Potential Impacts to Biodiversity from Proposed Lithium Extraction in Nevada and California

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COVER Lithium mining in Nevada © Jassen Todorov/TNC Photo Contest 2022; THIS PAGE The Virgin River © Chip Carroon/TNC; Pronghorn © Chip Carroon/TNC; Desert tortoise © Dana Wilson/BLM; Jackson Basin in Esmeralda County, Nevada has several potential lithium projects © Michael Clifford/TNC

Introduction

Climate change and biodiversity loss are two of the greatest threats to ecosystems and human health (Chapin III et al. 2000; Diaz et al. 2019). The impacts of climate change can drive species range shifts (Chen et al. 2011), cause local extirpations (Sinervo et al. 2010), and increase species extinctions (Pounds et al. 2006). At the same time, the loss of key species can disrupt vital ecosystem services, such as pollination, nutrient cycling, and carbon sequestration, creating a feedback loop that intensifies both climate change and biodiversity loss (Chapin III et al. 2000; Cardinale et al. 2012; Diaz et al. 2019). Thus, climate change and biodiversity loss are strongly connected and solutions to maintain biodiversity such as restoring habitat, or maintaining landscape connectivity can mitigate climate change through carbon uptake and storage (Pörtner et al. 2023; von Jeetze et al. 2023).

Addressing these interconnected challenges necessitates comprehensive strategies that combine emissions reduction, conservation efforts, habitat restoration, and sustainable land-use practices to protect habitats and species. However, climate change solutions may come at the expense of biodiversity if appropriate planning is not done to avoid developing where the most sensitive species and habitats occur (Sonter et al. 2020; Sonter et al. 2023; Wu et al. 2023). Solutions focused only on mitigating climate change and reducing greenhouse gases may undermine biodiversity by not taking a holistic perspective of the two issues. Present rates of extinction are estimated at 1000-times higher than background-levels (Primm et al. 2014), which is largely driven by habitat loss (Ceballos et al. 2015; Diaz et al. 2019; Powers and Jetz 2019). Rates of extinction vary by geography and taxa, but the highest rates occur in small range and small population species (Primm et al. 2014; Staude et al. 2020). Extinction risk is further exacerbated by climate change (Sinervo et al. 2010).

Actions must be taken to limit the amount of greenhouse gas emissions to keep global temperatures below the often agreed upon warming goal of 1.5° C (IPCC 2018). To keep global average temperatures from crossing critical targets, decreasing the use of fossil fuels is necessary. Shifting from fossil fuel-based energy and internal combustion engines to renewable energy and electric vehicles (EVs) will reduce carbon emissions. However, the energy shift will significantly increase the need to mine additional minerals in order to meet material demands for renewable energy generation (e.g., photovoltaic cells and wind turbines) (Sonter et al. 2020), transmission, and storage beyond what is currently mined and extracted (Jowitt and McNulty 2021). In particular, lithium is an important mineral in the production of batteries, specifically lithium-ion batteries, which are relatively light in weight, making them well suited for EVs, mobile phones, and other domestic uses. Lithium-ion batteries are also highly energetic and hold long charges relative to other metals; 80% of global lithium production in 2022 was used to manufacture batteries (USGS 2023). To replace the global supply of internal combustion engines with EVs, it has been estimated that the amount of lithium produced will need to increase approximately 40-times (Herrington 2021; Haddad et al. 2023).

Three global regions currently dominate lithium production, including Australia (47% of global lithium production by weight), South America (35%), and China (15%) (Bradley et al. 2017; Parker et al. 2022). At present the US has one operational lithium extraction facility that is located in Nevada (Bradley et al. 2017). Large concentrations of lithium deposits have been identified throughout the contiguous US (Bradley et al. 2017), but Nevada and California contain approximately 89% of known reserves (Parker et al. 2022). Lithium deposits in the US are found in several forms, including brines, clays, and granitic rocks.

The different methods used to extract lithium from each source material vary in their potential environmental impacts (Vera et al. 2023; Parker et al. 2024). Proposed methods of lithium extraction in California and Nevada include brine extraction, open pit mining, and clay surface mining (Parker et al. 2022).

Underground brine reservoirs (salars or playas) are the focus of 75% of the proposed lithium projects in the region (Parker et al. 2022). In the evaporative concentration method, brine is pumped to the surface where it is concentrated in a series of evaporation ponds (Vera et al. 2023). Evaporation ponds typically require warm, dry climates, and result in a large surface disturbance of hundreds to thousands of hectares. Additionally, the evaporative process consumes large amounts of water (Vera et al. 2023), and produces large volumes of waste (Flexer et al. 2018). Direct Lithium Extraction (DLE) is an emerging technology that has yet to be implemented at industrial scales, but is a process where brines are pumped to the surface, and lithium is extracted in a closed system through mechanical, chemical, electrical, or other methods and the lithium-depleted brines are reinjected back into the brine deposits (see Vera et al. 2023 for detailed review). DLE likely has a small land disturbance area relative to other mining methods (Parker et al. 2022), however the freshwater requirements may be significant (Vera et al. 2023). Lithium extracted from hard rock deposits rely on open pit mining, usually of pegmatites (spodumene). Conceptually, the surface disturbances of open pit mining for lithium are similar to other open pit mines where the ore is extracted, crushed, and treated to obtain the desired mineral. However, the chemicals used to extract lithium from the ore may be different than those used for other minerals. Groundwater may also be intercepted during mine development and would require removal to access the lithium.

Lithium mine claims in California and Nevada are located in the desert regions where there is low annual precipitation. These desert ecosystems are mostly intact landscapes with pockets of high biodiversity and unique species adapted to the extreme climatic conditions (Randall et al. 2010). The region also has many isolated wetlands and groundwater dependent ecosystems (GDEs), which are known to hold outsized importance for biodiversity as many contain rare or endemic species that have been isolated for millennia (Davis et al. 2013). GDEs and the unique species assemblages they support are highly vulnerable to change, and therefore impacts to these systems can serve as a proxy for environmental impact and biodiversity loss. Furthermore, water scarcity and increasing aridity is a major challenge with many basins that are already over pumped (Parker et al. 2021; Saito et al. 2022). Understanding the impacts to groundwater resources from lithium extraction is important for predicting ecosystem responses to changes in hydrology.

To evaluate the risk of hydrological impacts from lithium mining at a project level, The Nature Conservancy (TNC) contracted the Desert Research Institute (DRI) to develop a framework and checklist (Saftner et al. 2023). The checklist and framework can be used to identify areas of uncertainty with respect to potential impacts to the hydrology, surface water or groundwater on individual projects during the life-cycle of a mine from development through post-closure. The framework and checklist were designed to be used with all available hydrological data (e.g., environmental documents, project plans, reports, etc.) for a project area. Questions in the framework can lead the user to determine if "red flags" exist in a developer's plans, or if additional studies or information should be requested.

Here we investigate possible impacts to biodiversity from the development of potential lithium projects in California and Nevada. Parker et al. (2024) provided a broad analysis of potential environmental impacts of this activity at 72 proposed extraction sites in the US. Our analyses use data from Parker et al. (2024) to further focus and analyze the possible impacts to biodiversity in California and Nevada. We specifically focus on the potential impacts to imperiled and vulnerable species (G1-G3 and S1-S3 rank) from potential lithium extraction at two different scales: proposed lithium projects and a broader lithium focus area.

Sarcobatus Flat in Nye County, Nevada has several potential lithium projects © Michael Clifford/TNC

Methods

To evaluate the potential impacts of lithium extraction on biodiversity, we used a geospatial overlay analysis at a fine-scale individual project level, and a broad-scale regional analysis to identify conflict between species occurrence and potential mining operations in California and Nevada. For our fine-scale analysis, we defined "proposed lithium projects", which were individual mine projects consisting of mine claims based on the "potential lithium projects" identified by Parker et al. (2024). These included contiguous mine claims operated by a single entity (e.g., company, individual, etc.) that could be grouped and had company plans or filings with the state and/or federal government, and were actively being explored, permitted, and developed. Lithium mine claims lacking a detailed company association were not included in our analyses. Each proposed lithium project area included a 3.2 km (2 mile) buffer around the original claim or claims because it is likely that a developed mine site will have im-

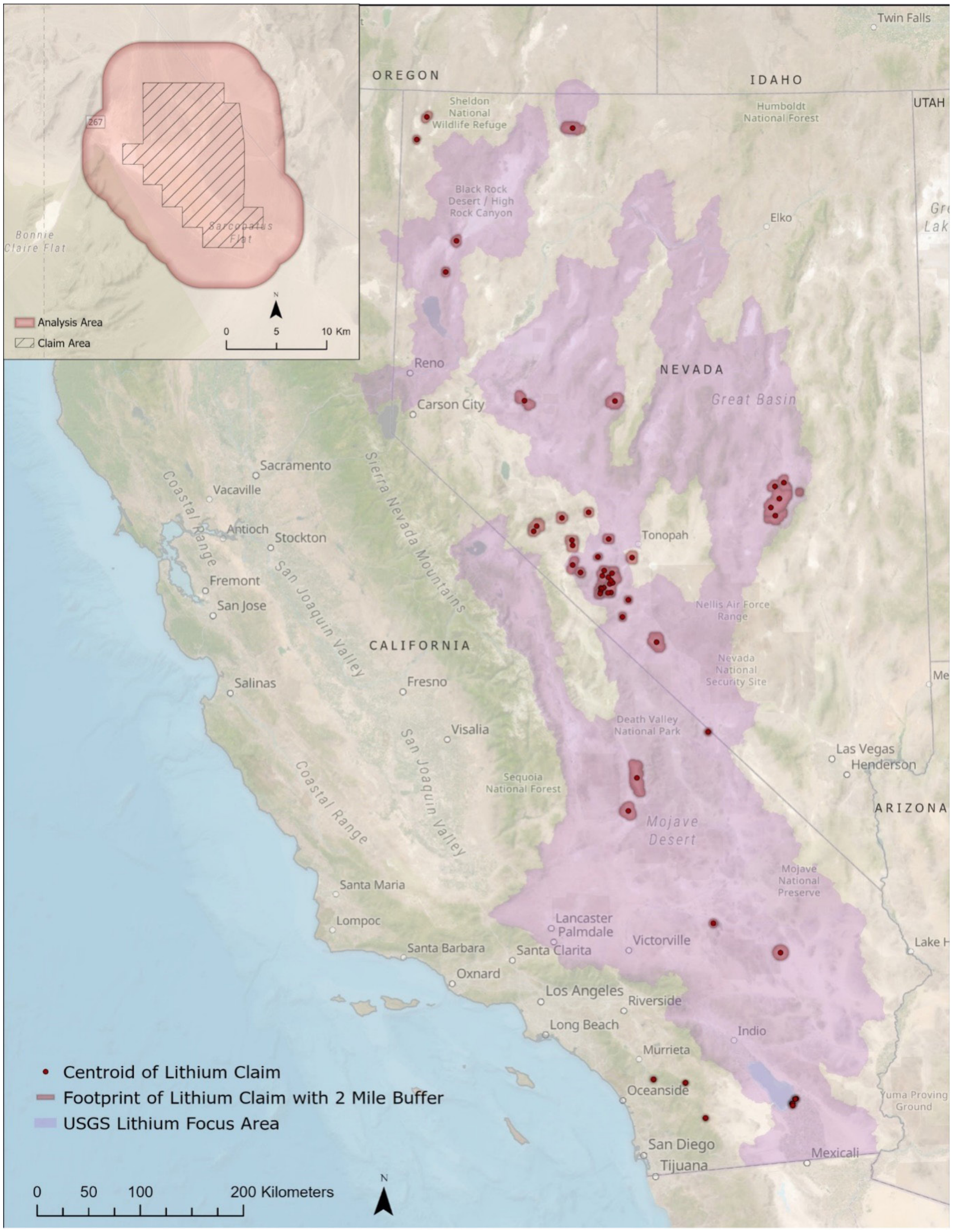


Figure 1. The study area showing individual proposed lithium projects and the lithium focus area. Inset map shows a proposed project, including the claim and buffer area.

pacts beyond the claim boundary in the form of light pollution, dust pollution, access roads, transmission lines, etc.

At the broader-scale we analyzed the potential impacts on biodiversity within the "lithium focus area" defined by the United States Geological Survey (USGS; Dicken et al. 2022). The lithium focus area is a broad, regionally delineated area with lithium deposits. These areas have documented concentrations of lithium in sediments or brines, and may be more likely to include projects that are developed into mine sites than other locations (Hammarstrom et al. 2020). Further, these areas are likely to receive greater pressures from the exploration process that often includes creating roads, drilling test wells, and collecting surface and subsurface ore samples.

Species records were obtained for the state of California from the California Natural Diversity Database (CNDDB) and for Nevada from the Nevada Division of Natural Heritage (NDNH). Data were abstain from iNaturalist (research grade records), a citizen/community science database, in both states. Data were filtered and species occurrences older than 1990 were removed from the analyses because they may no longer be valid if they have not been updated during the past 30 years. We classified data into four categories: 1) inside the proposed lithium project area, including the 3.2 km buffer; 2) outside the proposed lithium project area beyond the 3.2 km buffer; 3) inside the focus area; and 4) outside the focus area (Figure 1).

We focused our analyses on the imperiled to vulnerable ranked species, which globally are ranked as G1-G3 and T1-T2 and at the state level they are ranked as S1-S3. The globally ranked species are potentially at greater risk of extinction than S ranked species, because S ranked species may have a larger distribution occurring in another state or province. The S ranked species are often rare, occur at the edge of a species range, or they may be populations isolated from the main distribution of the species, and they may also include a G1-G3 species rank. The rankings are defined by NatureServe as:

G1: Critically Imperiled – at very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.

G2: Imperiled – at high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

G3: Vulnerable – at moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.

GX: Presumed Extinct – Not located despite intensive searches and virtually no likelihood of rediscovery.

GU: Unrankable – Unrankable due to lack of information or due to substantially conflicting information about status or trends.

T: Infraspecific Taxon (trinomial) - the status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above. Examples include a variety of a species like *Ivesia kingii* var. *eremica* (Ranked G4T1) or subspecies like *Euphilotes pallescens arenamontana* (Ranked G3?T1).

S1: Critically Imperiled – at very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.

S2: Imperiled – at high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

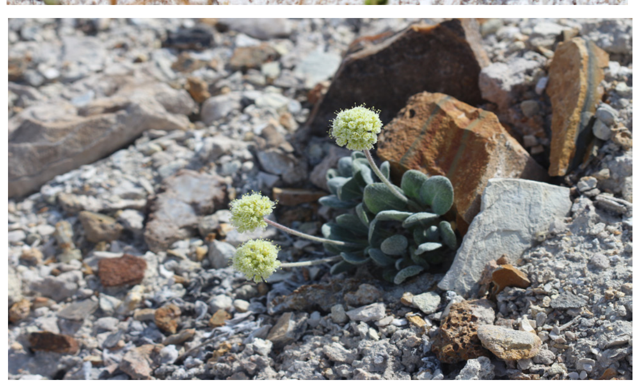
S3: Vulnerable – at moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.

To provide consistent analyses, the lowest ranking was used to define a species. For example, a species with multiple rankings (e.g., G1G2) was considered at the lower ranking (G1) to provide the most conservative conservation estimate. In cases where a species had a T1 or T2 ranking, those rankings were prioritized over the species G ranking because the subspecies or variety warranted a higher conservation ranking. For example, *Hesperia uncas fulvapalla* is ranked as G4G5T1, but the subspecies is only known to occur in the Railroad Valley of central Nevada. Its T ranking was used in the analyses because otherwise the G ranking would lump the endemic subspecies with the larger species taxonomic grouping which is found broadly through western North America.

The location of some species occurrence records obtained from iNaturalist were obscured by up to 30 km. When analyzing data in the potential lithium project areas we removed data with locations obscured by >1 km to avoid false positives/negatives on potential project locations. To analyze the species occurrences within the lithium focus area, we used all data including those with large location uncertainties, because the lithium focus area dataset is a regional dataset with broadly drawn boundaries.

We calculated the percentage of records occurring within proposed lithium projects and the lithium focus area to assess the overall potential impact of lithium mine development on individual species. The percentage of records within either the proposed lithium project or focus area provided an estimate of the proportion of a species range occurring within a project. The percentages of species recorded within the proposed lithium projects is not a direct assessment of the entirety of a species range, however it is a reasonable analog based on the best available data (Pearson et al. 2007).

The region where all proposed lithium projects were located is classified as desert and most of the lithium focus area in California and Nevada occurs in the desert regions. Because of the desert environment and importance of water resources to biodiversity, we analyzed wetland and spring information at each proposed lithium project. In California we used data from the National Wetland Inventory (NWI) and in Nevada we used data from the iGDE database (Saito et al. 2020). Spatial data from each dataset were overlayed and extracted at each proposed lithium project. Data were analyzed by calculating the amount of wetland area or number of springs within proposed lithium projects.



Amargosa niterwort (Nitrophila mohavensis) from the Amargosa Valley; Tiehm's buckwheat (Eriogonum tiehmii) from the Silver Peak Range, Nevada © Naomi Fraga

Fish Lake Valley in Esmeralda County, Nevada has several potential lithium projects © Michael Clifford/TNC

Results

We analyzed 15 proposed lithium projects in California and 40 proposed lithium projects in Nevada (Figure 1). Projects were not evenly distributed spatially, but were focused in specific regions of southern California near the Salton Sea, the playas or salars in western Nevada, and with ancient caldera landforms in northern and western Nevada. The proposed lithium projects in California comprised 77,702 acres (31,445 hectares) with 218,869 acres (88,563 ha) of buffer, while in Nevada proposed projects occurred on 309,339 acres (125,185 ha) with 724,593 acres (293,233 ha) of buffer. The lithium focus area occurred over 100,670 km^2 and 101,994 km^2 in California and Nevada, respectively. In California one proposed lithium project had a wetland feature, while in Nevada 36 proposed lithium projects had wetland features. There were three proposed projects in California with mapped springs located within the project boundary totaling 16 springs within the three projects. In Nevada, there were 27 proposed lithium projects with mapped springs located in the project boundary, and a total of 388 springs found within proposed projects. The total wetland area in proposed lithium projects was 98,626 acres (39,914 ha), of which over 99% of wetland area was found on proposed lithium projects in Nevada.

G1 and S1 Ranks – the critically imperiled species

There were 20 species recorded on proposed lithium projects that were ranked as G1/T1 or S1 and two species ranked GX and GU (Table 1). In California there were four G1/T1 ranked species which included *Agelaius tricolor*, *Cyprinodon macularius*, *Horkelia cuneata* var. *puberula*, and *Laterallus jamaicensis coturniculus*. In Nevada there were four G1 and three T1 ranked species. The GX and GU species both occurred in Nevada, which were *Pyrgulopsis ruinosa* and *Anaxyrus* sp. 2, respectively. There were 10 S1 ranked species recorded in California and 11 S1 ranked species recorded in Nevada on proposed lithium projects. While any of the G1/T1 or S1 ranked species recorded within a proposed lithium project increases the risk of extirpation or extinction, seven of the G1/T1/S1 ranked species had 100% of their records occur within a proposed lithium project (Table 1). The seven species also included both of the GX and GU ranked species. Species with 100% of their records within a proposed lithium project or focus area could therefore become extinct if adverse impacts from lithium extraction occur. Of the species with 100% of their records observed within proposed lithium projects, only *Hulsea mexicana*, occurs in California, which captured the northernmost extent of its range; however, the species is known from a broader range outside of California and has historical records in California that were excluded from this analysis as they occurred prior to 1990. In Nevada, the six species were spread across the state, and were species with small ranges and small available habitat. For example, *Anaxyrus nevadensis* and *Anaxyrus* sp. 2, are endemic toad species occurring in wetlands in Railroad Valley and Fish Lake Valley, respectively. *Pyrgulopsis ruinosa* and *Pyrgulopsis lockensis* are freshwater snails found in only a few springs and each is located in a single valley.

Seventeen of the 20 species (85%) ranked G1/T1/S1 were dependent on wetlands for at least part of their life cycle, including both GX and GU ranked species. Further, five of the G1/S1 ranked species with 100% of their records occurring within a proposed lithium project were wetland dependent.

California

In California, there were 669 species recorded in the lithium focus area. Of the species recorded in the lithium focus area, 367 were imperiled and vulnerable species ranked G1-G3 or T1 or T2 (Table 2; Appendix A). At the state level, 647 species were ranked S1-S3 in the lithium focus area. Nearly 70% of all recorded species in the lithium focus area were plants. Plants were also the most imperiled and vulnerable group, comprising 71% of broader taxonomic groups. Additionally, in California there were five special habitats with G3 ranks that were recorded in the lithium focus area which were Mojave Mixed Steppe, Mojave Yucca Scrub and Steppe, Valley Needlegrass Grassland, Water Birch Riparian Scrub, and Crucifixion Thorn Woodland (California Department of Fish and Wildlife 2023). Those special habitats also ranked between S1 and S3.

There were 61 species recorded within the proposed lithium project areas in California (Appendix B). There were 34 species ranked G1-G3 or T1-T2 and 58 species ranked S1-S3 recorded within proposed lithium projects (Figure 2). Within the proposed lithium projects, two species were ranked G1, *Cyprinodon macularius* and *Agelaius tricolor*, and 10 species were ranked S1 (Table 1). All the G1 species were also ranked S1 (it is common in the NatureServe rankings to have overlap of G1 and S1 ranked species).

Nevada

A wide range of taxonomic groups were recorded in the lithium focus area of Nevada including insects, plants, mammals, and mollusks. Of the 304 species recorded in the lithium focus area, 190 species ranked G1-G3, including T ranked species, and there were two additional species ranked GU and GX. There were 267 species ranked S1-S3. Plants comprised more than half of the G-ranked species. There were 27 species ranked T1 and 15 species ranked T2. There were 116 species recorded in Nevada that had 100% of their records occur within the lithium focus area.

There were 43 species recorded within proposed lithium projects. There were 20 species ranked G1-G3, four species ranked T1-T2, one species ranked GX, one species ranked GU, and 38 species ranked S1-S3 recorded on proposed lithium projects. Plants comprised 33% of species recorded within proposed lithium projects (Table 2). While plants were also the most recorded species on the proposed lithium projects, mollusks and mammals were also present in relatively high proportions at >10% of species. Imperiled crustaceans and reptiles were not observed within the proposed lithium projects in Nevada.

Table 1. List of G1/T1 and S1 Ranked species recorded on lithium mine claims in California and Nevada. The GX and GU Ranked species are also included in the table.

Species	G rank, S rank	Percent in project	Wetland dependent	State
Agelaius tricolor	G1G2, S1S2	0.54%	Yes	CA
Anaxyrus nevadensis	G1, S1	100.00%	Yes	NV
Anaxyrus sp. 2	GU, S2	100.00%	Yes	NV
Crenichthys nevadae	G1, S1	16.67%	Yes	NV
Cyprinodon macularius	G1, S1	10.77%	Yes	CA
Empidonax traillii extimus	G5T2, S1	3.17%	Yes	CA
Eriogonum tiehmii	G1, S1	100.00%	No	NV
Euphilotes pallescens arenamontana	G3T1, S1	25.00%	No	NV
Gelochelidon nilotica	G5, S1	31.82%	Yes	CA
Hesperia uncas fulvapalla	G4G5T1, S1	100.00%	Yes	NV
Horkelia cuneata var. puberula	G4T1, S1	3.13%	No	CA
Hulsea mexicana	G3, S1	100.00%	No	CA
Juga acutifilosa	G2, S1	10.00%	Yes	NV
Laterallus jamaicensis coturniculus	G3G4T1, S1	0.51%	Yes	CA
Lepidium integrifolium	G2G3T2T3, S1	50.00%	Yes	NV
Pelecanus erythrorhynchos	G4, S1S2	0.29%	Yes	CA
Penstemon albomarginatus	G2, S1	4.55%	No	CA
Pyrgulopsis lockensis	G1, S2	100.00%	Yes	NV
Pyrgulopsis ruinosa	GX, S1	100.00%	Yes	NV
Pyrgulopsis wongi	G2, S1	25.00%	Yes	NV
Rallus obsoletus yumanensis	G3T3, S1S2	15.22%	Yes	CA
Siphateles bicolor ssp. 4	G4T1Q, S1	40.00%	Yes	NV

Table 2. Numbers of grouped species in California and Nevada on proposed lithium projects and the lithium focus area. Numbers in parentheses are the numbers of species with G1-G3 and T1-T2 Ranks.

Group	California		Nevada	
	Focus area	Proposed projects	Focus area	Proposed projects
Amphibians	15 (10)	2 (2)	7 (6)	3 (3)
Birds	65 (12)	25 (7)	37 (7)	4 (1)
Crustaceans	7 (7)	4 (4)	0 (0)	0 (0)
Fish	14 (11)	1 (1)	16 (13)	2 (2)
Insects	18 (17)	0 (0)	27 (20)	2 (2)
Mammals	49 (18)	4 (1)	36 (6)	16 (4)
Mollusks	15 (14)	0 (0)	44 (40)	5 (5)
Plants	462 (262)	21 (18)	124 (120)	10 (7)
Reptiles	24 (15)	4 (2)	14 (1)	1 (0)

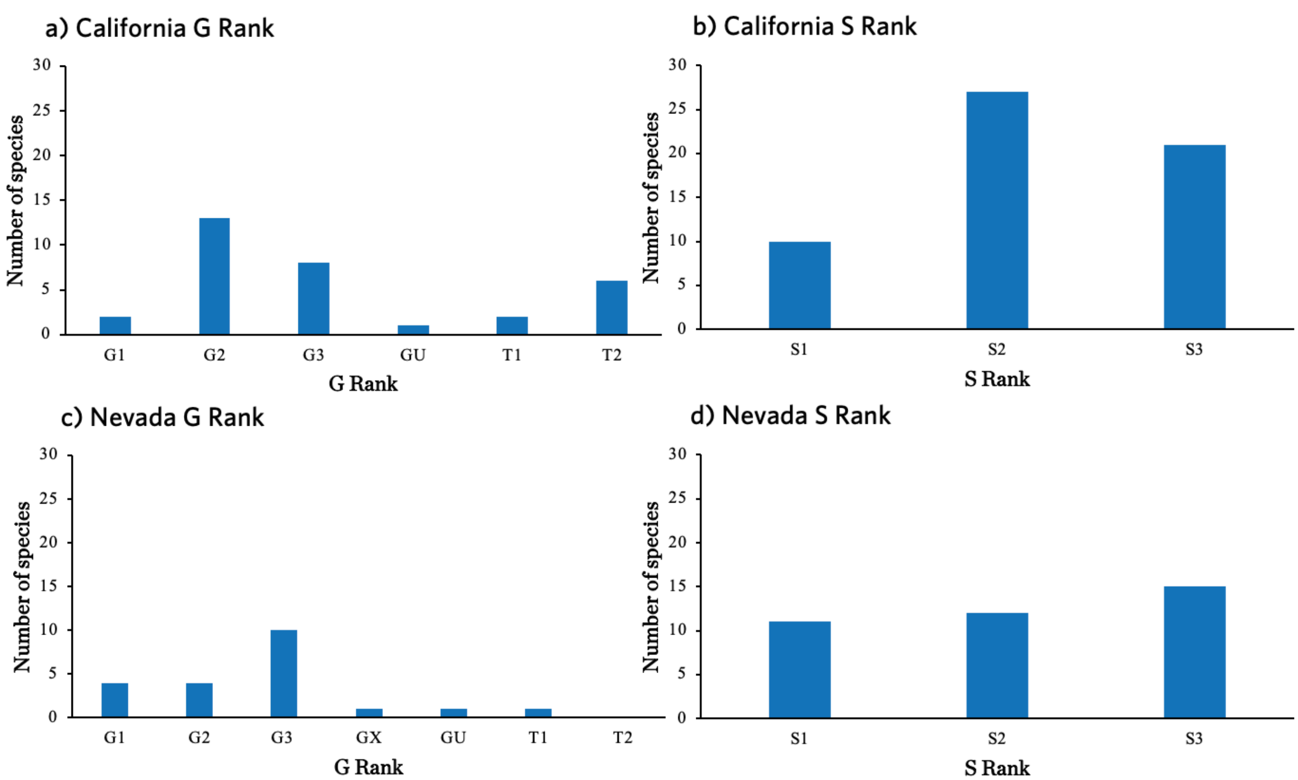


Figure 2. Number species recorded in proposed lithium projects in a) California G1-G3 and T1-T2 rank, b) California S1-S3 rank c) Nevada G1-G3 and T1-T2 rank, and d) Nevada S rank. Ranks of GX and GU are also included in G ranks.

The Amargosa River in southern California © Chip Carroon/TNC

Discussion

The development of proposed lithium projects in California and Nevada will negatively impact biodiversity if appropriate planning is not taken to avoid the most sensitive areas (e.g., Kiesecker et al. 2010). The 55 proposed projects in California and Nevada occur over a large area, broadly defined as desert with limited precipitation and surface water. Highlighting the importance of springs and wetlands to the biodiversity of the region, 17 of the 20 the most critically imperiled species recorded within proposed lithium projects were wetland dependent. More broadly, we identified 33 species in California with imperiled to vulnerable rankings on proposed lithium projects, while in Nevada we identified 24 species that were ranked imperiled to vulnerable. Even more broadly, we identified 367 species in the lithium focus area in California and 190 species in Nevada that were classified as globally imperiled or vulnerable.

We identified 20 critically imperiled species ranked G1/T1 and/or S1 recorded on proposed lithium projects. Further, 100% of the records for seven critically imperiled species occurred entirely within proposed lithium projects. These seven species face the greatest risk of extirpation or extinction if proposed lithium projects are developed. Several species, such as *Anaxyrus nevadensis*, *Eriogonum tiehmii*, and *Pyrgulopsis lockensis* are small ranged endemics and highlight the risk to such species (Primm et al. 2014). For example, *A. nevadensis* is an endemic species of toad occurring in isolated wetlands found in the Railroad Valley. *Eriogonum tiehmii* is a perennial plant that grows on less than 5 hectares in the Silver Peak Range, and was listed as federally endangered under the US Endangered Species Act in 2022 due to threats from mining. *Pyrgulopsis ruinosa*, an endemic spring snail located in Fish Lake Valley, Nevada also had 100% of its records within a proposed lithium project. However, *P. ruinosa* was presumed extinct (ranked GX) and was not observed between the early 1990s and 2020, despite efforts to locate the species (Springsnail Conservation Team 2020). *P. ruinosa* was finally observed in 2021 (E. Miskow, personal communication), and illustrates the difficulty in observing, monitoring, and tracking cryptic, small range endemic species. Regardless, project development covering the entire range of *P. ruinosa* will increase extinction risk due to habitat disturbance and/or mining-associated water pumping and use that could dry up its remaining habitat.

More broadly distributed species that have isolated or outlier populations such as *Hulsea mexicana* and *Hesperia uncas fulvapalla* have 100% of their records also occurring within a proposed lithium project. However, while these species are critically imperiled with rank S1, the existence of populations outside the states where they are rare and tracked as S1 species means that they are less likely to face extinction, and more likely to face local extirpation due to lithium project development. Other imperiled species with less than 100% of their range in a proposed lithium project still face increasing risks of extinction or extirpation as most of these species have small ranges, or small population sizes, and even the loss of a small portion of habitat or population can negatively impact their long-term survival (Purvis et al. 2000; Primm et al. 2014; Staude et al. 2018). The addition of lithium extracting activities within their home range will greatly increase pressure on those species.

Many of the most imperiled species are endemic or outlier populations of species, which is a common global pattern of extinction (Enquist et al. 2019; Kraus et al. 2023). Endemic species and outlier populations such as *Anaxyrus nevadensis*, *Hulsea mexicana*, and *Hesperia uncas fulvapalla* play a pivotal role in biodiversity, having evolved within the unique ecosystems of localized conditions and often have specialized adaptations that enable them to survive in unique environmental conditions (Cantonati et al. 2020). The presence of endemic species and outlier populations can indicate past climate changes (Jansson 2003), and may provide insights into species range shifts under climate change. Endemic species and outlier populations also provide unique ecosystem services relative to cosmopolitan species (Gorman et al. 2014). The conservation of endemic species is important to reducing biodiversity loss. In many definitions (including in this report), endemic species are defined by political boundaries (Shipley and McGuire 2022; Kraus et al. 2023), and do not require bi-state policy measures to increase conservation – conservation can be achieved with intrastate policies. Without the need for multi-state conservation policy, endemic species should be quicker to protect because of the reduced interstate governmental agencies involved.

Of the 20 most critically imperiled species, 17 species are also dependent on wetlands for at least part of their life cycle (Table 1), highlighting the need for protections of wetlands. While there was a high proportion of wetland dependent species classified as critically imperiled and these species are at risk from surface development adjacent to springs and wetlands, our analyses do not include the potential impacts to wetland dependent species outside the proposed project boundary that may be impacted due to groundwater pumping from lithium extraction processes. Further, risks to groundwater dependent ecosystems differs based on the nearby type of lithium extraction (e.g., DLE, evaporative concentration, open pit, etc.). The hydrological framework and checklist developed by Saftner et al. (2023) will provide a path forward in considering hydrologic risks from potential impacts at the project level. However, the dependence of these species on water, which is often in the form of groundwater, highlights the need for detailed assessments of the hydrogeology in each basin with proposed lithium extraction, and larger comprehensive water management plans that consider the importance of water for natural ecosystems.

Even though DLE is expected to use a closed loop system for lithium extraction, more data are needed to understand potential negative impacts to wetlands and springs such as changes in spring discharge and temperature due to the changes in aquifer dynamics from pumping and reinjection (Kristmannsdottir and Armannsson 2003; Simmons et al. 2021).

We recognize there are data inequalities in the databases we used for locating species records (i.e., NDNH, CNDDB, and iNaturalist). These inequalities occur in several ways, including spatial inequalities where locations adjacent to large population centers have more data than rural or sparsely populated areas, which is particularly prominent in Nevada (Taylor 2014).

Another inequality is in the species identified, with more charismatic species groups like plants and birds being overrepresented relative to other more difficult to identify groups like insects. Taxonomic bias is well-documented in conservation science (Clark and May 2002). Furthermore, we recognize there are shortcomings to using only presence data, and that the absence of a species in the data does not imply absence on the landscape. We used the best available data to project the potential impacts to biodiversity from an emerging land use and urge increased biological collections in the lithium focus area so that biodiversity is not impacted due to a lack of data. Many species remain undiscovered, poorly studied, or have only recently been described. This leaves gaps in our understanding of their ecological roles, distribution, vulnerabilities, and population trends. The paucity of species information exacerbates the challenges of conservation, creating significant obstacles to understanding which species are affected or lost (e.g., Primm et al. 2014). There are still taxonomic uncertainties in many species and the lack of comprehensive data hampers our ability to accurately assess the status of various ecosystems and identify species at risk. In the lithium focus areas of California and Nevada combined, there were 138 species ranked as GU or T1-T2. The taxonomic uncertainties in many of the species recorded in the lithium focus area or in proposed lithium projects further challenges conservation. Policy protections from government agencies may not apply to these taxonomically ambiguous or undescribed species as they do not fall under governmental protections. However, citizen/community science data has the potential to rapidly alter our understanding of species and their distributions through discoveries of new populations, range boundaries (Kohler et al. 2023), and new species by making images and locations broadly available to all (e.g., Amezquita et al. 2013; Jain et al. 2022).

Addressing global climate change is critically important for ecosystems and people, but climate change solutions must be balanced with the conservation of biodiversity (Wu et al. 2023). High biodiversity maintains ecosystem function, and typically sequesters more carbon than degraded systems experiencing extirpation. Extinction of cryptic species may signal weakening of ecosystem function and provide early indications of poorly functioning ecosystems. The loss of biodiversity significantly decreases ecosystem resiliency and ecosystem services that both humans and nature depend on for survival (Cardinale et al. 2012). While the ongoing renewable energy transition is a key component of climate change action, the deployment of technologies and resource extraction activities focused on furthering the transition needs to be planned so that projects avoid the most sensitive species areas, and consume the least amount of water, especially in arid regions.

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CLOCKWISE FROM LEFT Killdeer (Charadrius vociferus) in Nevada © Michael Swink; White-margin beardtongue (Penstemon albomarginatus) in Nevada; Tecopa birdsbeak (Chloropyron tecopense) in Fish Lake Valley, Nevada; Silver Peak Range © Naomi Fraga BACK PAGE Tecopa, California © Chip Carroon/TNC

Appendix A. List of Species with G rank and S rank within the lithium focus area, with percent of total occurrences. Some species were recorded in both California and Nevada. The first number corresponds to the percentage in California and second number listed for Nevada.

Species	Percent in Focus area	G Rank	S Rank	State
Abronia villosa var. *aurita*	27.69%	G5T2?	S2	CA
Abutilon parvulum	50.00%	G5	S2S3	CA
Acanthoscyphus parishii var. *cienegensis*	47.83%	G4?T2	S2	CA
Acanthoscyphus parishii var. *goodmaniana*	100.00%	G4?T1	S1	CA
Accipiter cooperii	1.14%	G5	S4	CA
Accipiter gentilis	4.21%, 31.08%	G5	S3, S3	CA, NV
Acleisanthes nevadensis	41.67%	G4?	S1	CA
Acmispon argyraeus var. *multicaulis*	33.33%	G4?T2	S2	CA
Acmispon haydonii	50.00%	G3	S3	CA
Aegialia crescenta	100.00%	G1	S1	NV
Agastache cusickii	100.00%	G3G4	S2	NV
Agave utahensis var. *eborispina*	100.00%	G4T3	S2	CA
Agelaius tricolor	2.48%	G1G2	S1S2	CA
Ageratina herbacea	100.00%	G5	S3	CA
Agrilus harenus	100.00%	G1G2	S1S2	CA
Agrostis humilis	35.29%	G4Q	S2	CA
Aimophila ruficeps canescens	2.55%	G5T3	S3	CA
Aliciella ripleyi	100.00%	G3	S2	CA
Aliciella triodon	57.14%	G5	S2	CA
Allium atrorubens var. *atrorubens*	42.86%	G4T4	S2	CA
Allium marvinii	2.27%	G1	S1	CA
Allium nevadense	26.32%	G4	S3	CA
Allium shevockii	83.33%	G2	S2	CA
Almutaster pauciflorus	100.00%	G4	S1S2	CA
Ambystoma macrodactylum sigillatum	1.52%	G5T4	S3	CA
Anaxyrus californicus	12.31%	G2G3	S2S3	CA
Anaxyrus canorus	10.89%	G2G3	S2S3	CA
Anaxyrus monfontanus	100.00%	G1	S1	NV
Anaxyrus nelsoni	100.00%	G2	S2	NV
Anaxyrus nevadensis	100.00%	G1	S1	NV
Anaxyrus sp. *2*	100.00%	GU	S2	NV
Androstephium breviflorum	84.35%	G4	S2?	CA
Anniella campi	37.50%	G1G2	S1S2	CA
Anniella pulchra	12.71%	G3	S3	CA
Anniella stebbinsi	5.00%	G3	S3	CA

Anodonta californiensis	25%, 40%	G3Q	S2?, S1	CA, NV
Antennaria marginata	50.00%	G4G5	S1	CA
Antigone canadensis tabida	0.47%, 20%	G5T5	S2, S2BM	CA, NV
Antrozous pallidus	18.7%, 31.7%	G4	S3, S3	CA, NV
Aplodontia rufa	57.14%	G5	S1	NV
Aplodontia rufa californica	6.52%	G5T3T4	S2S3	CA
Aquila chrysaetos	22.5%, 16.7%	G5	S3, S4	CA, NV
Arabis rigidissima var. *demota*	50.00%	G3T3Q	S2	NV
Arctomecon merriamii	83.3%, 17.9%	G3	S3, S3	CA, NV
Arctostaphylos glandulosa ssp. *gabrielensis*	16.13%	G5T3	S3	CA
Ardea alba	7.41%	G5	S4	CA
Ardea herodias	3.95%	G5	S4	CA
Arenaria lanuginosa var. *saxosa*	7.69%	G5T5	S2	CA
Argynnis nokomis apacheana	15.38%	G3T3	S3	NV
Arizona elegans	14.29%	G5	S4	NV
Arizona elegans occidentalis	10.09%	G5T2	S2	CA
Artemia monica	100.00%	G3	S3	CA
Artemisia tripartita ssp. *tripartita*	75.00%	G5T4T5	S2	CA
Artemisiospiza belli belli	1.64%	G5T2T3	S3	CA
Asclepias eastwoodiana	18.18%	G2	S2S3	NV
Asclepias nyctaginifolia	23.44%	G4?	S2	CA
Asio flammeus	30.00%	G5	S2	NV
Asio otus	26.83%, 30.77%	G5	S3?, S3	CA, NV
Aspidoscelis hyperythra	0.39%	G5	S2S3	CA
Aspidoscelis tigris stejnegeri	1.12%	G5T5	S3	CA
Assiminea infima	100.00%	G1	S1	CA
Astragalus albens	100.00%	G1	S1	CA
Astragalus allochrous var. *playanus*	100.00%	G4T4	S2	CA
Astragalus argophyllus var. *argophyllus*	100.00%	G5T4	S2	CA
Astragalus atratus var. *mensanus*	77.78%	G4G5T2	S2	CA
Astragalus austiniae	23.53%, 100%	G2G3	S2S3, S1	CA, NV
Astragalus beatleyae	100.00%	G2	S2	NV
Astragalus bernardinus	95.00%	G3	S3	CA
Astragalus callithrix	100.00%	G3	S3	NV
Astragalus calycosus var. *monophyllidius*	50.00%	G5T2Q	S3	NV
Astragalus cimae var. *cimae*	50.00%	G3T2T3	S2?	CA
Astragalus cimae var. *sufflatus*	33.33%	G3T3	S3	CA
Astragalus ertterae	33.33%	G2	S2	CA
Astragalus funereus	76.92%	G2	S2	NV

Astragalus gilmanii	100.00%	G2	S2	CA
Astragalus insularis var. *harwoodii*	47.57%	G5T4	S2	CA
Astragalus jaegerianus	100.00%	G2	S2	CA
Astragalus johannis-howellii	70%, 40%	G2	S1, S2	CA, NV
Astragalus kentrophyta var. *ungulatus*	100.00%	G5T3T4	S1	CA
Astragalus lemmonii	42.86%	G2	S2	CA
Astragalus lentiginosus var. *antonius*	60.00%	G5T2	S2	CA
Astragalus lentiginosus var. *coachellae*	100.00%	G5T1	S1	CA
Astragalus lentiginosus var. *latus*	23.08%	G5T2	S2	NV
Astragalus lentiginosus var. *piscinensis*	100.00%	G5T1	S1	CA
Astragalus lentiginosus var. *scorpionis*	37.50%	G5T3T4	S3?	NV
Astragalus lentiginosus var. *sesquimetralis*	100%, 100%	G5T1	S1, S1	CA, NV
Astragalus lentiginosus var. *sierrae*	31.58%	G5T2	S2	CA
Astragalus leucolobus	57.39%	G2	S2	CA
Astragalus magdalenae var. *peirsonii*	100.00%	G3G4T1	S1	CA
Astragalus mohavensis var. *hemigyrus*	100.00%	G3G4T2T3	S1	CA
Astragalus mohavensis var. *mohavensis*	4.00%	G3G4T3T4	S2S3	NV
Astragalus monoensis	96.15%	G2	S2	CA
Astragalus nyensis	6.25%	G3	S3	NV
Astragalus oophorus var. *clokeyanus*	31.03%	G4T2	S2	NV
Astragalus phoenix	100.00%	G2	S1	NV
Astragalus platytropis	28.57%	G5	S3	CA
Astragalus porrectus	40.00%	G3?	S3?	NV
Astragalus preussii var. *laxiflorus*	100.00%	G4T2	S1	CA
Astragalus pseudiodanthus	100%, 71%	G2Q	S2, S2	CA, NV
Astragalus pterocarpus	62.50%	G3	S3	NV
Astragalus pulsiferae var. coronensis	100.00%	G4T3	S1	NV
Astragalus ravenii	100.00%	G2	S2	CA
Astragalus sabulonum	12.5%, 33.3%	G4G5	S2, N/A	CA, NV
Astragalus serenoi var. *shockleyi*	71.43%	G4T3	S3	CA
Astragalus serenoi var. *sordescens*	100.00%	G4T2?	S2	NV
Astragalus tidestromii	56.25%	G4	S2	CA
Astragalus tiehmii	100.00%	G3	S2	NV
Astragalus toquimanus	33.33%	G2	S2	NV
Astragalus tricarinatus	98.04%	G2	S2	CA
Astragalus yoder-williamsii	50.00%	G3	S1	NV
Astrolepis cochisensis ssp. *cochisensis*	93.33%	G5?T4	S2	CA
Athene cunicularia	30%, 60%	G4	S3, NA	CA, NV
Athene cunicularia hypugaea	8.79%	G4T4	S3B	NV
Atriplex argentea var. *longitrichoma*	25.00%	G5T2	S2	CA
Auriparus flaviceps	19.30%	G5	S3	NV

Ayenia compacta	18.97%	G4	S3	CA
Bahia neomexicana	87.50%	G5	S2S3	CA
Batrachoseps campi	90.91%	G3	S3	CA
Batrachoseps major aridus	100.00%	G4T1	S1	CA
Batrachoseps robustus	53.85%	G3	S3	CA
Berberis fremontii	45.45%	G5	S3	CA
Blepharidachne kingii	25%, 66%	G4	S2, N/A	CA, NV
Boechera bodiensis	65%, 8.33%	G3	S3, S2	CA, NV
Boechera cobrensis	33.33%	G5	S3	CA
Boechera dispar	89%, 100%	G3	S3, S1S2	CA, NV
Boechera johnstonii	75.00%	G1	S1	CA
Boechera lincolnensis	100.00%	G4G5	S3	CA
Boechera ophira	36.36%	G1G2	S1	NV
Boechera parishii	58.06%	G2	S2	CA
Boechera peirsonii	50.00%	G1	S1	CA
Boechera pendulina	28.57%	G5	S2	CA
Boechera pinzliae	100.00%	G2	S1	CA
Boechera rectissima x Boechera retrofracta	42.86%	GNA	S1	NV
Boechera shockleyi	69.56%, 35.29%	G3	S2, S3	CA, NV
Boechera tiehmii	100%, 100%	G3	S3, S1	CA, NV
Boechera tularensis	21.43%	G3	S3	CA
Bombus crotchii	11.03%	G3G4	S1S2	CA
Bombus morrisoni	58%, 33%	G4G5	S1S2, N/A	CA, NV
Bombus occidentalis	5.00%	G2G3	S1	CA
Botrychium ascendens	11.76%	G3G4	S2	CA
Botrychium crenulatum	10.67%	G4	S3	CA
Botrychium minganense	1.28%	G4G5	S3	CA
Brachylagus idahoensis	70%, 31%	G4	S3, S3	CA, NV
Branchinecta lynchi	0.13%	G3	S3	CA
Branta hutchinsii leucopareia	4.35%	G5T3	S3	CA
Bursera microphylla	6.45%	G4	S2	CA
Buteo regalis	21%, 40%	G4	S3S4; S3B,S4N	CA, NV
Buteo swainsoni	2.50%, 79%	G5	S3, S3B	CA, NV
Calliandra eriophylla	80.56%	G5	S3	CA
Calochortus clavatus var. *gracilis*	0.74%	G4T2T3	S2S3	CA
Calochortus excavatus	100.00%	G2	S2	CA
Calochortus leichtlinii	100.00%	G4	S3	NV
Calochortus palmeri var. *munzii*	11.36%	G3T3	S3	CA
Calochortus palmeri var. *palmeri*	44.68%	G3T2	S2	CA

Calochortus plummerae	1.95%	G4	S4	CA
Calochortus striatus	93%, 56%	G3?	S2S3, S1	CA, NV
Calyptridium pygmaeum	66.67%	G1G2	S1S2	CA
Camissonia integrifolia	25.00%	G2	S2	CA
Carex davyi	28.57%	G3	S3	CA
Carex duriuscula	40.00%	G5	S2	CA
Carex limosa	6.25%	G5	S3	CA
Carex occidentalis	20.00%	G4	S3	CA
Carex petasata	3.08%	G5	S3	CA
Carex praticola	16.67%	G5	S2	CA
Carex scirpoidea ssp. *pseudoscirpoidea*	66.67%	G5T4	S2	CA
Carex tiogana	50.00%	G2Q	S1	CA
Carex vallicola	16.67%	G5	S2	CA
Carnegiea gigantea	8.00%	G5	S1	CA
Castela emoryi	92.00%	G3G4	S2S3	CA
Castilleja cinerea	28.26%	G1G2	S1S2	CA
Castilleja gleasoni	14.29%	G2	S2	CA
Castilleja lasiorhyncha	71.43%	G2?	S2?	CA
Castilleja salsuginosa	66.67%	G1	S1	NV
Catostomus fumeiventris	100.00%	G3G4	S3	CA
Catostomus platyrhynchus	23.08%	G5	S3	CA
Caulanthus barnebyi	100.00%	G1	S2	NV
Centrocercus urophasianus	2.33%	G3G4	S2S3	CA
Cercyonis oetus alkalorum	100.00%	G5T1	S1	NV
Chaenactis carphoclinia var. *peirsonii*	75.00%	G5T2	S2	CA
Chaenactis douglasii var. *alpina*	10.00%	G5T5	S2	CA
Chaenactis parishii	40.00%	G3G4	S3	CA
Chaetadelpha wheeleri	5.55%, 25%	G4	S2, N/A	CA, NV
Chaetodipus californicus femoralis	4.35%	G5T3	S3	CA
Chaetodipus fallax fallax	5.05%	G5T3T4	S3S4	CA
Chaetodipus fallax pallidus	79.31%	G5T3T4	S3S4	CA
Chaetodipus penicillatus	3.03%	G5	S1S2	NV
Charadrius montanus	59%, 100%	G3	S2S3, SNA	CA, NV
Charadrius nivosus nivosus	7.54%, 45%	G3T3	S2, S3B	CA, NV
Charina bottae	46.15%	G5	S3S4	NV
Charina umbratica	43.75%	G2G3	S2S3	CA
Chionactis occipitalis	50.00%	G5	S4	NV
Chlidonias niger	16.67%	G4G5	S2	CA
Chloropyron tecopense	100%, 100%	G2	S1, N/A	CA, NV
Chorizanthe parryi var. *parryi*	12.40%	G3T2	S2	CA
Chorizanthe xanti var. *leucotheca*	67.35%	G4T3	S3	CA

Chrysothamnus greenei	50.00%	G5	#N/A	NV
Chylismia arenaria	62.50%	G4?	S2S3	CA
Chylismia claviformis ssp. *cruciformis*	4.35%	G5T4	S2	CA
Chylismia megalantha	9.09%	G3Q	S3	NV
Circus hudsonius	2.65%, 18%	G5	S3, N/A	CA, NV
Cirsium arizonicum var. *tenuisectum*	42.86%	G5T2	S2	CA
Cirsium mohavense	18.75%	G3	S3	NV
Cladium californicum	75%, 100%	G4	S2, S2	CA, NV
Clarkia xantiana ssp. *parviflora*	23.53%	G4T3?	S3?	CA
Claytonia megarhiza	13.33%	G5	S2	CA
Claytonia panamintensis	100.00%	G1	S1	CA
Claytonia peirsonii ssp. *californacis*	100.00%	G2G3T1	S1	CA
Claytonia peirsonii ssp. *peirsonii*	44.44%	G2G3T2	S2	CA
Claytonia peirsonii ssp. *yorkii*	100.00%	G2G3T1	S1	CA
Coccyzus americanus occidentalis	6.85%	G5T2T3	S1	CA
Colaptes chrysoides	57.14%	G5	S1	CA
Coleonyx switaki	25.00%	G4	S1	CA
Colubrina californica	53.33%	G4	S2S3	CA
Contopus cooperi	100.00%	G4	S2B	NV
Cordylanthus eremicus ssp. *kernensis*	33.33%	G3T2	S2	CA
Cordylanthus parviflorus	38.46%	G4	S2	CA
Corynorhinus townsendii	27%, 26%	G4	S2, S2	CA, NV
Coryphantha alversonii	100.00%	G3	S3	CA
Coryphantha chlorantha	43.21%	G4	S3	CA
Coryphantha vivipara var. *rosea*	66.67%	G5T3	S1	CA
Crenichthys nevadae	83.33%	G1	S1	NV
Crepis runcinata	55.56%	G5	S3	CA
Crotalus cerastes	40.00%	G5	S4	NV
Crotalus ruber	12.85%	G4	S3	CA
Crotaphytus bicinctores	46.94%	G5	S4	NV
Croton wigginsii	90.00%	G2G3	S2	CA
Cryptantha clokeyi	93.75%, 100%	G3	S3, S1	CA, NV
Cuniculotinus gramineus	75.00%	G3G4	S3	CA
Cusickiella quadricostata	8.33%	G2	S2	CA
Cylindropuntia munzii	52.94%	G3	S1	CA
Cymopterus deserticola	100.00%	G2	S2	CA
Cymopterus gilmanii	28.57%	G3	S2	CA
Cymopterus globosus	100%, 46%	G3G4	S1, N/A	CA, NV
Cymopterus multinervatus	54.76%	G4G5	S2	CA
Cymopterus nivalis	100.00%	G5	S3	NV
Cymopterus ripleyi var. *saniculoides*	100%, 50%	G3G4T3Q	S1, S3	CA, NV

Cyprinodon diabolis	75.00%	G1	S1	NV
Cyprinodon macularius	92.65%	G1	S1	CA
Cyprinodon nevadensis pectoralis	100.00%	G2T1	S1	NV
Cyprinodon radiosus	100.00%	G1	S1	CA
Cyprinodon salinus milleri	100.00%	G1T1Q	S1	CA
Cyprinodon salinus salinus	100.00%	G1T1	S1	CA
Danaus plexippus	39.82%	G4	S3B	NV
Dedeckera eurekensis	62.50%	G3	S3	CA
Deinandra arida	100.00%	G1	S1	CA
Deinandra mohavensis	26.56%	G2	S2	CA
Delphinium inopinum	5.88%	G3	S3	CA
Delphinium purpusii	2.86%	G3	S3	CA
Delphinium recurvatum	1.41%	G2?	S2?	CA
Delphinium stachydeum	10.34%	G5?	S3	CA
Diadophis punctatus	100.00%	G5	S3	NV
Diadophis punctatus modestus	12.00%	G5T2T3	S2?	CA
Diadophis punctatus regalis	66.67%	G5TNR	S2S3	CA
Dieteria canescens var. *ziegleri*	100.00%	G5T1	S1	CA
Digitaria californica var. californica	50.00%	G5T5	S2	CA
Dinacoma caseyi	100.00%	G1	S1	CA
Diplacus mohavensis	100.00%	G2	S2	CA
Diplacus parryi	50.00%	G4G5	S3	CA
Diplacus pictus	2.22%	G2	S2	CA
Dipodomys merriami collinus	11.76%	G5T2?	S1S2	CA
Dipodomys panamintinus panamintinus	100.00%	G5T3	S3	CA
Dipodomys stephensi	0.88%	G2	S2	CA
Dipsosaurus dorsalis	26.09%	G5	S3	NV
Ditaxis claryana	42.86%	G3G4	S2	CA
Ditaxis serrata var. californica	92.86%	G5T3T4	S2?	CA
Draba arida	66.67%	G2	S2	NV
Draba asterophora var. asterophora	33.33%	G2T2Q	S1S2	NV
Draba cana	100.00%	G5	S2	CA
Draba lonchocarpa	60.00%	G5	S2S3	CA
Draba praealta	80.00%	G5	S3	CA
Draba saxosa	80.00%	G2G3	S2S3	CA
Draba sharsmithii	75.00%	G2	S2	CA
Draba sierrae	100.00%	G3	S3	CA
Draba subumbellata	50.00%	G3	S1	NV
Drosera anglica	5.26%	G5	S2	CA
Drymocallis cuneifolia var. cuneifolia	50.00%	G2T1	S1	CA
Drymocallis cuneifolia var. ewanii	100.00%	G2T2	S2	CA

Dudleya abramsii ssp. affinis	69.39%	G4T2	S2	CA
Dudleya densiflora	1.16%	G2	S2	CA
Dudleya saxosa ssp. saxosa	100.00%	G4T3	S3	CA
Egretta thula	11.76%	G5	S4	CA
Elanus leucurus	0.22%	G5	S3S4	CA
Elgaria coerulea palmeri	20.00%	G5T4	S2S3	NV
Elgaria coerulea shastensis	100.00%	G5T4	S1	NV
Elgaria panamintina	89.47%	G3	S3	CA
Elodium blandowii	25.00%	G4	S2	CA
Elymus salina	50.00%	G4G5	S2S3	CA
Empidonax traillii	26.92%	G5	S1S2	CA
Empidonax traillii extimus	9.37%, 26%	G5T2	S1, S1B	CA, NV
Emys marmorata	0.71%	G3G4	S3	CA
Enceliopsis covillei	100.00%	G2	S2	CA
Enceliopsis nudicaulis var. corrugata	50%, 100%	G5T1T2Q	S1, S1	CA, NV
Enneapogon desvauxii	35.85%	G5	S3	CA
Ensatina eschscholtzii croceater	8.33%	G5T3	S3	CA
Ensatina eschscholtzii klauberi	13.64%	G5T2?	S3	CA
Ephedra funerea	100.00%	G3	S2	NV
Epilobium howellii	5.10%	G4	S4	CA
Epilobium nevadense	25.00%	G3	S2	NV
Eptesicus fuscus	13.00%	G5	S3S4	NV
Eremarionta morongoana	100.00%	G1G3	S1	CA
Eremichthys acros	100.00%	G1	S1	NV
Eremogone ursina	55.56%	G1	S1	CA
Eremophila alpestris actia	4.35%	G5T4Q	S4	CA
Eremothera boothii ssp. boothii	100.00%	G5T4	S3	CA
Eremothera boothii ssp. intermedia	50.00%	G5T3T4	S3	CA
Eremothera nevadensis	25.00%	G3	S3	NV
Erethizon dorsatum	7.57%	G5	S3	CA
Eriastrum harwoodii	90.79%	G2	S2	CA
Eriastrum rosamondense	100.00%	G1?	S1?	CA
Eriastrum tracyi	18.27%	G3Q	S3	CA
Ericameria gilmanii	66.67%	G2	S2	CA
Erigeron compactus	37.5%, 100%	G3	S3, N/A	CA, NV
Erigeron miser	24.14%	G3?	S3?	CA
Erigeron parishii	100.00%	G2	S2	CA
Erigeron uncialis var. uncialis	83%, 100%	G3G4T2	S2, S1	CA, NV
Eriodictyon angustifolium	33.33%	G5	S3	CA
Eriogonum beatleyae	71.43%	G3	S3	NV
Eriogonum bifurcatum	27.50%	G3	S3	CA

Eriogonum callistum	83.33%	G1	S1	CA
Eriogonum contiguum	64.29%	G3	S2	CA
Eriogonum crosbyae var. crosbyae	100.00%	G4T3	S3	NV
Eriogonum eremicola	100.00%	G1	S1	CA
Eriogonum gilmanii	16.67%	G3	S3	CA
Eriogonum hoffmannii var. hoffmannii	100.00%	G3T2	S2	CA
Eriogonum hoffmannii var. robustius	100.00%	G3T3	S3	CA
Eriogonum intrafractum	100.00%	G3	S3	CA
Eriogonum kennedyi var. alpigenum	66.67%	G4T3	S3	CA
Eriogonum kennedyi var. austromontanum	29.63%	G4T2	S2	CA
Eriogonum kennedyi var. pinicola	100.00%	G4T1	S1	CA
Eriogonum mensicola	100.00%	G3	S3	CA
Eriogonum microthecum var. johnstonii	50.00%	G5T2	S2	CA
Eriogonum microthecum var. panamintense	83.33%	G5T3	S3	CA
Eriogonum nutans var. nutans	17.65%	G5T3T4	S2?	CA
Eriogonum ovalifolium var. eximium	50.00%	G5T3	S2	NV
Eriogonum ovalifolium var. vineum	96.00%	G5T1	S1	CA
Eriogonum ovalifolium var. williamsiae	100.00%	G5T1	S1	NV
Eriogonum robustum	82.24%	G2	S2	NV
Eriogonum rubricaule	25.00%	G3	S3	NV
Eriogonum thornei	100.00%	G1	S1	CA
Eriogonum tiehmii	100.00%	G1	S1	NV
Eriogonum umbellatum var. juniporinum	88.89%	G5T4	S3	CA
Eriogonum umbellatum var. torreyanum	66.67%	G5T2	S2	CA
Eriogonum wrightii var. olanchense	100.00%	G5T2	S2	CA
Erioneuron pilosum	80.00%	G5	S2	CA
Eriophyllum mohavense	100.00%	G2	S2	CA
Erythranthe calcicola	62.50%	G3	S3	CA
Erythranthe carsonensis	1.82%	G2	S2	NV
Erythranthe exigua	28.57%	G2	S2	CA
Erythranthe purpurea	40.00%	G2	S2	CA
Erythranthe rhodopetra	100.00%	G1	S1	CA
Erythranthe shevockii	30.77%	G1	S1	CA
Erythranthe utahensis	100.00%	G4G5	S1	CA
Eschscholzia lemmonii ssp. kernensis	1.23%	G5T2	S2	CA
Eschscholzia minutiflora ssp. twisselmannii	100.00%	G5T2	S2	CA
Eucnide rupestris	12.50%	G3	S1	CA
Euderma maculatum	32%, 57%	G4	S3, S2	CA, NV
Eumops perotis californicus	8.30%	G4G5T4	S3S4	CA

Euparagia unidentata	100.00%	G1G2	S1S2	CA
Euphilotes battoides fusimaculata	100.00%	G5T1	S1	NV
Euphilotes bernardino inyomontana	50.00%	G4T3T4	S1	NV
Euphilotes enoptes aridorum	20.00%	G5T1	S1	NV
Euphilotes pallescens arenamontana	100.00%	G3?T1	S1	NV
Euphilotes pallescens calneva	33.33%	G3?T1	S1	NV
Euphorbia abramsiana	35.65%	G4	S2	CA
Euphorbia arizonica	15.00%	G5	S3	CA
Euphorbia exstipulata var. exstipulata	33.33%	G5T5?	S2	CA
Euphorbia jaegeri	100.00%	G1	S1	CA
Euphorbia misera	1.54%	G5	S2	CA
Euphorbia parryi	100.00%	G5	S1	CA
Euphydryas editha quino	0.79%	G5T1T2	S1S2	CA
Euphydryas editha tahoensis	100.00%	G5T2T3	S1	NV
Falco columbarius	9.04%	G5	S3S4	CA
Falco mexicanus	15.00%	G5	S4	CA
Falco peregrinus	2.35%	G4	S3	NV
Fimbristylis thermalis	90%, 66%	G4	S1S2, N/A	CA, NV
Fluminicola dalli	100.00%	G1	S1	NV
Fluminicola turbiniformis	70.00%	G3	S3	NV
Fluminicola virginius	100.00%	G1	S1	NV
Formica microphthalma	100.00%	G2	S1	NV
Frasera albomarginata var. albomarginata	62.50%	G5T5	S3	CA
Frasera albomarginata var. induta	100.00%	G5T2	S1	CA
Frasera pahutensis	43.33%	G3Q	S3	NV
Funastrum crispum	100.00%	G4	S1	CA
Galium angustifolium ssp. borregoense	11.11%	G5T3?	S3?	CA
Galium angustifolium ssp. jacinticum	22.22%	G5T2?	S2?	CA
Galium angustifolium ssp. onycense	50.00%	G5T3	S3	CA
Galium hilendiae ssp. carneum	100.00%	G4T3	S3	CA
Galium hilendiae ssp. kingstonense	80.00%	G4T3	S2	CA
Galium hypotrichium ssp. tomentellum	100.00%	G5T1	S1	CA
Galium proliferum	53.85%	G5	S2	CA
Galium wrightii	100.00%	G5	S3	CA
Gambelia wislizenii	37.50%	G5	S4	NV
Gelochelidon nilotica	45.45%	G5	S1	CA
Geraea viscida	1.08%	G2G3	S2	CA
Gila orcuttii	2.00%	G2	S2	CA
Gilia leptantha ssp. leptantha	7.69%	G4T2	S2	CA
Gilia ripleyi	20.00%	G3	S3	NV
Gilmania luteola	100.00%	G2G3	S2S3	CA

Glaucomys oregonensis	6.90%	G5	S3	NV
Glaucomys oregonensis californicus	71.43%	G5T1T2	S1S2	CA
Glossopetalon pungens	100.00%	G2G3	S1	CA
Glyceria grandis	50.00%	G5	S3	CA
Gonidea angulata	28.57%	G3	S1	NV
Gopherus agassizii	65%, 23%	G3	S2S3, S2S3	CA, NV
Greeneocharis circumscissa var. rosulata	66.67%	G5T2	S2	CA
Grindelia fraxinipratensis	67%, 100%	G2	S1, S1	CA, NV
Grusonia parishii	38.46%	G3G4	S2	CA
Grusonia pulchella	11%, 100%	G4	S2, S3	CA, NV
Gulo gulo	44.44%	G4	S1	CA
Gymnorhinus cyanocephalus	40.00%	G3	S3	NV
Hackelia sharsmithii	80.00%	G3	S3	CA
Haliaeetus leucocephalus	2.34%, 38%	G5	S3; S2B,S4N	CA, NV
Harpagonella palmeri	2.04%	G4	S3	CA
Helianthus deserticola	100.00%	G2G3Q	S2B S4N	NV
Helianthus niveus ssp. tephrodes	33.33%	G4T2T3	S1	CA
Helminthoglypta concolor	33.33%	G1G2	S1S2	CA
Helminthoglypta fontiphila	33.33%	G1	S1	CA
Helminthoglypta greggi	100.00%	G1	S1	CA
Helminthoglypta taylori	100.00%	G1	S1	CA
Heloderma suspectum cinctum	33.33%	G4T4	S1	CA
Hesperia miriamae longaevicola	100.00%	G2G3T1T2	S3	NV
Hesperia uncas fulvapalla	100.00%	G4G5T1	S1	NV
Hesperia uncas grandiosa	37.50%	G4G5T1	S1	NV
Hesperidanthus jaegeri	40.00%	G2	S2	CA
Heuchera hirsutissima	90.48%	G3	S3	CA
Heuchera parishii	28.30%	G3	S3	CA
Histrionicus histrionicus	100.00%	G4	S1	NV
Holmgrenanthe petrophila	100.00%	G1	S1	CA
Horkelia hispidula	15.38%	G3	S3	CA
Hulsea vestita ssp. inyoensis	100.00%	G5T2T3	S1S2	CA
Hulsea vestita ssp. pygmaea	33.33%	G5T1	S1	CA
Hyalella muerta	100.00%	G1	S1	CA
Hyalella sandra	100.00%	G1	S1	CA
Hydromantes platycephalus	44.00%	G4	S4	CA
Hydroprogne caspia	33.33%	G5	S4	CA
Hygrotus fontinalis	100.00%	G1	S1	CA
Hymenopappus filifolius var. eriopodus	100.00%	G5T3	S2S3	CA
Hymenopappus filifolius var. nanus	75.00%	G5T4	S3	CA
Icteria virens	7.21%, 33%	G5	S3, SNA	CA, NV

Iliamna bakeri	3.13%	G4	S3	CA
Imperata brevifolia	36%, 75%	G3	S3, S1S2	CA, NV
Ipnobius robustus	100.00%	G1G2	S1	CA
Ipomopsis effusa	100.00%	G3?	SH	CA
Ipomopsis tenuifolia	38.46%	G4	S2	CA
Ivesia aperta var. aperta	60.00%	G2T2	S1	NV
Ivesia aperta var. canina	100.00%	G2T1	S1	CA
Ivesia argyrocoma var. argyrocoma	37.93%	G2T2	S2	CA
Ivesia arizonica var. arizonica	100.00%	G3T3	S1	CA
Ivesia callida	20.00%	G1	S1	CA
Ivesia campestris	18.18%	G3	S3	CA
Ivesia jaegeri	100.00%	G2G3	S1	CA
Ivesia kingii var. eremica	100.00%	G4T1	S1	NV
Ivesia kingii var. kingii	100.00%	G4T3Q	S2	CA
Ivesia patellifera	50.00%	G2	S2	CA
Ivesia sericoleuca	50.00%	G2	S2	CA
Ivesia webberi	18%, 23%	G2	S1, S2	CA, NV
Ixobrychus exilis	17%, 20%	G4G5	S2, S2B	CA, NV
Jaffueliobryum raui	33.33%	G4	S2	CA
Jaffueliobryum wrightii	89.47%	G5	S2S3	CA
Johanneshowellia crateriorum	100.00%	G1	S1	NV
Johanneshowellia puberula	100.00%	G4?	S1	CA
Juga acutifilosa	60.00%	G2?	S1	NV
Juncus interior	100.00%	G4	S1	CA
Juncus luciensis	11.11%	G3	S3	CA
Juncus nodosus	57.14%	G5	S3	CA
Juniperella mirabilis	100.00%	G1	S1	CA
Kobresia myosuroides	33.33%	G5	S2	CA
Koeberlinia spinosa var. tenuispina	75.00%	G4T4?	S2	CA
Ladeania lanceolata	11.11%	G5	S2	CA
Lanius ludovicianus	38.53%	G4	S4	CA
Larus californicus	37.50%	G5	S4	CA
Lasionycteris noctivagans	5.13%, 19%	G3G4	S3S4, S3	CA, NV
Lasiurus cinereus	2.14%, 25%	G3G4	S4, S2S3	CA, NV
Lasiurus frantzii	7.69%	G4	S2	NV
Lasiurus xanthinus	22.73%	G4G5	S3	CA
Laterallus jamaicensis	66.67%	G3	SNR	NV
Laterallus jamaicensis coturniculus	6.44%	G3G4T1	S1	CA
Lathyrus hitchcockianus	100%, 100%	G2	S1, S2	CA, NV
Layia heterotricha	8.60%	G2	S2	CA
Leiothlypis luciae	38.46%	G5	S2S3	CA

Leiothlypis virginiae	14.29%	G5	S2	CA
Lemmiscus curtatus	22.22%	G5	S3	NV
Lepidium integrifolium	100.00%	G2G3T2T3	S1	NV
Lepidium nanum	16.67%	G3	S3	NV
Lepus americanus tahoensis	40%, 29%	G5T3T4Q	S2, S3	CA, NV
Lepus townsendii townsendii	100.00%	G5T5	S3?	CA
Lewisia brachycalyx	16.67%	G4	S2	CA
Lewisia longipetala	28.57%	G2	S2	CA
Lilium parryi	29.55%	G3	S3	CA
Limenitis archippus lahontani	37.50%	G5T1T2	S1S2	NV
Linanthus bernardinus	100.00%	G1	S1	CA
Linanthus concinnus	52.17%	G2	S2	CA
Linanthus jaegeri	66.67%	G2	S2	CA
Linanthus killipii	53.85%	G1	S1	CA
Linanthus maculatus ssp. emaculatus	100.00%	G2T1	S1	CA
Linanthus maculatus ssp. maculatus	100.00%	G2T2	S2	CA
Linum puberulum	25.00%	G5	S2	CA
Lithobates onca	5.56%	G1G2	S1	NV
Lithobates pipiens	100%, 8.33%	G5	S2, S2S3	CA, NV
Loeflingia squarrosa var. artemisiarum	68.75%	G5T3	S2	CA
Lomatium grayi	25.00%	G5	S1S2	CA
Lomatium shevockii	100.00%	G2	S2	CA
Lupinus albifrons var. medius	40.00%	G4T2	S2	CA
Lupinus duranii	100.00%	G2	S2	CA
Lupinus gracilentus	6.25%	G3	S3	CA
Lupinus holmgrenianus	100%, 100%	G2	S2, S2	CA, NV
Lupinus magnificus var. hesperius	100.00%	G3T1Q	S1	CA
Lupinus magnificus var. magnificus	100.00%	G3T3	S3	CA
Lupinus padre-crowleyi	100.00%	G2	S2	CA
Lupinus peirsonii	75.00%	G3	S3	CA
Lupinus pusillus var. intermontanus	10.00%	G5T5?	S2	CA
Lycium parishii	73.33%	G4	S1	CA
Macrobaenetes valgum	100.00%	G1G2	S1S2	CA
Macrotus californicus	58.14%	G3G4	S3	CA
Malperia tenuis	72.41%	G4?	S2?	CA
Margaritifera falcata	2.86%, 7.14%	G4G5	S1S2, S1	CA, NV
Marina orcuttii var. orcuttii	100.00%	G2G3T1T2	S2?	CA
Martes caurina	12.50%	G4G5	S2S3	NV
Martes caurina sierrae	14.46%	G4G5T3	S3	CA
Matelea parvifolia	33.33%	G5	S3	CA
Maurandella antirrhiniflora	100.00%	G5	S2	CA

Meesia triquetra	21.43%	G5	S1	NV
Meesia uliginosa	38.00%	G5	S3	CA
Melanerpes uropygialis	29.17%	G5	S1	CA
Melospiza melodia	1.07%, 28%	G5	S3?, N/A	CA, NV
Melozone crissalis eremophilus	100.00%	G4G5T2	S2	CA
Menodora scabra var. scabra	46.15%	G5T4T5	S3	CA
Menodora spinescens var. mohavensis	100.00%	G4T2	S2	CA
Mentzelia hirsutissima	22.86%	G4?	S3	CA
Mentzelia inyoensis	67%, 100%	G2	S1, S1	CA, NV
Mentzelia leucophylla	100.00%	G1	S1	NV
Mentzelia mollis	100.00%	G2	S1	NV
Mentzelia polita	37.50%	G2G3	S2?	CA
Mentzelia pterosperma	33%, 100%	G4	S1S2, N/A	CA, NV
Mentzelia puberula	50.00%	G5	S2	CA
Mentzelia torreyi	93.33%	G4	S2	CA
Mentzelia tridentata	97.06%	G3	S3	CA
Mertensia oblongifolia var. oblongifolia	14.29%	G5T5	S3	CA
Micrathene whitneyi	16.67%	G5	S1	CA
Microdipodops pallidus	62.86%	G3	S2	NV
Micromonolepis pusilla	50.00%	G5	S3?	CA
Microtus californicus mohavensis	100.00%	G5T1	S1	CA
Microtus californicus vallicola	100.00%	G5T3	S3	CA
Miloderes amargosensis	100.00%	G1	S1	NV
Mirabilis coccinea	20.00%	G4G5	S2	CA
Monardella beneolens	100.00%	G2	S2	CA
Monardella boydii	100.00%	G1?Q	S1?	CA
Monardella eremicola	80.00%	G3Q	S3	CA
Monardella linoides ssp. oblonga	35.42%	G5T2	S2	CA
Monardella nana ssp. leptosiphon	11.11%	G4G5T2Q	S2	CA
Monardella robisonii	100.00%	G3	S3	CA
Muhlenbergia appressa	60.87%	G4	S3	CA
Muhlenbergia arsenei	66.67%	G4	S2?	CA
Muhlenbergia pauciflora	75.00%	G5	S2	CA
Muhlenbergia utilis	62.50%	G4	S2S3	CA
Munroa squarrosa	75%, 100%	G5	S2, N/A	CA, NV
Myiarchus tyrannulus	50.00%	G5	S3	CA
Myotis californicus	22.00%	G5	S3S4	NV
Myotis ciliolabrum	16%, 27%	G5	S3, S3S4	CA, NV
Myotis evotis	4.10%, 18%	G5	S3, S3	CA, NV
Myotis lucifugus	18.75%	G3G4	S2S3	NV
Myotis thysanodes	7.05%, 16%	G4	S3, S2	CA, NV

Myotis velifer	14.29%	G4G5	S1	CA
Myotis volans	10%, 22%	G4G5	S3, S3S4	CA, NV
Myotis yumanensis	3.44%	G5	S4	CA
Myurella julacea	50.00%	G5	S2	CA
Nama demissa var. covillei	100.00%	G5T3	S3	CA
Nama dichotoma var. dichotoma	100.00%	G5T5?	S1	CA
Nardia hiroshii	100.00%	G4G5	S1	CA
Navarretia fossalis	1.67%	G2	S2	CA
Navarretia peninsularis	19.23%	G3	S2	CA
Navarretia setiloba	1.96%	G2	S2	CA
Nemacaulis denudata var. gracilis	90.91%	G3G4T3?	S2	CA
Nemacladus inyoensis	70.59%	G3	S3	CA
Neotamias amoenus celeris	66.67%	G5T1	S2	NV
Neotoma albigula venusta	50.00%	G5T3T4	S1S2	CA
Neotoma lepida intermedia	35.94%	G5T3T4	S3S4	CA
Nitrophila mohavensis	100%, 100%	G1	S1, S1	CA, NV
Notiosorex crawfordi	21.74%	G4	S3	NV
Numenius americanus	50.00%	G5	S2S3B	NV
Nycticorax nycticorax	6.90%	G5	S4	CA
Nyctinomops femorosaccus	8.57%	G5	S3	CA
Nyctinomops macrotis	8.33%	G5	S3	CA
Ochlodes yuma lutea	50.00%	G4TNR	S2	NV
Ochotona princeps	24.84%	G5	S2	NV
Ochotona princeps schisticeps	54.15%	G5T4	S2S4	CA
Oenothera longissima	100.00%	G4	S1	CA
Oliarces clara	100.00%	G1G3	S2	CA
Oncorhynchus clarkii henshawi	11%, 28%	G5T3	S1, S3	CA, NV
Oncorhynchus clarkii utah	6.67%	G5T4	S1	NV
Onychomys torridus tularensis	8.33%	G5T1T2	S1S2	CA
Opuntia basilaris var. brachyclada	50.28%	G5T3	S3	CA
Oreocarya roosiorum	83.33%	G2	S2	CA
Oreocarya schoolcraftii	87.50%	G3	S3	NV
Oreohelix hemphilli	23.53%	G2	S2	NV
Oreonana vestita	43.40%	G3	S3	CA
Orobanche ludoviciana var. arenosa	100.00%	G5T5	S2	CA
Orobanche valida ssp. valida	50.00%	G4T2	S2	CA
Oryctes nevadensis	96%, 50%	G3	S2, S2S3	CA, NV
Ovis canadensis nelsoni	80%, 4%	G4T4	S3, S4	CA, NV
Ovis canadensis nelsoni pop. 2	50.00%	G4T3Q	S2	CA
Ovis canadensis sierrae	100.00%	G4T2	S2	CA
Oxytheca watsonii	75%, 100%	G3?	S1, S3?	CA, NV

Oxytropis oreophila var. juniperina	100.00%	G5T4T5	S1	CA
Oxytropis oreophila var. oreophila	50.00%	G5T4T5	S2	CA
Packera bernardina	43.48%	G2	S2	CA
Palaeoxenus dohrni	50.00%	G3?	S3?	CA
Palafoxia arida var. gigantea	100.00%	G5T3?	S2	CA
Pandion haliaetus	2.33%, 22%	G5	S4, S4	CA, NV
Panicum hirticaule ssp. hirticaule	66.67%	G5T5	S2	CA
Parastrellus hesperus	26.23%	G5	S3S4	NV
Parnassia parviflora	100.00%	G5?	S2	CA
Paruroctonus arenicola arenicola	100.00%	GNRTNR	S1	NV
Pedicularis crenulata	100.00%	G4	S1	CA
Pediomelum castoreum	100.00%	G3	S2	CA
Pelecanus erythrorhynchos	4.88%, 31%	G4	S1S2, S2B	CA, NV
Pelecanus occidentalis californicus	3.45%	G4T3T4	S3	CA
Pellaea truncata	50.00%	G5	S3	CA
Pelocoris biimpressus	100.00%	G1G3	S1S2	CA
Penstemon albomarginatus	100%, 69%	G2	S1, S2	CA, NV
Penstemon calcareus	72.73%	G3?	S3?	CA
Penstemon californicus	80.00%	G3	S2	CA
Penstemon floribundus	85.71%	G2	S2	NV
Penstemon fruticiformis ssp. amargosae	26.32%	G4T3	S2	NV
Penstemon fruticiformis var. amargosae	100.00%	G4T3	S2	CA
Penstemon janishiae	100.00%	G4	#N/A	NV
Penstemon pahutensis	100%, 86%	G3	S1, S3	CA, NV
Penstemon palmeri var. macranthus	9.09%	G4G5T2?	S2?	NV
Penstemon pseudospectabilis ssp. pseudospectabilis	30.00%	G4G5T4	S3	CA
Penstemon pudicus	50.00%	G1G2	S1	NV
Penstemon stephensii	81.25%	G3?	S3?	CA
Penstemon sudans	2.13%	G4	S4	CA
Penstemon thompsoniae	20.00%	G4	S1	CA
Penstemon utahensis	50.00%	G4	S2	CA
Perdita frontalis	100.00%	G1G2	S1S2	CA
Perideridia parishii ssp. parishii	55.17%	G4T3T4	S2	CA
Perityle inyoensis	68.75%	G2	S2	CA
Perityle villosa	100.00%	G2	S2	CA
Perognathus alticola inexpectatus	100.00%	G2T1T2	S1S2	CA
Perognathus inornatus	1.09%	G2G3	S2S3	CA
Perognathus longimembris bangsi	90.00%	G5T2	S2	CA
Perognathus longimembris brevinasus	36.36%	G5T2	S1S2	CA
Perognathus mollipilosus xanthonotus	100.00%	G5T2	S1S2	CA
Petalonyx linearis	21.74%	G4	S3?	CA

Petalonyx thurberi ssp. gilmanii	100.00%	G5T2	S2	CA
Petrophytum caespitosum ssp. acuminatum	33.33%	G5T2	S2	CA
Phacelia anelsonii	16.67%	G3	S2	CA
Phacelia barnebyana	100.00%	G3?	S2	CA
Phacelia beatleyae	5.26%	G3	S2	NV
Phacelia coerulea	33.33%	G5	S2	CA
Phacelia filiae	58.33%	G3	S3	NV
Phacelia glaberrima	100.00%	G3?	S3?	NV
Phacelia gymnoclada	45.45%	G4	#N/A	NV
Phacelia inconspicua	25.00%	G2	S1	NV
Phacelia inundata	14.29%	G3	S2?	NV
Phacelia inyoensis	100.00%	G2	S2	CA
Phacelia monoensis	11.11%	G3	S2	CA
Phacelia mustelina	100.00%	G3	S2	CA
Phacelia nashiana	92.16%	G3	S3	CA
Phacelia novenmillensis	40.91%	G3	S3	CA
Phacelia parishii	75.00%	G2G3	S1	CA
Phacelia perityloides var. jaegeri	100.00%	G4T2	S2	CA
Phainopepla nitens	0.45%	G5	S3	NV
Phlox dolichantha	37.14%	G2	S2	CA
Pholisma sonorae	100.00%	G2	S2	CA
Pholistoma auritum var. arizonicum	36.36%	G5T4?	S3	CA
Phrynosoma blainvillii	8.71%	G3G4	S3S4	CA
Phrynosoma mcallii	59.72%	G3	S2	CA
Phrynosoma platyrhinos	38.30%	G5	S4	NV
Phyciodes pulchella shoshoni	100.00%	G5T2	S2	NV
Phyciodes pulchella vallis	100.00%	G5T4	S2	NV
Physalis lobata	41.67%	G5	S1S2	CA
Physaria chambersii	75.00%	G5	S3	CA
Physaria kingii ssp. bernardina	33.33%	G5T1	S1	CA
Physaria ludoviciana	50.00%	G5	S1	CA
Physocarpus alternans	70.00%	G4	S3	CA
Picoides arcticus	10.53%	G5	S2	CA
Pinus albicaulis	10.53%	G3G4	S3	NV
Pinus ponderosa ssp. washoensis	66.67%	G3Q	S2	NV
Piptatherum shoshoneanum	100.00%	G2G3	S1	NV
Piranga rubra	42.00%	G5	S1	CA
Plagiobothrys glomeratus	66.67%	G2G3	S2	NV
Plagiobothrys parishii	100.00%	G1	S1	CA
Plebulina emigdionis	37.50%	G1G2	S1S2	CA
Plegadis chihi	4.89%, 41%	G5	S3S4, S3B	CA, NV

Plestiodon gilberti rubricaudatus	65.91%	G5T4	S2S3	NV
Poa atropurpurea	5.88%	G2	S2	CA
Poa lettermanii	100.00%	G4	S3	CA
Pohlia tundrae	25.00%	G3	S3	CA
Polemonium chartaceum	43%, 100%	G2	S2, S1	CA, NV
Polioptila californica californica	0.32%	G4G5T3Q	S2	CA
Polioptila melanura	58.33%	G5	S3S4	CA
Polites sabuleti genoa	33.33%	G5T3T4	S1	NV
Polyctenium fremontii var. bisulcatum	100.00%	G4TH	SNA	NV
Polyctenium williamsiae	40.00%	G2Q	S1	CA
Polygala acanthoclada	8.70%	G4	S2S3	CA
Polygala intermontana	100.00%	G4	S2	CA
Polygala subspinosa	10.34%	G4?	S3	CA
Populus angustifolia	100.00%	G5	S2	CA
Potamogeton robbinsii	71.43%	G5	S3	CA
Potentilla morefieldii	40.00%	G2	S2	CA
Potentilla rimicola	60.00%	G2	S1	CA
Prosopium williamsoni	20%, 100%	G5	S3, S3	CA, NV
Prunus eremophila	75.00%	G2	S2	CA
Pseudocopaeodes eunus flavus	60.00%	G3T3	S1	NV
Pseudocopaeodes eunus obscurus	72.73%	G3T1	S1	NV
Pseudocotalpa andrewsi	100.00%	G1	S1	CA
Pseudocotalpa giulianii	100.00%	G1	S1	NV
Pseudorontium cyathiferum	22.22%	G4G5	S1	CA
Psiloscops flammeolus	12%, 33%	G4	S2S4, S3	CA, NV
Puccinellia parishii	100.00%	G3	S1	CA
Puccinellia simplex	17.14%	G3	S2	CA
Pyrgulopsis aloba	100.00%	G1	S1	NV
Pyrgulopsis aurata	100.00%	G1	S1	NV
Pyrgulopsis basiglans	100.00%	G1	S1	NV
Pyrgulopsis bifurcata	100.00%	G1	S1	NV
Pyrgulopsis bruesi	100.00%	G1	S1	NV
Pyrgulopsis bryantwalkeri	100.00%	G1	S1	NV
Pyrgulopsis crystalis	100.00%	G1	S1	NV
Pyrgulopsis dixensis	100.00%	G1	S1	NV
Pyrgulopsis eremica	36.36%	G2	S2	CA
Pyrgulopsis erythropoma	100.00%	G1	S1	NV
Pyrgulopsis fairbanksensis	100.00%	G1	S1	NV
Pyrgulopsis gibba	52.78%	G3	S3	NV
Pyrgulopsis isolatus	100.00%	G1	SX	NV
Pyrgulopsis kolobensis	2.94%	G5	S3	NV

Pyrgulopsis licina	100.00%	GNR	S1	NV
Pyrgulopsis limaria	100.00%	G1	S1	NV
Pyrgulopsis lockensis	100.00%	G1	S1	NV
Pyrgulopsis longiglans	93.33%	G2	S2	NV
Pyrgulopsis micrococcus	100.00%	G1	S1	NV
Pyrgulopsis militaris	50.00%	G1	S1	NV
Pyrgulopsis nanus	100.00%	G1	S1	NV
Pyrgulopsis owensensis	100.00%	G1G2	S1S2	CA
Pyrgulopsis papillata	100.00%	G1	S1	NV
Pyrgulopsis pellita	100.00%	G1	S1	NV
Pyrgulopsis perturbata	100.00%	G1	S1	CA
Pyrgulopsis pisteri	100.00%	G1	S1	NV
Pyrgulopsis ruinosa	100.00%	GX	S1	NV
Pyrgulopsis sadai	50.00%	G2	S1S2	NV
Pyrgulopsis sanchezi	100.00%	GNR	S2	NV
Pyrgulopsis turbatrix	14.29%	G3	S1	NV
Pyrgulopsis umbilicata	100.00%	G1Q	S1	NV
Pyrgulopsis varneri	100.00%	G1	S1	NV
Pyrgulopsis villacampae	100.00%	G1	S1	NV
Pyrgulopsis wongi	81%, 50%	G2	S2, S1	CA, NV
Pyrocephalus rubinus	32.80%	G5	S2S3	CA
Pyrrocoma uniflora var. gossypina	14.29%	G5T1	S1	CA
Rallus obsoletus yumanensis	41%, 62%	G3T3	S1S2, S1B	CA, NV
Rana draytonii	0.12%	G2G3	S2S3	CA
Rana luteiventris pop. 3	0.66%	G4T2T4Q	S2S3	NV
Rana muscosa	18.03%	G1	S1	CA
Rana sierrae	6.69%	G1	S1	CA
Ranunculus hydrocharoides	100.00%	G4	S1	CA
Rhamnus alnifolia	52.94%	G5	S3	CA
Rhinichthys osculus nevadensis	100.00%	G5T1	S1	NV
Rhinichthys osculus ssp. 12	100.00%	G5T1	S1	CA
Rhinichthys osculus ssp. 2	100.00%	G5T1T2Q	S1S2	CA
Rhinichthys osculus ssp. 5	100.00%	G5T1	S1	NV
Rhinichthys osculus ssp. 6	100.00%	G5T1	S1	NV
Riparia riparia	2.46%, 67%	G5	S2, S2B	CA, NV
Rynchops niger	1.34%	G5	S2	CA
Sabulina stricta	75.00%	G5	S3	CA
Salix brachycarpa var. brachycarpa	100.00%	G5T5	S2	CA
Salix nivalis	70.00%	G5	S2	CA
Saltugilia latimeri	93.33%	G3	S3	CA
Salvadora hexalepis virgultea	2.50%	G5T4	S2S3	CA

Salvia greatae	100.00%	G2G3	S2S3	CA
Sanvitalia abertii	44.07%	G5	S2S3	CA
Sarcobatus baileyi	50%, 50%	G4	S1, N/A	CA, NV
Satyrium sylvinus megapallidum	33.33%	G3G4T2T4	S2	NV
Sauromalus ater	75.44%	G5	S3	NV
Scaphiopus couchii	83.33%	G5	S2	CA
Sceloporus graciosus graciosus	100.00%	G5T5	S3	CA
Schoenus nigricans	57%, 67%	G4	S2, N/A	CA, NV
Sclerocactus blainei	50.00%	G1G2Q	S1	NV
Sclerocactus johnsonii	100.00%	G3	S2	CA
Sclerocactus polyancistrus	62.50%	G3	S2S3	NV
Scutellaria bolanderi ssp. austromontana	3.57%	G4T3	S3	CA
Scutellaria galericulata	3.13%	G5	S2	CA
Selaginella eremophila	18.99%	G4	S2S3	CA
Senna covesii	15.15%	G5	S3	CA
Setophaga petechia	7.86%, 16%	G5	S3S4, N/A	CA, NV
Sidalcea covillei	100.00%	G2	S2	CA
Sidalcea hickmanii ssp. parishii	10.53%	G3T1	S1	CA
Sidalcea neomexicana	16.67%	G4	S2	CA
Sidotheca emarginata	39.29%	G3	S3	CA
Sigmodon hispidus eremicus	83.33%	G5T2T3	S2	CA
Silene krantzii	33.33%	G1	S1	CA
Silene nachlingerae	8.33%	G2	S2	NV
Silene oregana	8.00%	G4	S2	CA
Siphateles bicolor euchila	100.00%	G4T1Q	S1	NV
Siphateles bicolor mohavensis	83.33%	G4T1	S1	CA
Siphateles bicolor newarkensis	100.00%	G4T1	S1	NV
Siphateles bicolor snyderi	100.00%	G4T1	S1	CA
Siphateles bicolor ssp. 4	60.00%	G4T1Q	S1	NV
Siphateles bicolor ssp. 6	100.00%	G4T1	S1	NV
Siphateles bicolor ssp. 7	100.00%	G4T1Q	S1	NV
Siphateles bicolor ssp. 9	100.00%	G4T1Q	S1	NV
Sisyrinchium funereum	100%, 100%	G2	S2, S1S2	CA, NV
Solorina spongiosa	100.00%	G4G5	S1	CA
Sorex merriami	20.00%	G4	S3	NV
Sorex navigator	10.34%	G5	S2	NV
Sorex tenellus	7.69%	G4	S2	NV
Sorex trowbridgii	100.00%	G5	S2	NV
Spea hammondii	0.32%	G2G3	S3	CA
Spermolepis gigantea	100.00%	G2G3	SH	CA
Sphaeralcea rusbyi var. eremicola	44.44%	G4T2	S2	CA

Sphaeromeria argentea	100.00%	G3G4	S1?	NV
Sphaeromeria potentilloides var. nitrophila	100.00%	G5T4?	S2	CA
Sphenopholis obtusata	25.00%	G5	S2	CA
Spinus lawrencei	7.43%	G3G4	S4	CA
Spiranthes infernalis	100.00%	G2	S1	NV
Spizella atrogularis	11.11%	G5	S2B	NV
Spizella breweri	100%, 14%	G5	S4, S3B	CA, NV
Stenelmis calida calida	100.00%	GNRT1	S1	NV
Stenopelmatus cahuilaensis	100.00%	G1G2	S1S2	CA
Stipa arida	38.10%	G5	S3?	CA
Streptanthus bernardinus	33.33%	G3G4	S3S4	CA
Streptanthus campestris	16.98%	G3	S3	CA
Streptanthus cordatus var. piutensis	25.00%	G5T1	S1	CA
Streptanthus medeirosii	33.33%	G1	S1	CA
Streptanthus oliganthus	25.00%	G3	S3	CA
Strix occidentalis occidentalis	22.22%	G3G4T2T3	S1	NV
Stygobromus myersae	100.00%	G1G2	S1S2	CA
Stygobromus sheldoni	100.00%	G1	S1	CA
Stygobromus sierrensis	100.00%	G1	S1	CA
Suaeda occidentalis	33.33%	G5	S2	CA
Symphyotrichum defoliatum	3.45%	G2	S2	CA
Symphyotrichum greatae	14.71%	G2	S2	CA
Tadarida brasiliensis	17.86%	G5	S4	NV
Tamiasciurus douglasii	4.76%	G5	S5	NV
Taraxacum californicum	18.18%	G1G2	S1S2	CA
Taxidea taxus	6.64%, 14%	G5	S3, N/A	CA, NV
Tetracoccus ilicifolius	100.00%	G2	S2	CA
Tetradymia tetrameres	80%, 20%	G4	S2, N/A	CA, NV
Teucrium cubense ssp. depressum	100.00%	G4G5T3T4	S2	CA
Thamnophis hammondii	9.09%	G4	S3S4	CA
Thelypodium integrifolium ssp. complanatum	100.00%	G5T4T5	S2	CA
Thomomys bottae abstrusus	100.00%	G5T1	S1	NV
Thysanocarpus rigidus	50.00%	G1G2	S1	CA
Tidestromia eliassoniana	100.00%	G5	S2	CA
Tonestus alpinus	100.00%	G2	S2	NV
Tonestus graniticus	100.00%	G1	S1	NV
Tortella alpicola	50.00%	G5?	S1	CA
Townsendia condensata	30.00%	G4	S3	CA
Townsendia leptotes	37.50%	G4	S2	CA
Toxostoma bendirei	61.54%	G4	S3	CA

Toxostoma crissale	20.00%	G5	S3	CA
Toxostoma lecontei	67%, 6.67%	G4	S3, S2	CA, NV
Trichinorhipis knulli	100.00%	G1	S1	CA
Trichophorum pumilum	33.33%	G5	S3	CA
Trichostema austromontanum ssp. compactum	100.00%	G3G4T1	S1	CA
Trifolium dedeckerae	78.57%	G2	S2	CA
Trifolium rollinsii	36.36%	G2G3Q	S2	NV
Triglochin palustris	62.50%	G5	S2	CA
Tripterocalyx crux-maltae	50.00%	G4?	#N/A	NV
Triteleia piutensis	33.33%	G1	S1	CA
Tryonia angulata	100.00%	G1	S1	NV
Tryonia elata	100.00%	G1	S1	NV
Tryonia ericae	100.00%	G1	S1	NV
Tryonia margae	100.00%	G1	S1	CA
Tryonia monitorae	100.00%	G1	S1	NV
Tryonia rowlandsi	100.00%	G1	S1	CA
Tryonia variegata	100.00%	G2	S2	NV
Uma inornata	100.00%	G1Q	S1	CA
Uma notata	55.56%	G3	S2	CA
Uma scoparia	88.24%	G3G4	S3S4	CA
Viola lithion	40.00%	G1G2	S1	NV
Viola pinetorum ssp. grisea	17.86%	G4G5T3	S3	CA
Viola purpurea ssp. aurea	27.27%	G5T2	S2	CA
Vireo bellii pusillus	3.76%	G5T2	S2	CA
Vulpes macrotis	100.00%	G4	S3	NV
Vulpes vulpes necator	4.55%	G5T1T2	S1	CA
Wislizenia refracta ssp. palmeri	100.00%	G5T3T5	S1	CA
Wislizenia refracta ssp. refracta	100.00%	G5T5?	S1	CA
Woodsia plummerae	50.00%	G5	S2	CA
Xanthocephalus xanthocephalus	23%, 27%	G5	S3, N/A	CA, NV
Xantusia gracilis	50.00%	G1	S1	CA
Xerospermophilus mohavensis	99.17%	G2G3	S2S3	CA
Xerospermophilus tereticaudus chlorus	100.00%	G5T2Q	S2	CA
Xylorhiza cognata	100.00%	G2	S2	CA
Xylorhiza orcuttii	10.71%	G3?	S2	CA
Xyrauchen texanus	12.50%	G1	S1S2	CA
Zapus princeps	12.31%	G5	S2	NV
Zeltnera namophila	100.00%	G2Q	S1	NV

Appendix B. List of species recorded on proposed lithium projects in California and Nevada with the percent of their records found within the proposed projects, their G rank and S rank. Four species were *recorded in both states, the first value in the cell corresponds to data from California and the second value from Nevada.*

Species	Inside project	G Rank	S Rank	State
Accipiter cooperii	1.14%	G5	S4	CA
Agelaius tricolor	0.54%	G1G2	S1S2	CA
Anaxyrus californicus	1.59%	G2G3	S2S3	CA
Anaxyrus nevadensis	100.00%	G1	S1	NV
Anaxyrus sp. 2	100.00%	GU	S2	NV
Androstephium breviflorum	0.87%	G4	S2?	CA
Antigone canadensis tabida	3.57%	G5T5	S2B, S2M	NV
Antrozous pallidus	0.82%, 4.95%	G4	S3, S3	CA, NV
Aquila chrysaetos	0.34%	G5	S3	CA
Arctostaphylos rainbowensis	4.94%	G2	S2	CA
Asclepias eastwoodiana	9.09%	G2	S2S3	NV
Aspidoscelis hyperythra	0.39%	G5	S2S3	CA
Athene cunicularia	0.63%	G4	S3	CA
Boechera shockleyi	5.88%	G3	S3	NV
Brachylagus idahoensis	2.51%	G4	S3	NV
Branchinecta lynchi	0.40%	G3	S3	CA
Branchinecta mesovallensis	1.52%	G2	S2S3	CA
Brodiaea orcuttii	1.01%	G2	S2	CA
Buteo swainsoni	0.24%	G5	S3	CA
Castela emoryi	2.63%	G3G4	S2S3	CA
Charadrius montanus	5.13%	G3	S2S3	CA
Charadrius nivosus nivosus	2.22%, 9.09%	G3T3	S2, S3B	CA, NV
Chorizanthe polygonoides var. *longispina*	2.65%	G5T3	S3	CA
Circus hudsonius	0.42%	G5	S3	CA
Cirsium mohavense	6.25%	G3	S3	NV
Corynorhinus townsendii	1.61%, 4.41%	G4	S2, S2	CA, NV
Crenichthys nevadae	16.67%	G1	S1	NV
Cyprinodon macularius	10.77%	G1	S1	CA
Deinandra mohavensis	1.59%	G2	S2	CA
Downingia pusilla	2.17%	GU	S2	CA
Elanus leucurus	0.24%	G5	S3S4	CA
Empidonax traillii extimus	3.17%	G5T2	S1	CA
Emys marmorata	0.09%	G3G4	S3	CA
Enceliopsis covillei	37.50%	G2	S2	CA
Eptesicus fuscus	1.00%	G5	S3S4	NV
Eriogonum hoffmannii var. *hoffmannii*	33.33%	G3T2	S2	CA

Eriogonum tiehmii	100.00%	G1	S1	NV
Euderma maculatum	14.29%	G4	S2	NV
Eumops perotis californicus	0.44%	G4G5T4	S3S4	CA
Euphilotes pallescens arenamontana	25.00%	G3?T1	S1	NV
Gelochelidon nilotica	31.82%	G5	S1	CA
Gopherus agassizii	0.11%	G3	S2S3	CA
Gratiola heterosepala	2.44%	G2	S2	CA
Grusonia pulchella	100.00%	G3G4	S3	NV
Haliaeetus leucocephalus	0.15%	G5	S3	CA
Hesperia uncas fulvapalla	100.00%	G4G5T1	S1	NV
Horkelia cuneata var. puberula	3.13%	G4T1	S1	CA
Hulsea californica	2.22%	G3	S3	CA
Hulsea mexicana	100.00%	G3	S1	CA
Hydroprogne caspia	33.33%	G5	S4	CA
Icteria virens	1.08%	G5	S3	CA
Juga acutifilosa	10.00%	G2?	S1	NV
Larus californicus	12.50%	G5	S4	CA
Lasionycteris noctivagans	1.41%	G3G4	S3	NV
Lasiurus cinereus	1.89%	G3G4	S2S3	NV
Laterallus jamaicensis coturniculus	0.51%	G3G4T1	S1	CA
Legenere limosa	3.23%	G2	S2	CA
Lepidium integrifolium	50.00%	G2G3T2T3	S1	NV
Lepidurus packardi	0.33%	G4	S3S4	CA
Limnanthes alba ssp. *parishii*	5.88%	G4T2	S2	CA
Linanthus bellus	2.13%	G2G3	S2	CA
Linderiella occidentalis	0.62%	G2G3	S2S3	CA
Melospiza melodia	0.07%	G5	S3?	CA
Microdipodops pallidus	8.57%	G3	S2	NV
Myotis californicus	2.00%	G5	S3S4	NV
Myotis ciliolabrum	4.81%	G5	S3S4	NV
Myotis lucifugus	3.13%	G3G4	S2S3	NV
Myotis thysanodes	1.96%	G4	S2	NV
Myotis volans	3.00%	G4G5	S3S4	NV
Ochotona princeps	1.27%	G5	S2	NV
Oryctes nevadensis	25.00%	G3	S2S3	NV
Parastrellus hesperus	4.10%	G5	S3S4	NV
Pelecanus erythrorhynchos	0.29%	G4	S1S2	CA
Pelecanus occidentalis californicus	16.67%	G4T3T4	S3	CA
Penstemon albomarginatus	4.55%	G2	S1	CA

Petalonyx thurberi ssp. *gilmanii*	25.00%	G5T2	S2	CA
Plegadis chihi	0.69%, 2.00%	G5	S3S4, S3B	CA, NV
Polioptila melanura	22.22%	G5	S3S4	CA
Pyrgulopsis gibba	2.78%	G3	S3	NV
Pyrgulopsis lockensis	100.00%	G1	S1	NV
Pyrgulopsis ruinosa	100.00%	GX	S1	NV
Pyrgulopsis wongi	25.00%	G2	S1	NV
Rallus obsoletus yumanensis	15.22%	G3T3	S1S2	CA
Rana luteiventris pop. 3	0.33%	G4T2T4Q	S2S3	NV
Rynchops niger	0.90%	G5	S2	CA
Sagittaria sanfordii	3.06%	G3	S3	CA
Salvadora hexalepis virgultea	3.57%	G5T4	S2S3	CA
Selaginella eremophila	1.61%	G4	S2S3	CA
Sigmodon hispidus eremicus	5.56%	G5T2T3	S2	CA
Siphateles bicolor ssp. 4	40.00%	G4T1Q	S1	NV
Spea hammondii	0.32%	G2G3	S3	CA
Tetracoccus dioicus	12.12%	G2G3	S2	CA
Toxostoma lecontei	1.82%	G4	S3	CA
Vireo bellii pusillus	0.24%	G5T2	S2	CA
Vulpes macrotis	100.00%	G4	S3	NV

Limestone monkeyflower (Erythranthe calcicola) in Nevada © Naomi Fraga


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