BEFORE THE SECRETARY OF THE INTERIOR

EMERGENCY PETITION TO LIST THE MOHAVE SHOULDERBAND (*HELMINTHOGLYPTA (COYOTE) GREGGI*) AS THREATENED OR ENDANGERED UNDER THE ENDANGERED SPECIES ACT

Mohave Shoulderband © Lance Gilbertson

January 31, 2014

CENTER FOR BIOLOGICAL DIVERSITY

Notice of Petition

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PETITIONER

The Center for Biological Diversity ("Center") is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center is supported by more than 675,000 members and activists including members in California. The Center and its members are concerned with the conservation of endangered species and the effective implementation of the Endangered Species Act.

CENTER for BIOLOGICAL DIVERSITY — Because life is good.

Submitted this 31st day of January, 2014

Pursuant to Section 4(b) of the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity, Dave Goodward, and Tierra Curry hereby petition the Secretary of the Interior, through the United States Fish and Wildlife Service ("FWS," "Service"), to protect the Mohave Shoulderband (*Helminthoglypta (Coyote) greggi)* as a threatened or endangered species.

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." 16 U.S.C. § 1533(b)(3)(A). FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id*.

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EXECUTIVE SUMMARY

The Mohave Shoulderband is a desert snail that is found on three hills in southern Kern County, California and nowhere else on Earth. All of the hills have undergone past mining for gold and silver. Approximately eighty-six percent of the snail's remaining habitat is on Soledad Mountain which has been permitted for a new open-pit gold mine that has begun construction. Without Endangered Species Act protection, there are no regulatory mechanisms in place to prevent the extinction of the Mohave Shoulderband.

The Mohave Shoulderband warrants immediate listing as a threatened or endangered species. The Endangered Species Act states that a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)). The snail is threatened by at least two of these factors-- the modification or curtailment of habitat or range, and the inadequacy of existing regulatory mechanisms to ensure its survival.

Petitioners request emergency listing of the Mohave Shoulderband because the Golden Queen Mine on Soledad Mountain has begun construction and no mitigation measures are in place to safeguard the snail.

INTRODUCTION

The Mohave Shoulderband (*Helminthoglypta (Coyote) greggi*) is a small terrestrial snail with a light brown spiraling shell that is pale pinkish underneath and approximately one-half inch tall (Willett 1931). It is found only in the western Mohave Desert on three isolated mountain peaks in southern Kern County, California, southeast of Bakersfield. Its total range is less than eight square miles. The snail is threatened with extinction due to an approved gold mine currently under construction on Soledad Mountain that will destroy at least half of its occupied habitat. The Mohave Shoulderband is also threatened by arsenic and other toxic tailings present in the area from historical mining, and by climate change. Without Endangered Species Act protection, extinction looms for this unique snail that is part of California's irreplaceable natural heritage. In this section, we provide context for our petition seeking federal protection for the Mohave Shoulderband. We then review the natural history of the species and the threats to its persistence. Finally, we request that the Service designate critical habitat to ensure the snail's long-term survival.

Though generally underappreciated, snails play many important roles in the environment. They decompose vegetative litter, recycle nutrients, build soils, and provide food and calcium for many other animals including birds, amphibians, reptiles, small mammals, and other invertebrates (Jordan and Black 2012, p. 5). As primary consumers of plant, animal, and fungal matter, mollusks aid in decomposition processes and contribute to nutrient cycling, soil formation, and soil productivity. The activities of snails physically and chemically alter decaying plant material in ways that promote fungal and bacterial growth. Terrestrial mollusks can also play an important role in plant pollination and dispersal of fungi and seeds (Jordan and Black 2012, p. 7).

Snail shells are high in calcium, and terrestrial snails play an important role in storing, releasing, and cycling calcium. Empty snail shells are used as shelters and egg laying sites by insects and other arthropods, and broken down shells return calcium to the soil (Jordan and Black 2012, p. 7). Snail shells are the primary calcium source for the eggs of some bird species. In Europe, declines in mollusk abundance in forest ecosystems have been significantly linked to eggshell defects, reduced reproductive success, and population declines in the song bird *Parus major* (Graveland et al. 1994, Graveland and van der Wal 1996).

On a global scale mollusks are one of the most imperiled groups of animals because they are particularly vulnerable to changes in the environment brought about by humans. Approximately 40 percent of recorded extinctions since the year 1500 have been mollusks, including 260 species of gastropods (snails and slugs), the majority of which were terrestrial (Lydeard et al. 2004). The International Union for Conservation of Nature (IUCN) assessed extinction risk for 2,306 mollusk species and categorized 55 percent of them (1,282 species) as threatened or near threatened (2009). For an additional 582 species, not enough information was available to determine the status of this understudied group of organisms.

Within the continental United States, 38 snail species are listed as Threatened or Endangered. Of these, 11 are land snails. This low number is not an indication that populations are secure, but rather that land snails as a group are poorly known and understudied (eg. Minton and Perez 2010). The vast majority of mollusks have not a thorough assessment of their conservation status (Lydeard et al 2004).

Though there is growing concern that many terrestrial mollusk species may be in decline, due to the limited financial resources available, few research efforts have been undertaken for this group of relatively obscure animals. Southern California desert land snails such as the Mohave Shoulderband are a case in point. Many of these desert snails are known only from their original descriptions, many of which date back to the 1930s (e.g. Berry, 1930a, 1930b). For some desert snails, little is known of their distribution beyond their type locality, the site of the original specimen collection. Though researchers such as Walter Miller, Robert Goodman, Lance Gilbertson, Barry Roth, and others have made and continue to make important contributions to our knowledge of land snails in California, there is no shortage of information gaps that need to be filled. Desert snails new to science are still being discovered in southern California, such as *Cahuillus fultoni* from the Soda Mountains in the Mohave Desert (Gilbertson et al. 2013).

Desert snails of the genera *Cahuillus*, *Sonorelix*, *Eremarionta*, *Helminthoglypta* and others have become isolated by pre-Holocene climate change and topographical barriers to dispersal and gene flow. In southern California, desert snails survive in isolated shady canyons in desert ranges and peaks separated by inhospitable terrain where they cannot find shelter from excessive heat and dryness. These snails are the descendants of species that were presumably more widespread in the Pleistocene and earlier when the climate was cooler and wetter, as described through analysis of woodrat middens (Betancourt et al. 1990) and other techniques.

The now-isolated canyon and mountain habitats where snails have diversified are analogous to islands which are known to have the highest extinction rates due to dispersal barriers. For example, Hawaiian land snails have suffered very high levels of extinction. Of the 75 land snails that have gone extinct in the United States, 68 were from Hawaii (Minton and Perez 2010). Up to 90 percent of the Hawaiian land snails may now be extinct, due primarily to introduced predators, habitat destruction and overcollecting (Solem 1990, Hadfield et.al. 1993). Isolated desert snail populations in the American west are similarly vulnerable to extinction. There are no regulatory mechanisms in place to protect the Mohave Shoulderband. The snail needs immediate Endangered Species Act protection to prevent its extinction.

RANGE

The Mohave Shoulderband snail is restricted to the western edge of the Mohave Desert in southern Kern County, California on three hills-- Soledad Mountain, Standard Hill, and Middle Butte (Figures 1 and 2). The total area of the three hills is approximately 1,944 hectares (4,802 acres or 7.5 square miles). On these hills, the snail is found only in rock outcroppings and talus areas that provide appropriately moist and shaded microhabitat. Repeated searches for the snail in surrounding areas including the Rosamond Hills and Tropico Hill south of the occupied range have been negative (Dave Goodward, unpublished data).

The vast majority of the population (approximately 86 percent) is found on Soledad Mountain. Visual assessment of satellite images of the three mountains where the snail is found revealed 105 rock outcrops that could provide suitable habitat for the snail. Of these, 90 are on Soledad Mountain, 13 are on Middle Butte, and two are on Standard Hill (Dave Goodward, unpublished data; we provide a latitude-longitude spreadsheet in the cd submitted with the petition).

Figure 1. Mohave Shoulderband Range. The snail is found on the three hills colored in red north of Rosamond and South of Mojave. Map Courtesy ESRI.

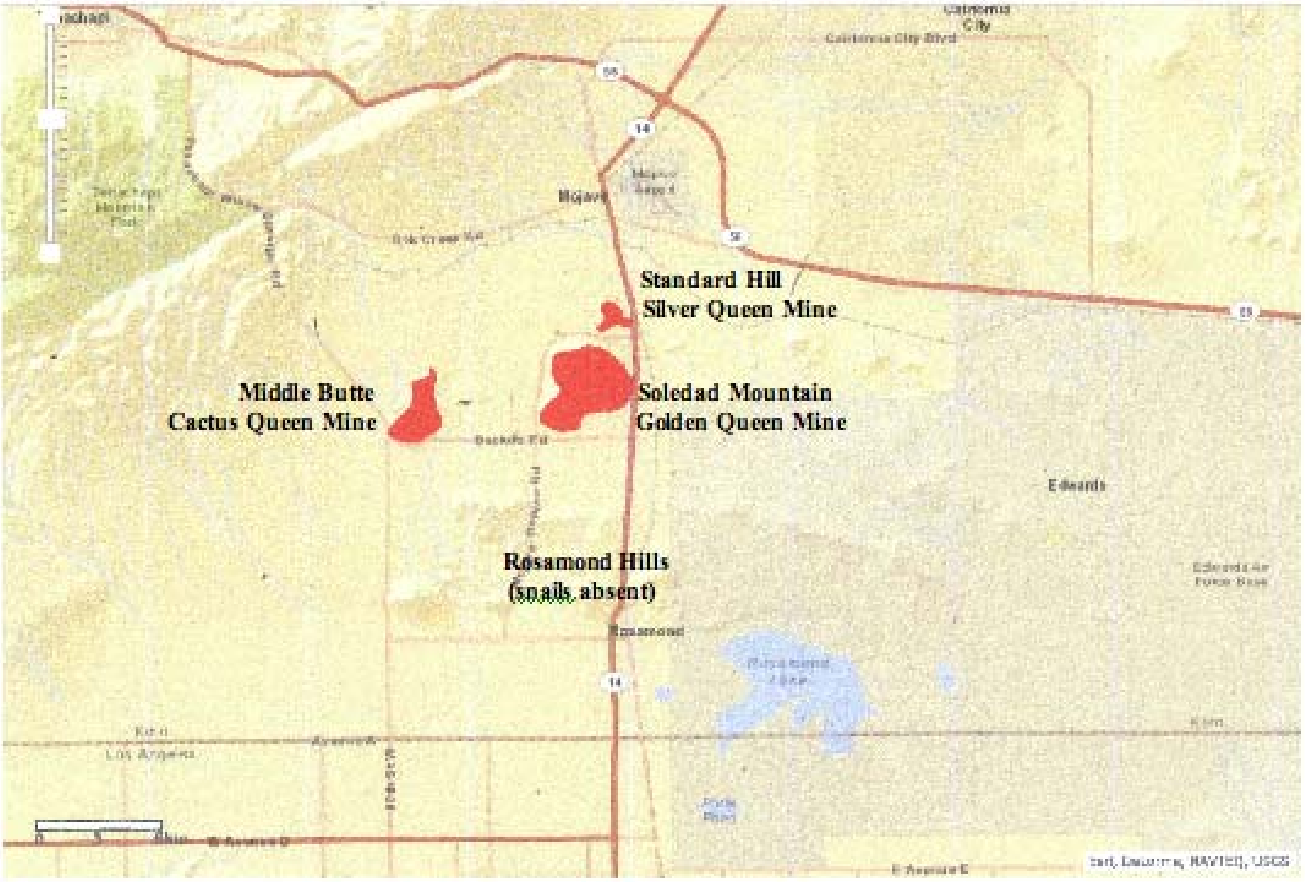


Figure 2. Hills Occupied by Mohave Shoulderband. The total area of the three hills is 4,802 acres or 7.5 square miles.

LAND MANAGEMENT/OWNERSHIP

The Mohave Shoulderband is found on land that is managed by the Bureau of Land Management and on private land.

STATUS

The Mohave Shoulderband is ranked as Critically Imperiled (G1) by NatureServe (2013). Due to lack of data, it does not have a state ranking from the California Natural Heritage Program (SNR) or the California Department of Fish and Game. It is not on the Bureau of Land Management's list of Special Status Animals. It has not been assessed by the IUCN.

NATURAL HISTORY

Taxonomy

The Mohave Shoulderband was described by Willet (1931). It is a valid species (Turgeon et al. 1998). The Interagency Taxonomic Information System (ITIS) serial number for this species is 77759.

The Mohave Shoulderband is in Class Gastropoda, Subclass Pulmonata, Order Stylommatophora (land snails and slugs), Family Helminthoglyptidae, Genus Helminthoglypta, Subgenus Coyote (Reeder and Roth 1988). Its species name honors Dr. Wendell O. Gregg, an accomplished malacologist who specialized in the land snails of the American southwest.

The family Helminthoglyptidae includes desert snails (Pilsbry 1939). The genus Helminthoglypta is mainly confined to the Pacific coast of North America, and contains 104 California species (Roth and Sadeghian 2003). Of these, 14 are in the recently described subgenus *Coyote*, including *H. greggi*. Most members of this subgenus are found in the western and central Mohave Desert. Snails in the Coyote subgenus are characterized by a prominent bulge at the anterior end of the upper penial chamber and a papillose shell.

There are very few other species of desert snails in the general vicinity of *H. greggi* on the desert or desert edge of southeastern Kern County. None of them have ranges that overlap with that of *H. greggi*. For context and comparison, we provide brief information on nearby species:

1) Helminthoglypta micrometalleoides Miller 1970, known only from the El Paso Mountains and nearby Red Mountain in the Rand Mountains. This, the smallest known Helminthoglypta, has been placed in the subgenus Coyote, along with *greggi* (Roth and Sadeghian 2003.) This snail is rather similar in appearance to *H. greggi*, though smaller. Its range is approximately 35 miles from Soledad Mountain, with much of the intervening land consisting of inhospitable desert flats unoccupied by land snails.

2) *Helminthoglypta sp.* An undescribed species of Helminthoglypta is found in Jawbone Canyon (Dave Goodward, unpublished data). It is far different morphologically from *H. greggi*, being much larger, with a differently colored shell and soft parts. It is found approximately 20 miles from Soledad Mountain. It has not been assigned to a subgenus, but it does have a flattened shell characteristic of the subgenus Coyote.

3) *Sonorelix micrometalleus* Berry 1930. This small snail is also found in the El Paso Mountains, not far from *H. micrometalloides* which it superficially resembles. Their internal reproductive structures clearly indicate that the two snails belong to different genera (Miller 1970).

Though the taxonomic validity of the Mohave Shoulderband is not in dispute, recent genetic work corroborates its distinctness. Genetic sequencing has become a major tool in taxonomy, and coupled with morphological studies has revealed the existence of cryptic species among several groups including salamanders (Jockusch et al. 2002), snakes (Rodriquez-Robles et al.

2001), and birds (Drovetski et al. 2004). Since many desert snails are superficially similar in appearance, genetic sequencing is helpful in clarifying their taxonomic status. *Helminthoglypta greggi* and *H. micrometalleiodes* are allopatric and distant geographically from each other, but their phylogeny is unknown. Sequencing of the 16S and CO1 mitochondrial genes of *H. greggi*, *H. micrometalleoides,* and the undescribed *Helminthoglypta* species from Jawbone Canyon has confirmed that these three taxa are distinct species with very wide genetic divergence levels (Paul Rugman-Jones and Dave Goodward, unpublished data).

Description

The Mohave Shoulderband is approximately one-half inch tall with a light brown spiraling shell that is pale pinkish underneath. Its soft body is generally dark brown. Willett (1931) described the Mohave Shoulderband as follows:

Diameter 13.5-14.6 mm. Shell thin, depressed, with 4.5-4.75 whorls. Spire barely raised; suture impressed, whorls convex. Periphery rounded. Embryonic whorls about 1.5. Post embryonic sculpture of irregular collabral rugae and papillae that are irregularly developed on the rugose, upper surface but more regular, with diagonal trend, on base of body whorl. Body whorl tightly coiled, last quarter-turn descending. Base produced; umbilicus contained about 6 times in diameter. Aperture nearly circular; lip thickened, weakly turned outward; inner lip barely impinging on umbilicus. Shell pale pinkish tan under a light brown periostracum. Epiphallic caecum slightly shorter than penis plus epiphallus. Vagina moderately long; free oviduct about 1.25 times as long as vagina. Spermathecal diverticulum about twice as long as spermathecal duct above its origin.

Habitat

Because it must find moist microhabitat to avoid drying out, the Mohave Shoulderband is only found in rock outcroppings, rock slides, talus areas, and in clusters of rocks partially embedded in the soil. Like other desert snails, it needs access to deep crevices under the soil to provide shade and lower temperatures during dry periods.

Published data are lacking on the specific habitat requirements of the Mohave Shoulderband. Here we provide data available from the literature on other species of desert snails and personal data collected on *H. greggi* by Dave Goodward.

Much of the ecological information about American desert snails is based on observations of previous and current scientists and naturalists (eg., Berry 1922, Miller 1970). These scientists and collectors developed a search image for potential desert snail habitat, looking in rockslides and around boulders on partly shaded slopes and canyons of desert mountains. The presence of talus and/or boulders is an almost universal habitat requirement, which allows the snails refuge from the heat and dryness of the desert. In the American southwest, the genera Eremarionta, Sonorelix, Sonorella, Chamaearionta, Cahuillus, and the subgenus Coyote of Helminthoglypta to which *H. greggi* belongs all fit this same basic ecological profile. In recent years, a few scientists have begun to document the specific ecological parameters of desert snails. N.D. Waters and J.E. Hoffman have studied the Phoenix Talussnail (*Sonorella allynsmithi*) in Arizona and have documented many of the basic ecological preferences of this species. They found that it occurs mostly in talus but also at times in desert washes, and that there is only a weak preference for north-facing slopes (Hoffman 1995, Waters 2011). In terms of microclimate, Waters (2011) documented a summer talus temperature range of 30-37 degrees Celsius at depths from 0.1 to 0.5 meters while snails were aestivating, many degrees less than the recorded air and surface temperatures in the desert.

Wiesenborn documented the habitat and some of the environmental factors governing the activity of the White Desertsnail (*Eremarionta immaculate)* in extreme southeastern California. This snail is found in talus, with a positive correlation to the number of rocks present (Wiesenborn 2000). Like other desert snails, it is dormant during dry spells and is stimulated to become active by rainfall. When on the surface, its activity is positively correlated with high humidity (Wiesenborn 2003).

Field trips to Soledad Mountain have confirmed that *H. greggi* does not appear to deviate from the general habitat requirements of other desert snails. A lack of extensive talus on the lower slopes restricts its distribution to the base of vertical rock outcrops which have at least small patches of talus. In addition, *H. greggi* shows a strong preference for north-facing outcrops. This microhabitat is where the best shelter is available from the extreme heat and dryness of the Mohave Desert. These north facing outcrops have the most hours of shade due to the large proportion of the yearly season when the sun is shifted into the southern sky. This dependence on maximum shade relates directly to maximizing the retention of soil moisture. Steep slopes or outcrops increase the amount of scarce rainfall runoff that is guided to the base where it collects and seeps into the soil.

The Mohave Shoulderband shares with other desert snails the need for access to deep crevices under the soil surface where the snails can go dormant during dry periods. This is considered essential for the genus Sonorella in Arizona and Mexico, members of which seek shelter in steep slides of large rocks "where they can crawl through the interstices to the proper depth for protection and then seal to a rock when inactive" (Bequart and Miller 1973, p. 27). The soil under surface rocks will eventually dry and heat up, but deeper layers will stay at least marginally moist and definitely cooler, as documented in Arizona for *Sonorella allynsmithi* (Waters 2011). Soledad Mountain has extensive rockslides only at the higher elevations. These slides are occupied by *H. greggi* even when they are not immediately adjacent to rock outcrops. Mohave Shoulderband snail shells were found in talus at least 25 meters from outcrops in the northwest portion of Soledad Mountain.

Small patches of talus or clusters of rocks partially embedded in the soil at the base of the outcrops are also occupied by *H. greggi* at all elevations of Soledad Mountain.

Crevices and holes in the base of the rocky outcrops presumably can provide shelter for Mohave Shoulderbands as well. While *H. greggi* has not been seen seeking shelter in holes, Cahuillus and Eremarionta snails in similar habitats have been observed entering small holes at the base of rock outcrops (Dave Goodward, unpublished data).

Deep-rooted shrubs provide additional shade, and possibly additional subterranean access in the form of decayed root channels. On Soledad Mountain, Cliff Goldenbush (*Ericameria cuneata)* is the most common shrub among the rocks.

Wood rat (*Neotoma* spp.) nests may provide or enhance dormancy shelter for the snails. Wood Rats seek out shady crevices in rock outcrops, where they construct nests made of sticks, cactus pads and rocks (Vaughan 1990). The lower layers eventually decompose sometimes resulting in a compact mass with a hard covering, but also sometimes resulting in aprons of friable organic matter littered with bones and other objects collected by the wood rats. One collection of *H. greggi* in 2011 was from such a location, where empty shells and live dormant snails were found buried under several inches of rocks and organic debris from a Wood Rat nest in a narrow crevice.

Due to this species' preference for rock outcrops, much of Soledad Mountain's desert slopes are unsuitable for the Mohave Shoulderband because of a lack of shade and a lack of access to deep rock crevices.

The specific microhabitat requirements and limited range of the shoulderband make it highly vulnerable to extirpation from habitat altering activities such as mining.

Life History

No scientific studies have been published on the life history of *H. greggi* or any other desert *Helminthoglypta*. Here we provide information on the life history of desert snails in general, under the assumption that *H. greggi* does not vary widely from the general patterns described by Wiesenborn (2000) for *E. immaculata,* by Waters (2011) for *S. allynsmithi*, and from unpublished observations of D. Goodward and L. Gilbertson of southern California *Eremarionta, Sonorelix, Helminthoglypta,* and *Cahuillus*.

During the late fall, winter, and at least early spring, rainfall events stimulate emergence from dormancy. It is not known how much rainfall is required to trigger emergence, but observations on desert *Cahuillus* and *Eremarionta* suggest at least one to two centimeters of rain is needed. This appears to be enough to soak down to aestivation sites and help loosen the calcareous epiphragms that seal the snails to subterranean rocks. Some snails have one or more internal epiphragms or disc-like plugs that help prevent desiccation. During aestivation, snails can become quite dehydrated, with the body shrinking back into the shell. Within a day of a sufficient rain event, the snails come to the surface to feed, and if mature, search for mates. Activity is nocturnal and sometimes diurnal as well if the weather is cloudy and humid. After feeding sessions, the snails will rest and mobilize calcium to grow their shells. Resting takes place under surface rocks or in shallow shelters of other sorts. During resting and shell formation, the snails are partially withdrawn into their shells, with their tentacles at least partially retracted. The mantle, a band just inside the apterture, will be viscous and speckled with pale particles.

Once the soil surface begins to dry, the snails will once again seek shelter underground, though not necessarily as deep as their aestivation sites. It is not uncommon to find dormant snails sealed to the underside of surface rocks a few days following rain. These snails are well-hydrated, as judged by the lack of an internal epiphragm, with the body of the snail flush or nearly so with the aperture. If there is no more significant rainfall, the snails will seek deeper shelter and re-adhere to rocks.

If conditions allow, snails will mate, a process that has been seen on the surface but could theoretically also take place underground. Like most other land snails, *Helminthoglypta* are oviparous and simultaneously hermaphroditic (Gomez 2001). The result is that both snails could lay eggs following mating. There is only one gonad, which is segmented into tissue layers that produce eggs and sperm separately. The genital pore is on the side of the head, with mating taking place in a head to head position, at least in related genera.

Eggs are laid within the soil, presumably deep enough to be in a zone that will be continuously moist. The eggs are gelatinous with a thin enclosing membrane. Clutch size is not known for *H. greggi*. In captivity, *Cahuillus* and *Eremerionta* species have laid clutches of between 9 and 23 eggs where they laid their eggs on the floor of their containers buried underneath moist soil. Incubation period is unknown for *H. greggi*, though it is likely to be similar to that of *Cahuillus* and *Eremarionta*, at approximately 14 to 21 days (D. Goodward, unpublished data). The short hatching time could be an adaptation to the desert environment because it is in contrast to a tropical land snail, *Catinella rotundata*, which lays clutches of approximately 12 eggs but which take 43 to 70 days to hatch, and *Succinea thaanumi*, another Hawaiian land snail, that has eggs which take 36 to 50 days to hatch (Rundell and Cowie 2003). Clutch size has been reported for several other land snails, including in Egypt, where *Helicella vestalis* lay between 25 and 72 eggs which take 12-15 days to hatch (Mohammed 1999, Kassab and Daoud 1964 in Sallam and El Wakeil 2012). Rapid egg development in desert species would help the newly hatched snails to survive and grow during a short rainy season. This could be particularly important for a species like *H. greggi* in the Mohave Desert which has both low and irregular rainfall.

Newly hatched juveniles of other land snail species will consume remaining egg remnants and unhatched eggs. This results in faster growth and better survivability to the hatchlings compared to those that did not consume conspecific eggs (Baur 1990, Desbuquois et al 2000). This behavior has been observed in *Cahuillus* and *Eremarionta* species in captivity (D. Goodward, unpublished data), but it is not known whether it occurs in *H. greggi*. Any factor that increases growth rate and survivability will be at a premium for snails living in an environment where they have a very limited period in which to feed. In captivity, *H. greggi*, like other desert snails, consumes lettuce and green beans. Food sources in the wild have not been identified, but the Mohave Shoulderband likely consumes decayed organic matter. Lichen and cryptobiotic soil crust are also likely consumed.

The time to maturity of most desert snails is unknown. An exception is the Phoenix Talussnail, which is reported to mature in four years (Hoffman 1995). It could easily be longer for *H. greggi*, given the irregularity of rainfall in the west Mohave, and the limited windows of opportunity for growth and maturation. A long time to maturity can make it difficult for snails to rebound from environmental perturbations, as has been the case for declining and extinct native land snails in Hawaii (Rundell and Cowie 2003). Undoubtedly *Helminthoglypta greggi* and other desert snails have adapted to survive the low and intermittent rainfall of the Mohave, but it is not known how many seasons these snails can survive without any rain.

The very specific habitat requirements of the Mohave Shoulderband make it vulnerable to any activities that disturb the rock outcroppings and talus areas on which it depends for survival. Because it cannot travel over inhospitable terrain without drying out, extirpated populations cannot be replenished by dispersing individuals.

THE MOHAVE SHOULDERBAND WARRANTS PROTECTION UNDER THE ESA

There can be no reasonable doubt that the Mohave Shoulderband warrants listing as a threatened or endangered species. The Endangered Species Act states that a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)). The snail is threatened by at least two of these factors, habitat degradation and inadequacy of existing regulatory mechanisms, and thus qualifies for federal protection. Petitioners request emergency listing for the snail to ensure that mitigation measures are put in place to prevent its extirpation on Soledad Mountain due to construction of the Golden Queen Mine.

THREATS

MODIFICATION OR CURTAILMENT OF HABITAT OR RANGE

The Mohave Shoulderband has a total range of approximately 7.5 square miles (4,802 acres) within which it occurs only in appropriate habitat in rock outcroppings, rock slides, and talus slopes. Because the snail is dependent on moist micro-environments, it cannot successfully disperse across inhospitable terrain. It lives on three hills—Standard Hill, Middle Butte, and Soledad Mountain. The snail’s survival is threatened by a gold mine which is currently under construction, by contamination from past and future mining, and by global climate change.

Mining

The Mohave Shoulderband is threatened by mining and past mining pollution throughout its range. All three hills where it is found (Soledad Mountain, Standard Hill and Middle Butte) have been mined extensively in the past. Because the original range of the snail is unknown, it is not possible to quantify the percentage of the snail’s range that has already been lost to mining activities, but it is clear that the extensive earlier mining operations on the three hills have greatly reduced the snail’s habitat.

Terrestrial snails are vulnerable to mining activities because the disturbance of rock outcrops and talus slopes destroys the microhabitat conditions on which they depend for survival (eg., Lang 2000, FWS 1998, AGFD 2003, AGFD 2008). The Mohave Shoulderband is threatened by direct habitat destruction in the footprint of mining activities, and also by disturbance of microhabitat conditions in adjacent habitat due to microhabitat alteration and filling of interstitial spaces. The snail is also threatened by toxic mining pollutants including arsenic.

Snails within the footprint of the mine and mining infrastructure will be killed by activities such as blasting, crushing, and construction. The rocks blasted and removed will no longer exist as suitable habitat for the snail. Talus slopes and rock outcroppings adjacent to the mining footprint could also be rendered unsuitable for snail occupation due to the destabilization of hillsides and erosion caused by blasting and crushing.

Interstitial space between rocks is an important habitat feature for the Mohave Shoulderband because it allows for vertical migration in response to climatic variation. Dust and sediment from mining activities, soil removal and replacement, road construction and maintenance, traffic, and tailing piles could fill the interstitial spaces or alter moisture conditions, rendering adjacent habitat unusable (eg. Jontz et al. 2002, FWS 2011, p. 7).

Standard Hill (site of the Silver Queen Mine) and Middle Butte (site of the Cactus Queen Mine) are in reclamation, and do not currently have new mining projects planned.

Soledad Mountain was mined from the early 1900s to the 1980s, with underground, open pit and heap leach methods utilized. A new open pit gold mine, the Golden Queen, will use modern heap leach mining methods and is currently under construction (see: http://www.goldenqueen.com and also see: http://pcd.kerndsa.com/planning/environmental-documents/224-soledad-mountain-project).

The Soledad Mountain Project/Golden Queen Mine is an open pit gold-silver mine that will remove 108 million tons of overburden. The project site is 1,440 acres, and the mine is expected to have a life of 31 years (Kern County 2010b). The mine completed site preparations and started construction of infrastructure-related items in July 2013 (http://www.goldenqueen.com/s/NewsReleases.asp?ReportID=615269&_Type=News&_Title=Golden-Queen-Provides-a-Construction-Update). In January 2014 financing was secured to commence Phase 2 construction (http://www.goldenqueen.com/s/NewsReleases.asp?ReportID=617499&_Type=News&_Title=Golden-Queen-Secures-Interim-Financing-for-the-Ongoing-Development-of-its-S...).

The Golden Queen Mine will encompass the northern lobe of Soledad Mountain, about one-third of the hill's total area, with the eastern and southwestern lobes of the mountain remaining undisturbed. The proportion of Mohave Shoulderband habitat that will be destroyed by the mine is difficult to calculate due to the uneven distribution of the snail. A quantitative assessment of the snail population has not been undertaken. This assessment would need to take into account the two microhabitats of the snail-- 1) shaded base of rock outcrops and 2) higher elevation talus slopes. Suitable rock outcrops are present and widely distributed in all three lobes, but the talus slopes are present only in the northern lobe within the proposed mine boundary.

We attempted to quantify the number of suitable rock outcrops on Soldedad Mountain by visual assessment of satellite images (Figures 3, 4, 5, 6, and 7). Ninety apparently suitable outcrops were identified, with an additional two at Standard Hill and 13 at Middle Butte for a total of 105 outcrops within the range of the Mohave Shoulderband. On Soledad Mountain, approximately 44 of the outcrops are within the proposed mine footprint (Figure 7). Thus, 42 percent of all outcrops within the snail's range will be destroyed by the Golden Queen Mine. This is an underestimate of the overall impact of the mine on the existing *H. greggi* population due to the presence of occupied talus slopes exclusively within the mine footprint, resulting in a higher density of snails within the mine footprint as compared to the remainder of Soledad Mountain. Even without quantification of the numbers of snails in the high elevation talus, it is likely that more than 50 percent of the world population of the Mohave Shoulderband will be destroyed by the Golden Queen Mine.

It should be reiterated that the full original and current distribution of *H. greggi* on Middle Butte (Cactus Queen Mine) and Standard Hill are unknown. On Middle Butte, a single location outside of the mine footprint was found to be occupied, and the remaining outcrops within the mined sections of the butte have not been searched. On Standard Hill, only the outcrops outside of the mined footprint were searched, and were found to be occupied. Based on these observations, we assume that prior to mining, all suitable habitat on both hills was occupied by the Mohave Shoulderband.

To generate the proportion of Soledad Mountain, Standard Hill, and Middle Butte that contains rock outcrops, we highlighted all visible outcrops on aerial photographs (Figures 3 and 4).

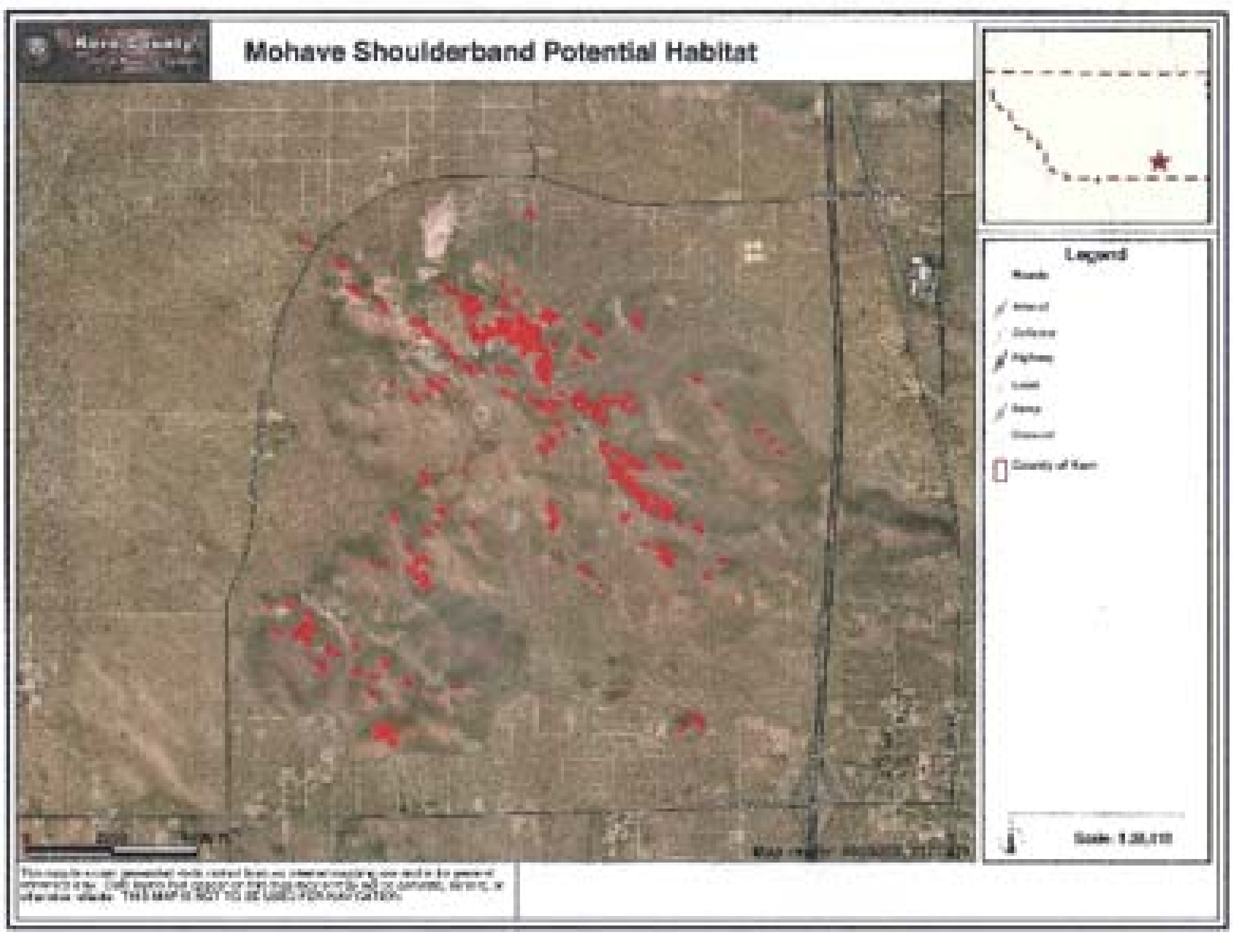
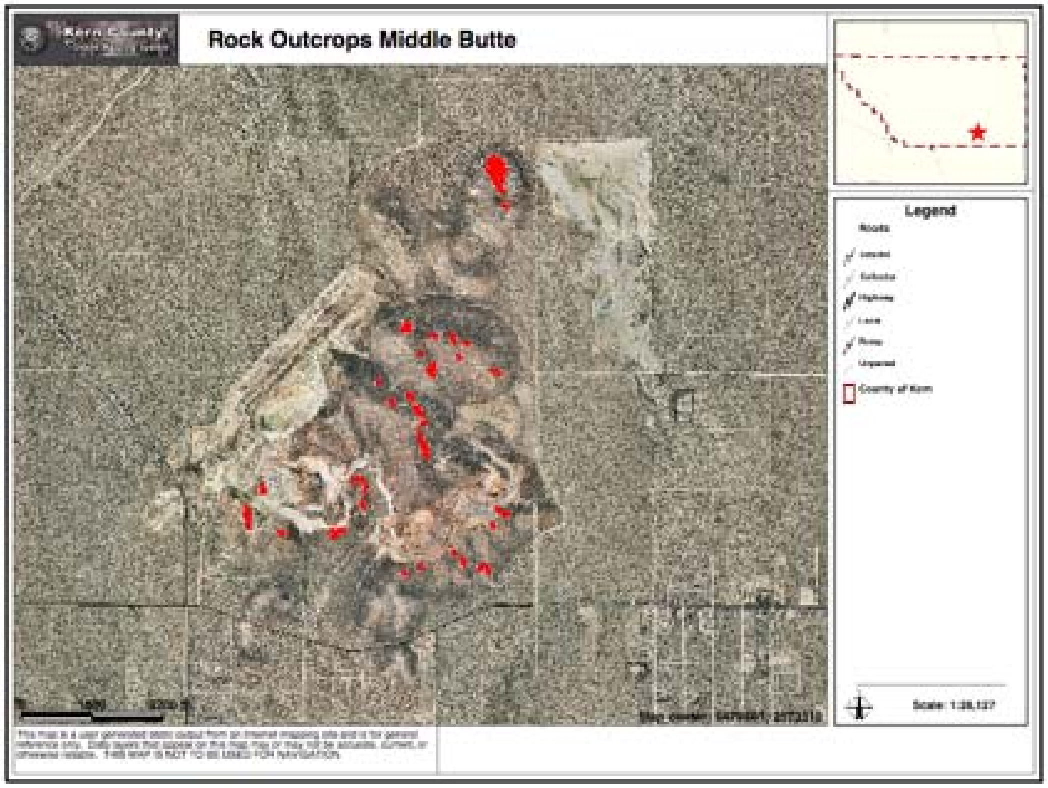


Figure 3. Rock outcrops on Soledad Mountain that provide potential habitat for the Mohave Shoulderband.



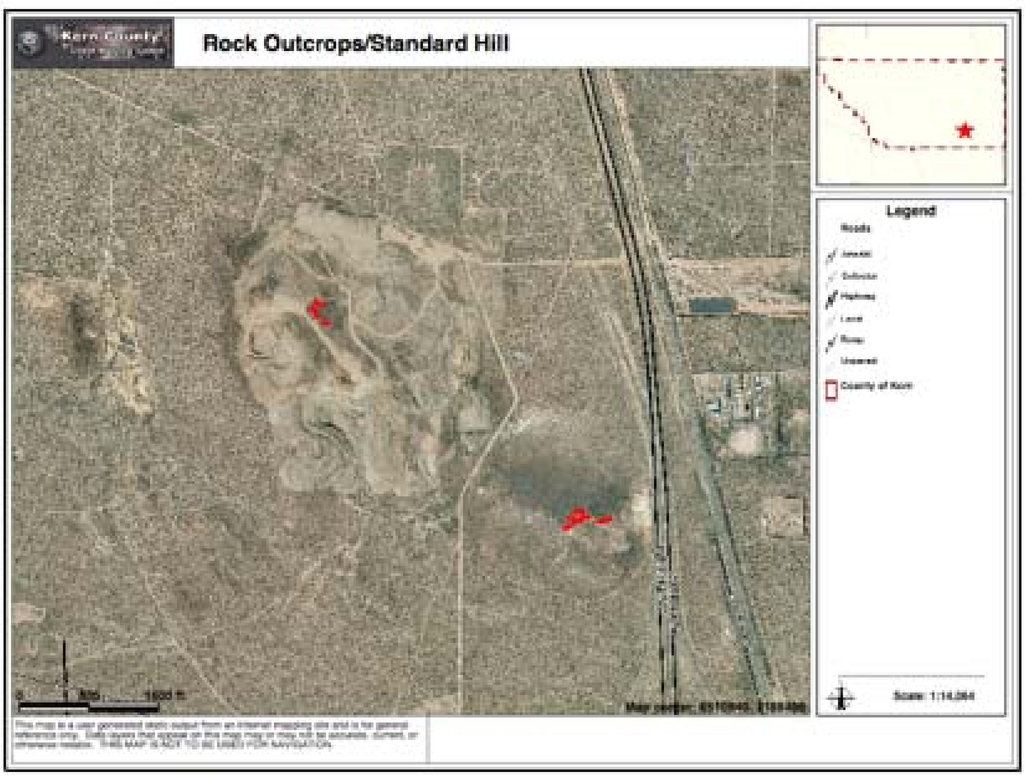


Figure 4. Rock Outcrops on Middle Butte and Standard Hill that provide potential snail habitat.

We conducted snail surveys on Soledad Mountain in an effort to refine the range of the snail. The locations marked by red dots in Figure 5 represent either live snails or empty shells of the Mohave Shoulderband. We did not sample all rock outcrops but assume that *H. greggi* would be found in all portions of Soledad Mountain in suitable habitat given its widespread occurrence in the southwestern and northern sections of the mountain. The lack of collections in the southeastern section is due to a lack of search effort, and does not indicate the absence of the snail. We assume the presence of empty shells indicates current occupation by live animals as in commonly accepted in terrestrial snail surveys. With other desert snails, the presence of empty shells almost invariably indicates the presence of an extant population. Where we found empty shells, we generally avoided moving multiple rocks to unearth live animals to minimize damage to the environment. We documented 17 shell or snail sites on Soledad Mountain, but assume that all other outcrops are occupied. The two outlier locations in the north and northwest are at small isolated rock outcrops. We provide a spreadsheet of latitude-longitude locations with the reference cd accompanying the petition.

Figure 5. Mohave Shoulderband Collection Sites on Soledad Mountain. The red dots represent 17 outcrops where snails or snail shells were found.

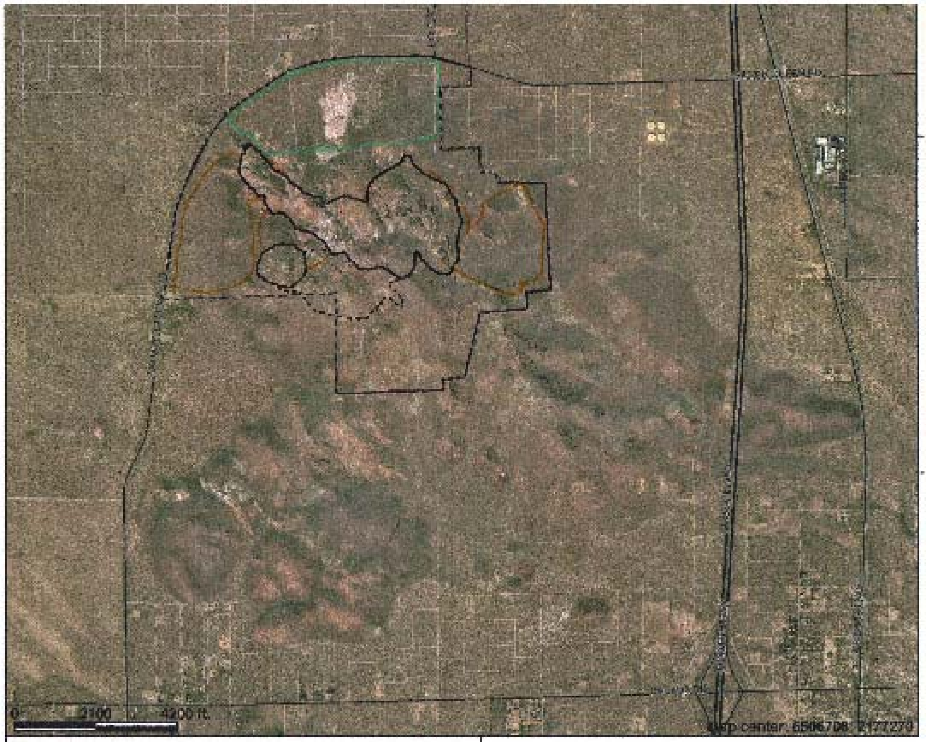


Figure 6. Golden Queen Mine Outlines on Soledad Mountain.

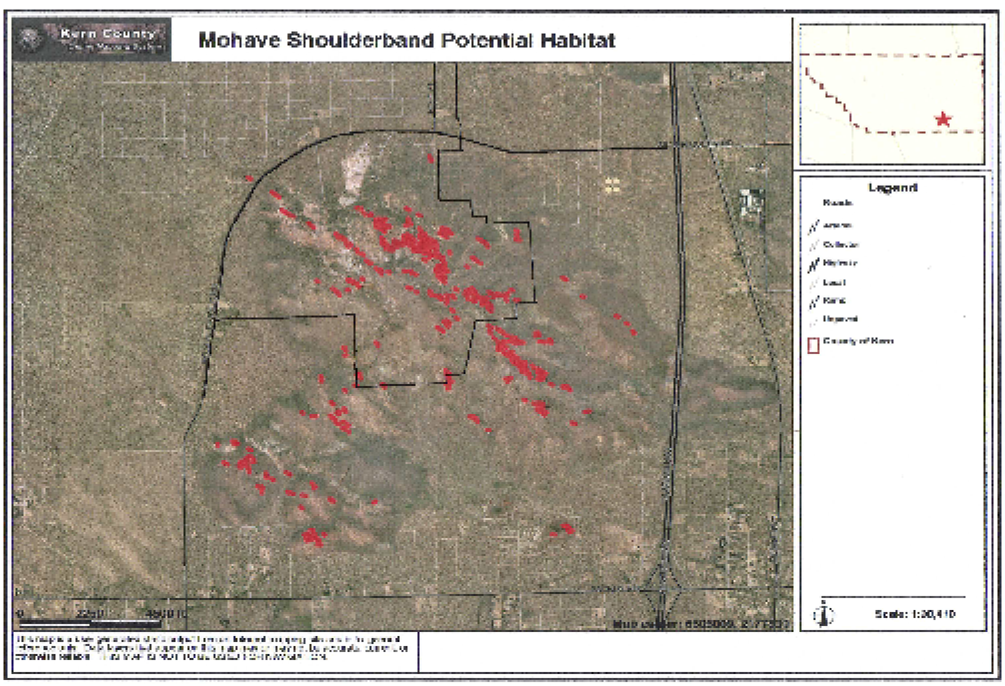


Figure 7. Golden Queen Mine Outlines Overlaid with Rock Outcrops. The outcrops provide potential habitat for the Mohave Shoulderband. Forty-four percent of the outcrops are within the mine's footprint.

Toxins from Mine Tailings

Soledad Mountain, Standard Hill, and Middle Butte have all been heavily mined in the past and none have undergone proper remediation. One of the toxic chemicals that is present that threatens the Mohave Shoulderband is arsenic which has long been known and studied as a health hazard for humans and wildlife (Eisler 1988, USDA 1998). The Mohave Desert contains locally high arsenic concentrations in soil and sediment. When gold and silver-bearing rock is broken up for extraction, the arsenic remains behind in the tailings. The small rock particles in tailings have a high surface to volume ratio, and release their arsenic to the environment via wind and water erosion.

The abandoned Cactus Queen Mine on Middle Butte, four miles from Soledad Mountain, has been studied for arsenic contamination by the Bureau of Land Management. Arsenic in tailings and sediments at Cactus Queen was sampled to determine how much had become mobilized into nearby water and soils. Cactus Queen has been identified by the Bureau of Land Management as an Abandoned Mine Lands Comprehensive Environmental Response, Compensation and Liability Act site (AML CERCLA) (Rytuba et al. 2011). The heap leach pad contains very high arsenic concentrations, with most samples over 2,000 parts per million (ppm). Similar levels were found in a natural channel leading from the heap leach pad. The constructed drainage channel leading from the heap leach pad yielded the highest arsenic concentrations. The Cactus Queen remediation plan has not yet been finalized.

Soledad Mountain has had extensive gold and silver mining in the past, with the resulting deposition of approximately 100,000 tons of mine tailings scattered over various parts of the mountain. As expected, these tailings contain elevated arsenic levels (Rytuba et al. 2011 and also see: http://www.blm.gov/ca/st/en/prog/aml/project_page/goldenqueen.html). To our knowledge, Soledad Mountain/Golden Queen Mine has not been designated as an AML CERCLA site. It appears as if the Golden Queen Mine may be able to move forward without remediating the tailings remaining from past mining. The elevated arsenic levels in the soil and tailings from previous and planned mining threaten the Mohave Shoulderband.

Arsenic in soil and water has long been known to be toxic to snails. Arsenic-based molluscicides were commonly used in the past until they were replaced by metaldehyde. Currently, metaldehyde molluscicides often still contain lesser amounts of arsenic compounds (www.Merckmanuals.com/vet/toxicology/metaldehyde-poisoning/overview-of-metaldehyde-poisoning.html). Arsenic toxicity and concentration in snails has been studied from the standpoint of snails as bioindicators of environmental pollution (Factor and de Chavez 2012). Effects of arsenic on embryos of the aquatic snail *Biomphalaria glabrata* include lethality at high doses, and reduction of total number of eggs laid and hatching time delays even at low doses (Ansaldo et al. 2009). Similar results were found with the aquatic snail *Radix quadrasi* with heavy metals including arsenic producing sublethal effects at concentrations encountered in polluted water in the Philippines (Factor and de Chavez 2012).

Arsenic in terrestrial systems and detritivoral invertebrates has received far less attention than aquatic systems. A study of arsenic from mine tailings in Britain revealed low levels of uptake by plants, but elevated levels in plant litter (Milton and Johnson 1999). The authors only assessed effects on small mammals, but as consumers of plant litter, terrestrial snails would also be adversely impacted by heightened arsenic levels in litter. In a study in France, terrestrial snail growth, hatching time, and embryonic survival were adversely affected by arsenic in soils (Couerdassier et al. 2010).

The Mohave Shoulderband is threatened by sublethal to lethal effects from arsenic in mine tailings, soil, and sediment distributed by water erosion and by particles swept airborne by the frequent powerful winds of the western Mohave. Arsenic contamination is already present on all three hills where the snail occurs, and more contamination will result from the upcoming operations of the Golden Queen Mine.

Other contaminants associated with past and future mining similarly threaten the shoulderband including heavy metals and cyanide (eg. Eisler 1991, Septoff 2006).

Global Climate Change

The Mohave Shoulderband is threatened by global climate change. The snail is dependent on moist microhabitat for survival and warmer conditions would be expected to decrease the suitable habitat for the snail. Kern County is expected to undergo a mean annual increase in temperature of 3 degrees Celsius from 2050-2074 (USGS 2013).

Because the snail only occurs in isolated, small patches it is already highly vulnerable to extinction. The snails generally only surface following adequate rainfall. Range contraction of desert snails is already attributed to drying of the climate since the Pleistocene, and desert snail ranges are expected to continue to contract with ongoing warming of the climate (Sullivan 1997). Decreased rainfall would negatively impact emergence, reproduction, and feeding. Global climate change is also expected to increase the frequency and intensity of severe weather events such as droughts and fires in southern California (U.S. Global Change Research Program 2013).

The negative effects of climate change on shoulderband populations will be exacerbated by reduced range and reduced population size resulting from habitat loss caused my mining.

OVERUTILIZATION

Overutilization does not threaten the Mohave Shoulderband at this time. As conservation interest in this species grows and as habitat is lost due to mining activities, population depletion due to collection could become a threat in the future.

DISEASE AND PREDATION

Neither disease nor predation is a documented threat to the Mohave Shoulderband at this time. Predation should be considered as a serious potential threat to the species in conjunction with habitat loss as populations become smaller and even more isolated.

There are no reported observations of predation on the Mohave Shoulderband, though snails have many predators including other invertebrates, birds, mammals, amphibians, and reptiles (Jordan and Black 2012, p. 5). Insects in the families Sciomyziidae, Lampyridae, and Sarcophagidae are possible snail predators.

Small mammals are known to be common predators of terrestrial snails. For example, in the Negev Desert in Israel, native small mammals are significant predators on snails (Yom-Tov 1971). Most of the rodents that share the desert habitat with the Mohave Shoulderband are either granivorous (*Dipodomys*, *Perognathus*, *Peromyscus*, *Rheithrodontomys*) or more broadly herbivorous (*Neotoma. Thomomys, Spermophilus, Microtus*) (Ingles 1947). There is strong overlap in the habitat of Woodrats (Neotoma) and the Mohave Shoulderband, but is unlikely that they prey on the snails as their diet is herbivorous (Betancourt et al 1990). The Southern Grasshopper Mouse (*Onychomys torridus*) is predatory, feeding mostly on arthropods, particularly Orthoptera and Coleoptera **(**Brylski 1988), but it is not known if it feeds on snails.

Raccoons (*Procyon lotor*), Striped Skunks (*Mephitis mephitis*), and Opposums (*Didelphis virginiana*) consume snails, but they are currently uncommon in Mohave Shoulderband habitat. These omnivores are generally found in more mesic habitats, including urban and suburban areas in southern California. If the area surrounding Soledad Mountain becomes urbanized in the future, these omnivores could potentially become predators of *H. greggi*, especially at lower elevation outcrops at the urban/wildlands interface. The Coyote (*Canis latrans*) is another omnivore that is a potential occasional predator of the Mohave Shoulderband, in that it has been recorded as consuming snails (Tesky 1995). Coyotes are broadly opportunistic feeders that feed on lagomorphs, rodents, carrion, large mammals, fruits and vegetable matter, garbage, domestic cats, and pet food (Sperry 1941, Murie 1951, Gehrt 2007).

Introduced rats have potential to be predators of the Mohave Shoulderband if urbanization takes over the land surrounding Soledad Mountain. Old world rats have proven to be devastating predators to native snails, particularly on islands, and the isolated distribution of the Mohave Shoulderband is ecologically equivalent to an island setting. Three species, the Black or Roof Rat (*Rattus rattus*) the Brown or Norwegian Rat (*Rattus norvegicus*) and the Pacific Rat (*Rattus exulans*) have all been implicated in land snail declines on islands. The most complete evidence comes from Hawaii, where the Hawaii'an Tree Snails (*Achatinella spp.*) have declined markedly due to introduced rats and other factors (Hadfield et al. 1993). Introduced rats have also adversely affected land snails on the Ogasawara Islands of Japan (Chiba 2010), Flax Snails in New Zealand (Meads et al 1984) and on Lord Howe Island, New South Wales, Australia (Ponder and Chapman 1999, Beeton 2005).

Black Rats and Norway Rats have long been established in California. Black Rats are widespread abundant pests in California, but historically have been considered to be absent from desert regions. In the last two decades, however, introduced rats have colonized Lancaster, Palmdale and other desert communities in the western Mohave as those communities experienced rapid growth (Los Angeles County Department of Environmental Health Vector Management Program, pers. comm., J. Baldridge, Dewey Pest Control, Lancaster, CA, pers. comm.). Both rat species have colonized these communities in the last 15 years. Black Rats consume a wide variety of food, including snails and slugs (Baker 1984, Timm et al. 2012). As with Opossums, Raccoons and Skunks, Black Rats would not be expected to venture far from mesic suburban situations onto the dry open slopes of Soledad Mountain, but they would be expected to predate on snails at low elevation outcrops at the urban/wildlands interface if sprawl encroaches to the base of Soledad Mountain.

Numerous bird species could potentially prey upon the Mohave Shoulderband, especially during rainy periods when the snails emerge en masse. Though birds are likely infrequent predators of these snails, because the snail emergences likely involve the vast majority of the population, any predators keying in to the mass emergence could have a serious effect on the population. Here we discuss the potential avian predators that have been observed on site or that have a high potential to occur-- American Kestrel (*Falco sparvarius*), California Quail (*Callipepla californica*), Common Raven (*Corvus corax*), Greater Roadrunner (*Geococcyx californianus*), Loggerhead Shrike (*Lanius lucovicianus*), European Starling (*Sturnus vulgaris*), and Rock Wren (*Salpinctes obsoletus*).

European Starlings feed on a wide variety of animal and plant material, with insects and other invertebrates dominating during the breeding season, and snails are recorded among the invertebrates they consume (Cabe 1993). In Europe, Starlings have been observed selectively choosing large individual snails as prey (Barker 1991). Starlings are ubiquitous in southern California including the deserts, where they concentrate around human habitation.

Common Ravens are opportunistic omnivores and eat a wide variety of food including carrion and garbage. Snails have not been documented in their diet (Boarman 1999), but given the opportunity they would likely readily consume them.

Greater Roadrunners have been documented preying on land snails in West Texas, where they were seen repeatedly cracking the snails' shells using a flat stone as an anvil (Maxon 2005). In California, there is a documented case of a roadrunner eating the introduced snail *Helix pomatia* (Wright 1973). California Quail are documented as consuming snails, though their diet consists predominantly of seeds and leaves (Calkins et al 1999). Rock Wrens are insectivores that probe and pry into rock crevices, and wrens are resident on Soledad Mountain, foraging and nesting on the same outcrops occupied by the Mohave Shoulderband. There are no records of Rock Wrens preying upon land snails (Lowther et al. 2000), but they would likely do so opportunistically. The American Kestrel and the Loggerhead Shrike consume mostly insects and other arthropods, small mammals, small birds and reptiles (Smallwood and Bird 2002, Yosef 1996).

INADEQUACY OF EXISTING REGULATORY MECHANISMS

There are no regulatory protections in place that offer any protection whatsoever to the Mohave Shoulderband.

It has no status in California, is unranked by the California Natural Heritage Program, and has not been evaluated by the California Department of Game and Fish. It is not included in the BLM Special Status Species Program.

The Final Environmental Impact Statement required under the National Environmental Policy Act for the Golden Queen Mine was completed in 1997 (BLM and County of Kern Planning Department 1997). A Final Supplemental Environmental Impact Report was completed by Kern

County in 2010 (Kern County Planning Department 2010). None of the NEPA or CEQA documents for the mine take into account the Mohave Shoulderband. Without Endangered Species Act protection, no mitigation will be required to benefit the snail.

OTHER FACTORS

Fire

The Mohave Shoulderband is potentially threatened by increased frequency and intensity of fires in the Mojave Desert. Severity and occurrence of large fires has grown in recent years in desert, sage scrub, and chaparral associations in the Mojave, attributed in part to increase in abundance of introduced grasses that provide a carpet of fuel that bridge open gaps between shrubs (Brooks 2011). The increase in grasses has in turn been linked to an increase in nitrogen in the soil from air pollution, which favors grasses that utilize the added fertility to a greater degree than native annuals and shrubs that are adapted to less fertile soils. Once grasses have become established and the fuel base increased, it becomes a self-perpetuating condition. A warming climate also increases the early drying of fuels, expanding the fire season and perpetuating the dominance of introduced grasses and an increased frequency of fires (Abatzoglou and Kolden 2011). The impact of vegetation denudation and the role of exotic grasses in this increased fire size and frequency is a major concern in the Mojave Desert (Vamstad and Rotenberry 2010).

Recreational activities such as off-road vehicles and campfires increase the risk of wildfires. Mojave Desert rocky hills are popular among off-roaders, paintball enthusiasts, and other people seeking recreation, and are at an increased risk of accidental or deliberate fire.

While the Mohave Shoulderband snails are sealed to rocks underground during fire season, it is conceivable that there may be some direct temperature-related mortality, particularly for snails fairly close to the surface. Fires could also negatively impact the vegetation, lichen, and cryptobiotic soils which the snails rely on for food.

REQUEST FOR CRITICAL HABITAT DESIGNATION

Petitioners urge the Service to designate critical habitat for the Mohave Shoulderband concurrently with its listing. Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. § 1532(5).

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that: classifying a species as endangered or threatened is only the first step in insuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence… If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat. H. Rep. No. 94-887 at 3 (1976).

Critical habitat is an effective and important component of the ESA, without which the Mohave Shoulderband's chance for survival diminishes. Petitioners thus request that the Service propose critical habitat for the Mohave Shoulderband concurrently with its proposed listing.

On behalf of all parties,

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