *et al.* 2009, p. 26; Tonenna 2011; Tonenna *in litt.* 2013). In the summer of 2007, Longland *et al.* (2009, pp. 26–30) initiated a study to determine what animal(s) remove *E. diatomaceum* flower stems. From July to October 2007, researchers visited two of BLM's *E. diatomaceum* macroplots. Tracking stations that extended 1.6 ft (0.5 m) around individual *E. diatomaceum* plants showed patterns of animal movement (rabbit tracks) indicative of rabbits selectively targeting *E. diatomaceum* plants (Longland *et al.* 2009, p. 27). Rabbit pellet counts revealed that rabbit activity was significantly focused on *E. diatomaceum* rather than other nearby neighboring plant species ($P<0.05$; Longland *et al.* 2009, p. 28). Camera traps captured photos of Blacktail jackrabbits (*Lepus californicus*) with their heads conspicuously placed in the flowering stems of *E. diatomaceum* (Longland *et al.* 2009, p. 28). Finally, patterns of flower removal were monitored on developing and flowers; by revealing that developing flowers were being removed, but not mature flowers, these observations were interpreted as consistent with rabbit herbivory (i.e., flower eating) and not rodent granivory (i.e., seed eating) (Longland *et al.* 2009, p. 28). Photos of grey foxes (*Urocyon cinereoargenteus*), predators of jackrabbits, were also captured by the camera traps, providing a basis upon which to assume that predation may be offsetting rabbit predation to some (unquantified) degree (Longland *et al.* 2009, pp. 28-29).

Although jackrabbit population levels and cycles at Churchill Narrows have not been documented, jackrabbit populations in arid environments tend to be cyclic and coupled with rainfall and abundance of forage (Wood 1980, pp. 72–77). In the western U.S., jackrabbit populations fluctuate sharply, oscillating from low to high densities in 7 to 10 year periods (Gross *et al*. 1974, pp. 57–64). Overgrazing because of high rabbit populations is common during high rainfall years and is a major reason for subsequent rabbit population crashes (Wood 1980, p. 77). During periods of drought, overgrazing on concentrated areas can increase the carrying capacity of jackrabbits and cause a population increase (Bronson and Tiemeier 1959, pp. 197–198). The significance of herbivory as a stressor depends not only on its frequency and intensity, but whether it interferes with seedling recruitment, which is a question that remains unanswered. Further studies need to be conducted to determine if management to reduce jackrabbit herbivory is necessary to maintain *Eriogonum diatomaceum* individuals and populations.

The timing of herbivory by jackrabbits is ongoing. Herbivory has been documented at all four populations of *Eriogonum diatomaceum*; therefore the scope is 100%. However, the severity of herbivory is unknown because the best available scientific information does not provide any indication of its effect on seedling recruitment of *E. diatomaceum*.

OHV Activity and Road Development

OHV activity and road development have been noted as a threat to *Eriogonum diatomaceum* at populations USFWS 1, 2, and 3 (Reynolds 2001, Table 1, Appendix 1, p. 1). Major dirt roads have been constructed to provide access to the mining claims, and a vehicle testing operation has a permit to test vehicles on some of the gravel roads adjacent to *E. diatomaceum* habitat (BLM 2003, p. 5). An annual organized OHV event occurs within 1 mi (1.6 km) of several occupied areas (Reynolds 2001, p. 12), and there has been an increase in OHV activity in the Churchill Narrows area (Tonenna 2007, 2011b). Roads can alter the hydrology of a site, and compacted road surfaces can limit *E. diatomaceum* population expansion. In addition, vehicles often leave the road, compacting soils, crushing plants, and providing a means for nonnative plant species to invade otherwise remote, intact habitats (Brooks and Pyke 2001, p. 4; Gelbard and Belnap 2003, entire Brooks and Lair 2005, p.8).

The timing of OHV activity and road development is ongoing. OHV activity and road development is affecting 3 of the 4 *Eriogonum diatomaceum* populations; therefore the scope of this factor is 75 percent. However, the severity of this factor is unknown, because we are currently not aware of individuals or habitat having been lost as a result of these activities and the best available scientific information does not provide an indication of the level in which OHV activity and road development affects *E. diatomaceum*.

Nonnative, Invasive Plant Species

Nonnative, invasive plant species such as *Bromus madritensis* L. (compact brome), *Bromus tectorum*, *Descurainia sophia* (L.) Webb ex Prantl (herb sophia), *Halogeton glomeratus*, and *Salsola kali* L. (Russian thistle) have become established to some degree and are part of the associated plant community at all populations of *Eriogonum diatomaceum.* Nonnative, invasive plant species can negatively affect *E. diatomaceum* due to altered wildfire frequency, competition with and displacement of native plant species, altered ecological function, and degradation of the quality and composition of the habitat in which *E. diatomaceum* occurs (D'Antonio and Vitousek 1992, pp. 68–72; Gonzalez *et al*. 2008, entire; Mazzola *et al*. 2011, pp. 514–515; Pierson *et al*. 2011, entire). In addition, most climate change models project conditions conducive to the further spread of nonnative, invasive plant species (see *Climate Change* below; Bradley *et al*. 2010, pp. 312–316; Balch *et al*. 2013, pp. 179–183).

Bromus tectorum can displace native plants, such as *Eriogonum diatomaceum*, by prolific seed production, early germination, and competitive abilities for the extraction of water and nutrients (Rice *et al*. 1992, entire; Pellant 1996, pp. 3–4; Chambers *et al*. 2007, pp. 117–120, 141–142). For example, *B. tectorum* soil seed banks can range from 5,000 to 15,000 seeds/m², which ensures high propagule pressure on native species (Humphrey and Shupp 2001, pp. 88–90; Mazzola *et al*., 2011, p. 523). Bradley and Mustard (2006, p. 1146) found that the best indicator for predicting future invasions of *B. tectorum* was the proximity to current infestations of this species. *Bromus tectorum* is the most common of the nonnative, invasive plant species present within *E. diatomaceum* populations. This species was present in 1,411 of the 3,200 BLM (44 percent) macroplot quadrats during survey years (2005, 2006, 2007, and 2012) with cover ranging from 0.01 to 25 percent per quadrat (Tonenna *in litt.* 2013).

Halogeton glomeratus is not an extremely competitive plant and does not become dominant in undisturbed areas or areas with competing vegetation. However, disturbances such as overgrazing, mechanical soil disturbance, and wildfire reduce desirable vegetation and increase bare soil which encourages the invasion and establishment of this species (DiTomaso *et al*. 2013, p. 200). *Halogeton glomeratus* is the second most common of the nonnative, invasive species present within *Eriogonum diatomaceum* communities and is present in 363 of the 3,200 BLM macroplot quadrats during survey years (2005, 2006, 2007, and 2012) with cover ranging from 0.01 to 12 percent per quadrat (Tonenna *in litt.* 2013). This species is most common at BLM macroplots 2a and 2b (110 of 363 of occupied quadrats are at these two macroplots) likely due to soil disturbances associated with past mining activities (see *Mineral Exploration and Development* above; Tonenna *in litt.* 2013).

When *Eriogonum diatomaceum* habitat is undisturbed, nonnative invasive plant species are not a threat because the specialized habitat of *E. diatomaceum* does not appear to be conducive to their spread. However, when soil disturbances occur within occupied *E. diatomaceum* habitat, nonnative, invasive plant species pose a threat to *E. diatomaceum* due to their ability to potentially compete with and displace this species from its habitat. Additionally, if nonnative, invasive plant species heavily invade the interspaces between *E. diatomaceum* populations, they may pose an indirect threat by contributing to the flammability of the surrounding vegetation and increasing the likelihood and frequency of wildfires and fire suppression activities in the area (Reynolds 2001, p. 12).

The timing of nonnative, invasive plant species is ongoing. Nonnative, invasive plant species are present within all *Eriogonum diatomaceum* populations; therefore the scope of this factor is 100 percent. Within the scope, the severity of nonnative, invasive plant species is unknown because the best available scientific information does not provide any indication of the level of which nonnative, invasive plant species affect *E. diatomaceum*.

Disease

A rust (fungal) pathogen was observed on approximately 26 percent of the overall *Eriogonum diatomaceum* population during survey work in the late 1990s (Reynolds 2001, p. 11). At this time, no studies are known to have identified this pathogen, its origin, or its ultimate effect on *E. diatomaceum*, and the long-term survival rate of rust infected plants has not been determined or monitored. Therefore, at least historically, the scope of this factor was approximately 26 percent. However, at present, based on the best available scientific and commercial information, the scope, severity, and timing of the potential threat of disease are unknown.

Climate Change

Our analyses under the Endangered Species 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). “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 2007, p. 78). 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 2007, p. 78).

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 2007, p. 30; and Solomon *et al*. 2007, pp. 35–54, 82–85). 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 2007, pp. 5–6 and figures SPM.3 and SPM.4; Solomon *et al*. 2007, pp. 21–35). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011, p. 4), who concluded it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

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 (e.g., IPCC 2007, pp. 8–12). Therefore, we use “downscaled” regional 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, pp. 58–61, for a discussion of downscaling).

In the Great Basin, where *Eriogonum diatomaceum* occurs, temperatures have risen 0.9 to 2.7 °F (0.5 to 1.5°C) and are projected to warm another 3.8 to 10.3 °F (2.1 to 5.7 °C) over the rest of the century (Chambers and Pellant 2008, p. 29; Finch 2012, p. 4). Winter temperatures are projected to increase by 3.6 to 16.2 °F (2 to 9 °C), which will change the balance of temperature and precipitation resulting in earlier spring snow runoff (Stewart *et al*. 2005, p. 1152), declines in snowpack (Knowles *et al*. 2006, p. 4557; Mote *et al.* 2005, entire), and increased frequency of drought and fire events (Seager *et al.* 2007, pp. 1181–1184; Littell *et al.* 2009, pp. 1014–1019; Abatzoglou and Kolden 2011, pp. 474–475). Warmer temperatures and greater concentration of atmospheric carbon dioxide create conditions favorable for nonnative, invasive plant species, such as *Bromus tectorum*, potentially exacerbating the positive feedback cycle between invasive annual grasses and fire frequency (Chambers and Pellant 2008, p. 32; Bradley *et al*. 2010, pp. 312–316; Balch *et al*. 2013, pp. 179–183).

Plant species, such as *Eriogonum diatomaceum*, that have a restricted range, specialized habitat requirements, and limited recruitment and dispersal have a higher risk of extinction due to demographic uncertainty and random environmental events (Shaffer 1987, pp. 69–75; Lande 1993, pp. 911–927; Hawkins *et al*. 2008, pp. 41–42). The potential for a population to adapt in a changing climate will be in part determined by the lifespan of the species and the age at which it reaches reproductive maturity, which are not known for *E. diatomaceum* (Jump and Peñuelas 2005, p. 1013). Increasing temperatures and drought frequency could adversely affect *E. diatomaceum* by causing physiological stress, altering phenology, and reducing recruitment events and/or seedling establishment (Parmesan 2006, pp. 642–644; Hawkins *et al.* 2008, pp. 16–32). Some plants may lack sufficient environmental tolerance in the face of these altered conditions (Jump and Peñuelas 2005, p. 1016); likewise, populations may lack sufficient genetic diversity to adapt or persist, resulting in localized extirpations of currently occupied habitats (Haskins and Keel 2012, p. 230).

Long-term average annual precipitation (1980–2010) during the growing season (October to September) at Churchill Narrows is 4.6 in (117.6 cm), with the majority of precipitation received between January–March and in May (Western Regional Climate Center, 2013; accessed online on September 11, 2013Churchill Narrows received 5.45 in (138.4 mm), 5.54 in (140.7 mm), and 1.77 in (45 mm) growing-season precipitation from 2006 through 2008, respectively (Western Regional Climate Center, 2013; accessed online on September 11, 2013). Comparing this information with the abundance of live plants at BLM macroplots (Table 2), the number of plants in all age classes decreased with reduced precipitation during the 2006–2007 growing season. Precipitation data beyond 2010 is incomplete; therefore we are unable to make any comparisons with the 2012 monitoring data.

The direct, long-term impact from climate change to *Eriogonum diatomaceum* is yet to be determined. Under current climate change projections, we anticipate further alteration of precipitation and temperature patterns. This may result in decreased survivorship of *E. diatomaceum* by causing physiological stress, altered phenology, and reduced recruitment events and/or seedling establishment. Additionally, future climatic conditions likely will favor invasion by nonnative, invasive species, especially in *E. diatomaceum* habitat with soil disturbance, and increase the frequency, extent, and severity of wildfires. Thus, climate change may exacerbate impacts from other factors currently affecting *E. diatomaceum* and its habitat.

The timing of climate change is ongoing. The scope of climate change is 100 percent because all areas of all four populations are impacted by climate change. Within the scope, the severity of climate change is unknown because even though climate projections exist for the Great Basin, we do not know how *Eriogonum diatomaceum* is likely to respond to these climatic changes.

TABLE 4—Scope, severity, and timing of each of the factors affecting *Eriogonum diatomaceum*.

Threats	Scope	Severity	Timing (Immediacy)
Mineral Exploration and Development	100%	> 22%	Past/historical
Livestock Grazing	100%	unknown	Ongoing
Herbivory	100%	unknown	Ongoing
OHV Activity and Road Development	75%	unknown	Ongoing
Nonnative, Invasive Plant Species	100%	unknown	Ongoing
Disease	26%	unknown	Past/historical
Climate Change	100%	unknown	Ongoing

SUMMARY OF FACTORS AFFECTING THE SPECIES

Eriogonum diatomaceum occurs on diatomaceous soil deposits, which is an economically valuable mineral that is in increasing demand. Placer claims, likely for gold deposits, also exist in the area occupied by this species – although BLM is not aware of these claims having ever been explored or developed. Mineral activity (exploration and development of diatomaceous earth deposits) has impacted *E. diatomaceum* habitat and resulted in the loss of individual plants and habitat at population USFWS 2, corresponding to 5 ac (1.67 ha) or 22 percent of historically-occupied habitat for the species. Two active mining claims still remain open within the species range (both in the vicinity of population USFWS 2) and 95 claims are closed within this area; all lands occupied by *E. diatomaceum* are open to mineral entry. With the exception of population USFWS 3, all *E. diatomaceum* populations contain less than 5 ac (1.67 ha) of occupied habitat, meaning that relatively small-scale mining operations have the potential to impact substantial portions, or the entirety of, known populations. If an operator files a Plan of Operations for mining activity in occupied or potential habitat for *E. diatomaceum*, the BLM analyzes the project under NEPA; however a NEPA analysis is not required for Notice level activity (5 ac or less). Under Notice activity, the BLM requires that the operation comply with State law and permits. In this case, since *E. diatomaceum* is listed threatened by the State, the BLM would require a claimant to be in compliance with State law (BLM 20014, entire).

Livestock grazing may result in direct impacts to individual *Eriogonum diatomaceum* plants due to trampling of vegetation and soil disturbance (compaction) in ways that can render habitat no longer suitable to established plants, while also discouraging population recruitment (by discouraging seed retention, seed germination, and seedling survival). Patterns of soil disturbance associated with grazing also create conditions conducive to the invasion of nonnative plant species. All populations of *E. diatomaceum* are within grazing allotments and exposed to livestock grazing. Therefore, we regard livestock grazing as likely to continue to impact the species and its habitat.

Herbivory by jackrabbits, in the form of clipping and apparent consumption of *Eriogonum diatomaceum* flower stems, has been documented at all populations of the species. Jackrabbit population levels and cycles at Churchill Narrows have not been documented, and the significance of herbivory as stressor depends not only on its frequency and intensity, but the degree to which it interferes with seedling recruitment. Further studies need to be conducted to determine if management to reduce jackrabbit herbivory is necessary to maintain *Eriogonum diatomaceum* individuals and populations.

OHV activity and road development have been noted as a threat to *Eriogonum diatomaceum* at three of the four populations (USFWS 1, 2, and 3). OHV activities can kill or damage individual plants, and modify habitat by compacting soils, and fragmenting both occupied and potential habitat, which in turn precludes or reduces potential recruitment and population expansion of *E. diatomaceum*. OHV and other road corridors also create vectors for nonnative, invasive plant species to invade otherwise remote, intact habitats. Although we expect OHV activity to continue to occur within the species habitat, we are currently not aware of individuals or habitat having been lost as a result of these activities.

Nonnative, invasive plant species can negatively affect *Eriogonum diatomaceum* through ecological function, competition with and displacement of native plant species, and degradation of habitat. Nonnative, invasive plant species can also be spread through OHV activity and other road corridors. All populations of *E. diatomaceum* are invaded by nonnative, invasive plant species. Therefore, we expect impacts from nonnative, invasive plant species to continue, however, the degree to which they affect *E. diatomaceum* is still unknown.

A rust (fungal) pathogen was observed on approximately 26 percent of the overall *Eriogonum diatomaceum* population during survey work in the late 1990s. At this time, no studies are known that identify this pathogen, its origin, or its ultimate effect on this plant species and the long-term survival rate of rust infected plants has not been determined or monitored. Therefore, based on the best available information, the potential threat of disease to this species is unknown at this time.

Given current climate change projections, we anticipate that the alteration of precipitation and temperature patterns may result in decreased survivorship of *Eriogonum diatomaceum* due to physiological stress of individual plants, altered phenology, and reduced seedling establishment and plant recruitment. Decreased precipitation during the 2006–2007 growing season has already been demonstrated to decrease the number of plants in all age classes across the populations. These alterations in climatic conditions are likely to exacerbate impacts to *E. diatomaceum* from other factors currently affecting *E. diatomaceum* such as nonnative, invasive plant species and herbivory.

Interactions Among Factors

Mineral development and exploration results in the loss of habitat; depending on the nature of mining activities these impacts can be permanent and irreversible (conversion to land uses unsuitable to the species) or less so (minor ground disturbance and loss of individual plants). When mineral development and exploration occurs in between (but not within) populations, this can eliminate corridors for pollinator movement, seed dispersal, and population expansion. Livestock grazing may result in direct impacts to individual *Eriogonum diatomaceum* plants due to trampling. Both livestock grazing and OHV/road corridors create patterns of soil disturbance that in turn alter habitat function and create conditions conducive to the invasion of nonnative plant species. Once nonnative, invasive plant species are established, these species tend to spread well beyond the footprint of mineral development and exploration or OHV/road corridors, further deteriorating otherwise intact habitat and native vegetation, including *E. diatomaceum*. Herbivory when combined with climate change and altered precipitation and temperature regimes, may interfere with seedling recruitment and persistence of the species on the landscape.

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