A PETITION TO LIST KINGS RIVER PYRG (*Pyrgulopsis imperialis*) UNDER THE ENDANGERED SPECIES ACT AS AN ENDANGERED OR THREATENED SPECIES AND TO CONCURRENTLY DESIGNATE CRITICAL HABITAT

Kings River pyrg (*Pyrgulopsis imperialis)*. Photo: Lynne Buckner

Petition Submitted to the U.S. Secretary of the Interior
Acting through the U.S. Fish and Wildlife Service
September 8, 2022

Petitioner:
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NOTICE OF PETITION

This is a formal petition to list Kings River pyrg (*Pyrgulopsis imperialis*) as endangered or threatened pursuant to the Endangered Species Act, 16 U.S.C. § 1531 et seq. (ESA), and to concurrently designate critical habitat.

PETITIONER

Petitioner Western Watersheds Project (WWP) is a non-profit organization with more than 12,000 members and supporters. Our mission is to protect and restore western watersheds and wildlife through education, public policy initiatives and legal advocacy. WWP has offices and staff in Nevada and other western states. The conservation of wildlife and rare plants is important to WWP members, supporters, and staff.

Pursuant to the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), WWP, hereby petitions the Secretary of the Interior, through the United States Fish and Wildlife Service ("FWS" or "Service"), to protect the Kings River pyrg (*Pyrgulopsis imperialis*) as an endangered species or threatened species and to concurrently designate critical habitat for the species.

The FWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on the Service. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted… within 90 days after receiving the petition." 16 U.S.C. § 1533(b)(3)(A).

On June 21, 2021 and June 24, 2021, WWP provided notice that this petition would be filed in no sooner than 30 days to the Nevada Department of Wildlife's (NDOW's) Director and Wildlife Diversity Division Administrator via email and certified mail (WWP, 2021, p. 3). The email and attached letter were also sent to the FWS's Pacific Southwest Regional Director and Reno Field Supervisor via email and certified mail (WWP, 2021, p. 3). NDOW staff signed for the certified mailings on June 30, 2021 (*Id.* at 4). FWS signed for the certified mailings on June 29, 2021 and July 8, 2021 (*Id*. at 5).

WWP submits this petition on its own behalf and on behalf of its members, staffers, and supporters with an interest in protecting Kings River pyrg and its habitat.

Submitted this 2nd day of September, 2022 on behalf of petitioner WWP.

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SUMMARY

Western Watersheds Project (WWP) respectfully requests that the Secretary of the Interior, acting through the U.S. Fish and Wildlife Service (FWS or Service) list the Kings River pyrg (*Pyrgulopsis imperialis*) as "threatened" or "endangered" under the U.S. Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544). WWP also requests that the Service designate critical habitat for this species. [1]

Kings River pyrg (*Pyrgulopsis imperialis*) is a rare endemic springsnail in the Hydrobiidae family that occupies 13 small, shallow, flowing springs in two locations in Humboldt County, Nevada:

1. a pass between the Montana Mountains and Double H Mountains (Thacker Pass), and
2. the adjacent southwestern slopes of the west-facing range front of the Montana Mountains.

Because of its small range, very limited mobility, and low numbers, Kings River pyrg is highly vulnerable to natural and human-caused threats. These include livestock grazing, various impacts associated with the recently approved Thacker Pass lithium mine, spring modification, hydrological drought, climate change, and the inadequacy of existing regulatory mechanisms. Kings River pyrg is a NatureServe Globally Imperiled species and a Nevada Department of Wildlife Species of Conservation Priority, but neither of those statuses offer any regulatory protection. Due to its extremely limited distribution and the threats facing this gravely imperiled species throughout its known range, the Service must immediately list the species under the Endangered Species Act.

THE ENDANGERED SPECIES ACT

The ESA, 16 U.S.C. §§ 1531 *et seq.,* was enacted in 1973 "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b). The protections of the ESA only apply to species that have been listed as endangered or threatened according to the provisions of the statute. The ESA delegates authority to determine whether a species should be listed as endangered or threatened to the Secretary of Interior, who has in turn delegated authority to the Director of the U.S. Fish & Wildlife Service. As defined in the ESA, an "endangered" species is one that is "in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6); *see also* 16 U.S.C. § 1533(a)(1). A "threatened species" is one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20). The Service must evaluate whether a species is threatened or endangered as a result of any of the five listing factors set forth in 16 U.S.C. § 1533(a)(1):

[1] WWP thanks Kelly Fuller, Lynne Buckner, Patrick Donnelly, and Kevin Emmerich for their assistance during the preparation of this petition.

A. The present or threatened destruction, modification, or curtailment of its habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. The inadequacy of existing regulatory mechanisms; or
E. Other natural or manmade factors affecting its continued existence.

A taxon need only meet one of the listing criteria outlined in the ESA to qualify for federal listing. 50 C.F.R. § 424.11.

The Service is required to make these listing determinations "solely on the basis of the best scientific and commercial data available to [it] after conducting a review of the status of the species and after taking into account" existing efforts to protect the species without reference to the possible economic or other impacts of such a determination. 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). "The obvious purpose of [this requirement] is to ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise." *Bennett v. Spear*, 520 U.S. 154, 176 (1997).

In making a listing determination, the Secretary must give consideration to species which have been "identified as in danger of extinction, or likely to become so within the foreseeable future, by any State agency or by any agency of a foreign nation that is responsible for the conservation of fish or wildlife or plants." 16 U.S.C. § 1533(b)(1)(B)(ii). *See also* 50 C.F.R. § 424.11(e) (stating that the fact that a species has been identified by any State agency as being in danger of extinction may constitute evidence that the species is endangered or threatened). Listing may be done at the initiative of the Secretary or in response to a petition. 16 U.S.C. § 1533(b)(3)(A).

After receiving a petition to list a species, the Secretary is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). Such a finding is termed a "90-day finding." A "positive" 90-day finding leads to a status review and a determination whether the species will be listed, to be completed within twelve months of receipt of the petition. 16 U.S.C. §1533(b)(3)(B). A "negative" initial finding ends the listing process, and the ESA authorizes judicial review of such a finding. 16 U.S.C. § 1533(b)(3)(C)(ii). The applicable regulations define "substantial information," for purposes of consideration of petitions, as "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1).

The regulations further specify four factors to guide the Service's consideration on whether a particular listing petition provides "substantial" information:

i. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;
ii. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;
iii. Provides information regarding the status of the species over all or significant portion

of its range; and

iv. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps. 50 C.F.R. § 424.14(b)(2)(i)-(iv).

Both the language of the regulation itself (by setting the "reasonable person" standard for substantial information) and the relevant case law underscore the point that the ESA does not require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004). *See also Moden v. U.S. Fish & Wildlife Serv.*, 281 F. Supp. 2d 1193, 1203 (D. Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms"). Rather, the ESA contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species may be warranted." *Morgenweck*, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A)) (emphasis added). *See also Ctr. for Biological Diversity v. Kempthorne*, No. C 06-04186 WHA, 2007 WL 163244, at *3 (N.D. Cal. Jan. 19, 2007) (holding that in issuing negative 90-day findings for two species of salamander, the Service "once again" erroneously applied "a more stringent standard" than that of the reasonable person).

NATURAL HISTORY AND ECOLOGY

Description and Taxonomy. The Kings River pyrg *(Pyrgulopsis imperialis)* is a tiny endemic springsnail in the Hydrobiidae family and *Pyrgulopsis* genus of freshwater gastropods. *See* Figure 1.

Figure 1: Kings River pyrg on substrate pebble (Photo: Lynne Buckner).

The species was described as a discrete species by Robert Hershler in 1998 (Hershler 1998: 86-87, *and see* figs. 8L, 21J-K, 39D-F). It has a shell height of less than two millimeters (Hershler 1998: 7); in comparison, a U.S. nickel coin is 1.95 mm thick on its edge. The Kings River pyrg differs from other species in its genus by characteristics of its penis, shell, lateral radial teeth, and oviduct (Hershler 1998), as well as by its DNA (Hershler and Liu 2017: 112).

Its common name refers to the location of its habitat, which is found in Humboldt County, Nevada. *See* Figure 1. Its habitat comprises small springs in the lower slopes of the Montana Mountains just to the east of Kings River Valley and in an adjacent mountain pass (Thacker Pass). The majority of the springs are in Thacker Pass.

Biology and Life History. Little is known specific to the Kings River pyrg's life history, but several characteristics of North American *Pyrgulopsis* springsnails are known in general. *Pyrgulopsis* springsnails are gill breathing, restricted to perennial waters throughout their life cycle, and have low tolerance for desiccation (Hershler and Liu 2008: 92, Hershler et al. 2014:694). Most *Pygulopsis* species occur in colder waters (MNASSI 2020a). They have little ability to disperse except within the particular springs in which they live although there is genetic evidence that at least one species has been distributed further by birds (Hershler and Liu 2008: 92, Hershler et al. 2014: 694, Liu et al. 2003: 2780). According to Hershler et al. (2014: 694), there are no well-corroborated reports of springsnails being successfully distributed through human activities. Therefore, it is vitally important to their continued existence that their spring habitats remain viable.

Springsnails graze on periphyton and detritus (Brown et al. 2008: 488, Hershler et al. 2014: 694), which gives them a role in spring ecosystem nutrient cycling. The extent to which native predators control springsnail populations is unknown, but some native fishes eat them (Brown et al. 2008: 489). Springsnails are known to be prey for nonnative crayfish and snails (Hershler et al. 2014: 697).

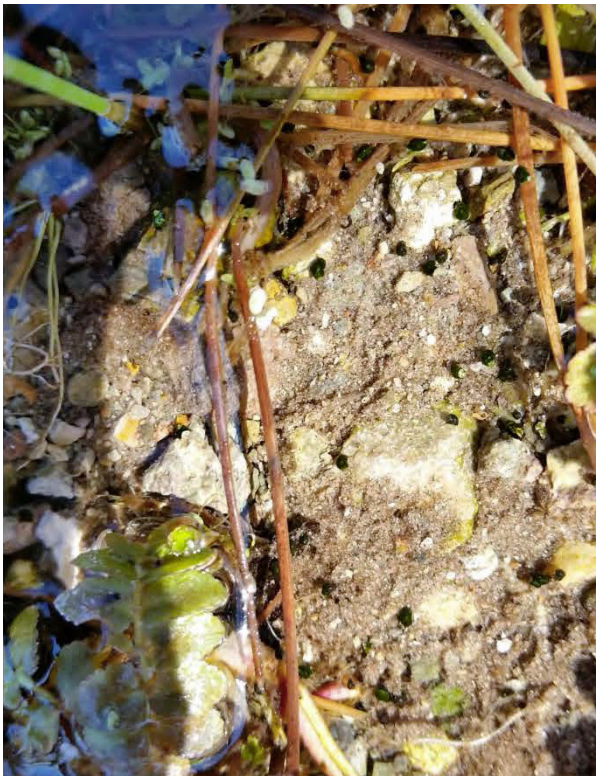
The reproductive productivity of Kings River pyrg is unknown. *Pyrgulopsis* springsnails reproduce sexually, and females are larger than males (Brown et al. 2008: 487). They lay egg capsules on hard substrates, and their young take eight days to hatch (*Ibid.*).

The lifespan of individual Kings River pyrg is unknown. Longevity for individual springsnails is likely up to one year in cool- or cold-water springs and shorter in warm water springs (MNASSI 2020a: 45). The July 2018 springsnail surveys found Kings River pyrg in waters ranging from 11.7 to 22.6 degrees Centigrade, with most springs between 17.2 and 21.9 degrees (WRC 2018: 43/81 – 65/81). Some of the temperature difference is attributable to where the spring temperature was measured, with cooler temperatures typically at the springhead and warmer temperatures typically along the run of the spring.

Habitat Requirements. *Pyrgulopsis* springsnails prefer cool, flowing water with gravel substrate, are most abundant near springheads, and unusually abundant in habitats with watercress (Sada and Pohlmann 2002: 5, Sada et al. 2001: 13). The typical habitats of Great Basin springsnails are small, shallow springs, some as little as one centimeter deep and less than

a meter wide (Hershler, 1998: 3). Kings River pyrg exhibits this pattern (WRC 2018). *See* Figure 2.

Figure 2. Spring habitat with Kings River pyrg (reproduced from WRC 2018: 1).



Kings River pyrg have been found in clear coldwater springs on substrates ranging from cobbles to fine gravel or pebbles to finer sands, as well as on vegetation and submerged branches of shrubs, usually with watercress present (WRC 2018: 10, 11-14). They occur in dense cover of vegetation as well as in open water (WRC 2018: 14). In some springs they are more abundant near the springhead than further down the spring run. (WRC 2018: 11-14), which is a common pattern for *Pyrgulopsis* springsnails (Wilcox 2021: 11).

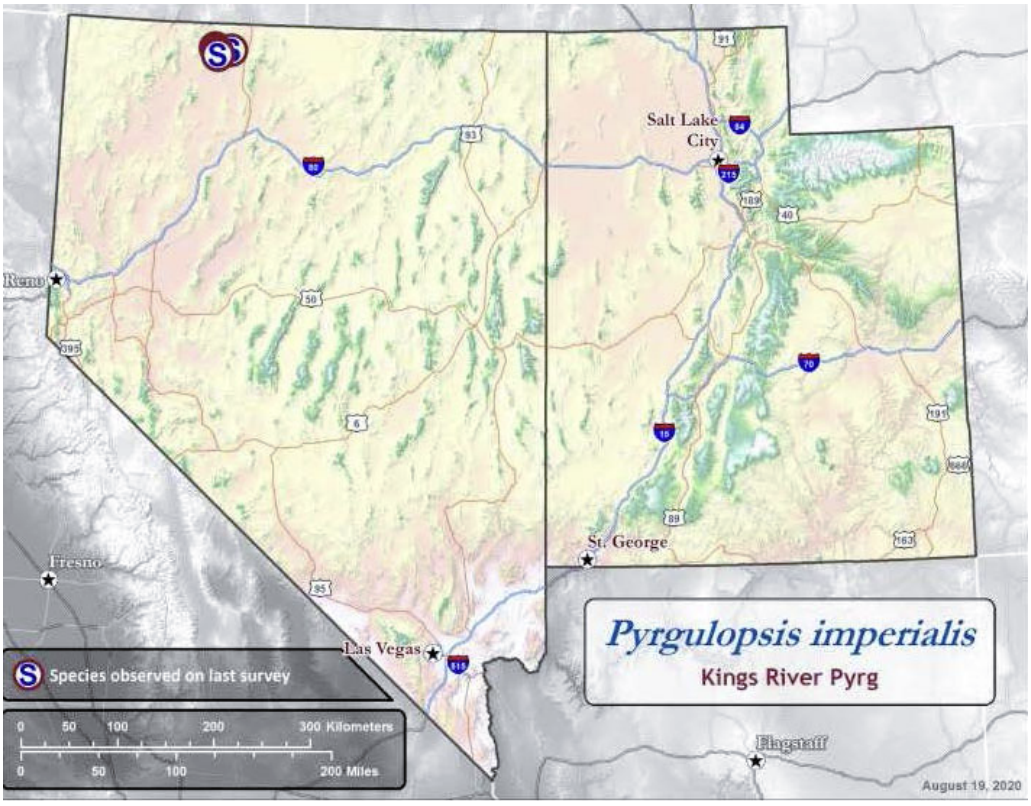
The 13 desert springs where Kings River pyrg have been found are narrow, shallow, and fragile. They range from 0.41 to 7 meters across, with the majority of the springs 1 to 2 meters across (WRC 2018: 9). Their depth in July 2018 ranged from 0.1 to 13.5 cm (WRC 2018: 9). During the 2018 surveys, the total length of occupied Kings River pyrg spring habitat was 1,992.5 meters (WRC 2018: 10). In springs where they have been found, they occupied less than 1% to almost 70% of the wet length of the spring runs (WRC 2018: 10). In addition, the 2018 survey report contains photographs of the springs where Kings River pyrg were found. Those photographs illustrate the species' habitat requirements and the small, fragile nature of the springs themselves (WRC 2018: 21/81 - 30/81).

DISTRIBUTION AND POPULATION

The Great Basin's endemic springsnail populations are a result of the many times in the last two million years when extensive waterways covered what is now dry land, only to later recede, leaving the springsnails in isolated small springs. As the springsnails adapted to their changed habitats, in many instances they evolved to become endemic to particular locations (NDOW 2013c: S-1).

The Kings River pyrg is one such endemic springsnail. Kings River pyrg have been observed during 19 surveys between 1991 and July 2018 (MNASSI 2020b: 96). Originally the species was known to occur only in two northwestern Nevada springs (Hershler 1998: 87). But a July 2018 search of 52 seeps and springs in the region increased the number of known occupied springs to 13 (WRC 2018: 2). *See* Figure 3. A search of four additional seeps and springs in 2019 did not find any Kings River pyrg (WRC 2019: 1).[2] A February 2021 request to the Nevada Division of Natural Heritage for the GIS locations of all Kings River pyrg in the Division's database returned only the locations that were found during the Wildlife Resource Consultants' 2018 survey, which included the locations where they were originally found. Springsnail surveying has been taking place across Nevada since the 1990s.

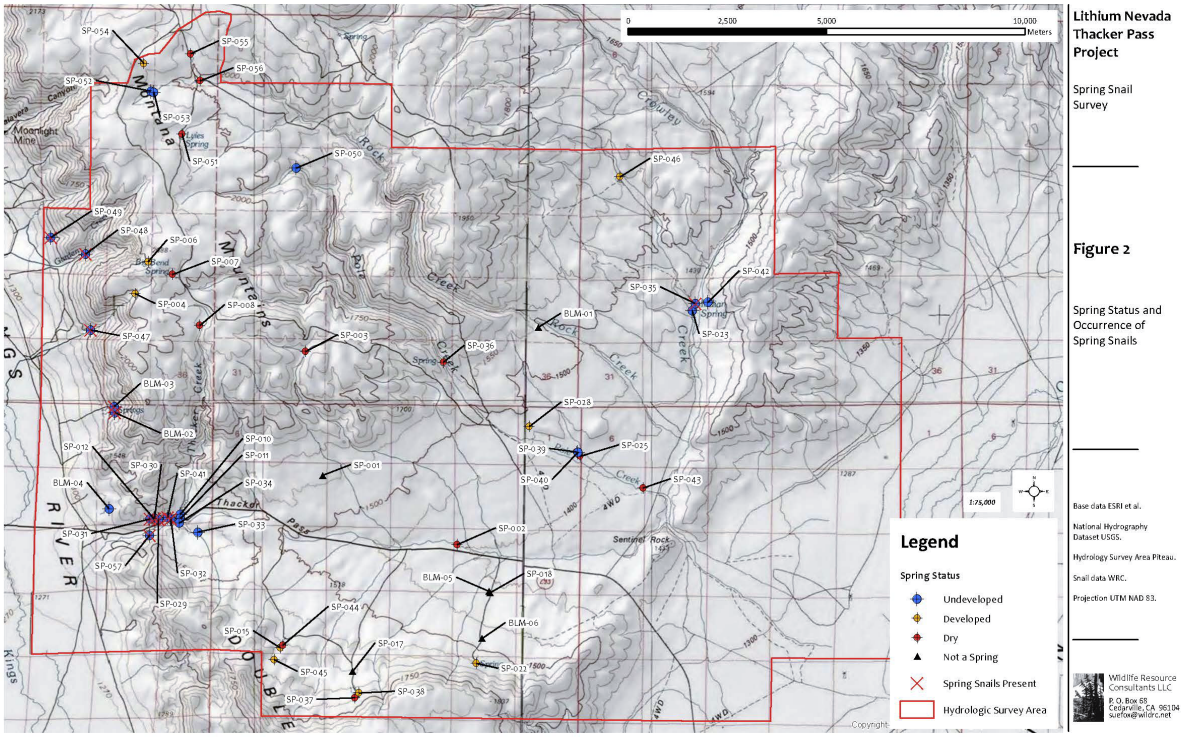
Figure 3. General location of Kings River pyrg habitat in northern Nevada. Survey observations on the map are not to scale (adapted from MNASSI 2020b: 97).



[2] *See* Figure 2 in the Wildlife Resource Consultants 2019 survey for a map of the additional four springs that were searched in 2019 (WRC 2019: 9/41).

Therefore, according to the best available science, the species is found only in 13 small desert springs located in Humboldt County, Nevada, in Thacker Pass and the Montana Mountains, near the eastern edge of the Kings River Valley. Twelve of the 13 springs are on the western edge of the area where the Kings River pyrg is found, and the isolated 13th spring is approximately 9.5 miles east of them. *See* Figure 4.

Figure 4. Location of springs occupied by Kings River pyrg in July, 2018. (WRC 2018, fig. 2.)



Five of the springs follow a rough line trending three miles northwest to southeast along lower portions of the western slopes of the Montana Mountains (SP-049, SP-048, SP-047, BLM-03, BLM-02).[3] *See* Figure 4. Continuing that line 1.7 miles to the south, seven springs are clustered together near Thacker Creek, which emerges from the Montana Mountains into Thacker Pass (SP-012, SP-029, SP-030, SP-31, SP-032, SP-041, SP-057).[4] These seven springs are all

[3] Very few of the springs where Kings River pyrg have been found have published names. For ease of reference, this petition refers to the springs by the numbers they were assigned for the Thacker Pass lithium mine's baseline studies and environmental review. Spring numbers that begin with the prefix "SP" identify springs on private land. Spring numbers that begin with the prefix "BLM" identify springs on BLM land.

[4] Of that cluster, fieldnotes from the 2018 survey state that springs SP-012 and SP-030 are likely the same spring or spring system (WRC 2018: 43/81, 47/81). The baseline hydrology reports for

within .05 to ½ mile of each other. The 13th spring is isolated from the rest and approximately 9.5 miles to the east, adjacent to Crowley Creek (SP-035). In between western springs and the eastern spring where Kings River pyrg were found, there are nine dried up and/or developed springs that were searched but in which springsnails were absent (*see* WRC 2018, fig. 2 and WRC 2018: 5-6). The presence of dried up and developed springs between the spring areas in which Kings River pyrg have been found suggests that Kings River pyrg may have already been extirpated from some local springs.

There are no current or historic population estimates for this species, nor has minimum viable population been calculated. However, *Pyrgulopsis* springsnails "often are found in densities exceeding >1000/m^2" (Hershler 1994: 1). During the July 2018 springsnail surveys, a total of only 3,573 Kings River pyrg were counted during 10-minute searches of the 13 springs where the species was found. The total includes those that were collected scientifically for DNA analysis and thus removed from the population.[5] The count for each spring ranged from 11 to 1,166 Kings River pyrg (SP-032, SP-049). Five springs had counts of fewer than 50 individuals (SP-012, SP-030, SP-032, SP-041, BLM-02). Three springs had counts of fewer than 20 individuals (SP-030, SP-032, SP-041).[6]

THREATS

Present or Threatened Destruction, Curtailment, or Modification of Habitat or Range. Habitat effects related to the proposed Thacker Pass lithium mine, livestock grazing, spring modification, roads, hydrological drought, and climate change are the primary imminent threats of destruction, curtailment, or modification of Kings River pyrg habitat. The presence of multiple threats to habitat is consistent with a 2016 review of environmental records for 2,256 Great Basin and Mojave Desert springs, which found evidence of human disturbance at approximately 83% of them. Approximately 65% were moderately or highly disturbed by diversion; horse, burro, or cattle use; recreation; or dredging; or a combination of these factors (Sada and Lutz 2016: iii, 12). These factors led to local extirpations of at least 13 *Pyrgulopsis* springsnail species in the Great Basin and Mojave Desert between the 1990s and the 2010s (Sada and Lutz 2016: 17-19). In addition, groundwater pumping caused the local extirpation of a 14th *Pyrgulopsis* species in

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the Thacker Pass mine go further and identify seven springs occupied by Kings River pyrg as being part of a Thacker Creek spring complex (SP-012, SP-029, SP-030, SP-031, SP-032, SP-041, and SP-057) (BLM 2020d, fig. 3.11). *See* Figure 8 in this petition.

[5] The exact number of Kings River pyrg that were collected and removed from the population during the July 2018 survey is not recorded in the survey report. *See* WRC (2018: 4, 7).

[6] Copies of the field data worksheets, which include 10-minute search counts, are on pages 42/81 to 81/81 of the Wildlife Resource Consultants LLC. 2018. Lithium Nevada 2018 Springsnail (*Pyrgulopsis spp*.) Survey (WRC 2018). Page 6 of the survey states that one turban pebblesnail (*Fluminicola turbiniformis*) was found, but all other springsnails were identified as Kings River pyrg. DNA analysis was used to identify the springsnails by species.

the 1990s; impoundment led to the extinction of a 15th in the 1970s (Sada and Lutz 2016: 17, 19).

Thacker Pass Lithium Mine. The approved-but-not-yet-constructed Thacker Pass open-pit lithium mine in Humboldt County, Nevada is a new threat that was not anticipated when the Kings River pyrg was designated G1, S1 by NatureServe (Critically Imperiled on both a global and subnational level) and placed on the Nevada Division of Natural Heritage's At-Risk Plant and Animal Tracking List.[7] *See* the Inadequacy of Existing Regulatory Mechanisms section for details of these designations. Thus, the mine's effects on Kings River pyrg habitat will be *in addition* to all the other threats the species already faces. *See* Figure 5 for the general location of the mine.

The Thacker Pass lithium mine was approved by the Bureau of Land Management on January 15, 2021 (BLM 2021: 3/32).[8] This surface mine will include a 2.3 square mile[9] and 370' deep open mine pit, ore leaching facility, sulfuric acid manufacturing plant,[10] waste rock and coarse gangue stockpile storage, interim stockpiles, road system, stormwater diversion structures and sediment ponds, soil stockpiles, water pipeline and water storage facilities, reclaim ponds, powerline with substations, and other infrastructure (BLM 2020a: 4-4, 1-2, 1-3). Large mining operations are a known threat to springsnails due to habitat elimination, groundwater depletion and contamination, spoil storage, surface drainage alteration, road construction and use, and fugitive dust generation (MNASSI 2020a: 49-51). But perhaps the greatest threat posed by the Thacker Pass lithium mine to the continued survival of Kings River pyrg as a species is spring flow reduction or elimination triggered by the mine's groundwater depletion.

Large mining operations such as the Thacker Pass lithium mine deplete groundwater in two major ways. First, groundwater may be pumped from nearby production wells to provide water needed for mine construction and operation. *See* Figure 6. Second, when mine pits reach the water table and then are excavated to levels lower than the water table, groundwater flows into the mine pit. This flow lowers the elevation of the water table. Pumping is then required to remove the groundwater flow from the pit (Wireman and Stover 2011: 312; Jhariya et al 2016: 274). The lowering of the water table is called drawdown.[11] In simplest terms, removal of groundwater from the water table, unless balanced by additional recharge such as precipitation, can result in reduced springflow (Bredehoeft 2011: 809, Patten et al. 2008: 3/17).

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[7] The current listings are found at NatureServe Explorer (2021a) and NDNH (2021), p. 12.

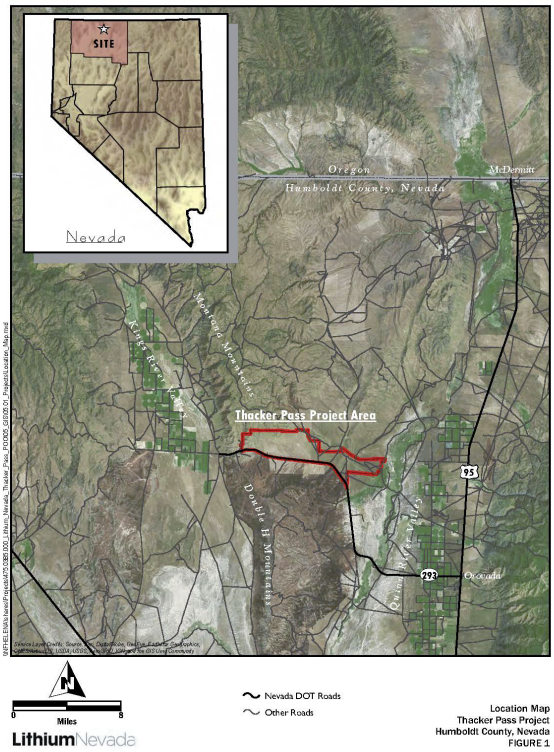
[8] When BLM approved the mine, it selected the EIS's Alternative A (the Proposed Action)(BLM 2021: 1-2).

[9] We calculated the mine's square mileage from its length and width measurements in the Thacker Pass Lithium Mine FEIS (BLM 2020a: 4-4).

[10] Sulfur will be trucked to the mine site and transformed into sulfuric acid in an on-site sulfuric acid manufacturing plant. Then the sulfuric acid will be used on site to extract lithium from the crushed ore. (BLM 2020a: 1-2, 1-3, 2-14).

[11] For a classic description of how drawdown operates, including the cone of depression, *see* Theis (1938).

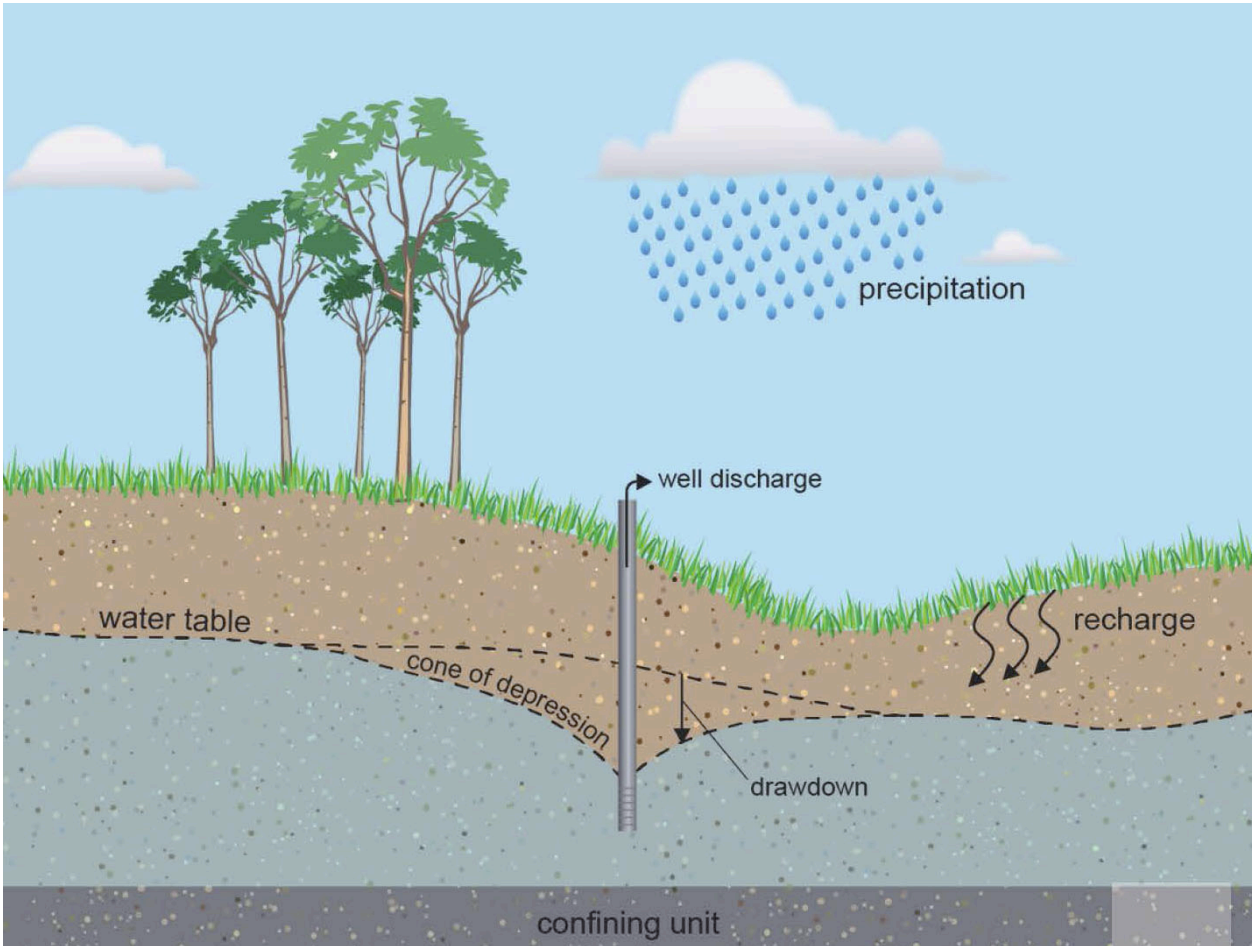
Figure 5. Location of Thacker Pass Lithium Mine Project (LNC 2021, fig. 1).



At the Thacker Pass lithium mine, cones of depression and groundwater drawdown will be created by the Quinn Production Well, its backup well and mine pit excavation into and below the water table (BLM 2020a: 4-6, 4-7, 4-12, 4-28, 4-30). The Quinn Production Well will be located approximately five miles east of the mine project, in the Quinn River Valley Hydrographic Area, which is within the Quinn River Valley Hydrographic Basin (033A) (BLM 2020a: 4-6; BLM 2020b, figs. 4.3-2, 4.3-3, 4.3-8). Only one of the 13 springs occupied by Kings River pyrg in 2018 is within the Quinn River Valley Hydrographic Basin (SP-035); the other 12 are in the Kings River Valley Hydrographic Basin (030A). *See* WRC (2018), fig. 2 for the locations of the occupied springs and compare to BLM (2020b), fig. 4.3-2 for the boundaries of the hydrographic basins. The mine's EIS does not present enough information to determine whether SP-035 will be affected by drawdown caused by the Quinn Production Well or its backup well. Thus, the most evident groundwater drawdown threat to the Kings River pyrg-occupied springs will be drawdown created by the excavation of the mine pit.

All of the 13 springs where Kings River pyrg were found in 2018 are within the hydrographic area where water resources may be affected by the Thacker Pass open-pit lithium mine (WRC 2018: 1). For the mine's EIS, the water consulting firm hired for the project calculated that the mine would draw down groundwater levels by 10 feet or more in an area that extends approximately 1.4 miles out from the mine project area (BLM 2020a: 2-21, 4-7). However, the drawdown will not end there, unless it has reached a hydrologic boundary of the underlying aquifer (*see* Theis 1938: 892). The exact boundaries of the underlying aquifer in relationship to each spring are not provided in the EIS, and to the best of our knowledge have not been

Figure 6. Illustration of cone of depression and water table drawdown resulting from a groundwater production well (adapted from USGS 2018: 1). A cone of depression and groundwater drawdown also occur when open-pit mines are excavated down into the water table or beyond.



mapped elsewhere. (Because these springs are located in a mountain pass and on the slopes of a mountain range rather than on a valley floor, their underlying aquifer has not undergone the decades of ongoing independent study that aquifers in many of Nevada's agricultural valleys have received.)

Although groundwater will be drawn down beyond the 10-foot drawdown contour, the amount and locations of that additional drawdown were not provided in the mine's EIS, despite requests from the Nevada Department of Wildlife, which was concerned about the effects of the mine's groundwater drawdown on springs used by wildlife (NDOW 2021: 2, 5/14 to 12/14). Instead, the EIS calculates a one-mile buffer zone beyond the 10-foot drawdown contour and states that springs within that one-mile buffer are at risk of reduced baseflow or drying up altogether (BLM, 2020a: 4-8, 4-9). Three springs occupied in 2018 by Kings River pyrg (SP-29, SP-032, SP-041) are within the one-mile buffer zone (BLM 2020a: 4-11, *see* Figure 7). Two of these three had the lowest Kings River pyrg counts of any occupied springs in the 2018 survey, numbers so low that

they are teetering on the edge of extirpation (11 in SP-032, 15 in SP-041) (WRC 2018: 50/81, 54/81).

Because groundwater drawdown can cause spring flow to diminish or to dry up altogether (Patten et al. 2008: 3/17), factors that cause groundwater drawdown are threats to springsnail habitat. Groundwater pumping and depletion has caused the elimination or extinction of several *Pyrgulopsis* springsnail species, and the large number of dried-up springs in the western United States indicates that other springsnail species likely have become extinct without human knowledge of their passing (Hershler et al. 2014: 695).

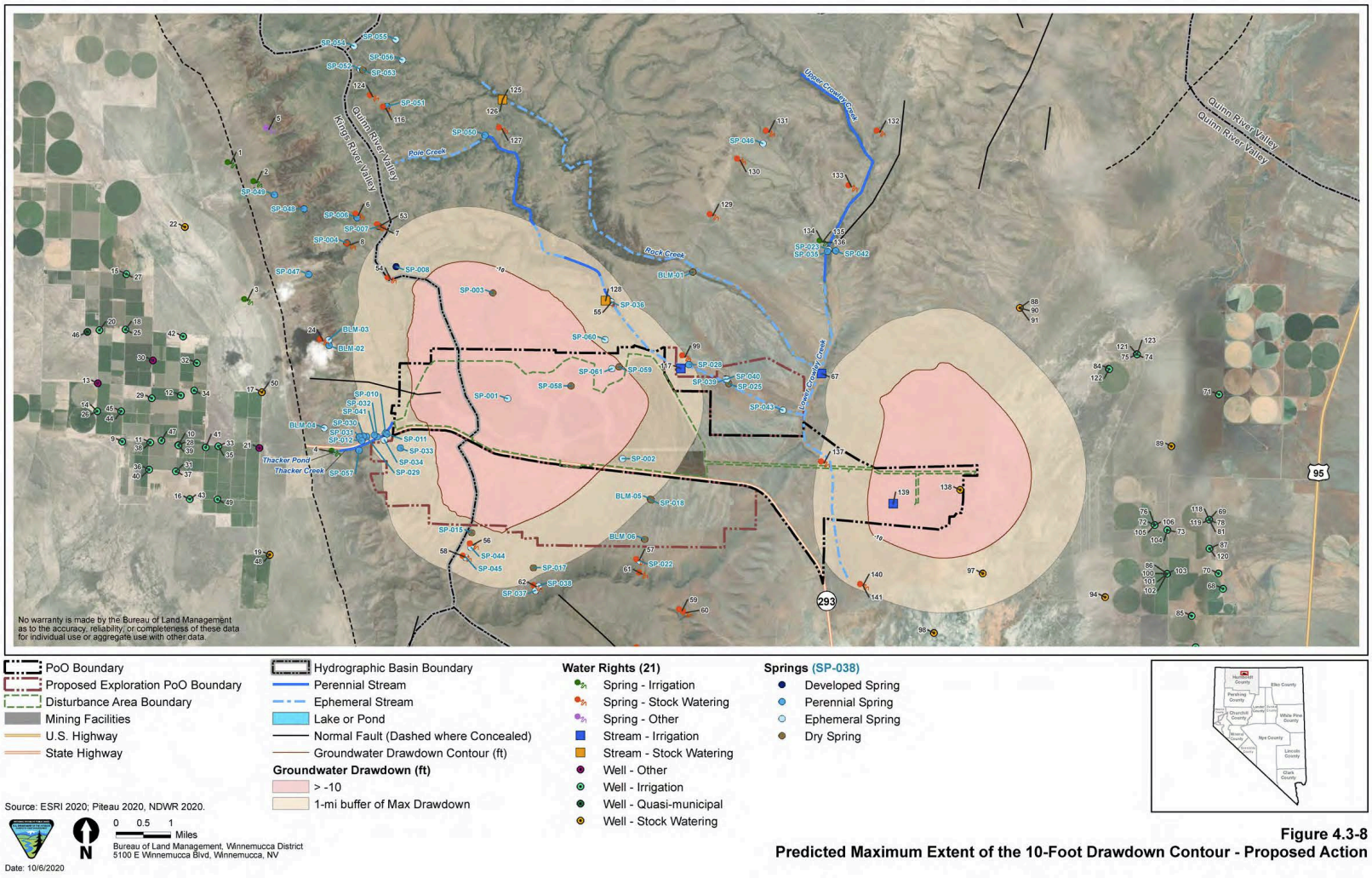
In addition, dust deposition and chemical dust suppression treatments from the mine also threaten the Kings River pyrg. A recent study found that chemical dust suppression treatments can run off into waterways and pose risk to aquatic organisms (Kunz et al. 2021). According to the Final Environmental Impact Statement ("FEIS") for the Thacker Pass mine, chemical dust suppression treatments, will be used on the Thacker Pass mine's roads and may include magnesium chloride (BLM 2020a: 4-16). The FEIS acknowledges that chemical dust suppression treatments may affect water quality along Thacker Creek and its tributaries (i.e., the springs that feed the creek) (BLM 2020a: 4-16). This threatens harm to Kings River pyrg in occupied springs in the Thacker Creek spring complex.[12] Thacker Creek is a gaining stream, and after it leaves its headwaters, it is fed by springs and groundwater upwelling (BLM 2020a: 4-9). A baseline water report included in the mine's FEIS states that Thacker Creek can be conceptualized as a large rheocrene spring (BLM 2020c: 8; *see* Figure 7).

In addition to experiencing water quality degradation related to runoff from chemical dust suppression treatments, Kings River pyrg may also be affected by changes to the springs it inhabits caused by dust deposition from the mine's construction, operation, and concurrent exploration. The mine is expected to generate 34.5 tons of fugitive dust emissions (PM_{10}) annually during two years of construction (BLM 2020a: 4-77). Concurrent exploration of new areas to the south and north of the mine was also approved by BLM when the mine was approved in January 2021 (BLM 2021: 1). Concurrent exploration is expected to produce 1.5 tons of PM_{10} and 0.2 tons of $PM_{2.5}$ fugitive dust emissions annually (BLM 2020a: 4-77.). Mine operation is expected to produce 54.5 tons of PM_{10} and 7.4 tons of $PM_{2.5}$ fugitive dust emissions annually during Phase 1 and 96.1 tons of PM_{10} and 13.2 tons of $PM_{2.5}$ fugitive dust emission annually during Phase 2 (BLM 2020a: 4-78).[13] Closure and reclamation of the mine would also create fugitive dust emissions, but these amounts were not quantified for the project EIS, so are unknown (BLM 2020a: 4-79).

[12] Springs occupied by Kings River pyrg that are part of the Thacker Creek spring complex are SP-012, SP-029, SP-030, SP-031, SP-032, SP-041, and SP-057 (BLM 2020d, fig. 3.11.) *See* Figure 8 in this petition.

[13] Phase 1 would be years one through four of the mine's initial construction and operation. Phase 2 would be years five through 41 of the mine's subsequent operation (BLM 2021: 3).

Figure 7. 10-foot drawdown contour and one-mile buffer, Thacker Pass Lithium Mine (BLM, 2020b, fig. 4.3-8)



The mine's FEIS acknowledges that fugitive dust can harm native vegetation communities and change vegetative composition (BLM 2020a: 5-7). Changes to native vegetation communities in the Kings River pyrg-occupied springs could have an adverse impact to the springsnails. Fugitive dust emissions are especially of concern regarding Kings River pyrg in the Thacker Pass spring complex, which is very close to the mine.

The mine's threats of groundwater drawdown, dust deposition, and chemical dust suppression treatments will be exacerbated if the mine expands.

Livestock grazing. In the western United States, livestock grazing is estimated to have damaged approximately 80% of stream and riparian ecosystems (Belsky et al. 1999: 2). Livestock grazing and trampling can alter aquatic environments by crushing individual springsnails, increasing fine sediments and water temperature, decreasing dissolved oxygen, changing nutrient concentrations, reducing water quantity, contaminating water with urine and feces, changing channel morphology and hydrology, damaging substrates, and removing vegetation (FWS 2012: 41092, Belsky et al. 1999: 25-33, Sada and Pohlmann 2002: 10-11). Non-native ungulate grazing is associated with native impacts on gastropod food quality (Sada and Lutz 2016: 3). Unsurprisingly, given all these negative impacts, livestock grazing in spring ecosystems can result in restricted distribution or extirpation of springsnails (FWS 2012: 41092). In addition, protecting springsnail species from livestock is not as simple as allowing cattle to remain and just fencing them out of the spring. At a disturbed spring, vegetation within fenced-off areas can overgrow and choke the spring (Minckley and Unmack 2000: 2/3). On public lands under federal administration, removing the cattle from the spring entirely would be more effective as it would allow wild herbivores continued access.

Lands used for livestock grazing, both BLM-managed and privately owned, include 100% of the Kings River pyrg's occupied springs. Unsurprisingly, cattle use was evident in or in the vicinity of *all* the springs where Kings River pyrg were found in July 2018 (WRC 2018: 11-14). Moreover, cattle were physically present during the July 2018 field counts for springs SP-012 and SP-031. (WRC 2018: 43/81, 49/81). WWP member Kelly Fuller also documented them in and around springs BLM-02 and BLM-03 in April 2022. *See* Figure 10. During the 2018 springsnail surveys, spring flow was ponded in cattle hoof prints at five of the springs (WRC 2018: 8, 10, 14), including the four springs with the lowest counts of Kings River pyrg (SP-032, SP-029, SP-30, and SP-12). These four lowest counts ranged from 11 to 22 Kings River pyrg. Those numbers include the individual Kings River pyrg that were collected from each spring for DNA analysis (WRC 2018: 8, 10, 14). At the fifth spring (SP-041), which had a count of 428 springsnails, Kings River pyrg were abundant near the springhead, but decreased in number farther down the spring run, with spring flow pooled in cattle hoof prints at the end of water (WRC 2018: 44/81). No evidence of wild horses or burros was found.[14]

[14] *See* the 2018 springsnail survey data collection sheets (WRC 2018: 42/81 - 67/81).

Figure 8. Map of Thacker Pass Springs showing location of Thacker Creek Spring Complex (BLM 2020c, fig. 3.11)

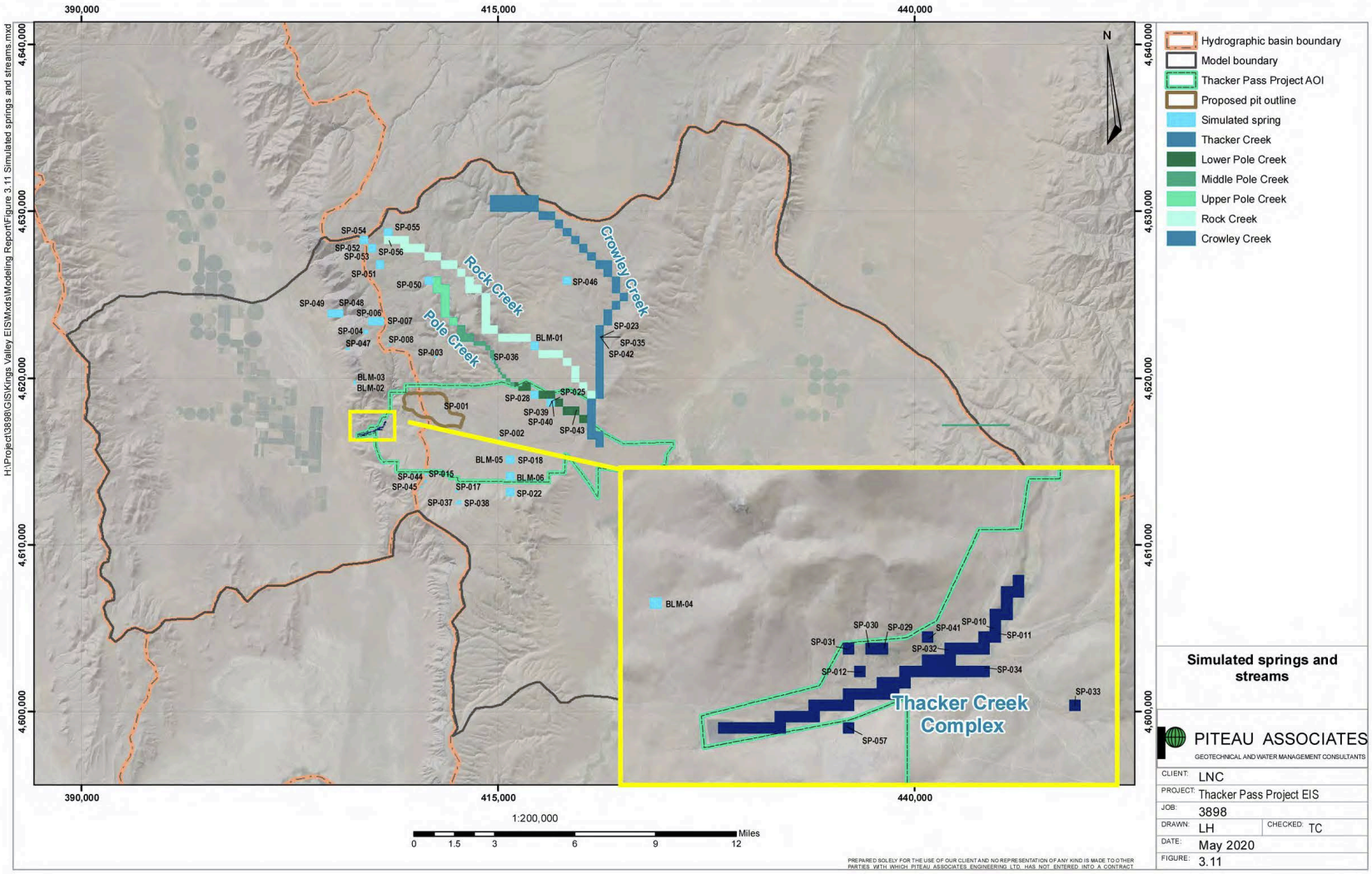


Figure 10. Cattle in and around spring BLM-03 in April 2022. Note the calf leaping out of the spring. Photo: WWP/Kelly Fuller.

Spring modification. Spring modification, that is changing the volume or patterns of flow of a spring, has "domino effects" on biotic communities in the desert (Unmack and Minckley 2008: 20). As a result, water diversion is one of the primary threats to springsnails (Sada et al. 2001: 13, Sada and Lutz 2016: iii, 12). Water diversion results in decreased species richness, functional shifts in aquatic and riparian communities, and replacement of crenobiotic species by others that are more tolerant of diversion (Sada and Polhmann 2002: 10). Capturing and diverting surface flows as well as spring "improvements" such as channelization and impoundments have greatly harmed some *Pyrgulopsis* populations (Hershler et al. 2014: 695, Sada and Lutz 2016: 17-19).

Sada and Lutz's review of environmental records for 2,256 Great Basin and Mojave Desert springs found that moderately and highly disturbed springs were most common on BLM-managed land, followed by private property (Sada and Lutz 2016: 12). Two of the 13 springs where Kings River pyrg were found in 2018 are on BLM land; the other 11 are on private land. All 13 occupied springs exhibited signs of habitat disturbance during the 2018 springsnail surveys (WRC 2018: 11-14). The flows of four occupied springs have already been modified in various ways (SP-029, SP-041, SP-048, SP-049) (WRC 2018: 11-14). All 13 springs are vulnerable to future spring modification and other habitat disturbance.

No assessment of the potential for increased artificial modification of spring heads and spring flows in the face of severe drought and climate change (see below) has taken place. Spring modifications such as mechanical excavation of spring heads to try to increase flow, casing of spring heads to pump water, piping and ditching spring flow for agricultural water troughs and irrigation, creation of stock ponds by dam construction around spring heads, downstream spring brook diversion, and other modifications have eliminated certain Nevada populations of

Pyrgulopsis (personal communication, Doug Threloff, then Biologist at Death Valley National Park, 2004).

Roads. Roads degrade spring habitat when they cross springs and when the runoff from nearby roads drains into springs. Because roads degrade spring habitat, the presence of roads in or nearby occupied Kings River pyrg habitat are a threat to the species. At the time of the 2018 Kings River pyrg survey, roads (including State Route 293) crossed or were on the spring run of four occupied springs (BLM-02, SP-029, SP-047, SP-048) (WRC, 2018, pp. 12-13). Roads were also noted as paralleling or within 4.5 to 30.5 meters upslope of five occupied springs (BLM-02, SP-12, SP-32, SP-035, SP-041) (WRC 2018: 12-14). Additional roads may be built to facilitate access for lithium mining.

Hydrological Drought and Climate Change. Hydrological drought abnormally lowers levels in rivers, streams, and groundwater (Van Loon 2015: 359). Lowered groundwater levels can result in affects to springs and wetlands. Drought that dries up springs results in species and abundance changes to aquatic and riparian communities (Sada and Pohlmann 2002: 9). Hydrological drought is complex, involving not only atmospheric processes, but also hydrological processes that feed water to the atmosphere and create water storage and surface water runoff (Van Loon 2015: 363). Hydrological drought can be triggered by anomalies in both precipitation and temperature (Van Loon 2015: 363). This type of drought takes longer to develop than meteorological drought, and restoration to normal conditions also takes longer (Van Loon 2015: 365). Because hydrological drought can be triggered by precipitation and temperature anomalies, the effects of climate change can be related and so are also discussed in this subsection.

In Nevada, drought is expected to increase by 3-15 times in frequency by the late 21st Century, and increases in evapotranspirative loss are projected to deplete water supply on a regional scale (McEvoy et al. 2020: 1). In the nearer term (2020-2050), increasing temperatures and trends toward a more arid climate in the Great Basin with more lengthy droughts are likely to continue (Snyder et al. 2019). Increasing evapotranspirative loss has an inverse relationship with spring flows as evaporation and transpiration claim groundwater before it can resurface at springs (Weissinger et al. 2016). These factors put springsnails in northwestern Nevada at increasing risk for habitat loss as climate change progresses.

The NDOW Wildlife Action Plan uses a Climate Change Vulnerability Index (CCVI) that has been calculated by the Nevada Natural Heritage program when designating species of conservation priority such as the Kings River pyrg. Changes in precipitation and temperature are part of the climate change vulnerability assessment (NDOW 2013d: 70-71). Species-specific sensitivity to climate change is calculated based on six factors:

- a species' ability to disperse and move toward more favorable climate conditions,
- predicted sensitivity to temperature and moisture changes,
- restriction to uncommon geological features or derivatives,
- reliance on interspecific interactions,
- genetic factors, and
- phenological response to changing seasonal temperature and precipitation dynamics (NDOW 2013d: 70-71).

If species-specific documented or modeled response to climate change data is available, that is also considered in the calculation of climate change vulnerability (NDOW 2013d: 70-71). The Kings River pyrg has a climate change vulnerability score of Extremely Vulnerable (the highest level of vulnerability) with a Very High confidence score (NDOW 2013a: 20/29).

Overutilization. There is no information available regarding the collection of Kings River pyrg other than the scientific collection documented in the baseline biological studies conducted for the Thacker Pass lithium mine's environmental review, such as WRC (2018).

Disease and Predation. There are no known disease threats to Kings River pyrg. In 2018, crayfish were found at three of the springs occupied by Kings River pyrg (WRC 2018: 11).[15] (*See below*, Section E, for discussion.)

Inadequacy of Existing Regulatory Mechanisms. The Kings River pyrg (*Pyrgulopsis imperialis*) has no legal protection under the U.S. Endangered Species Act or any state endangered species statutes. To the best of our knowledge, the Kings River pyrg has never been petitioned for listing under the Endangered Species Act, and it has no federal status. It is found on private and BLM lands, but is not listed as a Sensitive Species by the BLM. NatureServe ranks the species as G1, S1 meaning Critically Imperiled on both a global and subnational (State of Nevada) level (NatureServe Explorer 2021a). NatureServe defines Critically Imperiled as "At very high risk of extinction or collapse due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors" (NatureServe Explorer 2021b). The Kings River pyrg is on the Nevada Division of Natural Heritage's At-Risk Plant and Animal Tracking List, which uses this criteria for list membership: "Taxa considered at-risk and actively inventoried by NDNH typically include those with federal or other Nevada agency status, and those with global and/or state ranks 1-3, indicating some level of imperilment" (NDNH 2021: 1, 12). The Kings River pyrg is also a Species of Conservation Priority in the Nevada Department of Wildlife's Wildlife Action Plan (NDOW 2013e: F-2). However, these State of Nevada designations do not confer regulatory protection.

Similarly, the current Nevada Wildlife Action Plan has "no net loss of spring/springbrook dependent Species of Conservation Priority" as an Objective in its spring/springbrook conservation strategy (NDOW 2013b: 247). However, the Nevada Wildlife Action Plan lists existing species teams, recovery plans, and conservation agreements that protect spring/springbrook dependent Species of Conservation Priority, but they do not cover Kings River pyrg or the area of Nevada in which Kings River pyrg are found (NDOW 2013b: 248).

Because the Kings River pyrg lacks any kind of federal or state endangered species status, is not covered by other federal or state wildlife laws, and is not listed as a BLM Sensitive Species, it is without regulatory protection. All but two of the 13 springs occupied by Kings River pyrg are found on private land, which means that many actions that affect them, such as livestock grazing and spring development or diversion, can be undertaken without regulatory review or oversight.

[15] The implications of crayfish being found at three Kings River pyrg-occupied springs is discussed in detail in section III.E. of this petition ("Other Natural or Manmade Factors that Affect the Continued Existence of the Species").

Moreover, during an April 2022 visit to the two springs on BLM land (BLM-02, BLM-03), WWP member Kelly Fuller observed cattle in and adjacent to the springs. *See* Figure 10. Thus, whatever regulatory oversight BLM could be exercising to protect Kings River pyrg in springs BLM-02 and BLM-03, such as withdrawing that allotment from livestock grazing, it currently is not.

In addition, when BLM approved the Thacker Pass lithium mine in January 2021, it did not acknowledge the mine's potential to push the critically imperiled Kings River pyrg closer to extinction due to groundwater drawdown impacting springs where the species is found. BLM also failed to analyze the cumulative impacts of the mine and all of the existing threats to the Kings River pyrg's continued existence as a species. Nor did BLM require the mine to monitor at of all of the springs where the species is found where groundwater drawdown due to the mine may occur. Although the mine's monitoring plan was updated the summer after BLM approved the mine, six Kings River pyrg-occupied springs (BLM-02, BLM-03, SP-035, SP-047, SP-48, and SP-049) still will not be monitored (LNC 2021: 11). This is despite the fact that the Nevada Department of Wildlife, in its comments on the mine's FEIS, asked specifically to have monitoring at five of these six springs (BLM-02, BLM-03, SP-047, SP-048, and SP-049) (NDOW 2021: 2). As a result, there will be no warning if any of these six springs starts to dry up, which increases the level of risk the mine poses to this gill-breathing species. In addition, no mitigation that might help crenobiontic wildlife of any of the Kings River pyrg-occupied springs is currently proposed (LNC 2021: 16-19).

Other Natural or Manmade Factors that Affect the Continued Existence of the Species.

Nonnative Aquatic Species. FWS acknowledged nonnative species as a threat to springsnails in its designation of critical habitat for the endangered Chupadera springsnail (*Pyrgulopsis chupaderae*). One of the "primary constituent elements of the physical and biological features essential to the conservation of the Chupadera springnail" is habitat where "nonnative species are either absent or only present at low population levels" (FWS 2012: 41106). In the 1990s, non-native aquatic species were the sole cause or one of multiple causes of the extirpation of four *Pyrgulopsis* springsnail species from four springs in Nevada (Sada and Lutz 2016: 17-18). More specifically, introduced predaceous crayfish have negatively affected *Pyrgulopsis* springsnails in the western United States (Hershler et al. 2014: 697). Introduced crayfish not only affect springsnails by consuming them, but can also alter springsnail habitat by modifying water quality, sediment characteristics, native fauna, and vegetation composition (MNASSI 2020a: 56).

A 2018 springsnail survey found crayfish present at three of the Kings River pyrg-occupied springs (SP-012, SP-032, SP-041) (WRC 2018: 11). The evidence of habitat disturbance section of the survey's protocol instructs surveyors to document crayfish presence, but does not instruct surveyors to identify crayfish to species, so the species of the crayfish in the three occupied springs is unknown (WRC 2018: 4). However, the three springs where crayfish were found had the lowest Kings River pyrg counts of all 13 springs that were occupied in 2018, ranging from 11 to 22 individual Kings River pyrg (WRC 2018: 42/81, 50/81, 54/81).

Small Population Size and Limited Distribution

The Kings River pyrg is limited to 13 individual springs, one of them distant from the other 12. They occupy only small portions of two watersheds in northwest Nevada. This limited distribution puts them at elevated risk for extinction, particularly in light of large-scale strip-mining planned with large-scale hydrologic effects planned for the area. Comprehensive population estimates are unavailable, but for 5 springs where counts occurred, fewer than 50 individual pyrg were counted, with fewer than 20 individuals counted at three of these springs.

Lack of Mobility

There is a lack of surface connectivity between the 13 springs presently occupied by Kings River pyrg. The inability of this gill-breathing aquatic species to travel overland, and the arid nature of its environment elevates extinction risk, because snails will have difficulty recolonizing springs should they become extirpated.

Combined Effects of the Cumulative Threats to the Species

Livestock grazing and mining activities (including strip-mining, road construction, and generation of dust and water pollution, with aq total surface disturbance of 7,193 acres, BLM 2020a: 5-7) exert a combined detrimental effect on the habitat quality of the Kings River pyrg. Dewatering of aquifers due to mining and climate-change-related aridification are likely to have an increasing effect on groundwater recharge and springflow in the 13 springs currently occupied, with the likely result that some or all of the springs will dry up completely, destroying their populations of Kings River pyrg. Layered atop these impacts are the effects of predation from non-native crayfish. Together, these constraints will have synergistic negative effects on Kings River pyrg survival and population viability, placings this species at extreme risk of extinction.

CONCLUSION

The Kings River pyrg is a tiny springsnail that occupies 13 small and fragile desert springs in the Thacker Pass and southwest Montana Mountains of Humboldt County, Nevada. The Kings River pyrg is threatened by the environmental impacts of the Thacker Pass lithium mine, as well as livestock grazing, spring modification, roads, hydrological drought and climate change, and possible predation by non-native species. It does not have state or federal legal protection and is highly vulnerable to existing and future threats. When it was last surveyed in 2018, three of the 13 springs in which it was found had counts of fewer than 20 individual springsnails and five had counts of fewer than 50. Given the combined threats facing the species, its limited range, lack of mobility, and low count densities, the Kings River pyrg urgently needs the protection of the Endangered Species Act.

REQUEST FOR CRITICAL HABITAT DESIGNATION

We ask that FWS designate critical habitat for Kings River pyrg at the same time that the species is designated. Because Kings River pyrg faces threats everywhere it has been found, we request that all 13 springs that were occupied in 2018 be included in the critical habitat designation.

LIST OF FIGURES

REFERENCES[16]

Belsky, A.J., A. Matzke, and S. Uselman. 1999. Survey of Livestock Influences on Stream and Riparian Ecosystems in the Western United States. Originally published in Journal of Soil and Water Conservation, 1999, Vol. 54, pp. 419-431. Available at http://lshs.tamu.edu/docs/lshs/end-notes/survey%20of%20livestock%20influences%20on%20stream%20and%20ri-1577607170/survey%20of%20livestock%20influences%20on%20stream%20and%20riparian%20ecosystems%20in%20the%20western%20united%20states.pdf. Attachment 1.

Bredehoeft, J.D. 2011. Monitoring Regional Groundwater Extraction: The Problem. *In* Ground Water, (ed.) National Groundwater Association. Vol. 49, No. 6, pp. 808-814. Attachment 2.

Brown, K.M., B. Lang, and K.E. Perez. 2008. The conservation ecology of North American pleurocerid and hydrobiid gastropods. Journal of the North American Benthological Society. 2008, 27(2):484–495. DOI: 10.1899/07-062.1. Attachment 3.

Bureau of Land Management (BLM). 2020a. Thacker Pass Lithium Mine Project Final Environmental Impact Statement. Available at https://eplanning.blm.gov/public_projects/1503166/200352542/20030633/250036832/Thacker%20Pass_FEIS_Chapters1-6_508.pdf. Attachment 4.

Bureau of Land Management (BLM). 2020b. Thacker Pass Lithium Mine Project Final Environmental Impact Statement: Appendix A. Attachment 5.

Bureau of Land Management (BLM). 2020c. Thacker Pass Lithium Mine Project Final Environmental Impact Statement: Appendix P, Part 1. Attachment 6.

Bureau of Land Management (BLM). 2020d. Thacker Pass Lithium Mine Project Final Environmental Impact Statement: Appendix P, Part 2. Attachment 7.

Bureau of Land Management (BLM). 2020e. Thacker Pass Lithium Mine Project Final Environmental Impact Statement: Folder containing the full set of FEIS documents and FEIS attachments. Attachment 8.

Bureau of Land Management (BLM). 2021. Thacker Pass Lithium Mine Project Record of Decision and Plan of Operations Approval. Available at https://eplanning.blm.gov/public_projects/1503166/200352542/20033308/250039507/Th

[16] In addition to listing specific Thacker Pass lithium mine FEIS documents cited in the text as separate bibliographical entries in this References list and providing them with this petition as separate Attachment files (BLM, 2020, a-d), we have also provided an Attachments folder that contains all of BLM's Thacker Pass FEIS documents and appendices (BLM, 2020e). This is because many of the Thacker Pass FEIS documents reference other parts of the FEIS, and we want the Service to be able to look up those references easily if needed.

acker_Pass_Project_ROD_signed_2021-01-15.pdf. Attachment 9.

Fish and Wildlife Service (FWS). July 12, 2012. Determination of Endangered Status for the Chupadera Springsnail and Designation of Critical Habitat. Available at https://www.govinfo.gov/content/pkg/FR-2012-07-12/pdf/2012-16988.pdf. Attachment 10.

Hershler, R.H. 1994. A review of the North American freshwater snail genus *Pyrgulopsis* (Hydrobiidae). Smithsonian Contributions to Zoology 554: 115 p. Attachment 11.

Hershler, R.H. 1998. A systematic review of the hydrobiid snails (Gastropoda: Rissooidea) of the Great Basin, western United States. Part I. Genus *Pyrgulopsis*. Veliger, 41: 1-132. Attachment 12.

Hershler, R.H., and Liu, H.-P. 2008. Ancient vicariance and recent dispersal of springsnails (Hydrobiidae: *Pyrgulopsis*) in the Death Valley system, California-Nevada, in Reheis, M.C., Hershler, R., and Miller, D.M., eds., Late Cenozoic Drainage History of the Southwestern Great Basin and Lower Colorado River Region: Geologic and Biotic Perspectives: Geological Society of America Special Paper 439, p. 91- 101, doi: 10.1130/2008.2439(04). Available at https://repository.si.edu/bitstream/handle/10088/7295/IZ_HershlerLiu2008a.pdf?isAllowed=y&sequence=1. Attachment 13.

Hershler, R. H. and Liu, H.P. 2017. Annotated checklist of freshwater truncatelloidean gastropods of the western United States, with an illustrated key to the genera. Technical Note 449. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. Attachment 14.

Hershler, R.H., H.-P. Liu, and J. Howard. 2014. Springsnails: A New Conservation Focus in Western North America. BioScience 64: 693–700. Available at https://academic.oup.com/bioscience/article/64/8/693/2754294. Attachment 15.

Jhariya, D.C., R. Khan, and G.S. Thakur. 2016. Impact of Mining Activity on Water Resource: An Overview study. Conference Paper. Attachment 16.

Kunz, B.K., E.E. Little, and V.L. Barandino. 2021. Aquatic Toxicity of Chemical Road Dust Suppressants to Freshwater Organisms. Archives of Environmental Contamination and Toxicology. https://doi.org/10.1007/s00244-020-00806-y. Attachment 17.

Lithium Americas (LA). October 7, 2021. News Release: Lithium Americas Expands Resource at Thacker Pass and Increases Phase 1 Capacity to Target 40,000 tpa Lithium Carbonate. Attachment 18.

Lithium Nevada Corporation (LNC). 2021. Thacker Pass Project Monitoring Plan. Attachment 19.

Liu, H.-P., R. Hershler, and K. Clift. 2003. Mitochondrial DNA sequences reveal extensive cryptic diversity within a western American springsnail. Molecular Ecology 12: 2771–

2782. Available at https://repository.si.edu/bitstream/handle/10088/7357/IZ_Liu_et_al_2003.pdf?isAllowed=y&sequence=1. Attachment 20.

McEvoy, D. J., D. W. Pierce, J. F. Kalansky, D. R. Cayan, and J. T. Abatzoglou. 2020. Projected changes in reference evapotranspiration in California and Nevada: Implications for drought and wildland fire danger. Earth's Future 8: e2020EF001736. https://doi.org/10.1029/2020EF001736. Attachment 21.

Minckley W. L., and P.J. Unmack. 2000. Western springs: their faunas, and threats to their existence. Pp: 52-53. In: Freshwater Ecoregions of North America. Eds. Abell, R. A., Olson, D. M., Dinerstein, E., Hurley, P. T. et al. Island Press, Washington DC. Attachment 22.

Museum of Northern Arizona Springs Stewardship Institute (MNASSI). 2020a. Conservation Strategy for Springsnails in Nevada and Utah. Available at http://docs.springstewardship.org/Springsnails/SpringsnailFinal_26_Aug_2020_Final.pdf . Attachment 23.

Museum of Northern Arizona Springs Stewardship Institute (MNASSI). 2020b. Conservation Strategy for Springsnails in Nevada and Utah: Appendix A: Nevada and Utah Springsnail Species Descriptions. Available at http://docs.springstewardship.org/Springsnails/Springsnail_Summary_Reports_Aug_19_2020.pdf. Attachment 24.

NatureServe Explorer. 2021a. *Pyrgulopsis imperialis*. Available at https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.117353/*Pyrgulopsis*_imperialis. Accessed July 29, 2021. Attachment 25.

NatureServe Explorer. 2021b. Statuses. Available at https://explorer.natureserve.org/AboutTheData/Statuses Accessed July 29, 2021. Attachment 26.

Nevada Department of Wildlife (NDOW). 2013a. Wildlife Action Plan Appendix D: Identification of Species of Conservation Concern: Detailed Methods and Approach and Climate Change Vulnerability Index. Available at http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Conservation/2013-NV-WAP-Appendix-D-id-cons-species-methods-CCVI-tables.pdf). Attachment 27.

Nevada Department of Wildlife (NDOW) 2013b. Wildlife Action Plan: Warm Desert Riparian. Available at http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Conservation/2013-NV-WAP-Warm-Desert-Riparian-Springs-Bosques-Washes.pdf. Attachment 28.

Nevada Department of Wildlife (NDOW). 2013c. Wildlife Action Plan: Gastropods. Available at http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Conservation/2013-NV-WAP-Gastropods.pdf. Attachment 29.

Nevada Department of Wildlife (NDOW). 2013d. Wildlife Action Plan: Identification of Species of Conservation Priority: Climate Change Vulnerability Assessment of Conservation Priority Species. Available at http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Conservation/2013-NV-WAP-ID-SOCP-Wildlife-Landscape.pdf. Attachment 30.

Nevada Department of Wildlife (NDOW). 2013e. Wildlife Action Plan: 2012 Species of Conservation Priority Lists. Available at http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Conservation/2013-NV-WAP-Appendix-F-final-species-list-aquatic-terrestrial.pdf. Accessed July 29, 2021. Attachment 31.

Nevada Department of Wildlife (NDOW). 2021. January 4, 2021 Comments on the Thacker Pass Lithium Mine Final Environmental Impact Statement. Attachment 32.

Nevada Division of Natural Heritage (NDNH). July 2021. At Risk Plant and Animal Tracking List. Available at http://dcnr.nv.gov/uploads/heritage/2021-07_Track_List.pdf. Accessed September 14, 2021. Attachment 33.

Patten, D.T., L. Rouse, and J.C. Stromberg. 2008. Isolated Spring Wetlands in the Great Basin and Mojave Deserts, USA: Potential Response of Vegetation to Groundwater Withdrawal. Environmental Management 2008 Mar;41(3):398-413. DOI 10.1007/s00267-007-9035-9. Available at https://www.researchgate.net/publication/5788672_Isolated_Spring_Wetlands_in_the_Great_Basin_and_Mojave_Deserts_USA_Potential_Response_of_Vegetation_to_Groundwater_Withdrawal. Attachment 34.

Sada, D.W. and A.D. Lutz. 2016. Environmental Characteristics of Great Basin and Mojave Desert Spring Systems. Desert Research Institute. Attachment 35.

Sada, D.W. and Pohlmann, 2002. Spring Inventory and Monitoring Protocols. Conference Proceedings. Spring-fed Wetlands: Important Scientific and Cultural Resources of the Intermountain Region, 2002. Attachment 36.

Sada, D.W., J.E. Williams, J.C. Silvey, A. Halford, J. Ramakka, P. Summers, and L. Lewis. 2001. Riparian area management: A guide to managing, restoring, and conserving springs in the Western United States. Technical Reference 17 37-17. Bureau of Land Management, Denver, Colorado. BLM/ST / ST-01 / 001+1737. 70 pp. Attachment 37.

Snyder, K.A., L. Evers, J.C. Chambers, J. Dunham, J.B. Bradford, and M.E. Loik. 2019. Effects of changing climate on the hyodrological cycle in cold desert ecosystems of the Great Basin and Columbia Plateau. Rangeland Ecol. manage. 72: 1-12. Attachment 38.

Theis, C.V. 1938. The Significance and Nature of the Cone of Depression in Ground-Water Bodies. Society of Economic Geologists, Inc. Economic Geology, v. 33, pp. 889-902. Attachment 39.

Unmack, P.J. and Minckley, W.L. 2008. The demise of desert springs. In 'Aridland Springs in

North America; Ecology and Conservation.' (Eds LE Stevens and VJ Meretsky.) pp. 11–34. Attachment 40.

U.S. Geological Survey Water Science School (USGS). 2018. Cone of depression: Pumping a well can cause water level lowering, pp. 1/3 to 3/3. Attachment 41.

Van Loon, A.F. 2015. Hydrological drought explained. WIREs Water 2015, 2:359–392. doi: 10.1002/wat2.1085. Available at https://wires.onlinelibrary.wiley.com/doi/pdf/10.1002/wat2.1085. Attachment 42.

Weissinger, R., T.E. Phillips, and D. Thoma. 2016. Linking climate to changing discharge at springs in Arches National Park, Utah, USA. EcoSphere 7(10): e01491. Attachment 43.

Western Watersheds Project (WWP). 2021. 30 Days' Notice of Petition Filing, Mailing Receipts, and Proof of Delivery. Email with attached letter from Kelly Fuller (WWP) to Tony Wasley (NDOW) and Jennifer Newmark (NDOW), U.S. Postal Service Certified Mail Receipts, and Proof of Delivery Postcards. Attachment 44.

Wilcox, C.J. 2021. Distributions and Habitat Associations of Blue Point *Pyrgulopsis* and Blue Point *Tryonia*. MS Thesis, UNLV. 4221. https://digitalscholarship.unlv.edu/thesesdissertations/4221. Attachment 45.

Wildlife Resource Consultants LLC (WRC). 2018. Lithium Nevada 2018 Springsnail (*Pyrgulopsis* spp.) Survey. Attachment 46.

Wildlife Resource Consultants, LLC (WRC). 2019. Lithium Nevada 2019 Supplemental Springsnail (*Pyrgulopsis spp*.) Survey. Attachment 47.

Wireman, M. and Stover, B. 2011. Hard-Rock Mining and Water Resources. *In* Ground Water, (ed.) National Groundwater Association. Vol. 49, No. 3, pp. 310-316. Attachment 48.