Central Valley Landscape Conservation Project

Climate Change Vulnerability Assessment (January 2017 version)

Blunt-nosed Leopard Lizard

Vulnerability Assessment Summary

Overall Vulnerability Score and Components:

Vulnerability Component	Score
Sensitivity	Moderate-high
Exposure	High
Adaptive Capacity	Low
Vulnerability	**Moderate-high**

Overall vulnerability of the blunt-nosed leopard lizard was scored as moderate-high. The score is the result of moderate-high sensitivity, high future exposure, and low adaptive capacity scores.

Key climate factors for the blunt-nosed leopard lizard include air temperature, precipitation amount and timing, drought, and soil moisture. Air temperature regulates surface foraging, while precipitation and drought influence prey abundance and vegetation structure, impacting lizard foraging behavior, growth, and recruitment.

Key non-climate factors for blunt-nosed leopard lizards include urban/suburban development, land use change (agricultural and oil development), impervious surfaces, renewable energy development, invasive grasses, and poisons and pollution. Agricultural, urban, and oil development have destroyed and fragmented lizard habitats, and proposed solar development is a more recent threat to habitat continuity and quality. Impervious surfaces (roads) increase vulnerability to vehicular strikes, insecticides cause direct mortality, and invasive grasses reduce habitat quality by altering vegetation cover and density.

Key disturbance mechanisms for this species include wildfire, flooding, wind, and grazing. Wildfire eliminates shrub habitat and can promote invasive grass dominance, and flooding can drown lizards in burrows. Grazing has variable impacts, but is likely an important management tool for mitigating invasive grass cover.

Blunt-nosed leopard lizards display a mid-range reproductive strategy; they take 1-2 years to reach reproductive maturity, and egg clutches usually consist of 2-6 eggs, although annual recruitment varies according to environmental conditions. Blunt-nosed leopard lizards are

habitat and prey specialists; they eat primarily insects, rely on an open habitat structure with sparse vegetation, and utilize burrows created by the California ground squirrel (Otospermophilus beecheyi) or kangaroo rats (Dipodomys spp.).

Blunt-nosed leopard lizards have fragmented and declining populations, which, when paired with low dispersal ability, undermines genetic exchange and migration potential in the face of climate change or other disturbance. Several landscape barriers, including agricultural and rangeland practices, urban development, energy production, invasive species, and geologic features, further undermine population connectivity. This species has low intraspecific species diversity, although it may exhibit slight behavioral and life history diversity in response to variable environmental conditions. Continued decline of this species, even with federal listing and active recovery efforts, indicate that it may not be very resilient to current stresses.

Management potential for blunt-nosed leopard lizards was scored as moderate. Management options may include regulatory support from the Endangered Species Act and the California Endangered Species Act, habitat preservation, enhancing patch size and habitat connectivity, and grazing management to mitigate invasive species impacts.

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Introduction

Description of Priority Natural Resource

The blunt-nosed leopard lizard (*Gambelia sila*) is endemic to the San Joaquin Valley of California, including in the adjacent Coast Range foothills, Cuyama Valley and Carizzo Plain. It occupies desert grassland and shrub habitats (U.S. Fish and Wildlife Service 1998).

As part of the Central Valley Landscape Conservation Project, workshop participants identified the blunt-nosed leopard lizard as a Priority Natural Resource for the Central Valley Landscape Conservation Project in a process that involved two steps: 1) gathering information about the species group's management importance as indicated by its priority in existing conservation plans and lists and, 2) a workshop with stakeholders to identify the final list of Priority Natural Resources, which includes habitats, species groups, and species.

The rationale for choosing the blunt-nosed leopard lizard as a Priority Natural Resource included the following: the species group has high management importance, the species group's conservation needs are not entirely represented within a single priority habitat, and because the species is an indicator for species that rely on intact non-grassland habitats in the San Joaquin Valley and Tulare Basin. Please see Appendix A: "Priority Natural Resource Selection Methodology" for more information.

Vulnerability Assessment Methodology

During a two-day workshop in October of 2015, 30 experts representing 16 Central Valley resource management organizations assessed the vulnerability of priority natural resources to changes in climate and non-climate factors, and identified the likely resulting pressures, stresses, and benefits (see Appendix B: "Glossary" for terms used in this report). The expert opinions provided by these participants are referenced throughout this document with an endnote indicating its source[1]. To the extent possible, scientific literature was sought out to support expert opinion garnered at the workshop. Literature searches were conducted for factors and resulting pressures that were rated as high or moderate-high, and all pressures, stresses, and benefits identified in the workshop are included in this report. For more information about the vulnerability assessment methodology, please see Appendix C: "Vulnerability Assessment Methods and Application." Projections of climate and non-climate

change for the region were researched and are summarized in Appendix D: "Overview of Projected Future Changes in the California Central Valley".

Vulnerability Assessment Details

Climate Factors

Workshop participants scored the resource's sensitivity to climate factors and this score was used to calculate overall sensitivity. Future exposure to climate factors was scored and the overall exposure score used to calculate climate change vulnerability.

Climate Factor	Sensitivity	Future Exposure
Air temperature	High	High
Extreme events: drought	High	High
Increased wildfire	-	Moderate
Precipitation (amount)	High	High
Precipitation (timing)	Moderate-high	-
Soil moisture	High	-
Overall Scores	**High**	**High**

Changes in temperature, precipitation, and drought can affect blunt-nosed leopard lizard habitat quality, foraging opportunities, and vulnerability to invasive grasses (U.S. Fish and Wildlife Service 2010). Shifts in grassland, shrubland, and desert habitat availability may affect blunt-nosed leopard lizard populations. Modeling by Gardali et al. (2012) projects that grassland habitat in the San Joaquin Valley may decline 6-11% by 2070 due to warmer winter temperatures and variable precipitation, leading to overall drier conditions. Additionally, Thorne et al. (2016) project that the eastern edge of the Central Valley, particularly in the southern portion of the study region, is projected to become climatically unsuitable for grasslands under drier conditions. Projections also indicate that saltbrush shrubs (*Atriplex* spp.) in the Central Valley may become stressed and the region may no longer be climatically suitable for these shrubs by the end of the century if warmer and wetter conditions prevail (Thorne et al. 2016). Comparatively, projections indicate that under hotter and drier conditions, some current saltbrush habitat may remain climatically suitable, although habitat losses will still occur (Thorne et al. 2016).

Air temperature

Sensitivity: *High (high confidence)*
Future exposure: *High (high confidence)*

Potential refugia: *Coastal valleys, altitudinal changes. Panoche Hills, Carrizo Plain.*

Regardless of changes in precipitation, warmer temperatures are expected to increase evapotranspiration and cause drier conditions (Cook et al. 2015).

Air temperature moderates spring lizard emergence and above-ground lizard activity, with optimal foraging temperatures ranging from 74-104°F; peak foraging activity occurs when air temperatures are between 77-95°F (U.S. Fish and Wildlife Service 1985). Increased air temperatures may allow more lizard foraging activity in marginal habitat[1]. Smaller and/or younger lizards have a wider temperature tolerance and activity period than adults, frequently emerging from hibernation earlier, entering hibernation later, and foraging longer each day than adults (Montanucci 1965). For example, adults typically retreat to burrows and enter a dormancy period in August or September, while sub-adults forage until October or November (U.S. Fish and Wildlife Service 1998; Germano & Williams 2005). Air temperature also affects courting behavior[1].

Drought

Sensitivity: *High (high confidence)*
Future exposure: *High (high confidence)*
Potential refugia: *Panoche Hills and Carrizo Plain.*

Compared to the preceding century (1896-1994), drought years in California have occurred twice as often in the last 20 years (1995-2014; Diffenbaugh et al. 2015). Additionally, the recent drought (2012-2014) has been the most severe drought on record in the Central Valley (Williams et al. 2015), with record accumulated moisture deficits driven by high temperatures and reduced, but not unprecedented, precipitation (Griffin & Anchukaitis 2014; Williams et al. 2015). Additionally, the frequency and severity of drought is expected to increase due to climate change over the next century (Hayhoe et al. 2004; Cook et al. 2015; Diffenbaugh et al. 2015; Williams et al. 2015), as warming temperatures exacerbate dry conditions in years with low precipitation, causing more severe droughts than have previously been observed (Cook et al. 2015; Diffenbaugh et al. 2015). Recent studies have found that anthropogenic warming has substantially increased the overall likelihood of extreme California droughts, including decadal and multi-decadal events (Cook et al. 2015; Diffenbaugh et al. 2015; Williams et al. 2015). More frequent and severe drought is likely to impact blunt-nosed leopard lizard survival, growth, and recruitment (Germano et al. 1994; Germano & Williams 2005).

Drought periods limit herbaceous growth and insect prey availability, impacting blunt-nosed leopard lizard activity, reproduction, and growth. For example, during a one-year drought period in 1990 on Elkhorn Plain, adult blunt-nosed lizards did not emerge from burrows during the season (Germano et al. 1994; Germano & Williams 2005), above-ground activity of yearlings was shorter than average (Germano & Williams 2005), and yearlings did not breed (Germano et al. 1994). Adult blunt-nosed leopard lizards are able to withstand severe drought periods by entering into and remaining in dormancy for up to 22 months, but prolonged droughts could affect survival, growth, and recruitment for this species (Westphal et al. 2016), particularly for younger individuals with limited fat stores (Germano et al. 1994; Germano & Williams 2005).

For example, field surveys across the species' range in 2014 indicate that the 2012-2014 drought may have contributed to recruitment failure at some sites known to have previously supported lizard populations. When combined with human water withdrawals and increasing habitat fragmentation, severe drought has the potential to extirpate local populations. Recent surveys following the 2012-2014 drought indicate that potential drought refugia for this species exists in the Panoche Valley region, the Carrizo Plain National Monument, the Tejon Ranch region, and the eastern San Joaquin Valley (i.e., Pixley National Wildlife Refuge; Westphal et al. 2016).

Precipitation (amount)

Sensitivity: *High (high confidence)*
Future exposure: *High (moderate confidence)*

Precipitation volume, along with precipitation timing, influences herbaceous vegetation cover and prey availability, affecting blunt-nosed leopard lizard behavior, reproduction, and growth. Blunt-nosed leopard lizards appear to thrive best under moderate annual rainfall regimes, as consecutive years of average to above-average precipitation increases tall grass cover and thatch depth, which impedes lizard locomotion, predator evasion, and foraging (Montanucci 1965; Germano & Williams 2005), contributing to population declines (Germano & Williams 2005). Comparatively, low precipitation years reduce herbaceous vegetation productivity and arthropod populations, negatively impacting lizard foraging and reproductive activity (Germano et al. 1994).

Soil moisture

Sensitivity: *High (high confidence)*

Lower soil moisture as a result of reduced winter precipitation could reduce blunt-nosed leopard lizard egg laying and egg survival, but more definitive studies are needed (Westphal et al. 2016).

Precipitation (timing)

Sensitivity: *Moderate-high (high confidence)*

Low winter precipitation may reduce neonate blunt-nosed leopard lizard recruitment; recent range-wide surveys have shown that areas without juvenile blunt-nosed leopard lizards experienced less winter precipitation than areas with juveniles (Westphal et al. 2016). Winter precipitation is also particularly important for herbaceous annual plant germination, and years with average to above-average winter precipitation are correlated with higher plant productivity and arthropod prey availability, contributing to higher lizard foraging and reproductive potential (Germano et al. 1994). Higher resource availability increases the percentage of breeding females, the number of egg clutches laid per female per year, and juvenile growth (Germano & Williams 2005).

Non-Climate Factors

Workshop participants scored the resource's sensitivity and current exposure to non-climate factors, and these scores were then used to assess their impact on climate change sensitivity.

Non-Climate Factor	Sensitivity	Current Exposure
Impervious surfaces	High	Low-moderate
Invasive & other problematic species	High	Moderate-high
Land use change	High	High
Other factors	High	High
Pollution & poisons	High	Moderate
Roads, highways, & trails	Low-moderate	Moderate-high
Urban/suburban development	High	Low
Overall Scores	**High**	**Moderate**

Land use change

Sensitivity: *High (high confidence)*
Current exposure: *High (high confidence)*
Pattern of exposure: *Consistent across the landscape.*

Similar to other Central Valley resources, large portions of historic blunt-nosed leopard lizard habitat were lost to agricultural conversion and irrigation, which replaced 95% or more of natural lands on the valley floor. This conversion caused direct lizard mortality, and also contributed indirectly to mortality by fragmenting and disturbing remnant habitat (U.S. Fish and Wildlife Service 1998). Continued conversion of remnant habitat blocks, particularly on private land, undermines population connectivity and dispersal opportunities (U.S. Fish and Wildlife Service 2010).

Energy production & mining

Sensitivity: *High (moderate confidence)*
Current exposure: *High (high confidence)*
Pattern of exposure: *Localized; Panoche Hills.*

There are several proposed construction projects for solar facilities amongst remnant undisturbed lizard habitat. New energy facilities may further destroy and fragment habitat, increase vulnerability to vehicle strikes, and/or alter habitat quality. For example, they may

alter topography, vegetation patterns, and drainage pathways, and also affect ambient temperature and soil moisture, which could impact foraging opportunities (U.S. Fish and Wildlife Service 2010). Oil development also threatens this species, contributing to direct mortality (e.g., burrow burial during construction, oil exposure, vehicle kills) and habitat fragmentation and disturbance (U.S. Fish and Wildlife Service 1998).

Invasive & problematic species

Sensitivity: *High (high confidence)*
Current exposure: *Moderate-high (high confidence)*
Pattern of exposure: *Consistent across the landscape.*

Invasive annual grasses increase ground cover and thatch depth, reducing the open, sparse characteristics of desert and scrub habitats to which blunt-nosed leopard lizards are adapted. Invasive annual grasses have behavioral, mechanical, and physiological impacts on blunt-nosed leopard lizards; for example, they reduce foraging opportunities and increase vulnerability to predation (Germano et al. 2001). Blunt-nosed leopard lizard populations typically decline during periods of high herbaceous growth (Germano et al. 2012). Common problematic invasives include red brome (*Bromus rubens madritensis*), mouse-tail fescue (*Vulpia myuros*), Arabian grass (*Schismus arabicus*), foxtail (*Hordium murinum glaucum*), soft chess (*Bromus hordeaceus*), and ripgut brome (*Bromus diandrus*). These annual grasses respond quickly to precipitation (Germano et al. 2001), likely enhancing the vulnerability of blunt-nosed leopard lizards to precipitation increases.

Pollution & poisons

Sensitivity: *High (low confidence)*
Current exposure: *Moderate (moderate confidence)*
Pattern of exposure: *Localized; Water/western San Joaquin Valley.*

Insecticides targeted toward agricultural pests (e.g., beet leaf-hopper) can reduce other insect prey for the blunt-nosed leopard lizard. Insecticide application often coincides with key periods of this lizard's life history, including spring reproduction and fall foraging prior to hibernation (U.S. Fish and Wildlife Service 1998).

Impervious surfaces and off-highway vehicles

Sensitivity: *High (high confidence)*
Current exposure: *Low-moderate (high confidence)*
Pattern of exposure: *Consistent across the landscape.*

Blunt-nosed leopard lizards are vulnerable to vehicle strikes by off-highway vehicles and by heavy machinery used in construction or land conversion activities (reviewed in U.S. Fish and Wildlife Service 1998, 2010).

Urban/suburban development

Sensitivity: *High (high confidence)*
Current exposure: *Low (high confidence)*

Pattern of exposure: *Localized; Bahasadu/Coalinga.*

Urban development has contributed to extensive blunt-nosed lizard mortality and habitat loss and fragmentation, and continues to be a threat on private land within the Central Valley. Combined with agricultural development, urban development undermines habitat continuity and dispersal for this species (U.S. Fish and Wildlife Service 2010).

Roads, highways, & trails

Sensitivity: *Low-moderate (moderate confidence)*
Current exposure: *Moderate-high (high confidence)*

Blunt-nosed leopard lizards may utilize roads and roadside ditches in areas with high or dense grass cover (U.S. Fish and Wildlife Service 1985; Warrick et al. 1998), making them vulnerable to vehicle strikes (U.S. Fish and Wildlife Service 2010).

Disturbance Regimes

Workshop participants scored the resource's sensitivity to disturbance regimes, and these scores were used to calculate climate change sensitivity.

Overall sensitivity to disturbance regimes: *Moderate-high (high confidence)*

Wildfire

Future exposure: *Moderate (moderate confidence)*

Wildfires can temporarily reduce annual grass cover and thatch depth, but too-frequent fires prevent native shrub recovery, perpetuate increased invasive plant cover, and can facilitate shifts to annual grassland (Germano et al. 2001, 2012). These wildfire-driven changes degrade habitat quality for the blunt-nosed leopard lizard, decreasing shelter provided by shrubs and altering the open, sparse vegetation structure needed for optimum foraging and predator avoidance (Germano et al. 2001, 2012).

Flooding

Susceptibility to burrow flooding limits blunt-nosed leopard lizard habitat distribution (Montanucci 1965). Habitat availability may be further constrained by human water projects, particularly water-banking facilities, which can flood habitat (U.S. Fish and Wildlife Service 2010).

Grazing

Livestock grazing likely has variable impacts on blunt-nosed leopard lizards. Light to moderate grazing intensities, especially during wet years, may help mitigate invasive grass cover and thatch depth, helping maintain low cover that provides ideal foraging and predator avoidance (Germano et al. 2001; Germano & Williams 2005; Germano et al. 2012). However, high intensity and/or summer grazing may collapse burrows used by lizards or enhance soil erosion and compaction (reviewed in U.S. Fish and Wildlife Service 1998, 2010).

Wind

High wind conditions can reduce shrub habitat utilized by lizards, and undermine lizard viability by limiting foraging and courting ability[1].

Life history and reproductive strategy

Workshop participants scored the resource's life history and reproductive strategy, and these scores were used calculate climate change sensitivity.

> ***Species reproductive strategy, representing generation length and number of offspring**: Mid-range reproductive strategy (high confidence)*
> ***Average length of time to reproductive maturity:** 365-720 days*

Egg clutches, typically consisting of 2-6 eggs, are laid from June-July, and juveniles typically emerge in August-September (Montanucci 1965; Germano & Williams 2005). Females generally produce one egg clutch per year, although if ample resources are available they can lay 2-3 clutches; however, reproduction does not occur during environmentally-stressful years (e.g., drought periods; Germano & Williams 2005; Westphal et al. 2016). These lizards reach sexual maturity in 9-21 months, with females generally maturing faster than males (Montanucci 1965).

Dependency on habitat and/or other species

Workshop participants scored the resource's dependency on habitat and/or other species, and these scores were used calculate climate change sensitivity.

> ***Overall degree of specialization**: High (high confidence)*
> ***Dependency on one or more sensitive habitat types:** High (high confidence)*
> > ***Description of habitat:** Giant kangaroo rat precincts for burrows. Sage scrub desert endemic shrubs.*
> ***Dependency on specific prey or forage species:** High (high confidence)*
> ***Dependency on other critical factors that influence sensitivity:** Moderate (low confidence)*
> > ***Description of other dependencies:** California ground squirrel.*

Blunt-nosed leopard lizards prey primarily on grasshoppers, crickets, moths, and other insects, although they will occasionally eat small lizards. They inhabit open, sparsely vegetated habitat, including desert annual grassland, saltbrush scrub communities, and sink scrub communities (U.S. Fish and Wildlife Service 1998). Shrubs are thought to provide temporary refuge from predators (Montanucci 1965). Blunt-nosed leopard lizards typically use abandoned ground squirrel or kangaroo rat burrows for shelter and reproduction (Montanucci 1965).

Adaptive Capacity

Workshop participants scored the resource's adaptive capacity and the overall score was used to calculate climate change vulnerability.

Adaptive Capacity Component	Score
Extent, Status, and Dispersal Ability	Low
Landscape Permeability	Low
Intraspecific Species Diversity	Low
Resistance	Low
Overall Score	**Low**

Extent, status, and dispersal ability

Overall degree of extent, integrity, connectivity, and dispersal ability: *Low (high confidence)*
Geographic extent: *Endemic to a particular area (high confidence)*
Health and functional integrity: *Declining (high confidence)*
Population connectivity: *Patchy, with some connectivity (high confidence)*
Dispersal ability: *Low (high confidence)*
Maximum annual dispersal distance of species: *Less than 1 km (high confidence)*

The blunt-nosed leopard lizard is endemic to the San Joaquin Valley, with populations historically extending into the Coast Range foothills, Cuyama Valley, and Carizzo Plain (U.S. Fish and Wildlife Service 1998). Extensive agricultural, urban, and oil development have destroyed roughly 85% of blunt-nosed leopard lizard habitat, contributing to formal listing of this species under the Endangered Species Act in 1967 and state listing in California soon after (U.S. Fish and Wildlife Service 1998, 2010). These stressors continue to depress blunt-nosed leopard lizard populations (U.S. Fish and Wildlife Service 2010). Remnant populations are small and fragmented, occurring primarily on undeveloped land (see U.S. Fish and Wildlife Service 1998 for a complete list of extant locations). Some habitat segments are protected and provide habitat continuity, including the Carrizo Plain National Monument, the Semitropic Ridge Preserve, and the Pixley National Wildlife Refuge (U.S. Fish and Wildlife Service 2010). Home ranges for this species are fairly small, with male home ranges being slightly larger than female ranges (10.48 and 4.99 acres, respectively; Warrick et al. 1998).

Landscape permeability

Overall landscape permeability: *Low (high confidence)*
Impact of various factors on landscape permeability:

Urban/suburban development: *High (high confidence)*
Agricultural & rangeland practices: *High (high confidence)*
Invasive & other problematic species: *High (high confidence)*
Geologic features: *High (high confidence)*
Energy production & mining: *Moderate-high (moderate confidence)*

Frequently flooded and/or rocky, steep areas may act as barriers to blunt-nosed leopard lizard dispersal (Montanucci 1965). Habitat fragmentation from urban and agricultural development, energy production, and other human activities also inhibits migration opportunities for this species (U.S. Fish and Wildlife Service 1998, 2010). Off-highway vehicles (OHV) and vehicle traffic could further fragment occupied habitat, and increase mortality during attempted dispersal (reviewed in U.S. Fish and Wildlife Service 1998, 2010). Oil production activities affect this species[1].

Resistance

Resistance to stresses/maladaptive human responses: *Low (high confidence)*

Prolonged hibernation/dormancy may be an important adaptation strategy conferring resilience to adult blunt-nosed leopard lizards during unfavorable environmental periods (Montanucci 1965; Germano & Williams 2005). However, declining populations and continued listing status as an endangered species despite many decades of recovery efforts indicate that overall, the blunt-nosed leopard lizard may not be an inherently resilient species (U.S. Fish and Wildlife Service 1998, 2010).

Species diversity

Overall species diversity: *Low (high confidence)*
Diversity of life history strategies: *Low (high confidence)*
Genetic diversity: *Low (high confidence)*
Behavioral plasticity: *Low (high confidence)*
Phenotypic plasticity: *Low (high confidence)*

Blunt-nosed leopard lizards may exhibit slight behavioral plasticity; for example, they will utilize washes and other open areas within dense grassland home ranges (Warrick et al. 1998). Similarly, they might exhibit some life history diversity, delaying breeding or adjusting annual emergence timing depending on resource availability (Montanucci 1965; Germano & Williams 2005). Blunt-nosed leopard lizards hybridize with the long-nosed leopard lizard (*Gambelia wislizenii*) in the Cuyama Valley, exhibiting different morphology and color patterns; however, these hybrids display reduced fitness and are now isolated from other populations due to climate change and habitat loss (reviewd in U.S. Fish and Wildlife Service 2010). Genetic diversity was historically high amongst different blunt-nosed leopard lizard populations, but there is low contemporary genetic diversity within populations, and inbreeding may be an issue[1].

Other Factors

Overall degree to which other factors affect adaptive capacity: *Low-moderate (low confidence)*

Corvids

Corvids

As generalist predators known to occasionally prey upon blunt-nosed leopard lizards, increasing raven (*Corvus corax*) populations in the Central Valley could increase blunt-nosed leopard lizard mortality rates and undermine recovery efforts for this species (Davis 2014).

Management potential

Workshop participants scored the resource's management potential.

Management Potential Component	Score
Species value	Low-moderate
Societal support	Moderate
Agriculture & rangeland practices	High
Extreme events	Low
Converting retired land	High
Managing climate change impacts	Moderate
Overall Score	**Moderate**

Value to people

Value to people: *Low-moderate (high confidence)*
Description of value: *Aesthetics - beautifully colored, large lizards.*

Support for conservation

Degree of societal support for management and conservation: *Moderate (high confidence)*
Description of support: *Regulatory and legislative support, fully protected by the California Department of Fish and Wildlife, and has some support from the U.S. Fish and Wildlife Service.*

Degree to which agriculture and/or rangelands can benefit/support/increase resilience: *High (high confidence)*
Description of support: *Rangelands, not agriculture, can support this species. Grazing reduces non-native grasses and thatch that are detrimental to this species.*

Degree to which extreme events (e.g., flooding, drought) influence societal support for taking action: *Low (high confidence)*

Likelihood of converting land to support species

Likelihood of (or support for) converting retired agriculture land to maintain or enhance species: *High (high confidence)*
Description of events: *Fee title sale of natural lands to BLM conservation easements.*

Likelihood of managing or alleviating climate change impacts: *Moderate (moderate confidence)*

This species has some regulatory support under the Endangered Species Act and state endangered species status (U.S. Fish and Wildlife Service 1998, 2010). Protecting and enhancing connectivity between blunt-nosed leopard lizard habitats is likely an important strategy to maintain genetic diversity and provide migration options in the face of habitat loss due to climate change or non-climate-related stresses (U.S. Fish and Wildlife Service 2010). For example, connecting existing drought refugia with less drought-resilient habitat patches will allow this species to access refugia during dry years and recolonize marginal habitat areas during years with higher precipitation (Westphal et al. 2016). On currently protected lands, managed grazing can likely help mitigate invasive grass impacts under variable rainfall regimes (Germano et al. 2001; Germano & Williams 2005; Germano et al. 2012). Habitat protection should prioritize protecting large land parcels with extant populations and enhancing the size of smaller land parcels, as blunt-nosed leopard lizard abundance appears to be correlated with patch size (Bailey & Germano 2015). This species has been shown to recolonize agricultural lands if left uncultivated for several decades (U.S. Fish and Wildlife Service 1985).

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