CALIFORNIA CONNECTIONS

How Wildlife Connectivity Can Fight Extinction and Protect Public Safety

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Tiffany Yap, D.Env/Ph.D., Senior Scientist
J.P. Rose, Senior Attorney
Ileene Anderson, M.S., Senior Scientist
Aruna Prabhala, Urban Wildlands Director, Senior Attorney

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Cover photo: California newt / Jose Benedicto de Jesus

Desert tortoise/Brad Sutton, NPS

EXECUTIVE SUMMARY

Wildlife connectivity is critical for the survival of California's unique biodiversity and the protection of public safety. Sometimes referred to as landscape connectivity or ecological connectivity, wildlife connectivity is defined as "the unimpeded movement of species and the flow of natural processes that sustain life on Earth."[1] The ability of animals and plants to move among different areas of habitat to find food, shelter and mates is crucial for healthy ecosystems to function.

But when roads slice up habitat and cut off connectivity, it is dangerous for people and wildlife. From 2015 to 2018 more than 25,000 wildlife-vehicle collisions with large mammals were reported in California, resulting in human deaths, injuries and property damages estimated at more than $1 billion.[2–4]

As roads and development continue to plow through habitat, imperiled species like the mountain lion, San Joaquin kit fox, desert tortoise, California tiger salamander and coastal California gnatcatcher are being pushed closer to extinction. State biologists estimate that 100 to 200 mountain lions are killed by car strikes every year throughout the state,[5] while on a national level it's estimated that up to 340 million birds are killed annually on U.S. roads.[6]

But there is a path forward that can protect people and animals. Wildlife crossings have been shown to improve wildlife movement and reduce dangerous wildlife-vehicle collisions by 80% or more,[7,8] but California has yet to prioritize them.

Policymakers should do the following:

- Enact statewide legislation and regional land-use ordinances that establish clear mandates for public decision-makers to preserve and enhance wildlife connectivity;
- Designate sufficient resources for the construction and maintenance of wildlife crossings;
- Prioritize the conservation and permanent protection of areas critical to wildlife connectivity.

Elected officials, planners and engineers can make California a leader in biodiversity conservation while making our roads safer for drivers and wildlife. We need to allocate resources to preserve, enhance and restore wildlife connectivity so all communities can thrive.

ROADS, DEVELOPMENT DRIVING EXTINCTION CRISIS

Roads and poorly planned development have profoundly negative impacts on biodiversity and ecosystem function, both of which are deteriorating worldwide.[9,10] ***Life on Earth is experiencing a sixth mass extinction, with species disappearing at a rate of more than 1,000 times greater than the background extinction rate.***[11]

Species may naturally go extinct over time, but in this current mass extinction, populations are declining, ranges are shrinking and species are disappearing at a much higher rate. All life on Earth is being affected, including mammals,[12] amphibians,[13] birds,[14] reptiles,[15] fish[16] and insects.[17]

Habitat loss and fragmentation are the primary drivers of this extinction crisis.[9,18] Buildings, agricultural lands and roads are physical barriers to wildlife movement, and they impair *structural* connectivity. Traffic, light and noise pollution and other edge effects of such infrastructure severely degrade *functional* connectivity by affecting how animals behave and move through the environment. Without thoughtful land-use planning, even areas with structural connectivity may not be used by wildlife if edge effects hinder functional connectivity.

Edge effects of human infrastructure and activities impose environmental stressors that negatively affect species survival and ecosystem function in a variety of ways.

Since 2017 the Oakland Zoo has cared for 15 orphaned mountain lions. The kittens' mothers were likely killed by vehicle strikes, illegal poaching or wildfire. Because they learn survival skills from their mothers, the rehabilitated kittens are unable to be released into the wild. Instead, they are placed in zoos or sanctuaries.

Mountain lion kitten/NPS

Roadkill numbers demonstrate the need for improved connectivity. For example, traffic is estimated to kill millions, if not billions, of animals on U.S. roads every year.[6,19] Community scientists documented more than 15,000 roadkill newts over the past three breeding seasons on just four miles of road in Santa Clara County.[20] While car strikes can be immediately fatal, many animals struck by vehicles may survive the collision but then slowly die from their injuries away from the road.[21]

Preserving intact habitat and enhancing connectivity by implementing wildlife crossing infrastructure on existing roads would help protect biodiversity.

Other edge effects, like noise pollution, lighting and rat poisons, are plaguing wildlife in fragmented landscapes. Excessive noise has been found to heighten vigilance behavior and decrease foraging in songbirds, which can affect their physiological state and reproductive success.[22,23] Chronic exposure to noise pollution has also been linked to reduced seedling recruitment rates and shifted plant community structure, likely due to altered behaviors of seed dispersers and pollinators.[24]

Lighting at night can disorient hatchling sea turtles, confuse nocturnally migratory birds, and disrupt reproductive behaviors in amphibians.[25] Rat poisons have been found to be one of the leading causes of death in bobcats and mountain lions in areas where connectivity is highly constrained, which can further reduce gene flow.[26,27]

Even domestic dogs and cats pose a significant threat to native wildlife by spreading disease, harassing or killing billions of wild animals annually, and competing with native species for resources.[28,29]

The dire situation of mountain lions is a prime example of how human infrastructure can lead to mortalities and unhealthy genetic isolation. State biologists estimate that 100 to 200 mountain lions are killed by car strikes every year.[5] Additional deaths from collisions include young cubs that are orphaned and unable to survive after a parent is killed.

Harmful genetic isolation due to roads and development combined with increased mortalities from vehicle strikes as well as rodenticide poisoning, illegal killing, disease and wildfires are driving an extinction vortex in Southern California and Central Coast mountain lions.[30]

Unabated development and lack of wildlife connectivity planning has led to documented declines in native species richness, abundance, reproductive success and survival rates, as well as shifts in ecological communities.[31–33] Continued poor planning could eliminate remaining connectivity and doom much of California's unique biodiversity.

For example, the Sargent Quarry project in Santa Clara County is a proposed sand and gravel mine that threatens Juristac, the sacred ancestral lands of the Amah Mutsun Tribal Band. It is located in one of the last remaining connections between the Santa Cruz Mountains and the Gabilan Range, which is important for movement and gene flow among mountain lions and other wildlife. In addition, the Otay Villages 13 and 14 developments planned in San Diego County would destroy critical habitat and ecological connectivity for the federally endangered Quino checkerspot butterfly.

Approving such projects without adequately considering impacts to connectivity will push these species closer to extinction. ***To combat the extinction crisis and prevent ecosystem collapse, California needs to proactively preserve and enhance wildlife connectivity.***

CLIMATE CHANGE RESILIENCE, ADAPTABILITY RELY ON CONNECTIVITY

Climate change is worsening ecosystem stress and species extinction risk.[34] Increasing variability and extremes in temperature, wind, and precipitation are all products of a warming climate, leaving species struggling to adapt. As a result, species' genes are changing, physiological and physical features such as body size are changing, ranges are shifting as species try to maintain a suitable climate space, and numerous species are expressing new breeding and migration behaviors.[35]

For example, some plants are budding and flowering earlier, some marine and freshwater fishes are spawning either earlier or later, and some species with temperature-dependent sex determination are experiencing shifts in sex ratios. ***Climate-related local extinctions have already occurred in hundreds of plant and animal species.***[36] And one study found that terrestrial bird and mammal populations that are experiencing greater climate warming are more likely to be experiencing greater population declines.[37] Reportedly, climate change is already impacting 82% of key ecological processes that form the foundation of healthy ecosystems.[35] If climate change goes unabated, more than one third of all plant and animal species could become extinct in the next 50 years.[38]

Wildlife connectivity is critical for biodiversity resilience and climate change adaptability. A permeable landscape that has multiple pathways or linkages between habitat patches allows a wide variety of species to adjust to shifts in resource availability.[39–41] For smaller species with poor dispersal abilities, like San Francisco garter snakes, California red-legged frogs and San Bernardino kangaroo rats, multiple linkages can provide habitat while still allowing for their dispersal.

Multiple connections also help populations persist after extreme events worsened by climate change. During floods, landslides or wildfires, these pathways provide escape routes or refugia for animals seeking safety.[39–43]

Such events can cause local extinctions in small, isolated populations.

Prior to roads and development severely fragmenting and degrading habitats, a species could persist because individuals from neighboring populations would be able to recolonize an area that experiences a local extinction. But without adequate connectivity, recolonization and species persistence are improbable.

Riparian habitats are a good example of how connectivity areas can provide some resilience to climate change. The canopy cover of riparian trees and the availability of groundwater have a cooling effect for both air and water temperatures, which creates a cooler microclimate for species to find refuge from a warming climate.[44–46] These wooded streams also provide important habitat and movement corridors for numerous species, including anadromous fish, like coho salmon and steelhead, that rely on cool water temperatures and clear streams for spawning and rearing.[16]

Healthy streams require connectivity with adjacent, upland riparian habitat, which provides migration corridors and foraging and breeding habitat for terrestrial species, like mountain lions and black bears, as well as migratory birds, like the southwestern willow flycatcher and yellow-billed cuckoo.

It is estimated that 90% to 95% of historic riparian habitat in the state has been lost. Continued destruction and degradation of what little is left will have severe, harmful impacts on overall biodiversity, ecosystem function and climate change resilience. It is critical for state policymakers to prioritize preserving and restoring wildlife connectivity.

LOSS OF WILDLIFE CONNECTIVITY HARMS ALL COMMUNITIES

Ecosystem health and human health are inextricably linked. California's landscapes support high levels of biodiversity that help regulate our climate, purify our air and water, pollinate our crops, and create healthy soil.[47] Access and connectedness to nature also provide physical and mental health benefits.[48] This has been the case during the COVID-19 pandemic as communities turned to open space for safe and socially distanced gatherings.

Protecting sensitive species by preserving intact habitat and implementing wildlife crossing infrastructure would benefit imperiled wildlife and plants while safeguarding California's diverse ecosystems and the services they provide. For example, the presence of pumas has been shown to help promote watershed health and maintain diverse habitats that support a multitude of fish, amphibian, reptile, bird, mammal, insect and invertebrate species.[49,50] Salamanders and frogs are important in many terrestrial and aquatic ecosystems because they play key roles in the food chain,[51–53] and they have been shown to facilitate carbon sequestration.[54] Loss of these species due to habitat loss and fragmentation could potentially lead to further degraded ecosystems, decreased biodiversity, and loss of ecosystem services.

Lack of wildlife connectivity also directly impacts public safety and the economy. Every year thousands of wildlife-vehicle collisions with large mammals are reported on California's roads, with drivers hitting deer, coyotes, bears, wild pigs, mountain lions, and elk. ***From 2015 to 2018 more than 25,000 large mammal-vehicle collisions were reported. These collisions resulted in human deaths, injuries and property damages that cost an estimated $1 billion.***[2–4]

Alarmingly, many of these types of wildlife-vehicle collisions go unreported, with actual collisions estimated to be up to 10 times more than the number reported.[55–57] Insurance provider State Farm estimated more than 92,000 deer collision insurance claims in California from 2015 to 2018, which is more than three times what was reported in the same time frame.[58,59] This suggests that wildlife-vehicle collisions could have an even higher public safety and economic impact.

THE SOLUTION: PRESERVE EXISTING CONNECTIVITY, BUILD WILDLIFE CROSSINGS

California has an opportunity to reverse the trend of deteriorating biodiversity and degrading ecosystems by prioritizing wildlife connectivity in land-use planning. Conserving remaining large, intact habitats and reconnecting habitat areas with effective wildlife crossings would protect the state's rich biodiversity while making ecosystems and human communities more resilient to climate change.

Preserving existing connectivity and building wildlife crossings will require strong land-use policies and adequate funding.

On the local level, land-use ordinances can provide strong, enforceable guidance to protect and enhance wildlife connectivity so sensitive species like mountain lions and blunt-nosed leopard lizards have a fighting chance.

For example, Ventura County's habitat connectivity and wildlife corridor ordinances are a critical step in the right direction. These measures, which were the first of their kind in the state, were passed in 2019; they designate zones of habitat connectivity, wildlife corridors and critical wildlife passage areas and regulate development in these zones to minimize negative effects on wildlife connectivity.

Similarly, the city of Los Angeles has developed a draft pilot ordinance that would create a set of land-use regulations to maintain wildlife connectivity in portions of the city. Other jurisdictions should consider and implement their own local and regional measures to preserve existing connectivity.

State law currently provides some protections for wildlife connectivity, though more are needed. For instance, an existing state policy encourages voluntary steps to protect functioning wildlife corridors through acquisition of open space, wildlife-friendly fencing and implementation of roadway crossings (Fish & Game Code § 1930.5). State law also prohibits Caltrans from constructing barriers to fish passage in streams (Fish & Game Code § 5901) and establishes a program that remediates existing barriers to fish passage and assesses barriers to fish passage in planning new projects (Streets & Highways Code §§ 156-156.4).

This female barn owl was hit by a vehicle on the 101 freeway in Santa Barbara County. Motorists noticed the injured owl near the center divider and called the California Highway Patrol. She was taken to the Ojai Raptor Center, where she was treated and rehabilitated for a broken scapula and shoulder blade. After about six weeks the owl was released back into the wild, just in time for mating season.

Patrol officer next to an injured owl on the 101 freeway/California Highway Patrol Santa Barbara

However, no similar mandate exists for state agencies to design or improve crossings for sensitive terrestrial species on existing highways, despite the large role of transportation infrastructure in reducing connectivity. Moreover, agencies continue to interpret the state's landmark environmental law — the California Environmental Quality Act — as allowing for the construction of highways and other development in connectivity areas without adequate mitigation.

In addition to clearer polices, more designated funding is needed at the state and local level to conserve land critical for wildlife connectivity and build crossing infrastructure on new and existing roads and highways.

Protecting what wildlife connectivity remains throughout the state is crucial to tackling the extinction crisis, improving resilience to climate change and protecting public safety. However, much of the state is already severely fragmented. To boost species and ecosystem resilience to the stressors of habitat loss and fragmentation, more resources need to be immediately directed towards reconnecting habitats with effective wildlife crossings.

Research demonstrates that wildlife crossings work.

Research shows that if wildlife crossings are designed to accommodate both structural and functional connectivity, they can be highly effective at improving wildlife connectivity. For example, crossing structures on the Trans-Canada Highway in Banff National Park were found to facilitate sufficient gene flow in both grizzly bear and black bear populations.[60] Pronghorn were shown to gradually acclimate to crossing structures that allow them to migrate safely between their summer and winter ranges in the Greater Yellowstone Ecosystem and Grand Teton National Park.

Wildlife crossings are also showing promising signs for smaller, less mobile species. In a pilot study conducted in the Sierra National Forest, an elevated section of road allowed Yosemite toads and other small critters, including snakes, rodents and lizards, to safely cross a deadly road.[61] And new underpasses and upgraded culverts recently constructed along the I-90 Snoqualmie Pass in Washington have already led to pikas establishing new territories, native fishes colonizing restored streams, and toads and salamanders moving through new crossings and mitigation sites.[62–64]

Landscape connectivity has also been found to benefit plant diversity by facilitating important plant-animal interactions, like pollination and seed dispersal.[65] An 18-year study found that reconnected landscapes had nearly 14% more plant species compared to fragmented habitats, and that number is likely to continue to rise as time passes.[66]

Building more wildlife crossings would benefit numerous sensitive animals and plants and improve driver safety. Wildlife-vehicle collisions pose severe safety issues for sensitive species and people, as exemplified by a collision in July 2019 in Lake County that killed a mountain lion and injured nine people.[67]

Installing wildlife passage features such as underpasses, overpasses and directional fencing has proven to be a cost-effective means of reducing such collisions and facilitating wildlife movement.

States that have invested in wildlife crossing infrastructure, like Utah, Colorado and Wyoming, have seen 81% to 98.5% reductions in wildlife-vehicle collisions on sections of highways where they have implemented wildlife crossings.[7,8,68] The savings over the long term from the avoided wildlife-vehicle collisions more than pay for the upfront costs to build the crossings.[69]

Actively improving structural and functional connectivity by preserving existing intact habitat and constructing wildlife crossings to reconnect fragmented landscapes would benefit wildlife, public safety and the economy. By protecting wildlife connectivity, California decisionmakers can help protect us all.

Bobcat/NPS

Effective Wildlife Crossings

The implementation of wildlife crossings is gaining traction throughout the country, with states like Washington, Wyoming, Utah and Arizona recently completing large projects. Wildlife cameras show deer, pronghorn, javelinas, bobcats, bears and many other animals using the crossings.

Here are a few examples of wildlife crossings on the West Coast:

I-90 Snoqualmie Pass Wildlife Crossings, Washington

The Washington Department of Transportation worked with the I-90 Wildlife Bridges Coalition and the Cascades Conservation Partnership to design and implement a comprehensive approach to improve wildlife connectivity along 15 miles of the I-90 freeway (between Hyak and Easton). More than 20 crossings are planned in conjunction with widening the four-lane freeway to six lanes, and nearly 45,000 acres of land adjacent to the planned crossings were acquired for protection and restoration. Funding was acquired through legislation.

The crossings and restored sites will benefit numerous species. Four undercrossings, one overpass and associated restoration sites have been completed and are already showing promising signs of animal use. Pikas have established new territories in crossing rock piles; elk, coyotes, otters and Pacific giant salamanders have been documented using the crossings; and fishes and toads have been found in restored streams and wetlands. Researchers monitor the crossings to document use and improve upon future crossing design.

As more crossings are constructed and animals start to acclimate to them, biologists are hopeful that wolves and wolverines will be able to return and move freely through the area.

Fish Passage at Arroyo (Parida) Paredon Creek, Route 192, Santa Barbara County, California

Under emergency authorization, Caltrans District 5 replaced an existing bridge on Route 192 that was damaged by debris flow from storms in the Montecito area in January 2018. The existing 35.5-foot bridge was replaced with a full-span bridge. Concrete and revetment were removed, and the stream channel was graded and realigned to simulate upstream channel conditions. The crossing will benefit endangered Southern California steelhead trout and connect to 1.24 miles of steelhead habitat upstream. It cost an estimated $6.5 million and was funded by the State Transportation Improvement Program.

Pre-remediation barrier to fish passage, left, and post-remediation fish passage, right/Caltrans

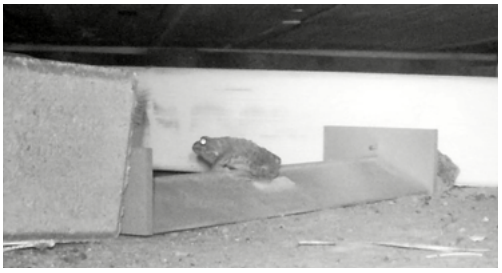
Sierra National Forest/USGS

Yosemite Toad Elevated Road Crossing, Sierra National Forest, California

U.S. Geological Survey and U.S. Forest Service biologists identified a particularly deadly stretch of road for federally threatened Yosemite toads migrating between breeding ponds and upland habitat. They installed an 8-inch-high, 100-foot-wide elevated road segment made out of road mats designed for use by heavy equipment at construction sites. The material allowed ambient light and rain to pass through to emulate the natural environment the toads usually move through. Directional fencing was installed to guide the toads and other small critters to the crossing.

View of the underside of an elevated road segment constructed for the Yosemite toad/Cheryl Brehme, USGS Western Ecological Research Center

This crossing was the first of its kind, and it proved to be successful. Many toads and other herpetofauna and small mammals were documented using the crossing, and road mortalities in the area were reduced. Based on this pilot study, USGS biologists are working with Caltrans and independent transportation engineers to develop elevated road segments that meet both transportation and wildlife needs.



Yosemite toad crossing under the elevated road/USGS

Wildlife Protection Fencing, 241 Toll Road, Orange County, California

The Transportation Corridor Agencies (TCA) installed six miles of wildlife fencing along the 241 Toll Road in Orange County, which cuts through the Santa Ana Mountains. The area was a known wildlife-vehicle collision hotspot, with pumas, deer, bobcats and coyotes as the most common victims.

The fencing is 10 to 12 feet high and 2 feet deep, which deters animals from going over or under it. It has jump-out ramps in the event that an animal gets trapped on the road and needs an escape outlet. The fencing guides animals to existing underpasses and culverts that provide safe passage across the road.

In the three years since the $10 million crossing infrastructure was implemented, vehicle strikes of pumas, deer and bobcats have been completely eliminated and collisions with coyotes have decreased by 90%.[70] Biologists have been monitoring the crossings and have documented animals using them. The U.S. Fish and Wildlife Service has recognized the TCA for improving wildlife connectivity and reducing wildlife-vehicle collisions in the area.

A Pacific fisher at the Twin Gulches Culverts/Caltrans

Twin Gulches Culverts, State Route 299, Shasta County, California

As part of the Twin Gulches Curve Improvement Project, Caltrans District 2 constructed culverts to provide safe passage under State Route 299 for wildlife. The project was completed in 2016. Numerous species, including the rare Pacific fisher, have been documented using the crossings.

California Tiger Salamander Tunnels, Junipero Serra Boulevard, Santa Clara County, California

Junipero Serra Boulevard is a busy, two-lane paved road that bisects a historical California tiger salamander breeding site and upland habitat on the Stanford University campus. A three-tunnel system was constructed by Stanford University in 2003, and barrier fencing was recently extended by USGS for study purposes. The tunnels have a grid ceiling that allows natural light and rain to permeate the length of the passages.

Once salamanders encounter the underpasses, the success rate of crossing is high. However, biologists have identified that guiding the salamanders to the crossings can be challenging.[61] This highlights the need to preserve any remaining, intact habitat while emphasizing that crossings at existing barriers must be tailored to the needs and behaviors of the target species. More studies are needed to determine how to make such crossings more effective.

Upgraded Culverts, State Route 118, Ventura County, California

Using wildlife movement and roadkill data, the National Park Service and Caltrans District 7 worked together to identify five existing drainage culverts along a 12-mile stretch of State Route 118 to retrofit for wildlife use. The two-lane highway bisects an important wildlife linkage area connecting the Santa Monica and Sierra Madre mountains. The upgrades included a ramp to improve accessibility to culverts and fencing to guide animals away from the road and towards the culverts. Wildlife cameras at the crossings have documented wildlife, including bears, mountain lions and coyotes, making use of the upgraded culverts, and Caltrans maintenance crews have reported less roadkill since the retrofits were completed.

Top photo: A culvert under Route 118 retrofitted for wildlife use/NPS
Bottom left and right: A black bear and mountain lion at retrofitted culverts/NPS

SPOTLIGHT SPECIES:

It is critical for animals to be able to move freely between different habitats at different stages of their life cycle. Here we provide examples of how species with different life history needs are impacted by roads and development.

Southern California and Central Coast Mountain Lion *(State Threatened-Candidate)*

The state's mountain lions are especially vulnerable to roads and development. Continued habitat loss and fragmentation have led to 10 genetically distinct populations within California. Six of those populations, located in Southern California and along the Central Coast, were provisionally listed under the California Endangered Species Act in response to a petition submitted by the Center for Biological Diversity and the Mountain Lion Foundation.

Mountain lion/NPS

Mountain lions are fearful of people and modify their behavior to avoid us as much as possible. These elusive, wide-ranging carnivores are facing an extinction vortex driven by a lack of connectivity that is causing a deadly combination of inbreeding, genetic isolation and human-caused mortalities, including car strikes, rodenticide poisonings, poaching, disease and wildfires.[71–73] Alarmingly, the Santa Ana and Santa Monica mountains puma populations are showing physical signs of inbreeding depression.[74,75] It is predicted that these populations could become extinct within 50 years or fewer if nothing is done to improve connectivity and reduce human-caused mortalities.[72,74]

Willowy monardella/Sabrina West, USWFS

Featured plant: While mountain lions are wide-ranging species that use a variety of habitats, they often rely on cover and prey attraction of creeks and streams. Because water is often intermittent and rare on California landscapes, many unique and rare plants are also found streamside too. Such beauties as the very rare willowy monardella (*Monardella viminea*) rely on ephemeral streamsides found only in San Diego County.

California Newt *(Southern Populations — Species of Special Concern)*

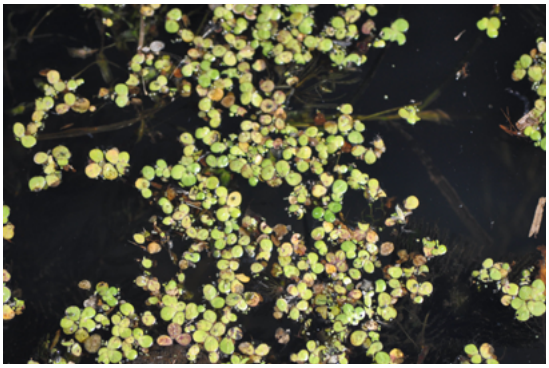
When the winter rains start, California newts emerge from their upland burrows and migrate up to two miles to breeding pools to mate and lay their eggs. They often have to cross roads, which can be deadly for these small, slow-moving creatures. In fact, community scientists have documented more than 15,000 roadkill newts over the past three breeding seasons on just four miles of road at Lexington Reservoir County Park in Santa Clara County. Such high road mortalities increase local extinction risk in newts and other amphibians.[76]

California newt/Connor Long

Warmer, drier conditions are also linked with reduced body condition in southern California newt populations, and scientists

predict similar trends will occur in northern populations by the end of the century.[77] Increased connectivity through seasonal road closures, elevated road segments or amphibian undercrossings embedded in the road would allow newts and other small wildlife to safely cross roads and improve climate resilience.

Featured plant: Many amphibians are directly tied to surface water for at least part of their life. One of the smallest flowering plants on the planet, duckweed (*Lemna minor*), floats on slow-moving waters, providing cover and sustenance for a variety of aquatic animals.



Duckweed/USFWS

Quino Checkerspot Butterfly *(Federally Endangered)*

Quino checkerspot butterflies exist in a network of interdependent metapopulations that cycle through colonization and extinction dynamics. The survival of the species depends on the ability of individuals to move between habitat patches and recolonize areas where local extinctions have occurred. Therefore, functional connectivity between patches is key for Quino persistence across a region.[78] These low-flying butterflies have been found to move more than 650 feet between host plants and nectar sources, and they generally avoid flying over objects taller than 7 to 8 feet.[79–81] Current threats to the Quino checkerspot butterfly include habitat loss and fragmentation due to roads and sprawl development, the U.S. southern border wall, cannabis cultivation, grazing, recreation (*e.g.*, biking, off-road vehicle use, equestrian activities), pollution, invasive species, increased drought and fire frequency and other signs of climate change.[79,82]

Quino checkerspot butterfly/Andrew Fisher, USFWS

White snapdragon/Joe Decruyenaere, CC-BY-SA

Featured plant: Quino checkerspot butterflies rely on specific plants as larval food sources, including the dwarf plantain (*Plantago erecta*) and the white snapdragon (*Anterrhinum coulterianum*). Stands of these plants are patchily distributed on the landscape; therefore, providing free-flying areas between patches of plants for the adult form (butterflies) is critical for the larval form (caterpillar) to flourish.

Tricolored Blackbird *(State Threatened)*

California supports more than 99% of tricolored blackbirds, though there are scattered populations throughout the West Coast. They form the largest colonies of any North American songbird and rely on wetlands and agricultural fields for nesting and foraging. They are nomadic, often moving extensively throughout their range in the nonbreeding season.[83]

Like the millions of migratory birds within the Pacific Flyway, a north-south migratory corridor that extends from Alaska to Patagonia, tricolored blackbirds require adequate habitat connectivity that allows them to find food and shelter during their

Tricolored blackbird/Alan Vernon, CC-BY-NC-SA

migrations as well as when they are foraging up to three miles from their nests to find food.

Featured plant: Tricolored blackbirds' native habitats are emergent wetlands where their open-up nests can be suspended from cattails (*Typha* sp.) and bullrushes (*Shoenoplectus* sp.).

Cattails/Arto J., CC-BY-SA

Chinook Salmon *(Federally Threatened and Endangered)*

Chinook salmon/Ryan Hagerty, USFWS

Cottonwood and willow riparian area/Ileene Anderson

Chinook salmon are anadromous. This means they're born in fresh water and spend some time in streams and estuaries until they head out to sea. After a few years they return to where they were born to spawn. They require aquatic connectivity that allows for unimpeded flow, seasonally or year-round, between suitable spawning and rearing habitat in natal streams and the open ocean.

In addition, healthy streams require connectivity with adjacent, upland riparian habitat. Intensive agriculture and urbanization that remove or degrade riparian habitat can disrupt stream flow and lead to erosion, increased water temperatures, decreased biodiversity and agricultural runoff that pollutes the streams. This disruption has driven major declines in Chinook salmon as well as other California freshwater and anadromous fish.[84–86] Dams and roads that block access to spawning habitat, coupled with climate change, are other threats to the survival of Chinook salmon and other anadromous fish.

Featured plant: Streams shaded by willows, cottonwoods and other water-loving trees keep the waters cool for the migrating salmon and young fry.

Mojave Desert Tortoise *(Federally Threatened, State Endangered-Candidate)*

The Mojave desert tortoise will become extinct if nothing is done to improve landscape connectivity among its populations.[87] In some locations, the population has declined by more than half since 2004. Habitat loss and fragmentation due to roads, expansion of cities, military operations, poorly sited renewable energy facilities, and wildfires threaten their recovery and long-term survival.[87] Maintaining an ecological network of remaining core habitat interconnected by large, high-quality linkages and wildlife crossings that help them safely cross roads and navigate around inhospitable habitat is critical for their long-term survival.[88]

Featured plant: The animal's key live-in and move-through habitat is typically dominated by the creosote bush, which typically occurs in soils where the desert tortoise can excavate deep burrows to escape from heat, cold and predators.

Top photo: Mojave desert tortoise/BLM
Bottom photo: Creosote bush/NPS

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