Critical Species LookBook

A compendium of California's threatened and endangered species for sustainable groundwater management

August 2019

Audubon | California Department of Fish and Wildlife | The Nature Conservancy | NOAA Fisheries | UC Davis

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Recommended Citation

Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California.

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Abbreviations and Acronyms

CNDDB	California Natural Diversity Database
CCR	California Code of Regulations
CESA	California Endangered Species Act of 1970
DFW	California Department of Fish and Wildlife (formerly, California Department of Fish and Game)
DO	dissolved oxygen
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
ESA	United States Endangered Species Act of 1973
ESU	Evolutionarily Significant Unit
GDE	Groundwater Dependent Ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
NC Dataset	Natural Communities Commonly Associated with Groundwater Dataset
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service (NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
SGMA	Sustainable Groundwater Management Act
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies
TNC	The Nature Conservancy
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
var.	variety

Units of Measurement

^{o}C	degrees Celsius
cfs	cubic feet per second
cm	centimeter
^{o}F	degrees Fahrenheit
fps	feet per second
ft	feet
ha	hectare
in	inches
m	meters
m^2	square meters
m/sec	meters per second
mg/L	milligrams per liter
mi	mile(s)
NTU	nephelometric turbidity units
ppm	parts per million
ppt	parts per thousand
µg/L	micrograms per liter
µS/cm	microSiemens

Overview

California is considered one of the world's top 25 biodiversity hotspots (Myers et al. 2000), containing more species of plants and animals than the rest of the United States and Canada combined (Calsbeek et al. 2003). For more than 200 years, California's natural ecosystems have been converted to other land uses, largely agricultural and urban. This landscape modification, in combination with massive hydrologic alterations (e.g., dams, surface water diversions, and groundwater pumping), has resulted in a ~95 percent reduction in the historical extent of California's aquatic and wetland habitats (Warner & Hendrix 1984; Moyle & Williams 1990; Moyle & Leidy 1992; Seavy et al. 2009).

Subsequently, >90 percent of all native freshwater species—particularly fish, amphibians, reptiles, and mollusks—endemic to California are vulnerable to extinction (Moyle et al. 2011; Moyle et al. 2013; Howard et al. 2015) within the next 100 years. To prevent this from happening, resource management must be adapted to address these landscape-scale changes and the negative effects of climate change.

Habitats ranging from mountains to deserts rely on groundwater resources, especially during the dry summer months.

Groundwater is critical for California's natural ecosystems, from plants and animals found in mountain and desert springs to those living in coastal wetlands. During dry summers and droughts, groundwater sustains streams, springs, and seeps and provides plant roots with a reliable water source when surface water is limited or inaccessible. These groundwater dependent ecosystems (GDEs) — which include species and ecological communities that rely on groundwater for some or all of their water requirements — are important beneficial users[1] of groundwater within California's 517 alluvial basins. If the connection between these ecosystems and groundwater is lost as a result of drought or unsustainable pumping practices, then streams, wetlands, and springs can be depleted. Vulnerable species that lose access to groundwater are put at great risk and may even become extinct.

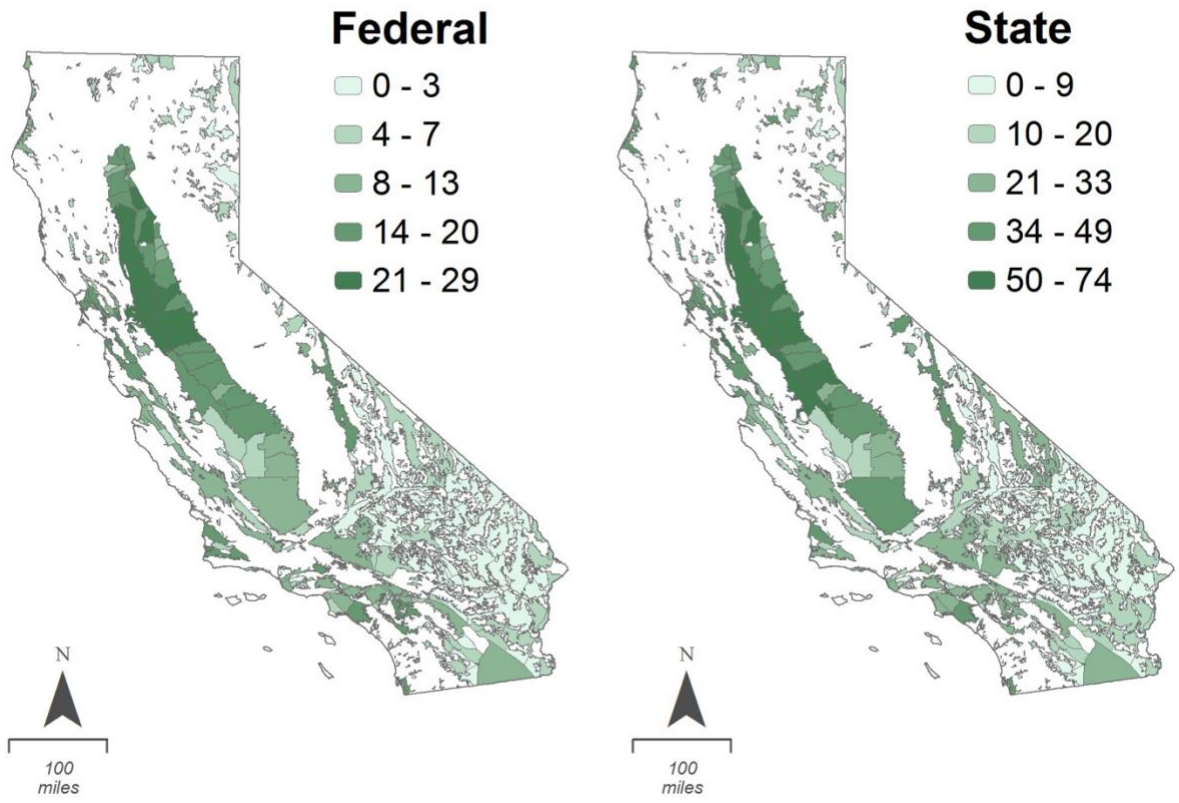


Figure 1. Number of threatened or endangered species in each of California's groundwater basins that are federally and state listed[2]

[1] GDEs are widely considered to be "beneficial uses" of groundwater. The GSP Regulations Definitions (23 CCR §351) adopt, by reference, the definitions of Bulletin 118, 2003. Bulletin 118, 2003, definitions are contained in the Glossary on page 215 and "beneficial use" is specifically defined as "one of many ways that water can be used either directly by people or for their overall benefit. The State Water Resources Control Board recognizes 23 types of beneficial use with water quality criteria for those uses established by the Regional Water Quality Control Boards." There are 23 beneficial use designations specified in Appendix E of Bulletin 118, 2003, on pages 239–240, including nine designations that fall within the GSP Regulations definition of GDEs.

[2] Data Source: California Freshwater Species Database

Objectives and Approach

This Critical Species LookBook is a compendium of 84 state and federally listed species that are likely to be affected by groundwater management and merit consideration by Groundwater Sustainability Agencies (GSAs) under the Sustainable Groundwater Management Act (SGMA). The main goal of this document is to synthesize the best available groundwater-relevant information for each species to ensure that their water needs are adequately considered when developing Groundwater Sustainability Plans (GSPs).

Under SGMA, conservation biologists and water resource managers will need to overcome professional knowledge barriers to sustainably manage California's water. This document is intended to help facilitate two-way communication by:

1) providing information about listed species found in groundwater basins for GSAs and their consultants to consider when developing GSPs, and

2) motivating academic researchers, non-governmental organizations (NGOs), and government resource agencies to expand research and monitoring of groundwater-reliant listed species.

Coast redwood forests are an example of groundwater-dependent vegetation type that provides important habitat for critical species such as California condors and marbled murrelets.

This document was developed with expert opinion and review from more than 90 professionals at federal and state agencies, academia, technical consultancy firms, NGOs, and local water agencies with either an expertise in a particular species or in water management.

Each critical species featured within this compendium contains an entry with the following fields:

Protected Status

Indicates whether the species has either threatened or endangered status under

- the federal Endangered Species Act of 1973 [ESA; 16 U.S.C. §1531 et seq.] (An up-to-date species list can be found here: (https://www.fws.gov/endangered), or
- the California Endangered Species Act of 1970 [CESA; Fish and Game Code § 2050 et seq.] (An up-to-date species list can be found here: (https://www.dfg.ca.gov/wildlife/nongame/t_e_spp).

Reliance on Groundwater

Specifies whether the species has a direct or indirect reliance on groundwater (for more details see page 12), along with a one- to two-sentence description on how it is potentially reliant on this resource. Where the reliance on groundwater is poorly understood, it will state “This species has no known reliance on groundwater.”

Distribution in California

A short description of which geographies the species inhabit.

Habitat

A short description of the species’ habitat requirements.

Associated Vegetation

A list of plant species that provide food or habitat for the species.

Groundwater-Related Threats

A short description of how groundwater management could have a negative impact on the species (e.g., reduced instream flow and water quality due to surface water depletions in spawning areas during the late-summer months).

Hydrologic Indicators

A table with quantitative hydrologic targets is available for some species that are directly reliant on groundwater. The values in the table are likely to vary by location and are intended to serve as starting points. It is best if they are confirmed by a biological expert with local knowledge. A table with quantitative targets is not available for species that are indirectly reliant on groundwater. Instead, a short description of the hydrological indicators best suited for monitoring potential negative groundwater-related impacts on these species is included. For example, willow flycatchers, which are dependent upon *Salix* spp. (willow) trees for habitat, could be protected against indirect groundwater impacts by monitoring changes in willow habitat extent/growth, and groundwater level thresholds could be set based on the those that support willow trees.

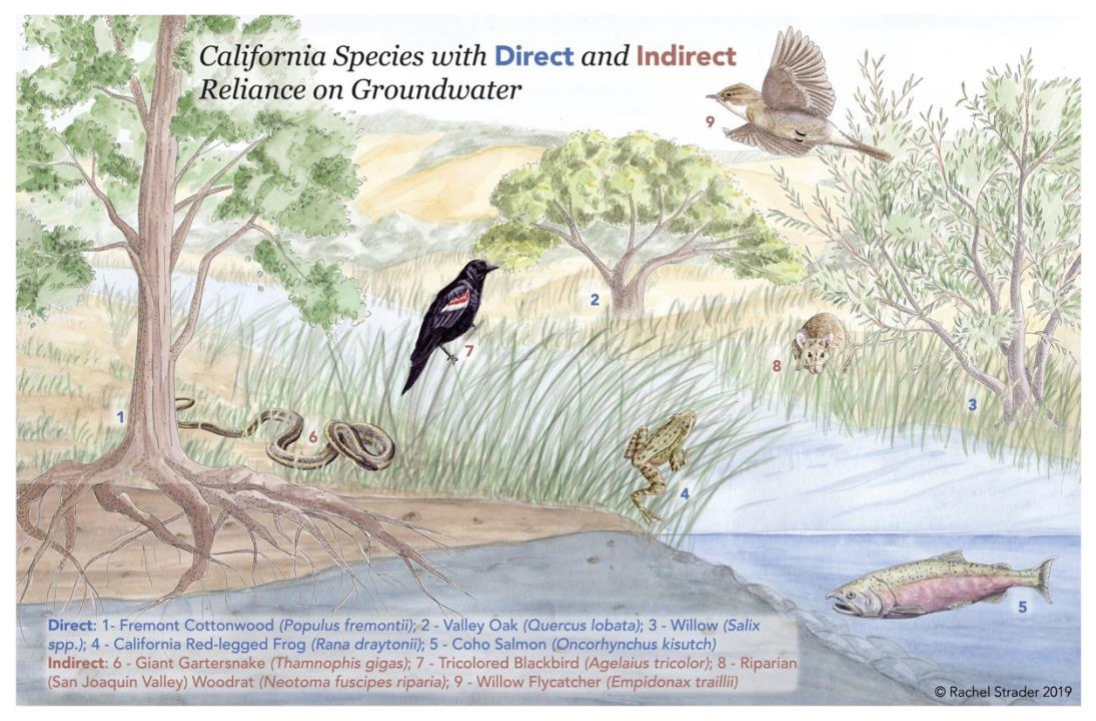
Groundwater Reliance

Plant and animal species can rely on groundwater directly or indirectly for water, nutrients, and stable temperatures. Groundwater reliance can be continuous, seasonal, or occasional (e.g., a few months out of a year), and becomes most apparent when a species loses access to groundwater long enough to display a negative response (e.g., reduced growth or reproduction, mortality).

Some species, such as those that rely on springs, may respond dramatically because springs are completely dependent upon groundwater. For other species, groundwater reliance can be more difficult to discern because a combination of water sources (e.g., groundwater, surface water, precipitation, irrigation return flow, stormwater runoff) are used simultaneously or in different seasons or life stages.

For example, when anadromous fish such as salmon return from the sea to spawn in rivers, their direct reliance on groundwater varies as they go through different life stages. At the mouth of the river, where salmon migration primarily occurs, groundwater baseflow is less critical compared to the upper reaches of the river, where juvenile rearing depends on the cool water temperatures provided by groundwater baseflow.

Because a species' water needs can be very site-specific, determining groundwater reliance locally is advised. In cases where there is no known reliance on groundwater due to data gaps, a conservative approach is advised.



Direct: Some species rely directly on groundwater for some or all of their water needs. Examples include: species inhabiting spring ecosystems (e.g., black toad), phreatophytes that rely on groundwater uptake through their roots during the dry season (e.g., willows, oaks), and anadromous fish that rely on groundwater baseflow into streams for juvenile rearing and spawning (e.g., Chinook salmon, steelhead).

Indirect: Some species rely indirectly on groundwater to support their habitat and forage requirements. Examples include riparian birds (e.g., willow flycatcher) that depend on specific groundwater-dependent vegetation (e.g., willow, cottonwood).

SGMA and the Environment

SGMA was one of the largest water reforms in California's history, empowering new local agencies, known as GSAs, to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. To balance these multiple priorities, SGMA requires that all beneficial groundwater uses and users—including environmental users —be considered in the development and implementation of GSPs (Water Code § 10723.2).

The GSP Regulations[3] include specific requirements to identify and consider impacts to beneficial uses and users of *groundwater*, including GDEs[4], as well as to beneficial uses and users of *surface water*, including environmental uses of interconnected surface water[5]. GSAs must evaluate whether groundwater conditions may have adverse impacts on these beneficial uses and users, with potentially undesirable results. Under SGMA, undesirable results occur when effects of groundwater conditions throughout the basin are deemed by locals to be "significant and unreasonable."

Because sustainable groundwater management is defined under SGMA as the absence of undesirable results, avoiding significant and unreasonable effects is critical. To protect against these undesirable results, GSAs must develop sustainable management criteria, including minimum thresholds[6] and measurable objectives[7].

Avoiding adverse impacts to the environment and preventing undesirable results are especially important where the conservation of species and habitats within GDEs and interconnected surface waters are required by other federal and state laws[8] (Table 1). Complying with these laws is likely to extend beyond the purview of GSAs and will require coordination with other agencies to ensure SGMA implementation does not preempt these existing laws.

[3] All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2 (23 CCR § 350 et seq.), available from https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainability-Plans.

[4] Groundwater dependent ecosystems are defined under SGMA as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" —23 CCR §351(m).

[5] Interconnected surface water is defined under SGMA as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted" —23 CCR §351(o).

[6] Minimum threshold is defined under SGMA as "a numeric value for each sustainability indicator that is used to define undesirable results" —23 CCR §351(t).

[7] Measurable objectives are defined under SGMA as "specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin" —23 CCR §351(s).

[8] Preemption of SGMA is referenced in Water Code § 10720.3(d) and Water Code § 10720.5(b).

Table 1. Environmental Laws Relevant to SGMA[9]

Federal	State	Local
The Clean Water Act	Public Trust Doctrine	County and other local groundwater regulation ordinances (e.g., basin management plans, general waste discharge requirements)
The Rivers and Harbors Act of 1899	Porter-Cologne Water Quality Act	
The Endangered Species Act	Fish and Game Code	
The Comprehensive Environmental Response, Compensation and Liability Act	Surface Mining and Reclamation Act of 1975	
The Fish and Wildlife Coordination Act	California Endangered Species Act	
The National Environmental Policy Act	California Environmental Quality Act	

Mesquite is type of groundwater-dependent vegetation that supports a number of the critical species in California's more arid environments.

[9] For more details, refer to the GDE Guidance Document (Rohde et al. 2018)

Species Selection

The 84 species featured in this Critical Species LookBook are species protected under federal or state law that are potentially groundwater-dependent. The final list of species was derived using a geographic information system (ArcGIS) to identify critical species (California Natural Diversity Database; CNDDB) found in ecosystems commonly associated with groundwater (Natural Communities Commonly Associated with Groundwater Dataset; NC Dataset) and freshwater species (California Freshwater Species Database) found in surface water features that may or may not be interconnected with groundwater. This document assumes that surface water systems are fed by groundwater unless otherwise known; however, the connection between groundwater and surface water needs to be determined locally.

Threatened and endangered species were selected from the combined dataset[10]. For simplicity, only descriptions of amphibians and reptiles, birds, fish, and mammals were included in this compendium. Appendix I provides a list of additional types of listed species that were omitted: crustaceans (Table A1), insects (Table A2), and plants (Table A3).

In addition, there may be other critical species (e.g., Species of Special Concern[11]) that should be considered, particularly those that wholly depend on groundwater for their existence but were not included in this compendium (see Appendix II for a list). Lastly, any species that have been extirpated or are no longer threatened or endangered in California were also removed from the final list.

Data used to identify potentially groundwater-dependent protected species are described below. Since a species' reliance on groundwater can vary temporally or spatially across California's basins, groundwater reliance needs to be locally confirmed.

California Freshwater Species Database
https://www.scienceforconservation.org/products/california-freshwater-species-database
This freshwater species database of 3906 freshwater-dependent taxa historically found in California is derived from ~400 data sources that include locality observations or distribution information of mammals (*n=6*), fish (*n=130*), birds (*n=105)*, herpetofauna (*n=62*), invertebrates (*n=2777*), and vascular plants (*n=826*). These are species that depend on freshwater for at least one stage of their life history. For more details on the methods used to compile the California Freshwater Species Database, refer to Howard et al. 2015.

California Natural Diversity Database (CNDDB)
https://www.wildlife.ca.gov/data/cnddb
The CNDDB is an inventory of the status and locations of rare plants and animals in California. Species data used in this LookBook are from the January 2018 CNDDB database. Subscribers

[10] All duplicates were removed. Most duplications occurred because the California Freshwater Species Database included data from the CNDDB.

[11] The DFW maintains a list and account for Species of Special Concern online. Available from https://www.wildlife.ca.gov/Conservation/SSC.

can download CNDDB spatial data as a shapefile or access it via the BIOS Data Viewer at https://www.wildlife.ca.gov/Data/CNDDB/Maps-and-Data.

Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset)
https://gis.water.ca.gov/app/NCDatasetViewer/
The NC Dataset is a compilation of 48 publicly available state and federal agency datasets that map 98,275 vegetation, wetlands, springs, and seeps commonly associated with groundwater in California's basins[12].

Groundwater Basins (2016)
https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer
California's 517 groundwater basins are delineated for alluvial aquifers and are officially described in Bulletin 118[13].

Both adult spawners as well as juvenile Chinook salmon rely on groundwater-fed streams to provide the water quality, temperature, and volume they need to survive and breed.

[12] For more details on the mapping methods, refer to Klausmeyer K, Howard J, Keeler-Wolf T, Davis-Fadtke K, Hull R, Lyons A. 2018. Mapping indicators of groundwater dependent ecosystems in California: Methods report. San Francisco, California. Available from https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf.

[13] Bulletin 118 is available from https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118.

How to Use This Compendium Under SGMA

Avoiding significant and unreasonable adverse effects on environmental beneficial users of groundwater and surface water under SGMA, especially those protected under other federal and state laws, depends on the following:

- Identifying and mapping areas within a basin where groundwater supports interconnected surface waters;
- Identifying and mapping species and habitat areas that are environmental beneficial users of groundwater or interconnected surface water in the basin;
- Determining what groundwater conditions are necessary to prevent adverse effects on environmental beneficial users of groundwater or interconnected surface water in the basin;
- Determining how historical, current, and future groundwater conditions differ from the groundwater conditions environmental beneficial users of groundwater or surface water require; and
- Identifying which indicators can be incorporated into monitoring networks to track whether environmental beneficial users are experiencing adverse effects due to groundwater conditions.

Consistent with SGMA's emphasis on local control, this document is designed to inform local planning and decision-making. The following couple steps, and the information contained within this compendium, provide the best available information on how GSAs can meet SGMA requirements, or even go beyond the actions required by SGMA to sustain and improve groundwater conditions for legally protected species.

Step 1. Determine which freshwater species in the California Freshwater Species Database are in your basin.

Visit The Nature Conservancy's website www.GroundwaterResourceHub.org to find a list of freshwater species for each groundwater basin that are reliant on either surface water, groundwater,or both. Determine which of those species are legally protected and included in this compendium. Find the locations of those listed species within the basin by accessing or downloading CNDDB spatial data via the BIOS Data Viewer: https://apps.wildlife.ca.gov/bios/.

Step 2. Incorporate listed species information into GSPs.

Table 2 provides specific information on how to consider listed species in GSPs. Other tools and datasets that may be useful in considering legally protected species include:

- **NC Dataset:** https://gis.water.ca.gov/app/NCDatasetViewer/
  Some of the vegetation associated with a critical species may be dependent on groundwater and mapped in the NC dataset. Refer to this dataset to evaluate where associated vegetation overlaps with critical species locations.

- **Plant Rooting Depth Database:** https://groundwaterresourcehub.org/gde-tools/gde-rooting-depths-database-for-gdes/

Rooting-depth information for most groundwater-dependent vegetation species can be found on TNC's Rooting Depth Database. This information can provide a preliminary indication of the groundwater levels that may be necessary to protect vegetation associated with a listed species' habitat, but needs to be used with care, since rooting-depth data are site-specific.

- **GDE Pulse:** https://gde.codefornature.org/
  GDE Pulse is a free, online tool that allows users to assess changes in vegetation growth and moisture content. It provides 35 years of satellite imagery from NASA's Landsat mission for every NC Dataset polygon, local precipitation data, and depth to groundwater measurements from nearby shallow monitoring wells for every NC dataset polygon.

- **Numerical Groundwater and Surface Water Models**
  Determine what groundwater levels and gradients are necessary to prevent adverse impacts on legally protected species by inputting measurable hydrological condition targets—such as stream flow requirements along a particular reach, or groundwater levels for associated vegetated areas—into the basin's numerical groundwater model. When establishing sustainable management criteria in the basin, minimum thresholds should consider which groundwater conditions are necessary to prevent adverse impacts on environmental beneficial users, especially those with additional legal protections. Depending on the sustainability goal(s) for the basin, measurable objectives can be established to recover pre-SGMA groundwater conditions that mitigate or restore habitat for protected species.

Table 2. Incorporating listed species, and other species of concern, into Groundwater Sustainability Plans

GSP Outline[14]	GSP Regulations[3]	What to include?
2.1.5 Notice & Communications	23 CCR §354.10	When describing beneficial users of groundwater, explicitly specify which listed species (and others such as Species of Special Concern[10]) are present in the basin.
2.2.2 Current & Historical Groundwater Conditions	23 CCR §354.16(g)	• When identifying groundwater-dependent ecosystems within the basin, specify whether listed species are present in mapped groundwater-dependent ecosystem areas. • When identifying interconnected surface water systems within the basin, specify whether listed species are present in mapped interconnected surface water areas.
3.3 Minimum Thresholds	23 CCR §354.28	• Determine what groundwater conditions are necessary to prevent adverse impacts to legally protected species. • Describe any differences between the selected minimum thresholds and the state, federal, or local standards relevant to the listed species and their habitats residing in GDEs or aquatic ecosystems dependent on interconnected surface waters.
3.4 Undesirable Results	23 CCR §354.26	Evaluate how the mapped location of listed species in the basin and the measurable hydrological conditions they require relate to groundwater conditions: • Incorporate measurable hydrological conditions into the basin's groundwater models to determine the groundwater levels or water quality conditions that are required to meet the species' needs. • Consult with biological experts by contacting regional staff from state and federal resource agencies or NGOs.
3.5 Monitoring Network	23 CCR §354.34(b)(2) & 23 CCR §354.34(c)(6)(D)	Identify appropriate biological and hydrological data that can identify and monitor adverse impacts to listed species dependent on groundwater or surface water.
	23 CCR §354.34(f)(3) & 23 CCR §354.38(e)(3)	Adjust monitoring frequency and density to provide adequate levels of detail about site-specific surface water and groundwater conditions to assess the effectiveness of management actions of preventing adverse impacts to listed species.
4.0 Projects and Management Actions	23 CCR §354.44(b)(6)	If projects or management actions rely on water from outside the agency's jurisdiction, an explanation of the source and reliability of that water should also discuss any listed species that are directly linked to it.

[14] In reference to DWR's GSP annotated outline guidance document, available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GD_GSP_Outline_Final_2016-12-23.pdf

Use and Limitations

This document is neither dispensing legal advice nor warranting any outcome that could result from the use of information in this document. The use of this information does not guarantee approval of a GSP or compliance with SGMA, both of which will be determined by the California Department of Water Resources (DWR) and the State Water Resources Control Board.

All references to SGMA relate to California Water Code sections in Division 6, Part 2.74. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2 (23 CCR § 350 et seq.).

This document is not a substitute for SGMA, GSP Regulations, or DWR's Best Management Practices and Guidance Documents[15], but rather, is designed to complement these resources. The information contained here represents the best available science on legally protected species likely to be reliant on groundwater in California at the time of publication. This document is best used with the assistance of biological experts, since the functional range of habitat conditions for species may be site- and species-specific and thus may vary by groundwater basin. Sustainable groundwater criteria that meet the needs of listed species should be developed through deliberations among the GSA and federal, state, and biological experts.

Please contact the following agencies for help with reaching an expert in your local area:

Audubon California
Working Lands Program
workinglandsCA@audubon.org

California Department of Fish and Wildlife
Groundwater Program
groundwater@wildlife.ca.gov

NOAA Fisheries
Rick Rogers
rick.rogers@noaa.gov

The Nature Conservancy
California Water Program
https://groundwaterresourcehub.org/contact-us

[15] DWR's best management practices and guidance documents are available from https://www.water.ca.gov/Programs/Groundwater-Management.

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The LookBook

Amphibians & Reptiles

A-1 | Alameda Whipsnake

Masticophis lateralis euryxanthus

© Bill Stagnaro

Protected Status

Federal	State
Threatened	Threatened

Reliance on Groundwater

Indirect. Alameda whipsnakes rely on native, groundwater-dependent vegetation (e.g., *Quercus* spp.), which they climb into when threatened or pursued by predators.

Distribution in California

The Alameda whipsnake currently inhabits the inner Coast Range primarily in Contra Costa and Alameda Counties, with additional occurrence records from San Joaquin and Santa Clara Counties. The current distribution of this subspecies has been reduced to five separate areas with little or no interchange among them due to habitat loss, alteration, and fragmentation: 1. Sobrante Ridge, Tilden/Wildcat Regional Parks to the Briones Hills, in Contra Costa County (Tilden-Briones population). 2. Oakland Hills, Anthony Chabot area to Las Trampas Ridge, in Contra Costa County (Oakland-Las Trampas population). 3. Hayward Hills, Palomares area to Pleasanton Ridge, in Alameda County (Hayward Pleasanton Ridge population). 4. Mount Diablo vicinity and the Black Hills, in Contra Costa County (Mount Diablo-Black Hills population). 5. Wauhab Ridge, Del Valle area to the Cedar Mountain Ridge, in Alameda County (Sunol-Cedar Mountain population).

Habitat

Alameda whipsnakes use rock outcroppings, stream channels, grasslands, and oak savanna areas; however, they are typically found in chaparral, northern coastal sage scrub, and coastal sage. Recent telemetry data indicate that, although home ranges of Alameda whipsnakes are centered on shrub communities, they have been tracked farther than 500 ft (142 m) into adjacent habitats, including grassland, oak savanna, and occasionally oak-bay woodland.

Associated Vegetation

This species is associated with coastal sage scrub, chaparral, northern coastal scrub, grasslands, oak savanna, and oak-bay woodlands.

Groundwater-Related Threats

The primary threat to these snakes is habitat loss, fragmentation, and degradation due to groundwater conditions that contribute to the loss of native vegetation or its conversion to *Eucalyptus* and other non-native chaparral and shrub communities that do not provide Alameda whipsnake habitat.

Hydrologic Indicators

This species relies on vegetation that may be groundwater-dependent (e.g., oaks). Therefore, monitoring shallow groundwater levels around groundwater-dependent vegetation can help monitor Alameda whipsnake habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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A-2 | Arroyo Toad

Anaxyrus californicus

© William Flaxington

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct and indirect. Arroyo toads depend directly on groundwater for breeding and indirectly on groundwater-dependent vegetation. This toad's specialized breeding habitat needs are supplied by groundwater through shallow, still pools for breeding and juvenile development, and through the support of riparian vegetation that provides the toad's foraging habitat.

Distribution in California

Arroyo toads are found south of Monterey County to northern Baja California in primarily coastal areas west of the desert.

Habitat

Arroyo toads need exposure to sandy stream banks with stable terraces (e.g., washes, arroyos, and sandy riverbanks) and scattered vegetation, as well as areas of very shallow, still, or low-flow pools with sandy or gravel bottoms free of predatory fishes. Damp areas that have less than 10 percent vegetation cover provide the best conditions for juvenile arroyo toad survival and rapid growth. Lower water and soil temperatures and poor algal mat development make heavily shaded pools generally unsuitable for larval and juvenile arroyo toads.

Associated Vegetation

Arroyo toads are associated with riparian vegetation such as *Salix* spp. (willow), *Platanus* spp. (sycamore), *Quercus* spp. (oak), and *Populus* spp. (cottonwood).

Groundwater-Related Threats

These toads are highly vulnerable to habitat destruction and alterations as a result of changes in groundwater levels (caused by human activities, drought, etc.), as they depend on riparian vegetation for foraging and on perennial still pools during at least two summer months for development and metamorphosis.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	4–6 in (10–15 cm)	Female toads lay their eggs in a single annual breeding effort over a sand, gravel, or cobble substrate in this depth of water. Tadpole development and metamorphosis depends on shallow pools with little current or vegetation.

References

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A-3 | Barefoot Gecko

Coleonyx switaki

© John H. Tashjian, California Academy of Sciences

Protected Status

Federal	State
Not Listed	Threatened

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

Barefoot gecko populations occur along the eastern fringe of the Peninsular Ranges from north of San Diego County south toward the Mexican border.

Habitat

The species lives in rocky, desert areas, especially foothills, volcanic talus and terraces, and canyons. It prefers areas with large rocks and sparse vegetation but has been found on flatlands up to 328 ft (100 m) from rock outcrops. It takes refuge in deep crevices among rocks and subterranean chambers.

Associated Vegetation

Barefoot geckos prefer to live in areas of sparse vegetation, and they do not directly use vegetation.

Groundwater-Related Threats

This species has no known reliance on groundwater. The overall feeding habits and diet of barefoot geckos are not well documented. They may obtain water by eating food with high water content or possibly by drinking dew. This species is more highly dependent on the presence of rock formations and rock rubble than on any other ecological factor.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

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A-4 | Black Toad

Anaxyrus exsul

© California Department of Fish and Wildlife

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Not Listed	Threatened	Fully Protected

Reliance on Groundwater

Direct. This species is completely reliant on spring-fed pools.

Distribution in California

With one of the most restricted ranges of all anuran amphibians, the black toad is endemic to Deep Springs Valley, located between the White Mountains and the Inyo Mountains in the high elevation California desert.

Habitat

Black toads have never been reported farther than 39 ft (12 m) from water. Deep Springs Valley is an arid desert environment with several springs in which the toad is found. Colonization of new spring habitats has never been truly demonstrated, and any movement between habitats may be the result of irruptive movements rather than through migration.

Associated Vegetation

This species is associated with spring-fed pools containing open water, *Typha* spp. (cattails), *Schoenoplectus* spp. (bulrush), *Distichlis spicata* (saltgrass), and other aquatic and groundwater-dependent plants.

Groundwater-Related Threats

Groundwater pumping that depletes spring-fed pools can adversely affect this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	6–8 in (15–20 cm)	Eggs generally are laid in the shallower parts of the marsh.

References

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A-5 | Blunt-Nosed Leopard Lizard

Gambelia sila

© California Department of Fish and Wildlife

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

The blunt-nosed leopard lizard is a desert-adapted species found throughout the arid habitats of the southern San Joaquin Valley (San Joaquin Desert). This species only has ~2 percent of their historical habitat remaining.

Habitat

This diurnal species primarily occupies arid grasslands and shrublands where their main prey is grasshoppers. They spend most of their time in extensive underground burrowing systems, except during the breeding season (approximately April through July). Their young are born and come above ground from approximately late July through early October.

Associated Vegetation

This lizard is associated with arid grasslands and shrublands in the San Joaquin Desert.

Groundwater-Related Threats

This species has no known reliance on groundwater. Blunt-nosed leopard lizards are a desert-adapted species that prefer sparse grasslands and shrublands (e.g., valley sink and saltbush scrub). This species is mainly affected by habitat loss as a result of human activity.

Hydrologic Indicators

This species has no known reliance on groundwater.

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A-6 | California Red-Legged Frog

Rana draytonii

© Joyce Gross

Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Direct. This species relies on surface water (e.g., wetlands, streams, perennial springs, natural or artificial ponds) that may be supported by groundwater.

Distribution in California

California red-legged frogs have lost ~70 percent of their historic range. Today, this species is only found in coastal areas and in the Coast Ranges (e.g., Santa Lucia, Gabilan, and Diablo Mountains) from Los Angeles County through Mendocino County, and a few drainages in the Sierra foothills and northern Transverse Ranges. It has essentially disappeared from most of the Sierra foothills and south of the northern Transverse Ranges in Ventura County. However, individuals have been recently discovered in a Riverside County location. Some populations also persist in Baja California.

Habitat

California red-legged frog habitat includes ponds, wetlands, seeps, and upland dispersal and foraging areas between those aquatic features. Upland habitat may be grasslands and/or woody vegetation, and even intensive croplands. Breeding sites are typically in ponds and low-gradient streams with depths of at least 1–2 ft (30–61 cm), emergent or overhanging vegetation for egg attachment, and ample sun exposure. Low-velocity or still water is required so that egg masses do not wash away. Nonbreeding aquatic sites may be the same as the breeding sites, or individuals may move to other aquatic sites when not breeding. California red-legged frogs can persist in intermittent ponds and streams if they can retreat to seeps, spring boxes, or perennial ponds to remain hydrated during the dry season.

Associated Vegetation

Associated aquatic vegetation includes any riparian, emergent, or floating vegetation. The upland vegetation type does not seem to be important.

Groundwater-Related Threats

Any type of aquatic habitat alteration, including water diversions and channelization, will disrupt this species' ability to persist. Drought and extreme weather patterns can cause habitat loss or egg masses to desiccate or be scoured out. Areas in the lower watersheds of coastal plains and Coast Range streams with lower groundwater tables have substantially reduced or eliminated California red-legged frog populations.

Hydrologic Indicators

There are no reported values for groundwater requirements for this species. However, monitoring shallow groundwater levels near interconnected surface waters can ensure that their habitat is not being adversely affected by groundwater conditions in the basin.

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A-7 | California Tiger Salamander

Ambystoma californiense

© California Department of Fish and Wildlife

Protected Status

Federal	State
Threatened	Threatened

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

The California tiger salamander is limited to central California's foothills and grasslands. Additionally, they can be found in the Coast Range from southern San Mateo County to northwestern Santa Barbara County. However, the Santa Barbara population (*Ambystoma californiense "Santa Barbara")* is considered to be endangered and is listed as a separate Distinct Population Segment under the Endangered Species Act, as is the Sonoma County population (*Ambystoma californiense "Sonoma"*).

Habitat

California tiger salamanders inhabit valley and foothill grasslands and the grassy understory of open woodlands, usually within 1 mi (1.6 km) of water. The California tiger salamander is terrestrial as an adult and spends most of its time underground in subterranean refugia. Underground retreats usually consist of ground-squirrel burrows and occasionally human-made structures. Adults emerge from underground to breed, but only for brief periods of time during the first major rainfall events of fall and early winter, returning to upland habitat after breeding. Tiger salamanders breed and lay their eggs primarily in vernal pools and other ephemeral ponds that fill in winter and often dry out in summer. They sometimes use permanent human-made ponds (e.g., stock ponds), reservoirs, and small lakes. During winter, the salamanders will leave their hibernation burrows to feed. They will then migrate up to 1 mi (1.6 km) to vernal breeding pools or seasonal ponds within grasslands to reproduce. The longer the larvae are able to remain in these pools, the more likely they will be to survive and reproduce. During the dry summer and autumn months, the salamanders live in small mammal burrows.

Associated Vegetation

This species is associated with grasslands.

Groundwater-Related Threats

California tiger salamanders have no known reliance on groundwater, unless groundwater depletion reduces the spatial and temporal availability of seasonal ponds, which could prevent larvae from completing their metamorphosis. California tiger salamanders are mainly affected by human-caused habitat loss.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

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A-8 | Coachella Valley Fringe-Toed Lizard

Uma inornata

Protected Status

Federal	State
Threatened	Endangered

Reliance on Groundwater

Indirect. The Coachella Valley fringe-toed lizard is reliant on groundwater-dependent vegetation (e.g., mesquite).

Distribution in California

This species is endemic to the Coachella Valley in Riverside County, California.

Habitat

The Coachella Valley fringe-toed lizard is restricted to sparsely vegetated arid areas with fine, aeolian (wind-blown) sands. The source of this sand is dry desert washes, where fine sediments accumulate after storms, become wind-borne, and are deposited downwind as desert dunes. This species is also found in washes and in flats with sandy hummocks around vegetation. It requires fine, loose sand to burrow.

Associated Vegetation

This lizard is associated with *Prosopis* spp. (mesquite).

Groundwater-Related Threats

Groundwater changes that are harmful to mesquite can threaten this species' habitat, as can human modifications to waterways that block wind and the aeolian processes that form sand dunes. It is critical to maintain open flood corridors that bring water and sand out of canyons, replenish the wind-blown sand feeding the lizards' dune habitat, and contribute to replenishing groundwater to support mesquite and other vegetation.

Hydrologic Indicators

This species relies on the fine wind-blown sand that accumulates around groundwater-dependent vegetation (e.g., mesquite). Monitoring shallow groundwater levels around mesquite helps monitor the health of this plant community, which is critical for the long-term sand and dune formation that provides habitat for the Coachella Valley fringe-toed lizard.

Reference

USFWS. 2011. Coachella Valley National Wildlife Refuge: Coachella Valley fringe-toed lizard. Available from https://www.fws.gov/saltonsea/Coachella/CV_endspecies.html.

A-9 | Desert Tortoise

Gopherus agassizii

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Protected Status

Federal	State
Threatened	Threatened

Reliance on Groundwater

Indirect. The desert tortoise may rely on groundwater-dependent vegetation.

Distribution in California

This species lives in the Mojave and Sonoran Deserts of Southern California.

Habitat

The desert tortoise prefers an arid desert climate and can survive in extreme temperatures. It spends up to 95 percent of its life underground and lives in a variety of habitats, from sandy flats and rocky foothills to alluvial fans, washes, and canyons that have enough soil for it to burrow. It is found at elevations ranging from near sea level to around 3,500 ft (1,067 m) or above.

Associated Vegetation

Most of the desert tortoise's water intake comes from its diet of grasses, wildflowers, cactus pads, wild fruit, and herbs.

Groundwater-Related Threats

Groundwater conditions that alter water availability for groundwater-dependent native plant species can threaten the tortoise's food sources, especially if groundwater conditions result in invasive plant species, like *Brassica tournefortii* (Sahara mustard), outcompeting groundwater-dependent native plant species. In addition, groundwater-development projects are proposed to deliver groundwater from the Mojave Desert to residents of Southern California. There are scientific disagreements over whether these projects will or will not have a significant impact on surrounding desert spring ecosystems, which could directly or indirectly affect water supply for tortoises. Although groundwater development projects in the Mojave Desert may jeopardize nearby springs, tortoises obtain most of their water through their diet.

Hydrologic Indicators

This species relies on vegetation that may rely on groundwater. Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure that these levels are not

adversely affecting this species' food and habitats. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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A-10 | Giant Garter Snake

Thamnophis gigas

© California Department of Fish and Wildlife

Protected Status

Federal	State
Threatened	Threatened

Reliance on Groundwater

Direct and indirect. Giant garter snakes rely on groundwater-supported summer wetlands and groundwater-dependent vegetation. This snake is highly aquatic and needs open water for foraging on fish and frogs, wetland plants for cover, and vegetated banks close to the water for basking in the sun.

Distribution in California

Giant garter snakes are endemic to the Central Valley, including the Sacramento-San Joaquin Delta. They live at elevations up to approximately 400 ft (122 m) from Butte to Kern Counties, but they have been extirpated south of northern Fresno for roughly 30 years. There is an approximately 62-mile (100-km) gap in distribution between San Joaquin and Merced Counties, and the remaining populations in the San Joaquin Valley are sparsely distributed.

Habitat

These snakes are found in natural, restored, and agricultural wetlands and other waterways, including irrigation and drainage canals, ponds, sloughs, low-gradient streams, and adjacent uplands. They are often associated with the rice-growing regions of the Sacramento Valley.

Associated Vegetation

Giant garter snakes use wetland plants (e.g., *Typha* spp. [cattails] and *Schoenoplectus* spp. [bulrush]) for foraging and cover. They also use grassy banks, or banks with at least partial sun and little tall woody vegetation, to bask in the sun, cool down in subterranean refugia, and overwinter.

Groundwater-Related Threats

Giant garter snakes are vulnerable to habitat degradation caused by reduced water availability and quality, which affects their associated vegetation and burrows. Wetland drying in the summer months to promote waterfowl forage and decreased irrigation and rice growing due to water transfers or drought also reduce their available habitat. Substitution of groundwater (with

its lower temperature and sometimes higher concentrations of contaminants like selenium, arsenic, and salts) for surface water could also degrade habitat suitability.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	>12 in (30 cm)	Giant garter snakes forage on fish and frogs (including tadpoles), so they require standing or slow-flowing water during their active season (April to September) to support prey populations and aquatic vegetation.
Water Quality		
Temperature	~85.6°F (29.8°C)	As ectotherms, giant garter snakes require specific temperatures for bodily functions.

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A-11 | Kern Canyon Slender Salamander

Batrachoseps simatus

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Protected Status

Federal	State
Under Review	Threatened

Reliance on Groundwater

Direct and indirect. This species is directly reliant on groundwater from seeps and indirectly reliant on groundwater via shaded areas provided by groundwater-dependent vegetation.

Distribution in California

The Kern Canyon slender salamander is endemic to California. It occurs in small, discrete patches of suitable habitat in a limited number of sites in the lower Kern River Canyon and Kern River tributary canyons with north-facing slopes.

Habitat

This salamander favors habitat in north-facing riparian zones in narrow canyons shaded with *Platanus* spp. (sycamore), *Salix* spp. (willow) and *Populus* spp. (cottonwood) and wooded hillsides supporting *Quercus* spp. (oak) and *Pinus* spp. (pine), including wet creek margins, seeps, and talus. These areas typically do not get sun in winter and remain damp and cool into the spring. Found in moist leaf litter, under rocks and logs, and within crevices in slopes. During dry years, this species retreats to moist underground or seepage areas. They do not inhabit streams or bodies of water, but they are capable of surviving for a short time if they fall into water.

Associated Vegetation

The Kern Canyon slender salamander is associated with *Platanus* spp., *Salix* spp., *Populus* spp., *Quercus* spp., and *Pinus* spp.

Groundwater-Related Threats

Adequate groundwater levels are necessary to provide perennial discharge from seeps and to support associated groundwater-dependent vegetation. The development of water storage facilities in Kern Canyon could pose an additional threat to the area's groundwater.

Hydrologic Indicators

There are no reported values for groundwater requirements for this species. However, monitoring discharge to seeps and shallow groundwater levels that support groundwater-dependent vegetation can ensure this species' habitat is not being adversely affected by groundwater conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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A-12 | San Francisco Garter Snake

Thamnophis sirtalis tetrataenia

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Direct and indirect. This species is reliant on groundwater-dependent vegetation for habitat and groundwater-fed water features for food sources.

Distribution in California

The San Francisco garter snake is primarily found in marshes, ponds, and land refuges in San Mateo County; however, distribution information is unreliable and lacks private property surveys.

Habitat

These snakes are found in densely vegetated ponds; sloughs; and wetlands with shallow, open water near the shoreline and proximate upland grassland habitat.

Associated Vegetation

San Francisco garter snakes are associated with emergent and bankside vegetation such as *Typha* spp. (cattails), *Schoenoplectus* spp. (bulrush), and *Eleocharis* spp. (spike rushes) as well as floating algal or rush mats.

Groundwater-Related Threats

This species is threatened by reduced habitat quality due to drought or the loss of bankside and emergent vegetation following saltwater inundation. Perennial ponds are also detrimental to these snakes, since they are able to support *Lithobates catesbeianus* (bullfrogs) which pose various threats to the garter snake.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<2 in (5 cm)	This is the water depth the San Francisco garter snake requires for successful hunting. Water levels in frog breeding ponds must have a long enough hydroperiod to allow for metamorphosis and a continuous food supply. This includes a minimum of two months for tree frogs, which are best for juvenile snakes (but cannot sustain adults). Adult snakes also rely on California red-legged frogs, which require approximately four to seven months to metamorphose.
Water Quality		
Salinity	>7 ppt	San Francisco garter snakes rely on cattail habitat and tree frogs as prey. Cattails die when exposed to salinities of 10 ppt, and those >7.0 ppt are lethal to tree frogs and their larvae.

References

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A-13 | Santa Cruz Long-Toed Salamander

Ambystoma macrodactylum croceum

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Direct. This salamander is reliant on ponds that may be supported by groundwater. It prefers breeding in ephemeral ponds but has also been documented breeding in permanent sites.

Distribution in California

The Santa Cruz long-toed salamander is found in southern Santa Cruz and northern Monterey Counties.

Habitat

Adults live in upland chaparral, riparian areas, and oak woodland forests and migrate to aquatic habitats for breeding at the beginning of the rainy season. Ephemeral ponds are primarily used for breeding. This species prefers these kinds of temporary sites to reduce predation on their young from *Lithobates catesbeianus* (bullfrogs) or fish. Permanent ponds are also more subject to competitors, parasites, and agricultural runoff. Although this species has been documented in permanent ponds, not much information has been found regarding their existence in these habitats.

Associated Vegetation

Adults spend much of their life under leaf litter and among tree roots. Terrestrial habitat can be composed of upland coastal scrub, areas of *Quercus agrifolia* (coast live oak) or *Pinus radiata* (Monterey pine), and riparian vegetation such as *Salix lasiolepis* (arroyo willows). Larvae use submerged root structures such as that of *Schoenoplectus californicus* (California bulrush) and emergent vegetation (i.e., *Polygonum* spp. [knotweeds] and native wetland species) for cover while in aquatic habitats.

Groundwater-Related Threats

Seawater intrusion could potentially turn freshwater aquifers into salt marshes and affect species like the Santa Cruz long-toed salamander. Seawater intrusion into aquifers due to changing groundwater conditions within the basin may also increase salinities within freshwater wetlands, which eliminates reproductive success for this species. In addition, a lowered groundwater table could have a negative impact on this species through degradation or elimination of associated riparian habitats and a reduction in hydrologic recharge, resulting in the loss of functional breeding conditions.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<1.6 ft (0.5 m)	This salamander attaches its eggs to vegetation in shallow (<1.6 ft/<0.5 m) ephemeral ponds.
Water Quality		
Salinity	Low	This species relies on freshwater systems. It is unknown how tolerant eggs and larvae are, but observations at Bennett Slough/Struve Pond (near Zmudowski State Beach) suggest that high salinity negatively affects reproductive success.

References

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A-14 | Sierra Nevada Yellow-Legged Frog

Rana sierrae

© Isaac Chellman, California Department of Fish and Wildlife

Protected Status

Federal	State
Endangered	Threatened

Reliance on Groundwater

Direct. The Sierra Nevada yellow-legged frog is reliant on groundwater when using shallow-water breeding sites. Groundwater helps sustain these shallow-water habitats in streams, meadows, springs, and small ponds, which are often used for breeding and larval development.

Distribution in California

This species is found throughout most of the Sierra Nevada, from Kings Canyon National Park up to northern Plumas County. Most populations are found on national forest and national park lands.

Habitat

Sierra Nevada yellow-legged frogs are highly aquatic, preferring lakes, ponds, marshes, meadows, and streams above about 4,900 ft (1,500 m) in elevation. However, these frogs are significantly less likely to occupy these habitats when fish are present. Fish prey on tadpoles and small frogs, and also reduce available food sources, such as benthic macroinvertebrates. These frogs spend the winter months at the bottom of frozen lakes and perennial streams.

Associated Vegetation

This species is associated with montane riparian habitats with *Pinus* spp. (lodgepole, yellow, sugar, and whitebark pine), *Abies concolor* (white fir), and other wet meadow vegetation. Sierra Nevada yellow-legged frogs may be found in areas with near-shore and emergent aquatic vegetation, but are also often found in open areas adjacent to water with little or no vegetation, such as talus piles, rock islands, and sandy shorelines.

Groundwater-Related Threats

This frog depends on a perennial water sources that do not fully freeze in the winter, which may be supported by groundwater. Changes in groundwater levels that reduce the required depth for overwintering tadpoles, or exacerbate oxygen depletion for overwintering adults, may adversely

affect this species. Large mortality events can occur if larval habitat dries up, or if overwinter oxygen depletion occurs.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	≥6.6 ft (2 m)	Sierra Nevada yellow-legged frogs use a wide array of aquatic habitats of varying depths, from shallow streams, pools, and lake margins only a few inches/centimeters deep to pools and lakes many feet/meters deep. However, this species often requires perennial waters that do not freeze completely during winter.

References

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A-15 | Southern Mountain Yellow-Legged Frog

Rana muscosa

© Isaac Chellman, California Department of Fish and Wildlife

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. This frog is reliant on surface water that may be supported by groundwater.

Distribution in California

This species is found mainly on national park and national forest lands. Their current range includes the southern Sierra Nevada, beginning in Kings Canyon National Park. Additional disjunct populations are located farther south in the Transverse Ranges.

Habitat

Southern mountain yellow-legged frogs are highly aquatic, preferring lakes, ponds, marshes, meadows, and streams above about 4,900 ft (1,500 m) in elevation. They are usually found no more than 3 ft (1 m) away from water. Since southern mountain yellow-legged frogs are highly aquatic, they often depend on groundwater for various stages of their life cycle. These frogs are significantly less likely to occupy a habitat when fish are present. Fish prey on tadpoles and small frogs, and fish also reduce the frogs' available food sources, such as benthic macroinvertebrates. These frogs spend the winter months at the bottom of frozen lakes and perennial streams.

Associated Vegetation

This species is associated with montane riparian habitats with *Pinus* spp. (lodgepole, yellow, sugar, and whitebark pine), *Abies concolor* (white fir), and other wet-meadow vegetation. Southern mountain yellow-legged frogs may be found in areas with near-shore and emergent aquatic vegetation, but are also often found in open areas adjacent to water with little or no vegetation, such as talus piles, rock islands, and sandy shorelines.

Groundwater-Related Threats

This frog depends on perennial water sources that do not fully freeze in the winter, which may be supported by groundwater. Changes in groundwater levels that reduce the required depth for overwintering tadpoles, or exacerbate oxygen depletion for overwintering adults, may adversely

affect this species. Large mortality events can occur if larval habitat dries up, or if overwinter oxygen depletion occurs.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	≥6.6 ft (2 m)	Southern mountain yellow-legged frogs use a wide array of aquatic habitats of varying depths, from shallow streams, pools, and lake margins only a few inches/centimeters deep to pools and lakes many feet/meters deep. However, this species often requires perennial waters that do not freeze completely during winter.

References

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A-16 | Southern Rubber Boa

Charina umbratica

© William Flaxington

Protected Status

Federal	State
Under Review	Threatened

Reliance on Groundwater

Indirect. The southern rubber boa is reliant on moist woodland and forested areas that may be groundwater-dependent, and on moist sand near springs, seeps, and streams.

Distribution in California

Southern rubber boas are found in the San Bernardino and San Jacinto Mountains. They are apparently absent from the San Gabriel Mountains; the species identity of rubber boas in the Transverse Ranges and southern Sierra Nevada is somewhat unresolved.

Habitat

This snake prefers to live in damp woodland and forest areas; grassy meadows; and moist, sandy areas along streams. Adequate soil moisture appears to be essential. The southern rubber boa uses rodent burrows and seeks cover in rock outcrops, logs, and leaf and pine-needle litter. Riparian corridors are important during warm weather; in the summer months, this species is most frequently observed in damp draws near springs, seeps, and streams.

Associated Vegetation

Mixed conifers and oaks with understories of bracken fern or other herbaceous plants, or chaparral shrubs like *Ceanothus* spp. (California lilac) and *Arctostaphylos* spp. (manzanita).

Groundwater-Related Threats

Groundwater depletion that causes soils and surface water features to dry up during the hot summer months can threaten this species' habitat and associated vegetation.

Hydrologic Indicators

Shallow groundwater levels near interconnected surface water features should be monitored to ensure that groundwater conditions are not depleting surface water or lowering groundwater levels to the point that woodland and forested areas lose access to groundwater.

References

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A-17 | Tehachapi Slender Salamander

Batrachoseps stebbinsi

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Protected Status

Federal	State
Not Listed	Threatened

Reliance on Groundwater

Indirect. The Tehachapi slender salamander may be reliant on groundwater-dependent vegetation during the dry season.

Distribution in California

This species is endemic to Kern County, with some reports from Los Angeles County. Two Distinct Population Segments exist in the Tehachapi Mountains and Caliente Canyon (in the Caliente Creek drainage in the Paiute Mountains).

Habitat

This terrestrial species is found in the oak and mixed woodlands that grow in moist canyons and ravines.

Associated Vegetation

This species is associated with *Pinus sabiniana* (foothill pine), *Quercus wislizeni* (interior live oak), *Quercus douglasii* (blue oak), *Populus fremontii* (Fremont's cottonwood), *Platanus racemosa* (western sycamore), and *Aesculus californica* (California buckeye). In Caliente Creek, associated vegetation includes *Juniperus californica* (California juniper), *Yucca* spp. (yucca), *Lupinus* spp. (bush lupine), and *Eriogonum* spp. (buckwheat).

Groundwater-Related Threats

Groundwater overdrafting will likely have a negative impact on associated vegetation, which will jeopardize this salamander's habitat.

Hydrologic Indicators

The Tehachapi slender salamander is a terrestrial species that relies on habitats that receive moisture from precipitation, but it also relies on vegetation that may be groundwater-dependent. Monitoring shallow groundwater levels around this groundwater-dependent vegetation (e.g., oak

woodlands, blue oak, Fremont's cottonwood) could help ensure that groundwater levels are not adversely affecting this species' food and habitat. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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A-18 | Yosemite Toad

Anaxyrus canorus

© California Department of Fish and Wildlife

Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Direct. The Yosemite toad relies on surface water that may be supported by groundwater for its breeding habitat.

Distribution in California

Yosemite toads are found at high elevations in the Sierra Nevada.

Habitat

This species is often found in wet mountain meadows, willow thickets, and forest borders, but also uses lakes, small ponds, shallow spring channels, side channels, and sloughs. However, Yosemite toads require shallow pools in wet meadows for reproduction and development. They have been documented traveling up to 0.78 mi (1.26 km) from the nearest breeding site (average 900 ft [275 m]).

Associated Vegetation

This species is associated with montane and subalpine wet meadows and other riparian vegetation.

Groundwater-Related Threats

Yosemite toads are vulnerable to habitat loss through reduced water availability. This species requires shallow pools in wet meadows and the margins of lakes and streams for breeding.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<3 in (8 cm)	Yosemite toad eggs are deposited in shallow water to accelerate tadpole development during the breeding and rearing season.

References

California Herps. 2019. Yosemite toad (*Anaxyrus canorus).* Available from http://www.californiaherps.com/frogs/pages/a.canorus.html.
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Birds

B-1 | Arizona Bell's Vireo

Vireo bellii arizonae

Protected Status

Federal	State
Not Listed	Endangered

Reliance on Groundwater

Indirect. This species prefers groundwater-dependent vegetation for nesting and breeding.

Distribution in California

The Arizona Bell's vireo is seen around Southern California during the summer. It is also apparent along the Colorado River, from Needles in San Bernardino County to Blythe in Riverside County.

Habitat

The species is most common in xeric riparian washes and mesquite forests (bosques). These habitats are dominated by *Salix* spp. (willow) that tend to grow in small patches interspersed among other plants. These habitats also have shrubs like *Baccharis salicifolia* (seep willow). This bird frequents early successional stages of dense, low, shrubby vegetation in riparian areas, brushy fields, young second-growth woodland, *Quercus berberidifolia* (scrub oak), coastal chaparral, and *Prosopis* spp. (mesquite) brushlands. The shrub layer needs to be dense and 2 to 9.8 ft (0.6 to 3 m) above ground. East of the lower Colorado River, the Arizona Bell's vireo is found in higher densities of *Prosopis glandulosa* (honey mesquite) and *Tamarisk* spp. (salt cedar) than of *Salix* spp. habitats at higher elevations. This bird is often found near water in arid regions, and it breeds in large strands of regenerated willows mixed with *Prosopis pubescens* (screwbean mesquite).

Associated Vegetation

The Arizona Bell's vireo is associated with *Salix gooddingii* (Goodding willow), *Salix* spp., *Prosopis pubescens*, *Populus* spp. (cottonwood), *Baccharis* spp., and *Rubus* spp. (wild blackberry), and uses dense shrubby vegetation and woodland edges.

Groundwater-Related Threats

Groundwater depletion can negatively affect this species' steadily shrinking nesting and breeding habitat if groundwater-dependent vegetation (e.g., willows) lose access to this resource.

Hydrologic Indicators

Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure these levels are not adversely affecting this species' habitats. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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B-2 | Bald Eagle

Haliaeetus leucocephalus

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Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Delisted due to recovery	Endangered	Fully Protected

Reliance on Groundwater

Indirect. Bald eagles are reliant on surface water that may be supported by groundwater and/or groundwater-dependent vegetation. This species often roosts and nests along lakes and rivers, where they hunt for fish living in surface water bodies that may be supported by groundwater.

Distribution in California

Bald eagles are mostly found in Northern California, but have been seen in the Sierra Nevada foothills, Central Coast, inland Southern California, and the Santa Catalina Islands. They are present throughout the year but more often after breeding months (December to March), particularly in the Klamath Basin.

Habitat

The bald eagle prefers mountainous or wooded areas near lakes, reservoirs, and rivers, especially during the winter. They can be seen in rangelands throughout the state when they are migrating or foraging.

Associated Vegetation

This species needs tall trees to construct nests high in the canopy zone.

Groundwater-Related Threats

Groundwater conditions that have a negative impact on the in-stream flow and water quality of larger bodies of water can adversely affect bald eagle food sources. Groundwater pumping that impairs streamflow and reduces fish populations can push this species to find more suitable habitat elsewhere.

Hydrologic Indicators

Shallow groundwater levels near interconnected surface water features should be monitored to ensure that groundwater conditions are not depleting surface water and deteriorating water quality within the bald eagle's habitat.

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B-3 | Bank Swallow

Riparia riparia

© Christopher L. Christie

Protected Status

Federal	State
Species of Least Concern	Threatened

Reliance on Groundwater

Indirect. This species relies on surface water that may be supported by groundwater.

Distribution in California

The bank swallow can be found throughout Alaska and Canada, and south into the United States. They migrate through California, and some breed in the northern part of the state. Approximately 70 percent of the state's breeding population is found in alluvial sections of the Sacramento and Feather Rivers.

Habitat

Bank swallows primarily live along bodies of water, such as rivers, streams, ocean coasts, and reservoirs. This species is highly colonial and breeds in nesting burrows that are up to 3.3 ft (1 m) deep and constructed in near-vertical banks that are greater than 6.6 ft (2 m) tall and generally more than 82 ft (25 m) long.

Associated Vegetation

This species' habitat tends to be devoid of vegetation around the burrow itself, but the banks and cliffs are usually characterized by coastal grassland and scrub. Along the Sacramento River, colony persistence was found to be greater at sites that had grasslands at the top of the nesting-cut banks than at colonies with riparian forest, scrub, or orchards above them.

Groundwater-Related Threats

The bank swallows' diet consists of aquatic and terrestrial insects that they catch over nearby water bodies and associated floodplain grasslands. On the Sacramento River, bank swallow reproductive success appears to be positively associated with the previous winter's streamflow, and nesting burrows are more common in actively meandering reaches. This suggests that higher flows in winter (prior to the initiation of nesting) improve nesting habitat and foraging conditions. However, high stream flows or rapid drawdowns during their nesting season (April to June) may increase the risk of nest failure due to inundation, bank slumping, or bank erosion. If

groundwater depletion results in reduced streamflow, then breeding habitat may become degraded.

Hydrologic Indicators

Monitoring shallow groundwater levels near interconnected surface water features can help determine changes in bank swallow habitat.

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B-4 | Belding's Savannah Sparrow

Passerculus sandwichensis beldingi

© Christopher L. Christie

Protected Status

Federal	State
Not Listed	Endangered

Reliance on Groundwater

Indirect. This species is reliant on salt marshes that may be supported by groundwater.

Distribution in California

The Belding's savannah sparrow is found in Southern California (Santa Barbara, Ventura, Los Angeles, Orange, and San Diego Counties, Mission Bay, San Diego Bay).

Habitat

This species lives in coastal salt marshes.

Associated Vegetation

Most Belding's savannah sparrow nests are found in dense areas of *Salicornia virginica* (pickleweed) and associated upper-marsh plants.

Groundwater-Related Threats

Groundwater depletion can destabilize salinity gradients within salt marshes by causing seawater intrusion or depleting groundwater or surface water inputs. Pickleweed has a high salinity tolerance and generally exists in soils that are about 1 percent salt. Excessive groundwater pumping is believed to diminish pickleweed.

Hydrologic Indicators

Monitoring shallow groundwater levels and interconnecting surface water conditions for tidal wetlands can help determine changes in habitat conditions required by the Belding's savannah sparrow.

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B-5 | California Black Rail

Laterallus jamaicensis coturniculus

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Not Listed	Threatened	Fully Protected

Reliance on Groundwater

Direct. The California black rail is reliant on groundwater-fed wetlands and marshes. It is found in areas with saturated soils and salt marshes, and where the groundwater table is at or above the land surface.

Distribution in California

California black rails are found along the Pacific Coast and the lower Colorado River, as well as in the wet meadows of the Sierra Nevada foothills and parts of the Sacramento-San Joaquin Delta and lower Imperial Valley.

Habitat

These birds prefer wet ground and portions of tidal and freshwater marshes with high plant stem densities, canopy coverage, and shallow water. Wetlands fed by large, reliable springs are among the most likely habitats to be occupied by black rails, regardless of the specific vegetation (with the exception of *Scirpus* spp.). Wetlands, especially those located in foothills, dominated by *Scirpus* spp. (bulrush) almost always lack California black rails.

Associated Vegetation

California black rails are associated with habitats dominated by *Juncus* spp. (rushes), *Typha* spp. (cattails), *Carex* spp.(sedges) and grasses, and other wetland plants, including *Baccharis salicifolia* (seep willow), *Pluchea sericea* (arrowweed), *Distichlis spicata* (saltgrass), *Salicornia* spp. (pickleweed) and *Populus* spp. (cottonwood).

Groundwater-Related Threats

These birds are vulnerable to significant or long-term changes in water levels, which threaten their suitable habitat and prey. During droughts, black rails will rapidly go locally extinct if wetlands lose their connection with groundwater and dry up.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<1.2 in (3 cm)	California black rails prefer shallow water marshes with little fluctuation in water levels, which provides a sustainable prey source.

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B-6 | California Condor

Gymnogyps californianus

© California Department of Fish and Wildlife, The Nature Conservancy

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Indirect. California condors rely on groundwater-dependent vegetation for nesting.

Distribution in California

Recent populations occur regularly in San Bernardino, Los Angeles, Ventura, Kern, Santa Barbara, San Luis Obispo, Monterey, San Benito, and possibly Santa Cruz Counties.

Habitat

Condor nesting habitats range from scrubby chaparral to forested mountain regions up to about 6,000 ft (1,829 m). Cliffs, rocky outcrops, or large trees are all used as nest sites. Foraging areas are in open grasslands, savanna habitats supporting *Quercus* spp. (oak), and at Central California coastal sites.

Associated Vegetation

California condors may nest in foothill grasslands, oak savannah habitats, and old-growth *Sequoiadendron giganteum* (giant sequoia) or *Sequoia sempervirens* (coast redwood).

Groundwater-Related Threats

Groundwater depletion can adversely affect California condor nesting sites in groundwater-dependent vegetation (e.g., giant sequoia, coast redwood).

Hydrologic Indicators

Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure that these levels are not having a negative impact on this species' habitats. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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B-7 | California Least Tern

Sternula antillarum browni

© Barbara Boethling

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered (petitioning to list as threatened)	Fully Protected

Reliance on Groundwater

Indirect. The California least tern is reliant on food supplies in estuaries that may be supported by groundwater.

Distribution in California

This species is found along the Pacific Coast from San Francisco Bay to Baja California. They have designated nesting habitat in the Port of Los Angeles, where their population is heavily monitored and managed. The tern has concentrated nesting sites in the San Francisco Bay Area, the Sacramento River Delta, and South Coast region (San Luis Obispo County to San Diego County).

Habitat

This species is mostly found living on open beaches in areas free of vegetation along the coast where they feed in shallow estuaries and lagoons. Breeding habitat can also include dried mudflats and sandbars/sandspits.

Associated Vegetation

This tern prefers areas with little to no vegetation.

Groundwater-Related Threats

Groundwater depletion that reduces freshwater discharge to estuaries by altering interconnected surface water regimes can change salinity concentrations in estuaries that are necessary to support key forage species that least terns feed on.

Hydrologic Indicators

Shallow groundwater around interconnected surface water systems, especially estuaries, should be monitored to ensure groundwater conditions are not depleting surface water nor altering salinity gradients within estuaries that support this species.

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B-8 | California Ridgway's Rail

Rallus obsoletus obsoletus

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Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. This species is reliant on wetland and marsh habitats that may be supported by groundwater.

Distribution in California

Historically, California Ridgway's rails may have been found in salt marshes from Humboldt Bay to Morro Bay. Currently, this species can be found in the marshes of the San Francisco Bay estuary, with the densest population located in the southern San Francisco Bay and North Bay. Some smaller populations can be found widely distributed in San Pablo Bay and Suisun Marsh.

Habitat

This species' habitat is wetlands; salty and brackish marshlands are preferred.

Associated Vegetation

California Ridgway's rails are associated with *Salicornia virginica* (pickleweed) and *Spartina* spp. (cordgrass).

Groundwater-Related Threats

Wetland loss and habitat degradation are the major threats to the continued existence of this species. For example, San Francisco Bay's tidal wetlands have decreased by 75 percent from their historical extent. Groundwater pumping that depletes wetlands or alters salinity gradients within the rails' habitat area can have an adverse impact on this species.

Hydrologic Indicators

There are no reported values for groundwater requirements for this species. However, monitoring shallow groundwater levels near interconnected surface waters can ensure that this species' habitat is not being negatively affected by groundwater conditions.

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B-9 | Coastal California Gnatcatcher

Polioptila californica californica

© Christopher L. Christie

Protected Status

Federal	State
Threatened	Endangered

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

The coastal California gnatcatcher is only found in coastal sage scrub along the Southern California coastline (Ventura County to Baja California).

Habitat

This species lives in coastal sage scrub composed of low shrubby habitat (3 to 6 ft / 91 to183 cm tall).

Associated Vegetation

This gnatcatcher is associated with coastal sage scrub: *Artemisia californica* (California sagebrush), *Eriogonum fasciculatum* (California buckwheat), *Salvia* spp. (sage), and *Opuntia* spp. (prickly pear cactus). It gets nesting materials from *Artemisia californica*, *Eriogonum fasciculatum*, *Encelia californica* (California sunflower), *Baccharis sarothroides* (broom baccharis), and *Malosma laurina* (laurel sumac).

Groundwater-Related Threats

This species has no known reliance on groundwater.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

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B-10 | Elf Owl

Micrathene whitneyi

© Don Getty

Protected Status

Federal	State
Not Listed	Endangered

Reliance on Groundwater

Indirect. The elf owl is reliant on groundwater-dependent vegetation that provides habitat for itself and for its prey.

Distribution in California

These owls are found along the Lower Colorado River.

Habitat

Elf owls are associated with riparian habitats, wooded habitats, and saguaro deserts.

Associated Vegetation

This species is associated with *Carnegiea gigantea* (saguaro cactus) and *Prosopis* spp. (mesquite) in deserts, and with *Platanus occidentalis* (sycamore) and *Quercus* spp. (oak) in wooded areas.

Groundwater-Related Threats

Elf owls are vulnerable to the loss of the vegetative communities they depend on for habitat and foraging due to reduction in water availability. Similarly, changes in hydrology that affect insect populations, the elf owl's main prey, can have cascading impacts on this species.

Hydrologic Indicators

This owl relies on riparian and wooded vegetation (e.g., mesquites, sycamores, oaks) that may themselves be reliant on groundwater. Monitoring shallow groundwater levels in these vegetated areas can help monitor elf owl habitat. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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B-11 | Gila Woodpecker

Melanerpes uropygialis

© Bob Griffith, The Nature Conservancy

Protected Status

Federal	State
Not Listed	Endangered

Reliance on Groundwater

Indirect. This woodpecker is reliant on groundwater-dependent vegetation for its habitat.

Distribution in California

Gila woodpeckers are mostly known to occur in southeastern California within the Imperial Valley and Lower Colorado River Valley. Individuals in California have been spotted north of Griffith Park, Los Angeles County; Ontario, San Bernardino County; Coachella Valley, Riverside County; and Corn Springs, Riverside County.

Habitat

This species is found in arid deserts that have large cactuses or trees suitable for nesting, dry subtropical forests, mesquite bosques, riparian woodlands, and residential areas. It can also be found in habitat dominated by *Populus* spp. (cottonwood), *Salix* spp. (willow), and *Prosopis* spp. (mesquite) near the Lower Colorado River. The woodpecker is primarily seen in areas with high foliage density and diversity, and is associated with high canopy, large trees, and snags.

Associated Vegetation

Gila woodpeckers are associated with *Carnegiea gigantea* (saguaro cactus), *Populus* spp. (cottonwood), *Salix* spp. (willow), and *Prosopis* spp. (mesquite).

Groundwater-Related Threats

Water diversion, groundwater withdrawals, and river channel incision threaten riparian habitats with indirect impacts on Gila woodpecker productivity, abundance, and distribution. Groundwater declines impair recruitment and long-term viability of mesquite bosque and riparian habitat, and can also promote drought-tolerant, non-native *Tamarisk* spp. (saltcedar), leading to reduction of vegetation community biodiversity.

Hydrologic Indicators

Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure that these levels are not adversely affecting this species' habitats. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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B-12 | Gilded Flicker

Colaptes chrysoides

Protected Status

Federal	State
Not Listed	Endangered (listed as *Colaptes auratus chrysoides)*

Reliance on Groundwater

Indirect. The gilded flicker may be reliant on groundwater-dependent vegetation for nesting.

Distribution in California

These birds are usually found in very arid regions in the southeastern part of California, adjacent to Arizona and along the Lower Colorado River. Hybrids with northern flickers are found slightly north in riparian regions.

Habitat

Gilded flickers are found in lowlands and desert regions of the southeastern part of the state adjacent to Arizona. In this region, they nest in *Carnegiea gigantea* (giant saguaro cactus*)* and *Prosopis* spp. (mesquite). In areas adjacent to northern flicker range, gilded flickers will nest in riparian forests and wooded dry washes. The species also nests in *Yucca brevifolia* (Joshua tree) in the northern part of its range.

Associated Vegetation

Associated vegetation is most commonly *Carnegiea gigantea*. The species sometimes nests in riparian woodland and wooded dry washes, where it may excavate nest cavities and build nests in *Prosopis* spp., *Populus* spp. (cottonwood), and *Salix* spp. (willow) trees.

Groundwater-Related Threats

Groundwater depletion that causes dieback of groundwater-dependent riparian vegetation (e.g., cottonwood, willow, and mesquite) can harm nesting sites for this species.

Hydrologic Indicators

Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure that these levels are not adversely affecting this species' nesting sites. Additionally,

monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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B-13 | Great Gray Owl

Strix nebulosa

© Kameron Perensovich

Protected Status

Federal	State
Not Listed	Endangered

Reliance on Groundwater

Indirect. This species relies on groundwater-dependent vegetation for nesting sites and on foraging habitat in montane meadow wetlands that may be supported by groundwater.

Distribution in California

The great gray owl can be found in the central Sierra Nevada, clustered around Yosemite National Park and surrounding national forests. Small satellite populations occur in El Dorado National Forest and in the far northeastern portions of California along Modoc Plateau.

Habitat

The great gray owl uses dense, coniferous forest habitat with large-diameter snags for nesting, and open montane meadows for foraging. It is also known to use oak woodland with open understory along riparian corridors at elevations down to 2,500 ft (762 m).

Associated Vegetation

This species is associated with *Pinus* spp. (pine), *Abies* spp. (fir), montane meadow vegetation, and *Quercus* spp. (oak).

Groundwater-Related Threats

Groundwater depletion that causes dieback of groundwater-dependent riparian vegetation (e.g., oaks) and depletes surface water in montane meadow wetlands can harm great gray owl nesting and foraging sites.

Hydrologic Indicators

Monitoring shallow groundwater levels and interconnected surface water conditions for montane meadow wetlands can help track changes in vegetation composition and, more generally, habitat conditions required for quality great gray owl foraging habitat. Additionally, monitoring

plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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B-14 | Greater Sandhill Crane

Antigone canadensis tabida

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Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Not Listed	Threatened	Fully Protected

Reliance on Groundwater

Direct. This species is reliant on freshwater wetlands that may be supported by groundwater for breeding, roosting, and foraging habitat.

Distribution in California

Greater sandhill cranes breed in northeastern California and winter throughout the Central Valley.

Habitat

This species is found in wetlands, hayfields, pastures, and grain fields. It is also often found in open freshwater wetlands, including shallow marshes and wet meadows or agricultural fields. It roosts in shallow ponds, flooded agricultural fields, sloughs, canals, or lakes; nests are generally built in shallow water or on dry land near a wetland. The cranes forage in wetlands, wet meadows, and agricultural land, including pasture, grain crops, and alfalfa.

Associated Vegetation

The cranes consume tubers and the seeds of aquatic plants.

Groundwater-Related Threats

During the winter months, the cranes rely on wetlands and wildlife-friendly managed agricultural lands in the Central Valley. Excessive groundwater pumping is associated with a decrease in wetland habitat. When water tables in alpine meadows are lowered as a result of stream incision caused by overgrazing, riparian vegetation removal, or other means, their breeding habitat is adversely affected.

Hydrologic Indicators

Monitoring shallow groundwater levels and interconnected surface water conditions for wetlands and alpine meadows during the breeding and wintering periods can help detect changes in habitat conditions required by the greater sandhill crane.

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B-15 | Least Bell's Vireo

Vireo belli pusillus


© Bruce Farnsworth, The Nature Conservancy

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Indirect. This species relies on groundwater-dependent vegetation in riparian areas, particularly during breeding periods.

Distribution in California

Least Bell's vireos range throughout most of California, from the southern coast north through the Central Valley. They are more frequently found in Southern California, particularly riparian areas in San Diego County, Cleveland and Los Padres National Forests, and the Santa Clara River watershed.

Habitat

These birds require low-elevation riparian areas near water with a dense shrub understory and canopy layer. Such habitats are generated by alluvial river systems. Active river meandering and flooding are highly beneficial to this species because they support riparian vegetation succession, which creates the habitat the birds depend upon.

Associated Vegetation

Least Bell's vireo associate with *Salix* spp. (willow) and dense areas of riparian shrubs, trees, and vines for nesting.

Groundwater-Related Threats

These birds are vulnerable to riparian habitat and vegetation loss due to lowering of groundwater levels and overall reduction in water availability, particularly during breeding and nesting periods. Disconnecting rivers from their floodplains is detrimental to this species due to the resulting habitat loss. Altered river flows may also contribute to habitat loss by not supporting riparian habitat recruitment.

Hydrologic Indicators

Monitoring shallow groundwater conditions that support riparian vegetation, in particular *Salix* spp., can help track least Bell's vireo habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful in diagnosing reduced vegetation production and habitat decline over time.

References

Kus BE. 1998. Use of restored riparian habitat by the endangered least Bell's vireo (*Vireo bellii pusillus*). Restoration Ecology **6**:75–82. DOI: 10.1046/j.1526-100x.1998.06110.x.

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B-16 | Light-Footed Ridgway's Rail

Rallus obsoletus levipes

© Nigel Voaden

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. The light-footed Ridgway's rail is reliant on coastal groundwater discharge areas where interconnections between groundwater and surface water are likely to exist.

Distribution in California

The species' current range is from Ventura County, California, to the Mexican border. Historically, it ranged from Santa Barbara County to San Quintin Bay, Baja California, Mexico. It is currently absent from Santa Barbara and Los Angeles Counties.

Habitat

This species uses coastal salt marshes, lagoons, and maritime environments for nesting and breeding. Nesting habitat includes tall, dense vegetation in the low littoral zone, wrack deposits in the low marsh, and hummocks of high marsh within the low marsh zone. Fringing areas of high marsh serve as refugia during high tides, helping to reduce predation. Light-footed Ridgway's rails forage in all parts of the salt marsh, including shallow water and mudflats.

Associated Vegetation

This rail is associated with *Spartina* spp. (cordgrass), *Salicornia* spp. (pickleweed), and *Juncus acutus* ssp. *leopoldii* (spiny rush) for their nesting habitat.

Groundwater-Related Threats

Groundwater conditions that deplete surface water discharge or alter salinity gradients within salt marshes can cause salt marshes to recede, thereby reducing this species' habitat and breeding success.

Hydrologic Indicators

This species relies upon interconnected surface waters in coastal environments. Monitoring salinity gradients and interconnected surface waters (e.g., shallow groundwater levels,

groundwater gradients) in coastal discharge zones that support salt marshes and lagoons can help track light-footed Ridgway's rail habitat conditions.

References

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USFWS. 2009. Light-footed clapper rail (*Rallus longirostris levipes*). Five-year review: Summary and evaluation. Available from https://www.fws.gov/carlsbad/SpeciesStatusList/5YR/20090810_5YR_LFCR.pdf.

B-17 | Marbled Murrelet

Brachyramphus marmoratus

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Protected Status

Federal	State
Threatened	Endangered

Reliance on Groundwater

Indirect. Marbled murrelets rely on old-growth coastal tree stands that may rely on groundwater in dense forests to nest.

Distribution in California

The marbled murrelet's California breeding range extends from the Santa Cruz Mountains north to the Oregon border. During the winter, they are found offshore from nesting stands, and a very few may be seen in the waters off Southern California.

Habitat

This species is seen near marine shorelines and sometimes in coastal bays. They spend most of their lives at sea except when nesting. At that time, they travel up to 30 m (48 km) inland to nest on the branches of large, moss-covered trees in old-growth forests, which provide the multiple canopy layers they require to successfully hatch and raise their young. When at sea, they are usually within 2 m (3.2 km) of the shoreline.

Associated Vegetation

The murrelets' nesting stands are predominantly composed of old-growth *Sequoia sempervirens* (coast redwood) and *Pseudotsuga menziesii* (Douglas-fir). During nesting season, their plumage turns a mottled brown to better blend in with their surroundings and avoid detection by predators such as the Steller's jay.

Groundwater-Related Threats

Groundwater conditions that are not supportive of coast redwood and Douglas-fir woodland communities could harm this species' required nesting habitat. Existing habitat is limited because of historical old-growth timber losses.

Hydrologic Indicators

This species spends most of its life on or near the ocean. Since their most crucial life process requires them to go inland to forested areas, marbled murrelets can be influenced by

groundwater if it affects their old-growth forest nesting habitats and preferred vegetation. Monitoring shallow groundwater conditions that support large, old coast redwood and Douglas-fir can ensure the persistence of marbled murrelet nesting habitat. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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NPS. 2017. Marbled murrelet: Redwood National and State Parks. Available from https://www.nps.gov/redw/learn/nature/marbled-murrelet.htm.
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B-18 | Southwestern Willow Flycatcher

Empidonax traillii extimus

© Kelly Colgan Azar, Audubon

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Indirect. This flycatcher is reliant on groundwater-dependent riparian vegetation.

Distribution in California

Southwestern willow flycatchers breed along watercourses and canyon bottoms, as well as interior river bottoms, throughout Southern California and the Lower Colorado River.

Habitat

This species is found in bushes, willow thickets, brushy fields, and upland copses. It breeds in thickets of deciduous trees and shrubs, especially willows, or along woodland edges. Nest sites are typically located near slow-moving streams, or side channels and marshes with standing water and/or wet (surface-saturated) soils.

Associated Vegetation

The Southwestern willow flycatcher is associated with *Salix* spp. (willow), *Artemisia douglasiana* (mugwort), and other riparian vegetation.

Groundwater-Related Threats

These birds are vulnerable to riparian habitat and vegetation loss due to lowering of groundwater levels and overall reduction in water availability, particularly during breeding and nesting periods. Groundwater pumping that depletes surface water flow or disconnects rivers from groundwater is also detrimental to this species, due to the resulting habitat loss.

Hydrologic Indicators

This species relies on riparian vegetation and requires surface water or saturated soils near the nest sites. Monitoring shallow groundwater conditions that support riparian vegetation can help track Southwestern willow flycatcher habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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Sedgwick, JA. 2000. Willow flycatcher (*Empidonax traillii*), V2.0 in Poole AF, Gill FB, editors. The birds of North America. Cornell Lab of Ornithology, Ithaca, New York. Available from https://doi.org/10.2173/bna.533.

USFWS. 2002. Southwestern willow flycatcher recovery plan. Albuquerque, New Mexico.

B-19 | Swainson's Hawk

Buteo swainsoni

© Ron Wolf

Protected Status

Federal	State
Not Listed	Threatened

Reliance on Groundwater

Indirect. Swainson's hawks rely on groundwater-dependent vegetation in riparian woodland areas for nesting.

Distribution in California

The largest breeding population of this species is found in the Central Valley, with another smaller population in the Great Basin area in northeastern California. Isolated breeding populations are also known to occur in Shasta, Owens, and Antelope Valleys, as well as in the Mojave Desert.

Habitat

This species is found in relatively flat and open habitats. It nests in trees within riparian woodlands or small groves, and in scattered or isolated trees. The hawks forage within rangeland, grassland, disturbed fields, open desert, and particularly among low-growing crops in moderately cultivated areas. During the breeding season, this diurnal raptor is heavily reliant on low-growing agricultural crops as foraging habitat, particularly in the Central Valley.

Associated Vegetation

Swainson's hawk nesting trees in the Central Valley commonly include *Populus fremontii* (cottonwood), *Quercus* spp. (oak), *Salix* spp. (willow), *Platanus racemosa* (sycamore), *Juglans* spp. (walnut), and *Eucalyptus* spp. (eucalyptus). Preferred foraging habitat includes alfalfa, perennial grasslands, fallow fields, and dry-land and irrigated pasture.

Groundwater-Related Threats

Groundwater depletion that causes dieback of groundwater-dependent riparian vegetation (e.g., cottonwood, willow, oak, sycamore) can harm this species' nesting sites.

Hydrologic Indicators

Tracking shallow groundwater levels that support groundwater-dependent riparian vegetation can help monitor habitat conditions for this species. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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Cornell Lab of Ornithology. 2017. Swainson's hawk. Available from https://www.allaboutbirds.org/guide/Swainsons_Hawk/id.

DFW. 2018. Swainson's hawks in California. Available from https://www.wildlife.ca.gov/Conservation/Birds/Swainson-Hawks.

B-20 | Tricolored Blackbird

Agelaius tricolor

Protected Status

Federal	State
Not Listed	Threatened

Reliance on Groundwater

Direct. Tricolored blackbirds rely on emergent vegetation for breeding and roosting in groundwater-dependent wetlands, particularly semipermanent wetlands. Irrigated pasture and some groundwater-dependent crops (especially alfalfa) provide extremely important foraging habitat for breeding colonies of this species.

Distribution in California

This blackbird is nearly endemic to California, and is found in remaining wetlands in Southern California, along the Central Coast, and in the northeastern parts of the state, with the majority of the population relying on Central Valley habitats.

Habitat

This species uses semipermanent and permanent wetlands with dense tracts of tall emergent vegetation for nesting, and upland habitat for both nesting and foraging. Upland nesting habitat includes groundwater-dependent grain crops (primarily silage associated with dairies). Foraging habitat includes groundwater-dependent crops and irrigated pasture.

Associated Vegetation

Tricolor blackbirds are associated with *Typha latifolia* (cattails), *Scirpus acutus* (tules), *Schoenoplectus californicus* (bulrush), *Salix exigua* (sandbar willow), and *Artemisia douglasiana* (mugwort), as well as grasslands and agricultural crops for foraging.

Groundwater-Related Threats

Groundwater conditions that deplete wetlands threaten this species' habitat. Loss of native wetlands and upland foraging habitat to agriculture and urbanization—for example, losses of formerly productive foraging habitats to perennial, woody crops such as nut trees and vines—combined with low reproductive success in native habitats and complete breeding failure in

harvested agricultural fields, are the greatest threats. Drought and climate change also pose significant threats to the species because of their reliance on water to support nesting habitat and to enhance insect prey populations.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	8–12 in (20–30 cm)	Colonies tend to form in wetlands when there is water underneath the cattail patches. Standing water of 8–12 in (20–30 cm) discourages predators such as foxes, raccoons, and skunks from entering the colony. Additionally, water underneath the nests helps keep the nestlings cool during hot spring days, giving them a better chance of fledging.
Vegetation Cover	>0.4 ha (400 m^2)	Islands of cattails, with a stand width of at least 33–49 ft (10–15 m) wide, surrounded by open water to discourage predators from entering the colony. A 50:50 or 60:40 ratio of cattails to open water is desirable for most sites, allowing for larger stands of cattails with some waterways between stands.
Water Quality		
Contaminants	<1.05 µg/L	Imidacloprid insecticides have been detected in 89 percent of water samples taken from rivers, creeks, and drains in agricultural regions of California, with 19 percent of samples exceeding the USEPA's guideline concentration of 1.05 µg/L. This suggests that the insecticide moves from treatment areas and may affect non-target aquatic insects. Little is known about the uptake of neonicotinoids from soil and water by non-target plants, or the downstream effect on non-target invertebrates.

References

Clipperton N. 2018. Report to the Fish and Game Commission: A status review of the tricolored blackbird (*Agelaius tricolor*) in California. Available from https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=154287.

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B-21 | Western Snowy Plover

Charadrius nivosus nivosus

© Kathy Cline, Audubon

Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Indirect. Western snowy plovers primarily congregate on coastal beaches but can nest near wetlands that may be supported by groundwater.

Distribution in California

This species is found along the California coast from Damon Point, Washington, to Bahia Magdalena, Baja California, Mexico.

Habitat

These plovers breed above the high-tide line on coastal beaches, sand spits, dune-backed beaches, sparsely vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. They tend to nest near the shore, but also near freshwater or brackish wetlands (e.g., river mouths, estuaries, and tidal marshes).

Associated Vegetation

The coastal beaches where this species is found usually have sparse vegetation. However, the birds use driftwood, kelp, and dune plants for nest cover.

Groundwater-Related Threats

Groundwater conditions that deplete wetland surface water can reduce the species' nesting habitat area. Groundwater pumping that depletes streamflow can also reduce sand delivery to beaches and degrade water quality.

Hydrologic Indicators

Monitoring shallow groundwater levels and interconnected surface water conditions for wetlands and nearby rivers that deposit sand to beaches can help track changes in the western snowy plover's required habitat conditions.

References

Hornaday K, Pisani I, Warne B. 2007. Recovery plan for the Pacific coast population of the western snowy plover (*Charadrius alexandrines nivosus*). USFWS. Available from https://www.fws.gov/oregonfwo/documents/RecoveryPlans/Western_Snowy_Plover_RP.pdf.

USFWS. 2007. Recovery plan for the western snowy plover. Federal Register **72**(184):54279–54280. Available from https://www.govinfo.gov/content/pkg/FR-2007-09-24/pdf/FR-2007-09-24.pdf.

USFWS. 2011. Endangered and threatened wildlife and plants; revised critical habitat for the Pacific Coast population of the western snowy plover. Federal Register **76**(55):16046–16145. Available from https://www.govinfo.gov/content/pkg/FR-2011-03-22/pdf/2011-4906.pdf.

B-22 | Western Yellow-Billed Cuckoo

Coccyzus americanus

Protected Status

Federal	State
Threatened	Endangered

Reliance on Groundwater

Indirect. This species is reliant on groundwater-dependent riparian vegetation for habitat.

Distribution in California

The western yellow-billed cuckoo is an uncommon-to-rare neotropical migrant species that breeds in deciduous woodlands around rivers and streams. It is found along the Eel River in Humboldt County, throughout large portions of the Sacramento River between Red Bluff and Colusa and in various tributaries, along the south fork of the Kern River upstream of Lake Isabella, and along the lower portion of the Colorado River. It is also occasionally found on the San Joaquin River and various tributaries as well as the Santa Clara, Santa Ana, Amargosa, and San Luis Rey Rivers in Southern California. The current population range is estimated to be approximately 30 percent of its historic extent.

Habitat

This riparian obligate species utilizes riparian evergreen and deciduous woodland and southwestern North American wash/scrub complexes, selecting young stands of colonizing vegetation to mature riparian forests for foraging and nesting.

Associated Vegetation

This cuckoo prefers densely foliated deciduous trees and shrubs in riparian forests and associated bottomland vegetation dominated by *Populus* spp. (cottonwood), *Salix* spp. (willow), or *Prosopis* spp. (mesquite), with *Juglans californica* (California black walnut), *Quercus lobata (*valley oak), *Plantus racemose* (California sycamore), and *Acer negundo* (boxelder) present. It prefers areas with dense understory thickets made up of *Vitus californica* (California grape), *Rubus* spp. (blackberry), *Toxicodendron diversilobum* (poison oak), *Urtica dioica* (stinging nettle), and *Artemisia douglasiana* (mugwort).

Groundwater-Related Threats

Groundwater depletion that causes dieback of groundwater-dependent riparian vegetation (e.g., cottonwood, willow, and valley oak) can fragment and reduce the western yellow-billed cuckoo's habitat.

Hydrologic Indicators

Monitoring shallow groundwater conditions that support riparian vegetation can help track western yellow-billed cuckoo habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

Dettling MD, Seavy NE. 2012. Yellow-billed cuckoo survey effort along the Sacramento and Feather Rivers, 2012. A progress report to the DFW, Grant #1182002. PRBO Conservation Science. PRBO Contribution #1915.

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B-23 | Yuma Ridgway's Rail

Rallus obsoletus yumanensis

© Nigel Voaden

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Threatened	Fully Protected

Reliance on Groundwater

Direct. This rail is reliant on shallow marshes with vegetative communities that may be supported by groundwater.

Distribution in California

Yuma Ridgway's rails are found in the Imperial Valley near the Salton Sea. They are also present along the Lower Colorado River on the California and Arizona border, and along the Alamo and New Rivers, as well as in seep marshes along the U.S.–Mexico border.

Habitat

Yuma Ridgway's rails depend on freshwater and alkali marshes with a mosaic of early successional emergent marsh vegetation and shallow open water.

Associated Vegetation

These birds are associated with wet substrates dominated by *Typha* spp. (cattails) and *Schoenoplectus* spp. (bulrush).

Groundwater-Related Threats

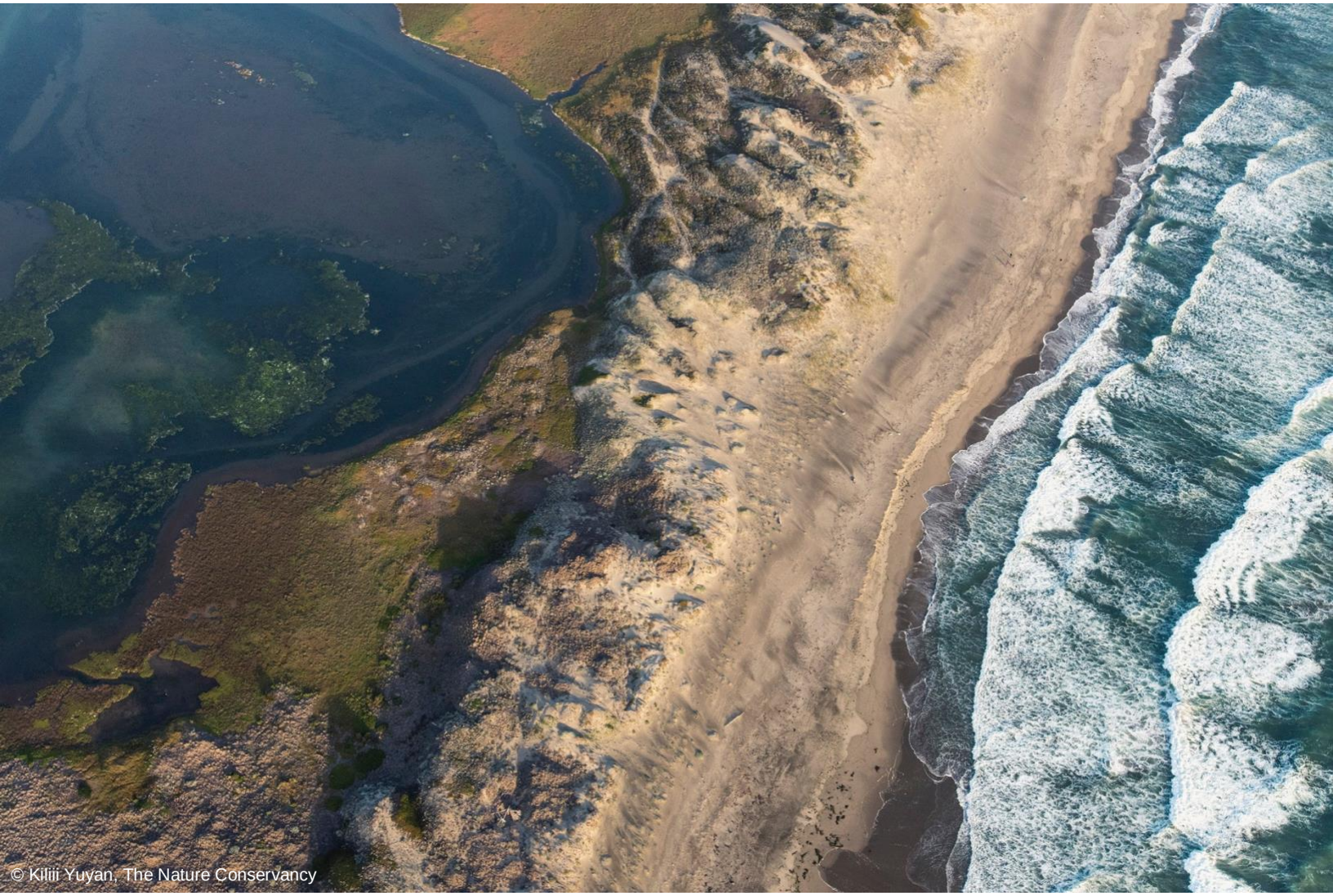
Groundwater conditions that deplete surface water in shallow marshes can result in a loss of nesting habitat in the surrounding vegetation and loss of shallow-water prey sources.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<12 in (30.4 cm)	Yuma Ridgway's rails depend on habitat that includes interspersed areas of shallow open water for access to aquatic prey.

References

USFWS. 2019. Yuma clapper rail. Available from https://www.fws.gov/nevada/protected_species/birds/species/yucr.html.
USFWS. 2019. Yuma clapper rail (*Rallus longirostris yumanensis*). Available from https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=B00P.



Fish

F-1 | Chinook Salmon

Oncorhynchus tshawytscha

Protected Status

Federal	State
Endangered (Sacramento River Winter-run Evolutionarily Significant Unit [ESU]); **Threatened** (Central Valley Spring-run ESU & California Coast ESU)	Endangered (Sacramento River Winter-run ESU) Threatened (Central Valley Spring-run ESU)

Reliance on Groundwater

Direct. Chinook salmon are reliant on groundwater-fed rivers to provide adequate water quality, temperature, and volume for upstream migration in the fall before rainfall elevates river flows, as well as for spawning and freshwater residency.

Distribution in California

These fish are found in larger watersheds from the Oregon border south to, and including, the Sacramento/San Joaquin river systems.

Habitat

Chinook exhibit two major life history patterns: one in which juveniles spend a relatively short time in fresh water, heading to estuaries or marine environments for the bulk of this phase of their lives, and one in which juveniles may spend more than a year maturing in freshwater. In either case, adult Chinook spawn in larger rivers and streams, where they require sufficient flows for migration and largely sediment-free gravel for spawning. Juveniles need deep pools, cool temperatures in warm months, and areas of refuge from high water velocities during the wet season (e.g., floodplains, backwaters, etc.). Water quality, including temperature and dissolved oxygen, is important for juveniles living in estuaries. Groundwater augmentation into streams provides important cold-water refugia, particularly for winter- and spring-run juveniles in the Central Valley and foothills during hot, dry summer months.

Associated Vegetation

This species is associated with native riparian vegetation. During winter, submerged floodplain vegetation provides critical cover and food.

Groundwater-Related Threats

Groundwater pumping can have an adverse impact on the survival of this species by depleting surface water flows for upstream migration, impeding migration by disconnecting groundwater and surface water, destabilizing water temperatures by decreasing baseflow at spawning sites, and reducing riparian habitat.

Hydrologic Indicators

Given the large geographic range of Chinook salmon across California, it is best to develop site-specific, quantitative hydrological indicators. Please consult with NOAA Fisheries for more information on this species.

References

Moyle PB. 2002. Inland fishes of California. University of California Press, Berkeley.
NMFS. 2014. Recovery plan for the evolutionarily significant units of Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon and the distinct population segment of California Central Valley steelhead. California Central Valley Area Office. Available from https://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/california_central_valley/california_central_valley_recovery_plan_documents.html.
NMFS. 2016. Final coastal multispecies recovery plan. NOAA Fisheries, West Coast Region, Santa Rosa, California. Available from https://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/north_central_california_coast/Final%20Materials/vol._i_chapter_1-8_coastal_multispecies_recovery_plan.pdf.

F-2 | Clear Lake Hitch

Lavinia exilicauda chi

© Ben Ewing, California Department of Fish and Wildlife

Protected Status

Federal	State
Under Review	Threatened

Reliance on Groundwater

Direct. Clear Lake hitch are reliant on rivers that may be supported by groundwater.

Distribution in California

This species is only found in Clear Lake and its tributaries in Northern California.

Habitat

Clear Lake hitch prefer to live in slow, warm water in lakes or in quiet river stretches.

Associated Vegetation

These fish are associated with aquatic vegetation.

Groundwater-Related Threats

Changing groundwater conditions that alter surface water flow and quality (temperature and salinity) can impair habitat and spawning conditions for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Salinity	<9 ppt	N/A
Temperature	Approximately 86°F (30°C)	This species is the most heat-tolerant of the Central Valley fish species.

References

CalFish. 2017. Clear Lake hitch. Available from http://calfish.ucdavis.edu/species/?ds=698&uid=33.
Center for Biological Diversity. 2017. Clear Lake hitch. Available from https://www.biologicaldiversity.org/species/fish/Clear_Lake_hitch/index.html.

F-3 | Coho Salmon

Oncorhynchus kisutch

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Protected Status

Federal	State
Endangered (Central California Coast Evolutionarily Significant Unit [ESU]) Threatened (Southern Oregon / Northern California Coasts ESU)	Endangered (Central California Coast ESU) Threatened (Southern Oregon / Northern California Coasts ESU)

Reliance on Groundwater

Direct. Coho salmon rely on groundwater-fed rivers.

Distribution in California

This species is found in coastal watersheds from the Oregon border south to Aptos Creek (Santa Cruz County), California.

Habitat

Juvenile coho rear for about one year in low-gradient coastal river/stream channels characterized by low water temperatures, deep pools, abundant instream cover, and areas of slow water velocity. Adults spawn in low-gradient coastal rivers and streams, usually in clean gravel at the tails of pools.

Associated Vegetation

Coho are associated with native riparian species.

Groundwater-Related Threats

Groundwater conditions that alter groundwater baseflow into rivers can negatively affect coho salmon habitat. Juvenile salmonids generally require cold, clear, well-oxygenated water and adequate streamflow volume during their time in fresh water. Adult salmon similarly require adequate water quality and volume during their upstream migration. Groundwater pumping can have a negative impact on instream habitat by depleting streamflow volume and interrupting the influx of cold groundwater into the stream environment.

Hydrologic Indicators

Given the large geographic range of coho salmon across California, it is best to develop site-specific quantitative hydrological indicators. Please consult with NOAA Fisheries for more information on coho salmon.

Reference

NOAA Fisheries. 2012. Final recovery plan for Central California Coast coho salmon evolutionarily significant unit. NOAA Fisheries, Southwest Region, Santa Rosa, California. Available from https://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/north_central_california_coast/central_california_coast_coho_recovery_plan.html.

F-4 | Colorado Pikeminnow

Ptychocheilus lucius

© J.E. Johnson, U.S. Fish and Wildlife Service

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered and extinct	Fully Protected

Reliance on Groundwater

Direct. Colorado pikeminnow are reliant on rivers that may be supported by groundwater, especially in river canyons with sandstone or limestone.

Distribution in California

This species is native to the Colorado River Basin. Construction of large dams has restricted its distribution to Utah and Colorado, although it is also believed to occur in San Bernardino County.

Habitat

The Colorado pikeminnow is a migratory species that spends its entire life in medium- to large-sized freshwater rivers. While juveniles prefer small, quiet backwaters, adults use various habitats including deep, turgid, strongly flowing waters, eddies, runs, flooded bottoms, or backwaters, as well as inundated lowlands. After spring runoff, these fish spawn in the fast-flowing rapids of deep canyons, where eggs stick to gravel substrate. The eggs hatch in 3 to 6 days and larvae drift downstream for over 62 m (100 km) to nursery habitat that has low, stable base flows in summer, fall, and winter to provide a supportive, warm, and productive nursery environment.

Associated Vegetation

No information was found on associated vegetation for this species.

Groundwater-Related Threats

Changes in groundwater conditions that alters baseflow to rivers can affect this species. Groundwater contamination is also deteriorating the water quality conditions needed for this species' habitat. For example, the Atlas Mills Tailings Pile on the north bank of the Colorado River near Moab, Utah, is releasing toxic discharges of pollutants (e.g., ammonia, uranium) through groundwater to the Colorado River. This part of the Colorado River was declared as

critical habitat because it's one of the few areas that contains known spawning and rearing habitats for the Colorado pikeminnow.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	68–71.6°F (20–22°C)	This species is adapted to warm waters. It spawns during the summer (late June to early August). Eggs hatch at 68–71.6°F (20–22°C), but survival and hatching are best at 68°F (20°C). Spawning occurs after spring flows, in 64.4–73.4°F (18–23°C) temperatures.

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F-5 | Cottonball Marsh Pupfish

Cyprinodon salinus milleri

Protected Status

Federal	State
Not Listed	Threatened

Reliance on Groundwater

Direct. This species is reliant on groundwater-fed surface water.

Distribution in California

Cottonball Marsh pupfish are found in Cottonball Marsh at the bottom of Death Valley, near Salt Creek.

Habitat

Cottonball Marsh pupfish primarily live in vegetation-lined pools surrounded by salt crusts and with highly variable temperature and salinity. These fish may find refuge for reproduction in the deeper water of pools during the high summer temperatures.

Associated Vegetation

These fish are associated with streams and channels bordered by *Distichlis spicata* (saltgrass), *Salicornia* spp. (pickleweed), and *Atriplex* spp. (saltbush).

Groundwater-Related Threats

Conditions that alter groundwater baseflow into streams can impair habitat conditions for this species and reduce the amount of suitable habitat for reproduction in the summer. Groundwater pumping can affect in-stream habitat by depleting streamflow volume, interrupting the influx of cold groundwater into the stream environment, and disrupting the tolerable salinity range for the pupfish, as well as a salinity gradient that supports associated vegetation.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<9.8 ft (3 m)	This species commonly lives within 6.6 ft (2 m) of water in the shallow marshes but may move to deeper waters (up to 9.8 ft/3 m) for reproductive refuge in the summer.
Water Quality		
Salinity	14–160 ppt	This species is tolerant of a wide range of salinity fluctuations, as its habitat is surrounded by salt crusts.
Temperature	32–104°F (0–40°C)	This species is highly tolerant of wide temperature fluctuations due to a shallow, variable habitat.

References

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F-6 | Delta Smelt

Hypomesus transpacificus

Protected Status

Federal	State
Threatened	Endangered

Reliance on Groundwater

Direct. This species relies on groundwater discharge to the Delta.

Distribution in California

Endemic to California, the Delta smelt primarily lives in or just upstream of the mixing zone between fresh and saltwater in the upper San Francisco Bay-Delta. However, they can be found as high as the southern end of the Yolo Bypass during spawning and rearing season.

Habitat

Delta smelt live in the open waters of bays, tidal rivers, channels, and sloughs of the upper San Francisco Estuary. The species tends to concentrate where saltwater and freshwater mix (salinity ~2 ppt) and in areas with dense zooplankton populations. Spawning occurs in fresh or slightly brackish water.

Associated Vegetation

Delta smelt are not dependent on many aquatic plant species for their survival. Their populations are being threatened by invasive aquatic plant species that have been decreasing turbidity.

Groundwater-Related Threats

Groundwater conditions that alter groundwater discharge to the Delta can alter surface water flow and salinity gradients required for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Salinity	10–12 ppt	Delta smelt only live in waters with salinity range of 10–12 ppt.

References

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F-7 | Desert Pupfish

Cyprinodon macularius

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Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. The desert pupfish relies on groundwater-fed springs.

Distribution in California

As of 2018, natural populations of this species inhabited three streams, irrigation drains, and shoreline pools and the Salton Sea. Additionally, there were 14 refuge populations. These populations are entirely in California's inland deserts.

Habitat

These pupfish are found in shallow waters of freshwater springs and oases, small streams, outflow/river edge marshes, backwaters, and saline/brackish pools with sand/silt substrates, aquatic plant life, and limited surface flow. They also live in irrigation drains and saline/brackish lakes such as the Salton Sea. Pupfish are well-adapted to limited surface flow, which corresponds to higher salinity, higher temperature, and lower dissolved oxygen.

Associated Vegetation

This species uses aquatic vegetation commonly associated with springs and wetlands.

Groundwater-Related Threats

Groundwater conditions that alter discharge to surface waters can result in habitat loss or alteration for this species. In some waters, this has led to seasonal increases in salinity above the upper limits for desert pupfish and has reduced available spawning habitat.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<3.5 ft (1 m)	The water depth identified here is associated with male-established breeding territories. Desert pupfish in the Salton Sea have been found at a depth of 7–8 ft (2.1–2.4 m). Preferred spawning depth for desert pupfish is approximately 7–9 in (18–22 cm).
Water Quality		
Salinity	15–35 ppt	This salinity range corresponds with optimal growth rates. The lower end of the range is conducive to improved growth rates for older fish, whereas the higher end of the range may be more suitable for younger fish. Pupfish have been observed in waters with salinity as high as 68 ppm; however, high salinity duration tolerance and survival rates are unknown.
Temperature	70–85°F (22–30°C)	This water temperature range supports adult fish spawning activities and encompasses optimal growth rates for both young and adult fish. Pupfish can withstand abrupt changes in temperature conditions but have an upper lethal tolerance of 108.3°F (42.4 ±0.2°C).
Dissolved Oxygen	>0.1 ppm	The pupfish has a high tolerance for low dissolved oxygen and has been observed in waters with DO as low as 0.1 ppm; however, low DO duration tolerance and survival rates are unknown.

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F-8 | Eulachon

Thaleichthys pacificus

Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Direct. This species is reliant on estuaries and lower reaches of rivers that are likely to be supported by groundwater.

Distribution in California

The eulachon was historically found from the San Francisco Bay Area north to the Oregon border. Currently, its observed range includes the lower riverine reaches from the Mad River to the Oregon border, although the Klamath River population is considered the only sub-population within the southern Distinct Population Segment. The Klamath, Redwood, and Mad Rivers contain designated critical habitat for the southern Distinct Population Segment.

Habitat

Adult fish inhabit the marine environment (along continental shelves, between 65–656 ft (20–200 m) and return to spawn within estuaries and the lower reaches of rivers. Spawning is initiated by high tides and flows.

Associated Vegetation

Eulachon prefer detritus and habitat containing sand or pea-gravel. They will seldom be found more than a few miles inland.

Groundwater-Related Threats

Groundwater conditions that alter surface water flow and depth can have a negative impact on water quality and quantity requirements for eulachon spawning.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Salinity	<16 ppt	Salinity greater than 16 ppt is lethal to eggs.
Temperature	39.2–42.8°F (4–6°C)	Spawning migration is initiated when temperatures are above 39.2°F (4°C) but slows or stops outside the range of 39.2–46.4°F (4–8°C); extended temperatures over 42.8°F (6°C) are lethal to eggs.

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F-9 | Green Sturgeon

Acipenser medirostris

Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Direct. This species relies on surface water flows that may be supported by groundwater.

Distribution in California

Green sturgeon can be found in marine and estuarine waters from the Bering Sea in Alaska to Baja California, Mexico. In California, they occur in riverine environments from the Sacramento River northward to the California border. Spawning populations are known to live in both the Klamath and Sacramento River Basins.

Habitat

This anadromous species spends most of its life at sea but returns to freshwater to spawn. Young fish may remain in these freshwater environments for up to two years. Adults spawn in fast, deep water during the first half of the year. Post-spawn adults then move back down the river during the fall and re-enter the ocean.

Associated Vegetation

The associated vegetation for this species is unknown.

Groundwater-Related Threats

Groundwater conditions that either temporarily or permanently alter surface water flows can have a negative impact on the spawning capabilities of this fish and decrease its population.

Hydrologic Indicators

There are no reported values for groundwater requirements for this species. However, monitoring shallow groundwater levels near interconnected surface waters can ensure this species' habitat is not being adversely affected by groundwater conditions.

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F-10 | Lahontan Cutthroat Trout

Oncorhynchus clarkii henshawi

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Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Direct. This species is reliant on surface water likely to be supported by groundwater.

Distribution in California

This fish is found in the Lahontan drainage basin of northeastern California. Its range extends from the Sierra Nevada crest in California northeast to Nevada. In California, the historic range includes Lake Tahoe, and the Carson, Truckee, and Walker River Basins. The only remaining indigenous population in California is in Independence Lake and By-Day Creek, a tributary of the Walker River system.

Habitat

Lahontan cutthroat trout are found in cold water habitats ranging from high-elevation mountain streams to low-elevation desert lakes. Spawning, which depends on stream flow, occurs between February and July.

Associated Vegetation

These trout are found in well-vegetated stream banks and are also associated with cottonwood forests.

Groundwater-Related Threats

Groundwater conditions that alter stream flow and temperature can negatively affect habitat conditions for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	<78.8–83.3ºF (26–28.5ºC)	The maximum daily temperature associated with trout occurrence ranged from 66–83.3ºF (18.9–28.5ºC), with occurrence more likely at <78.8ºF (26ºC). This species begins to show acute stress at warm temperatures (>71.6ºF/22ºC). Their absence from warmer-temperature waters may be due to emigration to cooler sites or mortality from higher temperatures.
Alkalinity	<3,000 mg/L	N/A
Total Dissolved Solids	<16,000 mg/L	N/A

References

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F-11 | Longfin Smelt

Spirinchus thaleichthys

Protected Status

Federal	State
Not Listed	Threatened

Reliance on Groundwater

Direct. For feeding and rearing, these fish rely on estuarine wetlands and sloughs that are likely to be supported by groundwater discharge.

Distribution in California

Longfin smelt are found in the San Francisco Estuary, the Sacramento/San Joaquin Bay Delta, Humboldt Bay, and the Eel and Klamath River Estuaries.

Habitat

These smelt depend on a diverse range of open water habitats, including coastal lagoons, bays, estuaries, sloughs, freshwater streams, and offshore open water. Longfin smelt are euryhaline and able to tolerate a variety of salinity in their habitats, from completely freshwater to marine.

Associated Vegetation

Longfin smelt are associated with aquatic estuarine vegetation, which acts as a substrate for egg attachment during spawning periods.

Groundwater-Related Threats

Groundwater conditions that alter surface water flow and temperature conditions can threaten suitable estuarine habitat for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	Adults: <64ºF (17.8ºC) Juveniles: <73ºF (22.8ºC)	Longfin smelt have a low tolerance for warm waters. Water diversion and drought may lead to increased water temperatures, threatening this species' survival.
Salinity	15–20 ppt	Longfin smelt reside in estuaries of this salinity range. However, these smelt are euryhaline and anadromous and can tolerate a range of salinities. They prefer lower salinities except during spawning periods. Water diversion alters the mixing zone and associated salinity levels of the water column, reducing suitable habitat and prey for this species.

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F-12 | Lost River Sucker

Deltistes luxatus

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Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Direct. The Lost River sucker is reliant on shallow surface waters that may be supported by groundwater.

Distribution in California

Regular Lost River sucker spawning occurs only in Clear Lake Reservoir. There have also been sightings in the Klamath Basin in Northern California.

Habitat

The Lost River sucker lives in stream and river, lake, marsh, and shoreline habitats. It spends the spring over gravel substrates in habitats less than 4.3 ft (1.3 m) deep in tributary streams and rivers. Larvae spend relatively little time in streams or rivers before drifting downstream to lakes by mid-summer. Larval habitat is generally along relatively shallow shorelines. Juveniles live in a wide variety of near- and offshore habitats, including emergent wetlands and non-vegetated areas. Adults are usually found in open water habitats.

Associated Vegetation

Emergent vegetation on shorelines provides cover from predators, protection from currents and turbulence, and abundant food, with algae as a known food source.

Groundwater-Related Threats

Groundwater conditions that alter surface water flow and quantity in lakes and rivers can have an adverse impact on the shallow waters and emergent vegetation that this species depends on for protection and food.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Dissolved Oxygen	1.4–1.58 mg/L	Dissolved oxygen below this level can lead to asphyxiation for adults. Oxygen levels are threatened during degrading algal blooms.

References

NatureServe. 2013. *Deltistes luxatus*. The IUCN Red List of Threatened Species 2013: e.T6338A15362648. Available from http://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T6338A15362648.en.

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F-13 | Modoc Sucker

Catostomus microps

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Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Delisted due to recovery	Endangered	Fully Protected

Reliance on Groundwater

Direct. This species relies in streams that are likely to be supported by groundwater.

Distribution in California

The Modoc sucker's historical range consisted of Northern California streams that crossed into Oregon. Today, they can be found in the Modoc National Forest and bordering waterways.

Habitat

These fish prefer streams with a moderate gradient and extensive muddy or rocky bottoms, which they use to seek refuge from predation. When snowmelt increases water flow, they move to tributaries to begin spawning.

Associated Vegetation

No associated vegetation is listed for the Modoc sucker.

Groundwater-Related Threats

Groundwater conditions that alter streams' high spring flows and low summer flows can adversely affect spawning and survival for this species. A significant amount of groundwater is needed to keep the temperature and flow rates within this species' functional range. Cool water temperatures are required for spawning, so groundwater reliance will increase if snowmelt or surface water conditions change.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Flow	High spring flows and low summer flows are needed at stream headwaters.	These flow conditions are necessary for maintaining spawning and habitat conditions.
Water Quality		
Temperature	<77ºF (25°C) headwaters are this species' usual habitat. After the snow melts in April, they move into tributary streams (55.4–60.8ºF/13–16°C).	These temperature conditions are necessary for maintaining spawning and habitat conditions.

References

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F-14 | Mohave Tui Chub

Gila bicolor mohavensis

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. The Mohave tui chub is reliant on surface water that may be supported by groundwater.

Distribution in California

While this species was previously found in the Mojave River, the Mohave tui chub can now only be found in highly modified refuge sites in San Bernardino County.

Habitat

This species lives in pools and sloughs.

Associated Vegetation

The chub is associated with *Salicornia* spp. (pickleweed), *Typha* spp.(cattails), *Juncaceae* spp.(rushes), *Distichlis spicata* (saltgrass), and *Tamarisk* spp. (salt cedar).

Groundwater-Related Threats

Groundwater conditions that alter surface water regimes can impact this species' habitat.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	Present (>1.6 ft/0.5 m)	Sufficient water is required to support habitat conditions.

References

DFW. 2018. Mohave tui chub. Available from https://www.wildlife.ca.gov/Regions/6/Desert-Fishes/Mohave-Tui-Chub.

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F-15 | Owens Pupfish

Cyprinodon radiosus

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fullly Protected

Reliance on Groundwater

Direct. The Owens pupfish relies on spring-fed pools and other surface waters that are likely to be supported to groundwater.

Distribution in California

This species is endemic to the Owens Valley. There are five discrete populations remaining, including those in Fish Slough.

Habitat

The Owens pupfish's historical habitat included spring pools, sloughs, irrigation ditches, swamps, and flooded pastures in the Owens Valley, from Fish Slough in Mono County to Owens Lake near Lone Pine in Inyo County. Remaining populations rely on habitats that are free of non-native predators, aquatic vegetation, and silt- or sand-covered bottom, spring-fed pools.

Associated Vegetation

This species is associated with aquatic vegetation common in springs, sloughs, and swamps.

Groundwater-Related Threats

Groundwater conditions that deplete spring-fed pools and interconnected surface waters threaten this species' habitat.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	50–77ºF (10–25ºC)	This represents the range of temperatures in which pupfish were historically found in abundance.

References

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F-16 | Owens Tui Chub

Siphateles bicolor snyderi

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Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. Groundwater provides water to isolated springs and the headwaters of streams in the Owens Basin.

Distribution in California

This species is endemic to Owens Basin (Owens, Round, and Long Vallies) of Mono and Inyo Counties. Historically, populations existed in Owens River from Long Valley to Lone Pine; tributaries near Owens River in Long Valley and Owens Valley, Fish Slough; and irrigation ditches and ponds near Bishop, Big Pine, and Lone Pine. Currently, populations exist in Little Hot Creek Pond, Hot Creek Headwaters, Sotcher Lake, Upper Owens Gorge, White Mountain Research Station, and Mule Spring.

Habitat

The Owens tui chub lives in slow-moving waters with lots of submerged vegetation for cover, habitat, and food. Morphology, swimming, and behavior suggest that this species is not adapted to moving through rapid waters. Rather, their movement requires the presence of vegetation beds, so high-velocity areas are encountered only briefly.

Associated Vegetation

The species needs plants for predator avoidance, reproduction, food, and reduced water velocity. Aquatic vegetation is important for plant food and habitat for aquatic invertebrates (their main food). They use *Chara* spp. (muskgrass) and *Typha* spp. (cattails) in Little Hot Creek Pond; *Salix* spp. (willow), *Typha* spp., *Urtica* spp. (stinging nettle), *Rosa californica* (wild rose), *Potamogeton* spp. (pondweed) and grasses in Owens Gorge; and *Populus* spp. (cottonwood) in White Mountain Research Stations. They also use *Nasturtium officinale* (watercress), *Azolla filiculoides* (water fern), *Lemna* spp. (duckweed), pondweed, *Ranunculus aquatilis* (aquatic buttercup), and *Elodea canadensis* (elodea) in Hot Creek Headwaters.

Groundwater-Related Threats

Groundwater conditions that reduce flows to isolated springs and the headwaters of Owens Basin can reduce the aquatic habitat for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Base Flow	In 1997, LADWP was ordered to release 40 cfs in lower Owens River.	Release increased habitat (runs, riffles, and pools), which did not benefit the Owens tui chub, and instead, benefited non-native species.
Water Quality		
Temperature	Variable: Typically constant at 59ºF (15ºC); Spring sites (57–64ºF/13.9–17.8ºC), hot springs (70–77ºF/21.1–25ºC), river (36–78ºF/2.2–25.6ºC)	Spawning is triggered by warming water temperatures; eggs hatch earlier in warmer water.
pH	6.6–8.9	N/A
Dissolved Oxygen	5–9.3 mg/l or ppm	N/A
Alkalinity	68–88.4 ppm	N/A

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F-17 | Paiute Cutthroat Trout

Oncorhynchus clarkii seleniris

Protected Status

Federal	State
Threatened	Threatened

Reliance on Groundwater

Direct. This species is reliant on stream pools that are likely supported by groundwater.

Distribution in California

Paiute cutthroat trout are native to Silver King Creek and tributaries in the headwaters of the East Fork Carson River drainage. There are also two out-of-basin populations in the central Sierra Nevada and two in the White Mountains.

Habitat

These trout depend on cool, well-oxygenated waters. Stream pool habitat in low-gradient meadows with overhanging banks and abundant vegetation are preferred by adults. Pools are also important as winter refuge and juvenile habitat.

Associated Vegetation

Paiute cutthroat trout are associated with riparian stream vegetation, which provides overhead cover.

Groundwater-Related Threats

Groundwater conditions that deplete surface water in streams can impair juvenile habitat and impede hydrologic connections between populations, which reduce the species' long-term survival.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	Less than 35.6ºF (2ºC)	Paiute cutthroat trout require high-elevation streams with these specific temperature, pH, and oxygen conditions to support growth and high survival.
pH	6.5–8.5	
Dissolved Oxygen	>8 mg/L	

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F-18 | Razorback Sucker

Xyrauchen texanus

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. This species is reliant on rivers and lakes that may be supported by groundwater.

Distribution in California

Razorback suckers are endemic to the Colorado River Basin and can be found in the backwaters, ponds, impoundments, and mainstem of the lower Colorado River, where it borders California and Arizona. This species remains in this portion of its native range through intensive stocking efforts. No naturally propagating populations are left in California.

Habitat

The razorback sucker occupies freshwater habitats. In general, adults can be found in rivers that include deep runs, eddies, backwater, and flooded off-channel environments in the spring. In the summer, they live in runs and pools, often in shallow water associated with submerged sandbars. In the winter, their habitats include low-velocity runs, pools, and eddies. For spawning, they favor rivers over cobble, gravel, and sand substrates with water temperature typically greater than 57.2ºF (14ºC). The razorback sucker is also known to occur in reservoirs with rocky shoals and shorelines. Juveniles require areas of quiet, warm, shallow water, such as backwaters and coves or reservoir shoreline areas.

Associated Vegetation

This species can usually be found in areas of sparse vegetation and has no major reliance on or association with any plant species. Frightened juveniles will hide in dense vegetation if living in cove environments, but gradually outgrow that trait.

Groundwater-Related Threats

Groundwater conditions that deplete surface water in rivers and lakes can impair habitat conditions for this species. Groundwater contamination can also affect their growth.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	Larvae: 50–79.9ºF (10–26.6ºC) Adults: 71.6–77ºF (22–25ºC)	Best suited for spawning; larvae are found in temperatures in this range.
pH	6–9	N/A
Dissolved Oxygen	2–6 mg/L	Dissolved oxygen below 2 mg/L results in more than 50 percent mortality.
Salinities	20,000–23,000 µS/cm	Salinity outside this range leads to at least 50 percent mortality.

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F-19 | Rough Sculpin

Cottus asperrimus

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Not Listed	Threatened	Fully Protected

Reliance on Groundwater

Direct. The rough sculpin relies on streams that may be supported by groundwater, which provide a certain depth and temperature to carry out its life processes.

Distribution in California

Today, the rough sculpin is found in the Northern California Lower Pit Watershed and in the Pit River in Shasta and Lassen Counties.

Habitat

These sculpin prefer to live in cool, spring-fed streams. These streams usually have clear water, muddy bottoms, and aquatic vegetation. However, the fish have also been found in reservoirs where surface water temperatures are approximately 86ºF (30°C).

Associated Vegetation

The fish live in areas where aquatic vegetation grows and there is a sand or gravel substrate.

Groundwater-Related Threats

Groundwater conditions that deplete surface water in rivers and lakes can impair habitat conditions for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	3.3-6.6 ft (1-2 m)	These depths represent general habitat needs within rivers and streams.
Water Quality		
Temperature	<59ºF (15°C)	Temperatures in this range meet general habitat needs for both the spawning and non-spawning season.

References

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PICES. 2014. *Cottus asperrimus*. Available from https://pisces.ucdavis.edu/content/cottus-asperrimus.

F-20 | Santa Ana Sucker

Catostomus santaanae

© Jennifer Paretti, California Department of Fish and Wildlife

Protected Status

Federal	State
Threatened	Not Listed

Reliance on Groundwater

Direct. The Santa Ana sucker is reliant on rivers that are likely to be supported by groundwater.

Distribution in California

This species is found in limited sections of the Los Angeles, San Gabriel, Santa Ana and Santa Clara River Systems.

Habitat

The Santa Ana sucker is primarily found within clear streams containing gravel, cobble, and sand substrates. Stream depth ranges from a few inches to several feet, with currents ranging from slight to swift. Perennial flows with suitable and stable water quality and substrates are necessary for the continued species survival. Groundwater upwelling contributes lower temperature inflows into some streams where the fish live, providing cool water refugia

Associated Vegetation

The Santa Ana sucker uses streamside vegetation and some aquatic vegetation and algae for foraging and refuge.

Groundwater-Related Threats

Groundwater conditions that alter instream flows or degrade water quality can threaten habitat conditions for this species. Changing river inflows where groundwater contributions have decreased over time can decrease water availability and cool water inflows, causing elevated water temperatures less suitable for the Santa Ana sucker.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quality		
Temperature	<72ºF (22.2°C)	This species is most abundant at temperatures <72ºF (22.2°C).

References

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F-21 | Shortnose Sucker

Chasmistes brevirostris

© Heather Hendrixson, The Nature Conservancy

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Direct. The shortnose sucker relies on surface waters (e.g., wetlands, rivers, lakes, and reservoirs) that may be supported by groundwater.

Distribution in California

The species is found in the Lost River, Clear Lake, and Klamath River Reservoirs below Keno. Suckers in Clear Lake spawn in the Willow Creek tributary.

Habitat

These fish use large, shallow lakes with high vegetation. Adults and juveniles like shallow, turbid, and highly productive lakes that are cool in the summer. In Upper Klamath Lake, this species prefers vegetated, shallow water, but in Gerber Reservoir and Clear Lake, they prefer shallow, unvegetated areas.

Associated Vegetation

Wetlands around Upper Klamath Lake are probably used to protect larvae from predators, such as non-native *Pimephales promelas* (fathead minnow). Emergent wetlands protect them from currents and turbulence. Emergent vegetation along lakeshore areas provides cover and habitat for shortnose sucker food species (zooplankton, macroinvertebrates, periphyton).

Groundwater-Related Threats

Groundwater conditions that deplete surface water flows or degrade water quality can adversely impact the habitat conditions for this species.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	Shallow lakes; 4.3–51.2 in (11–130 cm) in rivers	Adults and juveniles prefer shallow lakes that are well vegetated. This species spawns at depths of 4.3–51.2 in (11–130 cm) in rivers.
Water Quality		
Temperature	59–77 ºF (15–25ºC)	Adults and juveniles prefer cool water in the summer but may survive temperatures up to 87.8–91.4 ºF (31–33ºC). Higher water temperatures with emergent vegetation promotes faster growth of larvae.
Dissolved Oxygen	4–9 mg/L	Favors well oxygenated waters, but found in waters as low as 1 mg/L.

References

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F-22 | Steelhead

Oncorhynchus mykiss

Protected Status

Federal	State
Threatened (Distinct Population Segments: California Central Valley Northern California Coast, Central California Coast, and South-Central California Coast) **Endangered** (Southern California Coast Distinct Population Segment)	Not Listed

Reliance on Groundwater

Direct. Steelhead are reliant on rivers and streams that are likely supported by groundwater.

Distribution in California

This species lives in coastal and inland watersheds throughout the state. Steelhead are the most widely distributed of the native salmonids found in California.

Habitat

While steelhead are generally more adaptable to habitat extremes than either coho or Chinook salmon, they nevertheless require cold water and complex instream habitat during their freshwater juvenile residency, which generally lasts at least one year, including at least one dry season. Estuaries can provide important rearing habitat for steelhead, with opportunities for rapid growth prior to entering the marine environment. For spawning, all adult salmonids require sufficient flow and suitably cool water temperature for upstream migration to spawning grounds, and streambeds with clean gravel, free of excessive fine sediment deposition to spawn in. Unlike coho and Chinook salmon, some adult steelhead will survive to spawn a second or third time; thus, adequate streamflows are required for post-spawn adult steelhead to migrate downstream during spring.

Associated Vegetation

Steelheads are associated with native riparian species.

Groundwater-Related Threats

Groundwater conditions that alter instream flow and water quality can have an adverse impact on steelhead habitat conditions. Juvenile steelhead generally require cold, clear, well oxygenated water and adequate streamflow volume while residing in freshwater. Adult steelhead also require adequate water quality and instream flows during their upstream and downstream migration, which can be limited by streamflow depletion. Cold groundwater inputs can provide local areas of water temperature refugia in which rearing juvenile steelhead are less susceptible to stress or mortality that can otherwise result from elevated water temperatures during warm, dry months when streamflows are typically lowest. Groundwater pumping can affect instream habitat particularly in the summer by depleting streamflow volume and interrupting the influx of cold groundwater into the stream.

Hydrologic Indicators

Given the large geographic range of steelhead across California, it is best to develop site-specific quantitative hydrological indicators. Please consult with NOAA Fisheries for more information on steelhead.

References

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F-23 | Tidewater Goby

Eucyclogobius newberryi

Protected Status

Federal	State
Endangered	Not Listed

Reliance on Groundwater

Direct. Tidewater gobies rely on surface waters in coastal areas that are likely to be supported by groundwater discharge.

Distribution in California

This native fish occupies cool brackish water in lagoons and estuaries from Del Norte to San Diego Counties.

Habitat

These fish live in lagoons and estuaries with submerged and emergent aquatic vegetation that can provide protection from predators and flooding. They can also be found in backwater marshes and freshwater tributaries to estuarine environments. Their food sources include macroinvertebrates (e.g., amphipods, aquatic insects).

Associated Vegetation

Tidewater gobies are associated with *Potamogeton pectinatus* (sago pondweed), *Ruppia maritima* (beaked tasselweed), *Typha latifolia* (broadleaf catttail), and *Scirpus* spp. (clubrush).

Groundwater-Related Threats

Groundwater conditions that alter surface water flows in coastal lagoons and estuaries can have a negative impact on the species' breeding and foraging activities.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Surface Water Depth	<6 ft (2 m)	Recently, tidewater gobies were collected in Big Lagoon in Humboldt County during the breeding season at a water depth of 15 ft (4.6 m). Whether the use of these deeper waters is confined to this locality or is more widespread will require additional sampling at various depths and locations.
Surface Water Velocity	<0.5 ft/sec (0.15 m/sec)	High water velocities can flush tidewater gobies out to sea and eliminate them from an area, especially during floods. Although high water velocity can be detrimental to individuals and can wipe out a population, when the mouth of a lagoon is temporarily breached, they can join different populations and recolonize extirpated localities, maintaining their metapopulation structure. It is important that this does not happen too often, but it is an essential part of their natural history.
Water Quality		
Salinity	<10 ppt	While larval stages are largely intolerant of high salinities, adults can tolerate them. Spawning tidewater gobies have been documented breeding in water salinities between 1 and 30 ppt, but prefer salinities <10 ppt.
Temperature	46–77°F (8–25°C)	This water-temperature range supports spawning activities of adult fish or the presence of egg clutches.

Reference

USFWS. 2013. Endangered and threatened wildlife and plants; designation of critical habitat for tidewater goby: Final rule. Federal Register 78(25):8746–8819. Available from https://www.gpo.gov/fdsys/pkg/FR-2013-02-06/pdf/2013-02057.pdf.

F-24 | Unarmored Threespine Stickleback

Gasterosteus aculeatus williamsoni

© Tim Hovey, California Department of Fish and Wildlife

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Direct. The unarmored threespine stickleback is reliant on rivers and streams that may be supported by groundwater.

Distribution in California

Populations of this species in Southern California are limited to the Upper Santa Clara River and its tributaries (San Francisquito, Bouquet Canyon, and Soledad Canyon Creeks) in Los Angeles County, San Antonio Creek on Vandenberg Air Force Base in Santa Barbara County, and the Shay Creek area in San Bernardino County. Introduced populations exist in San Felipe Creek in San Diego County and Fish Canyon Creek in Los Angeles County.

Habitat

These sticklebacks generally, prefer slow-moving, quiet stream and river habitats with constant water flow. They favor habitats that are shaded by dense vegetation, shallow waters with weedy pools and backwaters, or areas with emergent plants at stream edges over bottoms of gravel, sand, and mud.

Associated Vegetation

The unarmored threespine stickleback uses aquatic vegetation, such as *Rorippa* spp. (watercress) and *Cladophora* spp. (filamentous algae). Males build nests with plant debris and algal strands. These fish may also use algal mats, sand bars, floating vegetation, etc. for refuge.

Groundwater-Related Threats

Groundwater conditions that alter instream flow or water quality conditions can adversely impact habitat conditions for this species. Groundwater pumping, especially during droughts, can deplete shallow streams or ponds and increase water temperatures.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Velocity	<0.05 ft/sec (1.5 cm/sec) and ≤1 ft/sec (30.5 cm/sec)	Slow-moving streams and rivers meet this species' velocity preferences or swimming speed. Water velocities of <0.05 and >2 ft/sec (1.5 cm/sec and 60.9 cm/sec) are not suitable, and water velocities between 1–2 ft/sec (30.5–61 cm/sec) have low suitability.
Surface Water Depth	≥6 in (15.2 cm) and ≤36 in (91.4 cm)	Water depths <1 in (2.5 cm) are not suitable and <6 (15.2 cm) have low suitability. In general, these fish appear to use a variety of depths. Shallow depths along stream margins are likely important as areas of lower velocity, where aquatic vegetation is present that may serve as a nursery for young fish. Stickleback may also exploit deeper habitat, particularly in pools where velocities are low.
Water Quality		
Temperature	<77°F (25°C)	Temperatures of <77°F (25°C) are not suitable. High rates of mortality occur when temperatures increase rapidly or exceed the critical thermal maximum of 94.2°F (34.6°C).
Dissolved Oxygen	>2.0 ppm	Studies have shown that oxygen concentrations ≤2.0 ppm are not suitable because they increase energy use for respiration.
pH	≥6 and ≤9	The pH requirements for unarmored threespine stickleback have not been systematically evaluated in existing literature. However, it is assumed that, like most other Southern California freshwater fish, it requires pH ranges from about 6 to 9.
Turbidity	≤40 NTU	Increased water turbidity enhances selection for intense courtship displays in sticklebacks because females pay attention to the male in turbid water only when he displays colors at a very high level.

References

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Mammals

M-1 | Amargosa Vole

Microtus californicus scirpensis

© Don Preisler, University of California Davis

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Direct. This species is reliant on springs and permanent surface water bodies fed by groundwater. Amargosa voles also rely on groundwater-dependent freshwater marsh ecosystems and vegetation for habitat and forage.

Distribution in California

The voles are endemic to the Amargosa River Valley in the Tecopa Hot Springs area, Inyo County, California.

Habitat

This species is dependent on the presence of permanent standing water and on groundwater-dependent *Schoenoplectus americanus* (Olney's three-square bulrush) dominated freshwater wetlands for both habitat and food.

Associated Vegetation

The Amargosa vole is dependent on the presence of *Schoenoplectus americanus* for protection from predators, forage, and thermal refuge. Additional associated freshwater marsh vegetation includes *Distichlis spicata* (inland saltgrass), *Anemopsis californica* (lizard tail), *Juncus cooperi* (Cooper's rush), *Juncus balticus* (wire rush), *Nitrophila occidentalis* (Western nitrophila), *Carex* spp. (sedges), *Eleocharis rostellata* (walking sedge), and *Phragmites australis* (common reed).

Groundwater-Related Threats

Changes to groundwater could cause habitat loss, fragmentation, or degradation through reduced groundwater outflows, leading to the loss of standing water or the reduction of native plant cover for forage and habitat needs. Accumulation of plant litter under drought conditions can suppress marsh vegetation even after water is reintroduced. Diversion or management of springflows by humans/landowners also presents a significant threat to Amargosa voles and their habitat. Additional threats include increased fire risk during drought conditions.

Hydrologic Indicators

Water availability must be sufficient to support the growth of wetland vegetation, especially *S. americanus*, as the vole is highly dependent on this species for its survival. Vole density increases with standing water and marshes with deeper standing water are more robust over time, offering reliable functioning habitat for sustainable vole populations. Monitoring shallow groundwater levels and spring outflows around this vegetation can help track habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-2 | Buena Vista Lake Ornate Shrew

Sorex ornatus relictus

© Brian Cypher, California State University

Protected Status

Federal	State
Endangered	Not Listed

Reliance on Groundwater

Indirect. This species is reliant on marshland that may be supported by groundwater for its habitat.

Distribution in California

These shrews are found in the marshes of the southern San Joaquin Valley. The Buena Vista Lake shrew formerly inhabited the interconnected seasonal and permanent lakes, wetlands, sloughs, and marshes around historic Tulare, Kern and Buena Vista Lakes in the Tulare Basin of the San Joaquin Valley. Approximately 95 percent of riparian and wetland habitat in the San Joaquin Valley has been lost, leaving only isolated remnants of suitable habitat where the shrew persists.

Habitat

Buena Vista Lake shrews are most often found in permanent and semipermanent wetlands. They need areas with moist soils and dense cover, and where there is a diversity of insects, which are their primary prey.

Associated Vegetation

These shrews are associated with dense, riparian understories. They are most often detected in locations with moist soils and dense cover consisting of *Juncus* spp. (rushes) or *Typha* spp. (cattails).

Groundwater-Related Threats

This species is vulnerable to marshland and riparian habitat loss and associated prey loss due to droughts and changing groundwater conditions, reducing the availability of water to support these wetland habitats.

Hydrologic Indicators

Monitoring shallow groundwater conditions that are supportive of marsh and riparian vegetation can help track habitat conditions for the Buena Vista Lake ornate shrew. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-3 | Fresno Kangaroo Rat

Dipodomys nitratoides exilis

© California Department of Fish and Wildlife

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

The Fresno kangaroo rat's historical range encompassed grassland and scrub communities on the San Joaquin Valley floor and spread from the marshes of Kings County to Fresno and Selma, and west to the wetlands of the Fresno Slough and the San Joaquin River. As of 1995, there were two populations in Kings County, but further research has not indicated any extant populations. However, small, isolated populations may persist on private lands or in areas that have not been thoroughly surveyed.

Habitat

This desert-adapted species prefers sparse grasslands and shrublands (e.g., valley sink and saltbush scrub communities). They typically occupy herbaceous areas with scattered shrubs and sandy loam soils.

Associated Vegetation

Fresno kangaroo rats are primarily found in arid grasslands and shrublands in the San Joaquin Desert. Associated shrubland vegetation includes *Suaeda* spp. (seepweeds), *Allenrolfea occidentalis* (iodine bush), and *Atriplex* spp. (saltbush).

Groundwater-Related Threats

This species has no known reliance on groundwater, and they are not likely to be threatened by groundwater-related changes. Changes in the San Joaquin Valley hydrology due to droughts, floods, and water management regimes may impact their survival.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

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M-4 | Giant Kangaroo Rat

Dipodomys ingens

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

The giant kangaroo rat is a desert-adapted species that historically occupied thousands of acres of continuous habitat in the western San Joaquin Valley, Carrizo Plain, and Cuyama Valley. Only ~2 percent of the species' historical habitat currently exists. The six major population units that remain are made up of more than 100 small and isolated populations throughout the southern San Joaquin Valley (San Joaquin Desert) and similar xeric habitats in the inner Coast Ranges.

Habitat

Giant kangaroo rats can primarily be found in the dry grasslands and shrublands of the San Joaquin Desert. They are nocturnal and spend most of their time underground in extensive burrow systems.

Associated Vegetation

This species eats the seeds of a variety of forbs and annual grasses. Green foliage may be an important part of the giant kangaroo rat's diet during lactation.

Groundwater-Related Threats

This desert-adapted species prefers sparse grasslands and shrublands. Due to their ability to collect and store food and the relatively high longevity of adults with established burrow systems, giant kangaroo rats may be able to endure severe drought for one to two years without a great risk of population extinction. They are not likely to be threatened by changes to groundwater unless occupied or potential habitat is used for groundwater recharge.

Hydrologic Indicators

The species has no known reliance on groundwater.

References

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M-5 | Mohave Ground Squirrel

Xerospermophilus mohavensis

Protected Status

Federal	State
Not listed	Threatened

Reliance on Groundwater

Indirect. The Mohave ground squirrel relies on groundwater-dependent vegetation for forage.

Distribution in California

This species is endemic to California's western Mojave Desert.

Habitat

Optimal Mohave ground squirrel habitats are desert scrub and Joshua tree communities between 1,800 and 5,000 ft (548.6 to 1524 m) in elevation. The squirrel also feeds in annual grasslands. This species avoids rocky areas, preferring sandy to gravelly soils, and inhabits flat to moderately hilly terrain.

Associated Vegetation

These ground squirrels are found in association with *Larrea tridentata* (creosote bush), *Ambrosia dumosa* (burrobush), various species of *Atriplex* spp. (saltbush), and *Yucca brevifolia* (Joshua tree).

Groundwater-Related Threats

Changing groundwater levels that results in a decline in the occurrence or status of plant species used by Mohave ground squirrels as forage could affect this species.

Hydrologic Indicators

Monitoring shallow groundwater conditions that are supportive of groundwater-dependent vegetation can help track this species' habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-6 | Morro Bay Kangaroo Rat

Dipodomys heermanni morroensis

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected (Note: California Department of Fish and Wildlife considers the species as possibly extinct)

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

This species is endemic to Morro Bay near Los Osos, in western San Luis Obispo County. It has not been observed in the wild since 1986, but some signs (e.g., burrows, tail drag marks, etc.) suggest it might still exist in isolated colonies.

Habitat

This kangaroo rat lives in grassland, coastal shrub, and chaparral provinces. It is adapted to arid habitats with sparse vegetation and loose, sandy soils. Its optimum habitat is early-stage coastal dune scrub.

Associated Vegetation

This species is associated with *Cardionema ramosissimum* (sandcarpet), *Lupinus chammisonis* (bush lupine), (*Artemisia californica* (California sagebrush)*, Salvia mellifera* (black sage)*, Cirsium occidentale* (cobweb thistle), *Croton californicus* (California croton), *Eriogonum parvifolium* (seacliff buckwheat), *Horkelia cuneata* (wedge-leaved horkelia), and *Lotus scoparius* (deerweed). They typically avoid dense vegetation that may limit movement, preferring the openness of sparse vegetation and sandy soil.

Groundwater-Related Threats

This species has no known reliance on groundwater. They obtain most of their water from their diet. The historical species range occurs within the Los Osos Valley Groundwater Basin, and associated habitat does not appear to have significant groundwater reliance.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

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M-7 | Nelson's Antelope Squirrel

Ammospermophilus nelsoni

© California Department of Fish and Wildlife

Protected Status

Federal	State
Not listed	Threatened

Reliance on Groundwater

Indirect. The Nelson's antelope squirrel relies on groundwater to maintain their primary food sources, including nutritious vegetation and small prey species (e.g., insects) in their arid grassland habitat.

Distribution in California

These squirrels are found in the southern San Joaquin valley, Cuyama, and Panoche Valleys and the Carrizo and Elkhorn Plains.

Habitat

Nelson's antelope squirrels depend on relatively arid annual grassland and shrubland communities in areas of low annual precipitation with sparse-to-moderate shrub cover.

Associated Vegetation

This species is associated with *Atriplex* spp. (saltbush), *Ephedra californica* (California ephedra), *Peritoma arborea* (bladderpod), *Gutierrezia californica* (matchweed), and other shrubs.

Groundwater-Related Threats

Nelson's antelope squirrels are vulnerable to the loss of their primary food source due to reduction in water availability. They are highly dependent on the moist, nutritious vegetation that also supports other prey species, such as insects and small vertebrates.

Hydrologic Indicators

Monitoring shallow groundwater levels around groundwater-dependent vegetation can help track habitat conditions for this squirrel species. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-8 | Pacific Pocket Mouse

Perognathus longimembris pacificus

Protected Status

Federal	State
Endangered	Not listed

Reliance on Groundwater

Indirect. The Pacific pocket mouse relies on groundwater-dependent vegetation as a food source.

Distribution in California

This species has been documented in the coastal region near El Segundo in Los Angeles County to the vicinity of the Mexican border in San Diego County.

Habitat

This dry-adapted species is most commonly found on gentle slopes or flat terrain with friable soils. Although it prefers loose sandy soils, it tolerates a wide range of soil types, from sandy loam to clay. It typically inhabits open, forb-dominated landscapes interspersed with bare ground, and has been documented up to 2.5 to 3.7 mi (4 to 6 km) from the coast.

Associated Vegetation

Seeds are the mouse's main food source, but it will also eat other vegetation and insects in the spring. Known food species include *Vicia americana* (American vetch), *Croton californicus* (California croton), *Calystegia macrostegia* (morning glory), *Acmispon glaber* (deerweed), *Corethrogyne filaginifolia* (San Diego sand-aster), *Chenopodium* spp. (goosefoot), *Erigonium fasciulatum* (California buckwheat), *Stipa pulcura* (purple needlegrass), *Brassica* spp. (mustard), *Ambrosia* spp. (ragweed), *Phacelia* spp., *Salvia* spp., and *Erodium* spp. (including filarees).

Groundwater-Related Threats

Associated plant species such as *Chryothamnus* spp. (rabbitbush) may depend on groundwater, so changes may indirectly affect the pocket mouse's food sources. Changes in groundwater management regimes may also affect soil substrates of the species' alluvial habitats, potentially having an impact on available forage and/or the distribution of non-native ants, (e.g., Argentine ants) thought to negatively affect the mice.

Hydrologic Indicators

This species may rely on groundwater-dependent vegetation. Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure that these levels are not having an adverse impact on this species' habitat. Additionally, a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-9 | Peninsular Bighorn Sheep

Ovis canadensis nelsoni

© Christopher L. Christie

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Threatened	Fully Protected (except in the area described in subdivision (b) of Section 4902)

Reliance on Groundwater

Indirect. Peninsular bighorn sheep are reliant on groundwater-dependent plants, shrubs, and cacti for sustenance. They also rely on surface water that may be supported by groundwater during the hot summer months.

Distribution in California

The species is found on desert slopes of the Peninsular Ranges in San Diego, Riverside, and Imperial Counties. Their range extends from the San Jacinto Mountains south to the US-Mexico border.

Habitat

These sheep are found in low elevations on rocky slopes, cliffs, canyons, washes, and alluvial fans where they prefer rugged and open habitats.

Associated Vegetation

Bighorn sheep are generalist herbivores that will forage on the most nutritious seasonally available vegetation.

Groundwater-Related Threats

This species relies on groundwater-dependent vegetation such as *Senegalia greggii* (catclaw acacia) and *Prosopis* spp. (mesquite) during the summer. Depletion of interconnected surface waters and groundwater-dependent vegetation can harm these forage species.

Hydrologic Indicators

Monitoring shallow groundwater levels near interconnected surface waters could detect changes in surface water available for this species during the summer. Therefore, monitoring shallow groundwater conditions that support vegetation can help monitor habitat conditions for this species. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-10 | Point Arena Mountain Beaver

Aplondontia rufa nigra

© Kim Fitts, BioConsultant

Protected Status

Federal	State
Endangered	Not listed

Reliance on Groundwater

Indirect. The Point Arena mountain beaver relies on groundwater only to the extent that it supports the herbaceous vegetation the beaver needs for forage. This mountain beaver sub-species needs water from vascular plants to maintain its metabolic levels and offset its limited ability to concentrate urine.

Distribution in California

This sub-species is only found in the coastal grasslands and forests of southern Mendocino County, between the community of Elk and the Gualala River.

Habitat

Point Arena mountain beaver live in underground burrow systems, but they forage on vegetation aboveground that they cache underground. Inhabited sites are mainly found on moist, steep, north-facing slopes with well-drained and friable soil.

Associated Vegetation

Due to the general lack of available water in occupied sites, Point Arena mountain beaver are reliant on abundant herbaceous vegetation that may be groundwater-dependent. This subspecies is not associated with a particular vegetation type but is often found in coastal scrub, coastal grasslands, coastal dunes, deciduous riparian areas, and coniferous forest. Vegetation associated with these communities typically thrive in a Mediterranean maritime climate.

Groundwater-Related Threats

Changes in groundwater conditions may adversely impact the herbaceous vegetation that the Point Arena mountain beaver relies for water intake. In addition to affecting vegetation, changes in groundwater conditions can also affect the humidity and moisture content in burrows and need to preserve cached vegetation, which can degrade the suitability of habitat within this mountain beaver's limited range.

Hydrologic Indicators

This species may rely on groundwater-dependent vegetation. Monitoring shallow groundwater conditions that support groundwater-dependent vegetation can help monitor habitat conditions for this species. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-11 | Riparian (San Joaquin Valley) Woodrat

Neotoma fuscipes riparia

© California Department of Fish and Wildlife

Protected Status

Federal	State
Endangered	Not listed

Reliance on Groundwater

Indirect. This riparian woodrat is reliant on groundwater-dependent vegetation and surface water that may be supported by groundwater for its habitat.

Distribution in California

This species was historically found along the San Joaquin, Stanislaus, and Tuolumne Rivers and in Corral Hollow in San Joaquin, Stanislaus, and Merced Counties. It is currently found in Caswell Memorial State Park and riparian areas along San Joaquin and Stanislaus Rivers in San Joaquin and Stanislaus Counties.

Habitat

These woodrats inhabit areas with *Quercus lobata* (valley oaks) and few live oaks, areas with dense shrub cover, and willow thickets with oak overstory in riparian areas. They also sometimes nest in tree cavities. They require access to perennial water to satisfy their daily minimum water needs.

Associated Vegetation

The riparian woodrat is associated with dense-canopied riparian oak forests dominated by *Quercus lobata* (valley oaks), with thick shrub layers composed of *Salix* spp. (willow), *Rosa* spp. (wild rose), *Rubus* spp. (blackberry), *Vitis californica* (wild grape), *Baccharis pilularis* (coyote bush), and *Ribes aureum* (golden currant).

Groundwater-Related Threats

Changing groundwater conditions in riparian areas with groundwater-dependent vegetation (e.g., valley oaks, willows, and wild grapes) that increases exposure to drought stress or causes dieback can compromise woodrat habitat. Similarly, groundwater conditions that alter conditions in interconnected surface waters can adversely affect woodrats, since they require access to surface water to meet their daily metabolic needs.

Hydrologic Indicators

This species relies on groundwater-dependent vegetation (e.g., valley oaks, willows) in riparian areas. Monitoring shallow groundwater conditions that support this vegetation and surface water bodies can help track woodrat habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-12 | Riparian Brush Rabbit

Sylvilagus bachmani riparius

Protected Status

Federal	State
Endangered	Not listed

Reliance on Groundwater

Indirect. This species may rely on groundwater-dependent vegetation for cover and forage.

Distribution in California

The extant riparian brush rabbit population includes two disjunct areas, one in the southeast San Joaquin Delta in the area roughly bound by a triangle between Tracy, Manteca, and French Camp (San Joaquin County), and the other along the San Joaquin River from Durham Ferry State Recreation Area in the north to Grayson (Stanislaus County) in the south, and up the Stanislaus River through Caswell Memorial State Park.

Habitat

These rabbits depend on large areas of dense, brushy riparian vegetation that contain mats of low-growing vines and shrubs ideal for building tunnels in close proximity to herbaceous forbs and grasses. Areas of suitable habitat elevated above the flood zone are necessary for rabbit populations to persist through periodic flood events.

Associated Vegetation

Riparian brush rabbits are associated with extensive thickets of *Rosa* spp. (wild rose), *Rubus* spp. (Himalayan and California blackberries), *Baccharis pilularis* (coyote bush), and *Salix* spp. (willow), as well as other herbaceous vegetation for food, such as *Poaceae* spp. (grasses), *Trifolium* spp. (clover), *Helianthus* spp. (forbs), *Artemisia douglasiana* (mugwort), and leaves of woody plants.

Groundwater-Related Threats

Changing groundwater conditions in riparian areas with groundwater-dependent vegetation that increases exposure to drought stress or causes dieback can compromise riparian brush rabbit habitat.

Hydrologic Indicators

This species may be reliant on groundwater-dependent vegetation (e.g., willows, blackberries) in riparian areas. Monitoring shallow groundwater conditions that support riparian vegetation can help track brush rabbit habitat conditions. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

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M-13 | Saltmarsh Harvest Mouse

Reithrodontomys raviventris

© Katie Smith, California Department of Fish and Wildlife

Protected Status

Federal	State	
ESA Listing	**CESA Listing**	**Fish & Game Code 5050**
Endangered	Endangered	Fully Protected

Reliance on Groundwater

Direct. The saltmarsh harvest mouse is reliant on San Francisco Bay Area tidal wetlands or diked managed wetlands that are flooded with saline waters and that may be supported by groundwater discharge.

Distribution in California

This species is endemic to the San Francisco, San Pablo, and Suisun Bays.

Habitat

The saltmarsh mouse lives in tidal or diked wetlands of mixed halophyte or *salicornia*-dominated vegetation that includes tall, nonsubmerged vegetation or adjacent upland areas for escape during high tides.

Associated Vegetation

This species is associated with most halophyte vegetation, including *Salicornia* spp. (pickleweed).

Groundwater-Related Threats

Changing groundwater table elevations and subsidence may have an impact on the extent of wetland habitats used by the saltmarsh harvest mouse. Groundwater depletion can also destabilize salinity gradients within tidal wetlands by causing seawater intrusion or by depleting groundwater or surface water inputs. Pickleweed has a high salinity tolerance and generally exists in soils that are about 1 percent salt. However, excessive groundwater pumping is believed to diminish pickleweed.

Hydrologic Indicators

Hydrologic Parameter	Functional Range	Biological Rationale
Water Quantity		
Depth to Groundwater	1–6 ft (0.3–1.8 m)	Pickleweed, as one type of associated vegetation, is most abundant in areas with a shallow depth to groundwater of 1–6 ft (0.3–1.8 m); the saltmarsh harvest mouse is known to thrive in areas with mixed halophyte vegetation, including pickleweed.

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M-14 | San Bernardino Kangaroo Rat

Dipodomys merriami parvus

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Protected Status

Federal	State
Threatened	Not listed

Reliance on Groundwater

Indirect. The San Bernardino kangaroo rat may rely on groundwater-dependent vegetation.

Distribution in California

The species is limited to three extant isolated populations found in San Bernardino and Riverside Counties, specifically within the San Jacinto River, Santa Ana River, and Lytle and Cajon Creeks areas.

Habitat

These kangaroo rats live in burrow networks typically found within alluvial fan systems that support alluvial fan scrub vegetation. Highly dynamic alluvial fans comprise a braided network of stream channels and terraces that are often reworked during storm events. Sandy or gravelly soils within the floodplain and in adjacent terrace/upland areas provide suitable habitat for burrowing. There are three phases of alluvial fan sage scrub: pioneer, intermediate, and mature. These phases are influenced by a number of factors, including flooding. The pioneer and intermediate phases support less than 50 percent canopy cover and have been observed to support the highest densities of kangaroo rats. These phases also experience more frequent flooding, which supports more open vegetation. The mature phase rarely experiences flooding and therefore supports dense vegetative cover and lower densities of kangaroo rats. However, the mature phase provides important refugia habitat that supports recolonization of areas that are flooded during storm events.

Associated Vegetation

Seeds and green vegetation provide important food and water sources for this species. Seed caching may enable them to endure temporary shortages of food. Alluvial fan systems and their processes support the habitat the species requires, including associated alluvial fan sage scrub vegetation such as *Eriogonum fasciculatum* (California buckwheat), *Lepidospartum squamatum* (scalebroom), *Eriodictyon crassifolium* (woolly yerba santa), *Eriodictyon trichocalyx* (hairy yerba santa), *Yucca whipplei* (our Lord's candle), *Rhus ovata* (sugar bush), *Rhus integrifolia* (lemonadeberry), *Malosma laurina* (laurel sumac), *Juniperus californicus* (California juniper),

Baccharis salicifolia (mulefat), *Penstemon spectabilis* (showy penstemon), *Heterotheca villosa* (golden aster), *Eriogonum elongatum* (tall buckwheat), *Encelia farinosa* (brittle bush), *Opuntia* spp. (prickly pear and cholla), *Adenostoma fasciculatum* (chamise), *Prunus ilicifolia* (holly-leaf cherry), *Quercus* spp. (oak), *Salvia apiana* (white sage), annual forbs, and native or nonnative grasses.

Groundwater-Related Threats

Changing groundwater conditions for groundwater-dependent vegetation that increases exposure to drought stress or causes vegetation dieback can compromise habitat conditions for this species. Lowered groundwater elevations can also reduce flooding, which is necessary for maintaining pioneer and intermediate phases of alluvial fan sage scrub. Periodic flooding maintains open-canopy habitat and associated suitable food resources.

Hydrologic Indicators

This species may be reliant on groundwater-dependent vegetation (e.g., mulefat, oak). Monitoring shallow groundwater levels around groundwater-dependent vegetation could help track this species' habitat condition. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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M-15 | San Joaquin Kit Fox

Vulpes macrotis mutica

Protected Status

Federal	State
Endangered	Threatened

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

San Joaquin kit foxes are found in the San Joaquin Desert, primarily on the valley floor and surrounding foothills as well as the interior valleys of the coastal ranges. Only ~5 percent of their historical habitat remains.

Habitat

These kit foxes primarily occupy dry grasslands and scrublands/shrublands in the San Joaquin Desert and similar habitats in the interior valleys of the Central California Coastal Ranges. They are a desert-adapted species that prefers sparse grasslands and scrublands/shrublands. Kit foxes are active year-round, are primarily nocturnal, and lives in underground dens. Their prey (kangaroo rats, rabbits, ground squirrels, and insects) is their primary water source.

Associated Vegetation

The San Joaquin kit fox primarily occupies dry grasslands and desert scrub communities in the San Joaquin Desert.

Groundwater-Related Threats

This species has no known reliance on groundwater.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

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M-16 | Sierra Nevada Bighorn Sheep

Ovis canadensis sierrae

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Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

Indirect. This species is adapted to living in arid climates but relies on groundwater-dependent herbaceous plants and shrubs for sustenance.

Distribution in California

These sheep are found exclusively in the Sierra Nevada. Historically, they inhabited a range that extended from Sonora Pass to Olancha Peak, and westward to the Mineral King region inside Sequoia National Park. Currently, the northernmost populations lie along the eastern boundary of Yosemite National Park, while other herds are found at the southeastern boundary of Sequoia National Park.

Habitat

The species prefers open terrain with rough, rocky, and steep ground. This includes alpine meadows, summit plateaus, and hanging meadows fed by springs. They can thrive in arid conditions and are well-adapted to snowy environments. Segments of all the California populations spend 12 months a year in alpine habitats.

Associated Vegetation

Sierra Nevada bighorn sheep are ruminant herbivores. They forage herbaceous plants and shrubs and will eat the most nutritious food available (usually new plant growth). The specific plant species they eat depends on the season and the location of the sheep.

Groundwater-Related Threats

This species may rely on groundwater-dependent vegetation. Conditions that cause that vegetation to become drought-stressed or die back can adversely affect their forage needs, especially during the dry summer months.

Hydrologic Indicators

Monitoring shallow groundwater levels around groundwater-dependent vegetation could help ensure that these levels are not having an adverse impact on this species' habitat. Additionally, monitoring plant cover with plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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DFW. 2019. Sierra Nevada bighorn sheep facts. Available from http://www.dfg.ca.gov/snbs/SheepFacts.html.

M-17 | Sierra Nevada Red Fox

Vulpes vulpes necator

Protected Status

Federal	State
Candidate for listing	Threatened

Reliance on Groundwater

Indirect. The Sierra Nevada red fox is reliant on groundwater-dependent vegetation for its habitat. Groundwater-dependent vegetation within this species' subalpine and alpine meadow habitats, along with other herbaceous dominated systems, provides critical resources for its prey species (e.g., small mammals and lagomorphs), and thus provides the foxes with critical foraging opportunities.

Distribution in California

This species can be found in two small, distinct populations in California: the eastern slope of the southern Sierra Nevada, and Lassen Volcanic National Park in the southern Cascades.

Habitat

The fox's preferred habitat is *Abies magnifica* (red fir), *pinus contorta* (lodgepole pine), and *Pinus albicaulus* (white bark pine) forests in the subalpine zone and alpine fell-fields of the Sierra Nevada.

Associated Vegetation

This species is associated with *Abies magnifica*, *pinus contorta*, and *Pinus albicaulus* tree types.

Groundwater-Related Threats

Groundwater conditions that do not support groundwater-dependent vegetation within riparian areas and wetlands can threaten this species' habitat.

Hydrologic Indicators

Monitoring shallow groundwater conditions that support riparian- and wetland-associated vegetation can help monitor red fox habitat conditions. Additionally, monitoring plant cover with

plots or a normalized difference vegetation index (NDVI) can be useful for diagnosing reduced vegetation production and habitat decline over time.

References

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M-18 | Stephens' Kangaroo Rat

Dipodomys stephensi

Protected Status

Federal	State
Endangered	Threatened

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

This species is found in Riverside County and western and central San Diego County. Within Riverside County, it lives at Lake Matthews, Lake Skinner/Domenigoni Valley, Motte Rimrock, Potrero Valley, San Jacinto/Lake Perris, Steele Peak, Sycamore Canyon/March Air Force Base, Corona/Norco, and Anza/Cahuilla. Within San Diego County, it can be found at Lake Henshaw, Ramona Grasslands, Rancho Guejito, MCBCP (Camp Pendleton), and Fallbrook.

Habitat

These kangaroo rats live in sparsely vegetated habitats such as open grasslands and scant coastal sage scrub with less than 30 percent perennial cover.

Associated Vegetation

This kangaroo rat is generally found in habitat comprised of herbs such as *Lasthenia* sp. (gold fields) and *Erodium cicutarium* (filaree) and grasses, such as *Vulpea megalura* (foxtail fescue) and *Bromus rubens* (foxtail chess). This species is also found in coastal sage scrub habitat that may include perennial species such as *Encelia farinosa* (encelia), *Artemisia californica* (coastal sagebrush), and *Eriogonum fasciculatum* (California buckwheat). It seems to prefer communities dominated by herbaceous plants with low-density grasses.

Groundwater-Related Threats

This species has no known reliance on groundwater.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

DFW. 2019. State and federally listed endangered and threatened animals of California. Available from https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405.

USFWS. 1997. Draft recovery plan for the Stephens' kangaroo rat. Available from https://ecos.fws.gov/docs/recovery_plan/970623.pdf.

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M-19 | Tipton Kangaroo Rat

Dipodomys nitratoides nitratoides

Protected Status

Federal	State
Endangered	Endangered

Reliance on Groundwater

This species has no known reliance on groundwater.

Distribution in California

Tipton kangaroo rats are found in the San Joaquin Desert, specifically, in approximately a dozen sites in the Tulare Basin. Only about <5 percent of its historical habitat remains.

Habitat

This species, which lives underground in burrow systems, prefers sparse, dry grasslands and arid scrublands/shrublands.

Associated Vegetation

Tipton kangaroo rats are often associated with *Atriplex* spp. (saltbush), *Allenrolfea occidentalis* (iodine bush), and *Suaeda nigra* (bush seepweed).

Groundwater-Related Threats

This species has no known reliance on groundwater.

Hydrologic Indicators

This species has no known reliance on groundwater.

References

Germano DJ, Saslaw LR, Smith PT, Cypher BL. 2013. Survivorship and reproduction of translocated Tipton kangaroo rats in the San Joaquin Valley, California. Endangered Species Research **19**:265–276. DOI: 10.3354/esr00470.

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Appendix I. Other Threatened or Endangered Species Relevant to SGMA

Table A1. Crustacean species found within California groundwater basins with state or federal status

Scientific Name	Common Name	Federal Status	State Status
Branchinecta conservatio	conservancy fairy shrimp	Endangered	Special
Branchinecta longiantenna	longhorn fairy shrimp	Endangered	Special
Branchinecta lynchi	vernal pool fairy shrimp	Threatened	Special
Branchinecta sandiegonensis	San Diego fairy shrimp	Endangered	Special
Lepidurus packardi	vernal pool tadpole shrimp	Endangered	Special
Pacifastacus fortis	Shasta crayfish	Endangered	Endangered
Streptocephalus woottoni	Riverside fairy shrimp	Endangered	Special
Syncaris pacifica	California freshwater shrimp	Endangered	Endangered

Table A2. Insect species found within California groundwater basins with state or federal status

Scientific Name	Common Name	Federal Status	State Status
Apodemia mormo langei	Lange's metalmark butterfly	Endangered	None
Callophrys mossii bayensis	San Bruno elfin butterfly	Endangered	None
Cicindela ohlone	Ohlone tiger beetle	Endangered	None
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	Threatened	None
Dinacoma caseyi	Casey's June beetle	Endangered	None
Elaphrus viridis	Delta green ground beetle	Threatened	None
Euphilotes enoptes smithi	Smith's blue butterfly	Endangered	None
Euphydryas editha bayensis	bay checkerspot butterfly	Threatened	None

Scientific Name	Common Name	Federal Status	State Status
Euphydryas editha quino	Quino checkerspot butterfly	Endangered	None
Euproserpinus euterpe	Kern primrose sphinx moth	Threatened	None
Plebejus icarioides missionensis	mission blue butterfly	Endangered	None
Plebejus idas lotis	lotis blue butterfly	Endangered	None
Polyphylla barbata	Mount Hermon (=barbate) June beetle	Endangered	None
Pseudocopaeodes eunus obscurus	Carson wandering skipper	Endangered	None
Rhaphiomidas terminatus abdominalis	Delhi Sands flower-loving fly	Endangered	None
Speyeria callippe callippe	callippe silverspot butterfly	Endangered	None
Speyeria zerene behrensii	Behren's silverspot butterfly	Endangered	None
Speyeria zerene hippolyta	Oregon silverspot butterfly	Threatened	None
Speyeria zerene myrtleae	Myrtle's silverspot butterfly	Endangered	None
Trimerotropis infantilis	Zayante band-winged grasshopper	Endangered	None

Table A3. Plant species found within California groundwater basins with state or federal status

Scientific Name	Common Name	Federal Status	State Status
Acanthomintha ilicifolia	San Diego thorn-mint	Threatened	Endangered
Acanthoscyphus parishii var. *goodmaniana*	Cushenbury oxytheca	Endangered	None
Allium munzii	Munz's onion	Endangered	Threatened
Alopecurus aequalis var. *sonomensis*	Sonoma alopecurus	Endangered	None
Ambrosia pumila	San Diego ambrosia	Endangered	None
Arctostaphylos glandulosa ssp. *crassifolia*	Del Mar manzanita	Endangered	None
Arctostaphylos hookeri ssp. *hearstiorum*	Hearsts' manzanita	None	Endangered
Arctostaphylos morroensis	Morro manzanita	Threatened	None

Scientific Name	Common Name	Federal Status	State Status
Arctostaphylos myrtifolia	Ione manzanita	Threatened	None
Arenaria paludicola	marsh sandwort	Endangered	Endangered
Astragalus albens	Cushenbury milk-vetch	Endangered	None
Astragalus brauntonii	Braunton's milk-vetch	Endangered	None
Astragalus claranus	Clara Hunt's milk-vetch	Endangered	Threatened
Astragalus jaegerianus	Lane Mountain milk-vetch	Endangered	None
Astragalus lentiginosus var. *coachellae*	Coachella Valley milk-vetch	Endangered	None
Astragalus lentiginosus var. *piscinensis*	Fish Slough milk-vetch	Threatened	None
Astragalus lentiginosus var. *sesquimetralis*	Sodaville milk-vetch	None	Endangered
Astragalus magdalenae var. *peirsonii*	Peirson's milk-vetch	Threatened	Endangered
Astragalus pycnostachyus var. *lanosissimus*	Ventura Marsh milk-vetch	Endangered	Endangered
Astragalus tener var. *titi*	coastal dunes milk-vetch	Endangered	Endangered
Astragalus tricarinatus	triple-ribbed milk-vetch	Endangered	None
Atriplex coronata var. *notatior*	San Jacinto Valley crownscale	Endangered	None
Atriplex tularensis	Bakersfield smallscale	None	Endangered
Berberis nevinii	Nevin's barberry	Endangered	Endangered
Blennosperma bakeri	Baker's blennosperma	Endangered	Endangered
Brodiaea filifolia	thread-leaved brodiaea	Threatened	Endangered
Brodiaea pallida	Chinese Camp brodiaea	Threatened	Endangered
Camissonia benitensis	San Benito evening-primrose	Threatened	None
Carex lemmonii	Lemmon's sedge	Endangered	
Castilleja campestris succulenta	fleshy owl's-clover	Threatened	Endangered
Castilleja campestris var. *succulenta*	succulent owl's-clover	Threatened	Endangered
Castilleja cinerea	ash-gray paintbrush	Threatened	None

Scientific Name	Common Name	Federal Status	State Status
Caulanthus californicus	California jewelflower	Endangered	Endangered
Ceanothus ferrisiae	coyote ceanothus	Endangered	None
Ceanothus ophiochilus	Vail Lake ceanothus	Threatened	Endangered
Chlorogalum purpureum var. *purpureum*	Santa Lucia purple amole	Threatened	None
Chlorogalum purpureum var. *reductum*	Camatta Canyon amole	Threatened	Rare
Chloropyron maritimum ssp. *maritimum*	salt marsh bird's-beak	Endangered	Endangered
Chloropyron molle ssp. *molle*	soft salty bird's-beak	Endangered	Rare
Chloropyron palmatum	palmate-bracted bird's-beak	Endangered	Special
Chorizanthe howellii	Howell's spineflower	Endangered	Threatened
Chorizanthe parryi var. *fernandina*	San Fernando Valley spineflower	Proposed Threatened	Endangered
Chorizanthe pungens var. *hartwegiana*	Ben Lomond spineflower	Endangered	None
Chorizanthe pungens var. *pungens*	Monterey spineflower	Threatened	None
Chorizanthe robusta var. *hartwegii*	Scotts Valley spineflower	Endangered	None
Chorizanthe robusta var. *robusta*	robust spineflower	Endangered	None
Chorizanthe valida	Sonoma spineflower	Endangered	Endangered
Cirsium fontinale var. *fontinale*	fountain thistle	Endangered	Endangered
Cirsium fontinale var. *obispoense*	Chorro Creek bog thistle	Endangered	Endangered
Cirsium hydrophilum var. *hydrophilum*	Suisun thistle	Endangered	Special
Cirsium rhothophilum	surf thistle	None	Threatened
Cirsium scariosum var. *loncholepis*	La Graciosa thistle	Endangered	Threatened
Clarkia speciosa ssp. *immaculata*	Pismo clarkia	Endangered	Rare
Cordylanthus rigidus ssp. *littoralis*	seaside bird's-beak	None	Endangered
Deinandra conjugens	Otay tarplant	Threatened	Endangered
Deinandra increscens ssp. *villosa*	Gaviota tarplant	Endangered	Endangered

Scientific Name	Common Name	Federal Status	State Status
Deinandra mohavensis	Mojave tarplant	None	Endangered
Delphinium bakeri	Baker's larkspur	Endangered	Endangered
Delphinium luteum	golden larkspur	Endangered	Rare
Diplacus vandenbergensis	Vandenberg monkeyflower	Endangered	None
Dithyrea maritima	beach spectaclepod	None	Threatened
Dodecahema leptoceras	slender-horned spineflower	Endangered	Endangered
Dudleya abramsii ssp. *setchellii*	Santa Clara Valley dudleya	Endangered	None
Enceliopsis nudicaulis var. *corrugata*	Ash Meadows daisy	Threatened	None
Eremalche parryi ssp. *kernensis*	Kern mallow	Endangered	None
Eremogone ursina	Big Bear Valley sandwort	Threatened	None
Eriastrum densifolium ssp. *sanctorum*	Santa Ana River woollystar	Endangered	Endangered
Erigeron parishii	Parish's daisy	Threatened	None
Eriogonum apricum var. *apricum*	Ione buckwheat	Endangered	Endangered
Eriogonum kennedyi var. *austromontanum*	southern mountain buckwheat	Threatened	None
Eriogonum ovalifolium var. *vineum*	Cushenbury buckwheat	Endangered	None
Eryngium racemosum	Delta coyote-thistle	None	Endangered
Erysimum capitatum var. *angustatum*	Contra Costa wallflower	Endangered	Endangered
Erysimum menziesii	Menzies' wallflower	Endangered	Endangered
Erysimum teretifolium	Santa Cruz wallflower	Endangered	Endangered
Euphorbia hooveri	Hoover's spurge	Threatened	None
Fremontodendron mexicanum	Mexican flannelbush	Endangered	Rare
Fritillaria roderickii	Roderick's fritillary	None	Endangered
Gilia tenuiflora ssp. *arenaria*	Monterey gilia	Endangered	Threatened
Gratiola heterosepala	Boggs Lake hedge-hyssop	None	Endangered
Grindelia fraxinipratensis	Ash Meadows gumplant	Threatened	None
Helianthus niveus ssp. *tephrodes*	Algodones Dunes sunflower	None	Endangered

Scientific Name	Common Name	Federal Status	State Status
Helminthoglypta walkeriana	Morro shoulderband (=banded dune) snail	Endangered	None
Hesperocyparis abramsiana var. *abramsiana*	Santa Cruz cypress	Threatened	Endangered
Hesperolinon congestum	Marin western flax	Threatened	Threatened
Hesperolinon didymocarpum	Lake County western flax	None	Endangered
Holocarpha macradenia	Santa Cruz tarplant	Threatened	Endangered
Lasthenia burkei	Burke's goldfields	Endangered	Endangered
Lasthenia conjugens	Contra Costa goldfields	Endangered	Special
Layia carnosa	beach layia	Endangered	Endangered
Lessingia germanorum	San Francisco lessingia	Endangered	Endangered
Lilium occidentale	western lily	Endangered	Endangered
Lilium pardalinum ssp. *pitkinense*	Pitkin marsh lily	Endangered	Endangered
Limnanthes floccosa californica	Shippee meadowfoam	Endangered	Endangered
Limnanthes floccosa ssp. *californica*	Butte County meadowfoam	Endangered	Endangered
Limnanthes vinculans	Sebastopol meadowfoam	Endangered	Endangered
Lupinus milo-bakeri	Milo Baker's lupine	None	Threatened
Lupinus nipomensis	Nipomo Mesa lupine	Endangered	Endangered
Lupinus tidestromii	Tidestrom's lupine	Endangered	Endangered
Monardella viminea	willowy monardella	Endangered	Endangered
Monolopia congdonii	San Joaquin woollythreads	Endangered	None
Nasturtium gambelii	Gamble's yellocress	Endangered	Threatened
Navarretia fossalis	spreading navarretia	Threatened	Special
Navarretia leucocephala ssp. *pauciflora*	few-flowered navarretia	Endangered	Threatened
Navarretia leucocephala ssp. *plieantha*	many-flowered navarretia	Endangered	Endangered
Neostapfia colusana	Colusa grass	Threatened	Endangered

Scientific Name	Common Name	Federal Status	State Status
Nitrophila mohavensis	Amargosa niterwort	Endangered	Endangered
Oenothera californica ssp. *eurekensis*	Eureka Dunes evening-primrose	Endangered	Rare
Oenothera deltoides ssp. *howellii*	Antioch Dunes evening-primrose	Endangered	Endangered
Opuntia basilaris var. *treleasei*	Bakersfield cactus	Endangered	Endangered
Orcuttia californica	California orcutt grass	Endangered	Endangered
Orcuttia inaequalis	San Joaquin Valley orcutt grass	Threatened	Endangered
Orcuttia pilosa	hairy orcutt grass	Endangered	Endangered
Orcuttia tenuis	slender orcutt grass	Threatened	Endangered
Orcuttia viscida	Sacramento orcutt grass	Endangered	Endangered
Pentachaeta bellidiflora	white-rayed pentachaeta	Endangered	Endangered
Pentachaeta lyonii	Lyon's pentachaeta	Endangered	Endangered
Physaria kingii ssp. *bernardina*	San Bernardino Mountains bladderpod	Endangered	None
Piperia yadonii	Yadon's rein orchid	Endangered	None
Plagiobothrys strictus	Calistoga popcornflower	Endangered	Threatened
Pleuropogon hooverianus	North Coast false semaphore grass	None	Threatened
Poa atropurpurea	San Bernardino blue grass	Endangered	None
Poa napensis	Napa blue grass	Endangered	Endangered
Pogogyne nudiuscula	Otay mesamint	Endangered	Endangered
Pseudobahia bahiifolia	Hartweg's golden sunburst	Endangered	Endangered
Pseudobahia peirsonii	San Joaquin adobe sunburst	Threatened	Endangered
Rorippa subumbellata	Tahoe yellowcress	Candidate	Endangered
Sedella leiocarpa	Lake County mock stonecrop	Endangered	Endangered
Sidalcea covillei	Owens Valley checkerbloom	None	Endangered
Sidalcea keckii	Keck's checkerbloom	Endangered	None
Sidalcea oregana ssp. *valida*	Kenwood Marsh checkerbloom	Endangered	Endangered
Sidalcea oregana valida	Kenwood Marsh checker-mallow	Endangered	Endangered

Scientific Name	Common Name	Federal Status	State Status
Sidalcea pedata	pedate checker-mallow	Endangered	Endangered
Suaeda californica	California sea-blite	Endangered	Special
Swallenia alexandrae	Eureka Valley dune grass	Endangered	Rare
Taraxacum californicum	California dandelion	Endangered	None
Thelypodium stenopetalum	slender-petaled thelypodium	Endangered	Endangered
Trifolium amoenum	two-fork clover	Endangered	None
Tuctoria greenei	Green's awnless orcutt grass	Endangered	Rare
Tuctoria mucronata	mucronate orcutt grass	Endangered	Endangered

Appendix II. Species of Special Concern

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Amphibians				
Ambystoma macrodactylum sigillatum	southern long-toed salamander	None	None	
Anaxyrus californicus	arroyo toad	Endangered	None	
Anaxyrus canorus	Yosemite toad	Threatened	None	
Aneides flavipunctatus niger	Santa Cruz black salamander	None	None	
Ascaphus truei	Pacific tailed frog	None	None	
Batrachoseps campi	Inyo Mountains slender salamander	None	None	
Batrachoseps minor	lesser slender salamander	None	None	
Batrachoseps relictus	relictual slender salamander	None	None	
Dicamptodon ensatus	California giant salamander	None	None	
Incilius alvarius	Sonoran Desert toad	None	None	
Lithobates pipiens	northern leopard frog	None	None	
Lithobates yavapaiensis	lowland leopard frog	None	None	
Rana aurora	northern red-legged frog	None	None	
Rana boylii	foothill yellow-legged frog	None	Candidate Threatened	
Rana cascadae	Cascades frog	None	Candidate Endangered	
Rana draytonii	California red-legged frog	Threatened	None	
Rana pretiosa	Oregon spotted frog	Threatened	None	
Rhyacotriton variegatus	southern torrent salamander	None	None	
Scaphiopus couchii	Couch's spadefoot	None	None	
Spea hammondii	western spadefoot	None	None	
Taricha rivularis	red-bellied newt	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Taricha torosa	Coast Range newt	None	None	
Birds				
Accipiter gentilis	northern goshawk	None	None	
Agelaius phoeniceus aciculatus	Kern red-winged blackbird	None	None	
Agelaius tricolor	tricolored blackbird	None	Threatened	
Aimophila ruficeps obscura	Santa Cruz Island rufous-crowned sparrow	None	None	
Ammodramus savannarum	grasshopper sparrow	None	None	
Anser albifrons elgasi	tule greater white-fronted goose	None	None	
Antigone canadensis canadensis	lesser sandhill crane	None	None	
Artemisiospiza belli clementeae	San Clemente sage sparrow	Threatened	None	
Asio flammeus	short-eared owl	None	None	
Asio otus	long-eared owl	None	None	
Athene cunicularia	burrowing owl	None	None	
Aythya americana	redhead	None	None	
Branta bernicla	brant	None	None	
Bucephala islandica	Barrow's goldeneye	None	None	
Callipepla californica catalinensis	Catalina California quail	None	None	
Campylorhynchus brunneicapillus sandiegensis	coastal cactus wren	None	None	
Centrocercus urophasianus	greater sage-grouse	None	None	
Chaetura vauxi	Vaux's swift	None	None	
Charadrius alexandrinus nivosus	western snowy plover	Threatened	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Charadrius montanus	mountain plover	None	None	
Chlidonias niger	black tern	None	None	
Circus hudsonius	northern harrier	None	None	
Cistothorus palustris clarkae	Clark's marsh wren	None	None	
Contopus cooperi	olive-sided flycatcher	None	None	
Coturnicops noveboracensis	yellow rail	None	None	
Cypseloides niger	black swift	None	None	
Dendragapus fuliginosus howardi	Mount Pinos sooty grouse	None	None	
Dendrocygna bicolor	fulvous whistling-duck	None	None	
Fratercula cirrhata	tufted puffin	None	None	
Gavia immer	common loon	None	None	
Gelochelidon nilotica	gull-billed tern	None	None	
Geothlypis trichas sinuosa	saltmarsh common yellowthroat	None	None	
Histrionicus histrionicus	harlequin duck	None	None	
Icteria virens	yellow-breasted chat	None	None	
Ixobrychus exilis	least bittern	None	None	
Lanius ludovicianus	loggerhead shrike	None	None	
Lanius ludovicianus anthonyi	island loggerhead shrike	None	None	
Lanius ludovicianus mearnsi	San Clemente loggerhead shrike	Endangered	None	
Melospiza melodia	song sparrow ("Modesto" population)	None	None	
Melospiza melodia graminea	Channel Island song sparrow	None	None	
Melospiza melodia maxillaris	Suisun song sparrow	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Melospiza melodia pusillula	Alameda song sparrow	None	None	
Melospiza melodia samuelis	San Pablo song sparrow	None	None	
Mycteria americana	wood stork	None	None	
Oceanodroma furcata	fork-tailed storm-petrel	None	None	
Oceanodroma homochroa	ashy storm-petrel	None	None	
Oceanodroma melania	black storm-petrel	None	None	
Oreothlypis luciae	Lucy's warbler	None	None	
Passerculus sandwichensis alaudinus	Bryant's savannah sparrow	None	None	
Passerculus sandwichensis rostratus	large-billed savannah sparrow	None	None	
Pelecanus erythrorhynchos	American white pelican	None	None	
Phoebastria albatrus	short-tailed albatross	Endangered	None	
Pipilo maculatus clementae	San Clemente spotted towhee	None	None	
Piranga rubra	summer tanager	None	None	
Polioptila californica californica	coastal California gnatcatcher	Threatened	None	
Pooecetes gramineus affinis	Oregon vesper sparrow	None	None	
Progne subis	purple martin	None	None	
Ptychoramphus aleuticus	Cassin's auklet	None	None	
Pyrocephalus rubinus	vermilion flycatcher	None	None	
Rynchops niger	black skimmer	None	None	
Setophaga petechia	yellow warbler	None	None	
Setophaga petechia sonorana	Sonoran yellow warbler	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Strix occidentalis occidentalis	California spotted owl	None	None	
Thryomanes bewickii leucophrys	San Clemente Bewick's wren	None	None	
Toxostoma bendirei	Bendire's thrasher	None	None	
Toxostoma crissale	Crissal thrasher	None	None	
Toxostoma lecontei	Le Conte's thrasher	None	None	
Tympanuchus phasianellus columbianus	Columbian sharp-tailed grouse	None	None	
Vireo huttoni unitti	Catalina Hutton's vireo	None	None	
Vireo vicinior	gray vireo	None	None	
Xanthocephalus xanthocephalus	yellow-headed blackbird	None	None	
Fish				
Acipenser medirostris	green sturgeon	Threatened	None	
Acipenser transmontanus	white sturgeon	None	None	
Archoplites interruptus	Sacramento perch	None	None	
Catostomus fumeiventris	Owens sucker	None	None	
Catostomus occidentalis lacusanserinus	Goose Lake sucker	None	None	
Catostomus platyrhynchus	mountain sucker	None	None	
Catostomus snyderi	Klamath largescale sucker	None	None	
Cottus gulosus	riffle sculpin	None	None	
Cottus klamathensis klamathensis	Upper Klamath marbled sculpin	None	None	
Cottus klamathensis macrops	bigeye marbled sculpin	None	None	
Cottus klamathensis polyporus	Lower Klamath marbled sculpin	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Cyprinodon nevadensis amargosae	Amargosa pupfish	None	None	
Cyprinodon nevadensis nevadensis	Saratoga Springs pupfish	None	None	Yes
Cyprinodon nevadensis shoshone	Shoshone pupfish	None	None	Yes
Cyprinodon salinus salinus	Salt Creek pupfish	None	None	Yes
Entosphenus folletti	Northern California brook lamprey	None	None	
Entosphenus hubbsi	Kern brook lamprey	None	None	
Entosphenus lethophagus	Pit-Klamath brook lamprey	None	None	
Entosphenus similis	Klamath River lamprey	None	None	
Entosphenus tridentatus	Pacific lamprey	None	None	
Entosphenus tridentatus ssp. 1	Goose Lake lamprey	None	None	
*Eucyclogobius newberry*i	tidewater goby	Endangered	None	
Gila coerulea	blue chub	None	None	
Gila orcuttii	arroyo chub	None	None	
Hysterocarpus traskii lagunae	Clear Lake tule perch	None	None	
Hysterocarpus traskii pomo	Russian River tule perch	None	None	
Lampetra ayresii	river lamprey	None	None	
Lavinia exilicauda exilicauda	Sacramento hitch	None	None	
Lavinia exilicauda harengus	Pajaro/Salinas hitch	None	None	
Lavinia symmetricus mitrulus	pit roach	None	None	
Lavinia symmetricus navarroensis	Navarro roach	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Lavinia symmetricus parvipinnis	Gualala roach	None	None	
Lavinia symmetricus ssp. 1	San Joaquin roach	None	None	
Lavinia symmetricus ssp. 2	Tomales roach	None	None	
Lavinia symmetricus ssp. 3	Red Hills roach	None	None	
Lavinia symmetricus ssp. 4	Russian River roach: Clear Lake	None	None	
Lavinia symmetricus subditus	Monterey roach	None	None	
Mylopharodon conocephalus	hardhead	None	None	
Oncorhynchus clarkii clarkii	coast cutthroat trout	None	None	
Oncorhynchus mykiss aguabonita	California golden trout	None	None	
Oncorhynchus mykiss aquilarum	Eagle Lake rainbow trout	None	None	
Oncorhynchus mykiss gilberti	Kern River rainbow trout	None	None	
Oncorhynchus mykiss irideus pop. 1	steelhead: Klamath Mountains Province Distinct Population Segment	None	None	
Oncorhynchus mykiss irideus pop. 36	summer-run steelhead trout	None	None	
Oncorhynchus mykiss ssp. 1	Goose Lake redband trout	None	None	
Oncorhynchus mykiss ssp. 2	McCloud River redband trout	None	None	
Oncorhynchus tshawytscha pop. 13	Chinook salmon: Central Valley fall/late fall-run ESU	None	None	
Oncorhynchus tshawytscha pop. 30	Chinook salmon: upper Klamath and Trinity Rivers ESU	None	Candidate Endangered	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Pogonichthys macrolepidotus	Sacramento splittail	None	None	
Prosopium williamsoni	mountain whitefish	None	None	
Rhinichthys osculus ssp. 1	Amargosa Canyon speckled dace	None	None	Yes
Rhinichthys osculus ssp. 2	Owens speckled dace	None	None	Yes
Rhinichthys osculus ssp. 3	Santa Ana speckled dace	None	None	
Rhinichthys osculus ssp. 5	Long Valley speckled dace	None	None	Yes
Siphateles bicolor pectinifer	Lahontan Lake tui chub	None	None	
Siphateles bicolor ssp. 1	Eagle Lake tui chub	None	None	
Siphateles bicolor thalassinus	Goose Lake tui chub	None	None	
Siphateles bicolor vaccaceps	Cow Head tui chub	None	None	
Mammals				
Antrozous pallidus	pallid bat	None	None	
Aplodontia rufa californica	Sierra Nevada mountain beaver	None	None	
Aplodontia rufa nigra	Point Arena mountain beaver	Endangered	None	
Aplodontia rufa phaea	Point Reyes mountain beaver	None	None	
Arborimus albipes	white-footed vole	None	None	
Arborimus pomo	Sonoma tree vole	None	None	
Brachylagus idahoensis	pygmy rabbit	None	None	
Chaetodipus californicus femoralis	Dulzura pocket mouse	None	None	
Chaetodipus fallax fallax	Northwestern San Diego pocket mouse	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Chaetodipus fallax pallidus	pallid San Diego pocket mouse	None	None	
Choeronycteris mexicana	Mexican long-tongued bat	None	None	
Corynorhinus townsendii	Townsend's big-eared bat	None	None	
Dipodomys californicus eximius	Marysville California kangaroo rat	None	None	
Dipodomys merriami parvus	San Bernardino kangaroo rat	Endangered	None	
Dipodomys nitratoides brevinasus	short-nosed kangaroo rat	None	None	
Dipodomys venustus elephantinus	big-eared kangaroo rat	None	None	
Euderma maculatum	spotted bat	None	None	
Eumetopias jubatus	Steller (=northern) sea-lion	Delisted	None	
Eumops perotis californicus	western mastiff bat	None	None	
Glaucomys oregonensis californicus	San Bernardino flying squirrel	None	None	
Lasiurus blossevillii	western red bat	None	None	
Lasiurus xanthinus	western yellow bat	None	None	
Leptonycteris yerbabuenae	lesser long-nosed bat	Delisted	None	
Lepus americanus klamathensis	Oregon snowshoe hare	None	None	
Lepus americanus tahoensis	Sierra Nevada snowshoe hare	None	None	
Lepus californicus bennettii	San Diego black-tailed jackrabbit	None	None	
Lepus townsendii townsendii	western white-tailed jackrabbit	None	None	
Lontra canadensis sonora	Southwestern river otter	None	None	
Macrotus californicus	California leaf-nosed bat	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Martes caurina humboldtensis	Humboldt marten	None	Endangered	
Microtus californicus mohavensis	Mohave river vole	None	None	
Microtus californicus sanpabloensis	San Pablo vole	None	None	
Microtus californicus stephensi	south coast marsh vole	None	None	
Microtus californicus vallicola	Owens Valley vole	None	None	
Myotis occultus	Arizona myotis	None	None	
Myotis velifer	cave myotis	None	None	
Neotoma fuscipes annectens	San Francisco dusky-footed woodrat	None	None	
Neotoma fuscipes riparia	riparian (=San Joaquin Valley) woodrat	Endangered	None	
Neotoma lepida intermedia	San Diego desert woodrat	None	None	
Neotoma macrotis luciana	Monterey dusky-footed woodrat	None	None	
Nyctinomops femorosaccus	pocketed free-tailed bat	None	None	
Nyctinomops macrotis	big free-tailed bat	None	None	
Onychomys torridus ramona	southern grasshopper mouse	None	None	
Onychomys torridus tularensis	Tulare grasshopper mouse	None	None	
Pekania pennanti	fisher: West Coast Distinct Population Segment	None	Threatened	
Perognathus alticola alticola	white-eared pocket mouse	None	None	
Perognathus alticola inexpectatus	Tehachapi pocket mouse	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Perognathus inornatus psammophilus	Salinas pocket mouse	None	None	
Perognathus longimembris bangsi	Palm Springs pocket mouse	None	None	
Perognathus longimembris brevinasus	Los Angeles pocket mouse	None	None	
Perognathus longimembris internationalis	Jacumba pocket mouse	None	None	
Perognathus longimembris pacificus	Pacific pocket mouse	Endangered	None	
Peromyscus maniculatus anacapae	Anacapa Island deer mouse	None	None	
Peromyscus maniculatus clementis	San Clemente deer mouse	None	None	
Puma concolor browni	Yuma mountain lion	None	None	
Scapanus latimanus parvus	Alameda Island mole	None	None	
Sigmodon arizonae plenus	Colorado River cotton rat	None	None	
Sigmodon hispidus eremicus	Yuma hispid cotton rat	None	None	
Sorex lyelli	Mount Lyell shrew	None	None	
Sorex ornatus relictus	Buena Vista Lake ornate shrew	Endangered	None	
Sorex ornatus salarius	Monterey shrew	None	None	
Sorex ornatus salicornicus	Southern California saltmarsh shrew	None	None	
Sorex ornatus sinuosus	Suisun shrew	None	None	
Sorex ornatus willetti	Santa Catalina shrew	None	None	
Sorex vagrans halicoetes	salt-marsh wandering shrew	None	None	
Spilogale gracilis amphiala	Channel Islands spotted skunk	None	None	
Taxidea taxus	American badger	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Xerospermophilus tereticaudus chlorus	Palm Springs round-tailed ground squirrel	None	None	
Zapus trinotatus orarius	Point Reyes jumping mouse	None	None	
Reptiles				
Anniella alexanderae	Temblor legless lizard	None	None	
Anniella campi	Southern Sierra legless lizard	None	None	
Anniella grinnelli	Bakersfield legless lizard	None	None	
Anniella pulchra	Northern California legless lizard	None	None	
Anniella sp.	California legless lizard	None	None	
Anniella stebbinsi	Southern California legless lizard	None	None	
Arizona elegans occidentalis	California glossy snake	None	None	
Aspidoscelis tigris stejnegeri	coastal whiptail	None	None	
Coleonyx variegatus abbotti	San Diego banded gecko	None	None	
Crotalus ruber	red-diamond rattlesnake	None	None	
Diadophis punctatus regalis	regal ringneck snake	None	None	
Elgaria panamintina	Panamint alligator lizard	None	None	
Emys marmorata	western pond turtle	None	None	Yes
Gambelia copeii	Cope's leopard lizard	None	None	
Heloderma suspectum cinctum	banded Gila monster	None	None	
Kinosternon sonoriense	Sonoran mud turtle	None	None	
*Masticophis flagellum ruddock*i	San Joaquin coachwhip	None	None	
Masticophis fuliginosus	Baja California coachwhip	None	None	

Scientific Name	Common Name	Protected Status		Groundwater-Dependent
		Federal	State	
Phrynosoma blainvillii	coast horned lizard	None	None	
Phrynosoma mcallii	flat-tailed horned lizard	None	None	
Salvadora hexalepis virgultea	coast patch-nosed snake	None	None	
Thamnophis hammondii	two-striped garter snake	None	None	
Thamnophis sirtalis pop. 1	south coast garter snake	None	None	
Uma notata	Colorado desert fringe-toed lizard	None	None	
Uma scoparia	Mojave fringe-toed lizard	None	None	
Xantusia gracilis	sandstone night lizard	None	None	
Xantusia vigilis sierrae	Sierra night lizard	None	None	