Credit: Jennifer Wilkening/USFWS

Can Solar Farms Be Wildlife Friendly?

A FACILITY IN THE SOUTHWEST HOPES TO FIND THE ANSWER

By Jennifer Wilkening and Kurt Rautenstrauch

Global demand for energy is increasing rapidly as the world's population grows and urbanization expands, creating new challenges for the use of conventional fossil-fuel energy resources. Not only are supplies of fossil fuels limited, burning them produces greenhouse gas emissions that negatively impact natural ecosystems and human health.

▲ **Large solar energy facilities provide a clean source of electricity but can result in habitat loss for wildlife and plant species in the Mojave Desert.**

But thanks to advances in technology, favorable policy changes and financial incentives, today development of renewable energy systems is flourishing (Cameron et al. 2012). These systems provide a cleaner and healthier source of electricity and can reduce dependence on fossil fuels while also mitigating impacts of climate change. Capturing the sun's thermal energy has emerged as one of the most promising technologies, with interest in solar-powered generation of electricity increasing exponentially over the last decade.

The environmental foot print of large-scale solar power plants can be considerable, however (Turney and Fthenakis 2011). Extensive tracts of land are typically needed to harness the sun's energy. One study estimated that a land mass roughly the size of the state of South Carolina would be required to meet the renewable energy demands of California alone (Hernandez et al. 2015a).

Paradoxically, construction of energy facilities that mitigate the adverse impacts of climate change can result in unexpected negative impacts on ecosystems and wildlife. Solar facilities located on previously undisturbed lands have the potential to threaten natural ecosystems through habitat loss and fragmentation, leading to reduced biodiversity and ecosystem resilience. These impacts are particularly detrimental to land in the southwestern United States, a region characterized by sensitive arid environments and where large tracts of public land are being considered for solar energy development (Lovich and Ennen 2011).

When Valley Electric Association, Inc. (VEA), a non-profit, member-owned electric cooperative in southern Nevada, decided to build a solar facility on land inhabited by the federally threatened Mojave Desert tortoise (*Gopherus agassizii*), co-op leaders agreed to work with the U.S. Fish and Wildlife Service to explore building a wildlife-friendly facility. Lessons learned at this facility could help guide future development of these renewable energy facilities.

Collecting the sun's energy

The Southwest, the sunniest region in the U.S., includes portions of three deserts — the Great Basin, Chihuahuan and Sonoran — and encompasses the entire Mojave Desert, a sparsely populated area distinguished by large tracts of public lands and many popular tourist destinations such as Death Valley and Joshua Tree national parks. Studies estimate that full development of solar energy resources in the Mojave alone could provide 50 percent of the demand for electricity in the U.S. (EIA US 2009).

Similar to other eco-regions defined by harsh environments, the Mojave is home to a disproportionately large number of endemic species and is considered a hotspot for threatened and endangered species (Flather et al. 1998). One such species is the Mojave Desert tortoise, a long-lived, slow-growing reptile with relatively low reproductive rates. The species was listed under the federal Endangered Species Act as threatened in 1990. Desert tortoises construct burrows that other wildlife species use, plus their conservation status benefits other plants and animals, elevating the ecological importance of the species (Tracy and Brussard 1994).

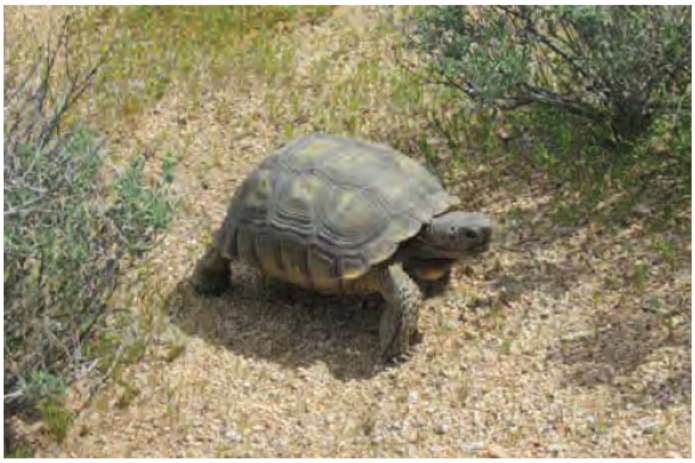
With construction and operation of solar energy facilities expanding in the Southwest, conservationists worried that the tortoise's ongoing population decline may be exacerbated by habitat loss and fragmentation. Developers typically grade the land, remove the vegetation, and install impermeable fences around the facilities to prevent animals from moving back inside. This means biologists often capture desert tortoises and translocate them to other sites before construction on a facility starts. USFWS wildlife managers also became concerned about the limited availability of translocation sites, as well as unintended negative impacts on translocated individuals in the Mojave.

Partnering to reduce wildlife impacts

VEA follows a cooperative business model that is guided by associated principles, including democratic member control and leadership, concern for the community, and emphasis on education and training opportunities. In 2015, the co-op, in partnership with Bombard Renewable Energy, proposed constructing an 80-acre solar energy facility on vacant land in Pahrump, Nev., an area inhabited by the Mojave Desert tortoise.

Before construction activities began, a team of biologists captured desert tortoises within the project footprint and moved them off site into holding pens. Temporary wildlife-exclusion fences were then erected to prevent the tortoises in adjacent habitat from wandering into the construction zone.

Rather than grading or leveling the entire site, construction crews left the ground underneath solar panels in its native state, retaining the natural

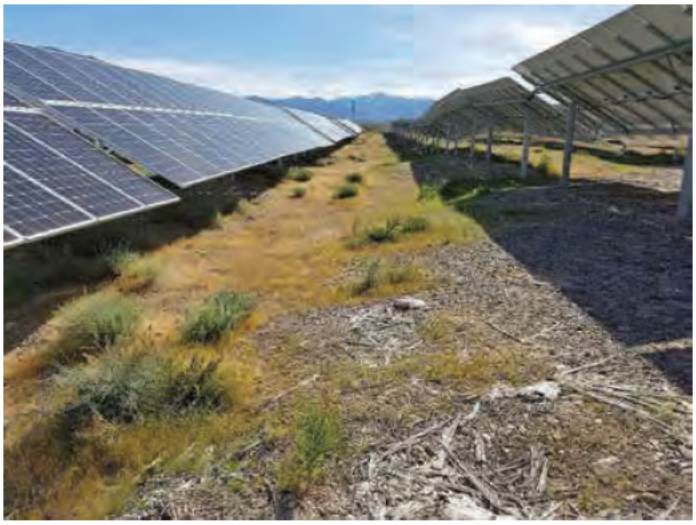


Credit Flo Gardipee/USFWS

▼ **The threatened Mojave Desert tortoise occurs in the Mojave and Sonoran deserts in southern California and Nevada, northwestern Arizona, and southwestern Utah.**

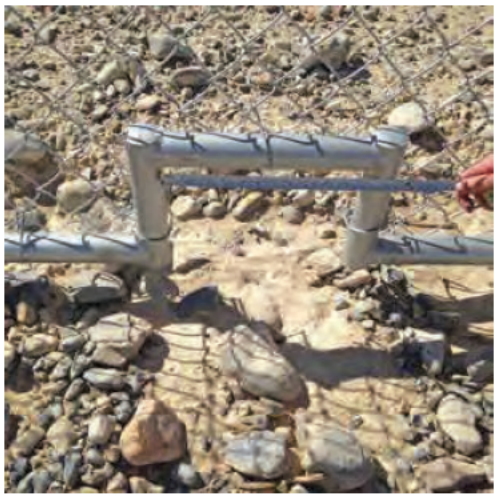
topography of the site and a watercourse that bisects the site. Native vegetation was clipped or mowed when necessary to avoid interfering with the solar panels.

The site plan included other modifications to make it more wildlife friendly. Construction crews built the solar panels 18 inches higher off the ground than the industry standard to allow more light to reach the vegetation underneath them. In order to evaluate impacts of solar panels on native vegetation and migratory birds, two different spacing configurations were installed. Rows of panels in the northern half of the site were spaced 14 feet apart, a commonly used separation in the solar industry. Rows in the southern half were spaced 20 feet apart to allow more light to reach the ground and potentially break up the lake-like optical illusion that may attract birds in search of water to solar farms. Instead of impermeable fencing, crews built the permanent fence surrounding the facility with openings around the bottom perimeter to allow desert tortoises and other wildlife to enter, exit and occupy the site during operation of the facility.



Credit: Jennifer Wilkening/USFWS

▲ **The VEA Community Solar Project in southern Nevada made modifications to make the facility wildlife friendly, leaving natural landscape features and vegetation to preserve continuity with the surrounding desert ecosystem.**



Credit: Jennifer Wilkening/USFWS

▶ **Desert tortoises and other wildlife species are able to move freely in and out of the facility via small openings at the base of the perimeter fence.**

VEA and USFWS also created operating guidelines to minimize risks to wildlife. Only small utility vehicles were allowed on the site, speed limits were set lower than normal, and workers received special desert tortoise awareness training.

Wildlife monitoring and research

At the completion of the project, VEA committed to funding research and monitoring studies to track desert tortoise use of the facility and examine the impact of different panel configurations on vegetation and avian mortality. These ongoing studies being conducted by researchers at HDR, a firm that provides environmental consulting services, and the University of Las Vegas, Nev., are designed to provide new knowledge regarding the ability of native plants to persist under solar panels and the use of habitat by wildlife. Research questions include: Does native and invasive vegetation response vary between the two spacing configurations? How do changes in panel configuration affect avian species? What are the specific siting and micro-climatic conditions that will promote successful restoration of native plants to provide additional forage for desert tortoises? How do soil conditions like temperature, moisture, and biotic soil crust change underneath solar panels following construction?

The facility removed the temporary exclusion fence surrounding the perimeter of the site in 2017, and biologists outfitted four tortoises previously captured — two adults, one sub-adult, and one juvenile — with radio transmitters and released them into artificial burrows created within the facility. The tortoises continued to move in and out of the facility using the openings in the bottom of the permanent fence. When colder temperatures set in, the adult and sub-adult tortoises moved into overwinter-

ing burrows outside the facility while the juvenile tortoise remained inside the facility. They continued to move in and out of the site during the spring and summer of 2018. Other wildlife species, including rattlesnakes (*Crotalus scutulatus)*, black-tailed jackrabbits (*Lepus californicus)* and kit fox (*Vulpes macrotis)*, were documented inside the facility, suggesting that they also used the openings.

Solar panels could cool desert surfaces and provide additional moisture under the panel drip line, creating favorable microclimates that enhance plant growth and survival, so the plan includes monitoring established plots under two panel configurations and outside the facility. Biologists also will assess the vegetation for growth, photosynthetic activity and flower production. Temperature sensors and soil moisture probes will be used to evaluate how solar panels influence ambient temperature and distribution of precipitation, and how differences in these environmental conditions affect vegetation.

Other studies planned for the future include avian mortality monitoring and transplanting native plant species like creosote (*Larrea tridentate)*, bursage (*Ambrosia dumosa)*, and beavertail cactus (*Opuntia basilaris)* into the site to evaluate habitat restoration techniques.

Options for the future

Although solar energy facilities designed to be wildlife friendly might lessen negative impacts, they are not a panacea. Appropriate site selection remains one of the most important considerations for balancing solar-energy projects with biodiversity protection. Some alternatives are to locate facilities on land with low conservation value, previously disturbed land or land adjacent to urban areas.

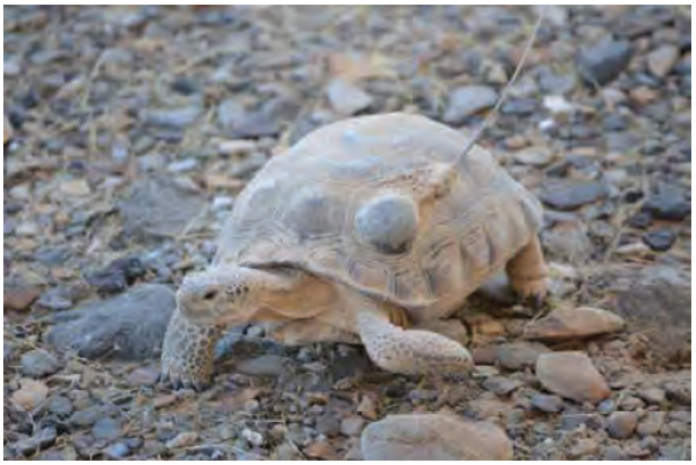
A systematic approach incorporating spatial data on biodiversity conservation value and solar potential found that sufficient land area exists to fully develop the Mojave, while still avoiding areas of high conservation value (Cameron et al. 2012). This type of research can help to guide solar-energy projects toward locations that are commercially attractive to developers because they are close to existing energy infrastructures and away from lands that are highly important ecologically. In California, for example, researchers determined that electricity produced from solar farms located on land within the existing infrastructure would exceed statewide energy demand (Hernandez et al. 2015b). Other options that could reduce impacts on wildlife include locating energy facilities on previously disturbed lands, such as brownfields, abandoned mines, or landfills.

Constructing solar-energy facilities on agricultural land is another option. Agricultural crops can be grown under and adjacent to solar panels, while

Credit: Kristin Mettke/Valley Electric Association, Inc.

◀ A tortoise moved back into the VEA Community Solar Project after construction was complete where it used an artificial burrow.

▼ A desert tortoise outfitted with a radio transmitter.



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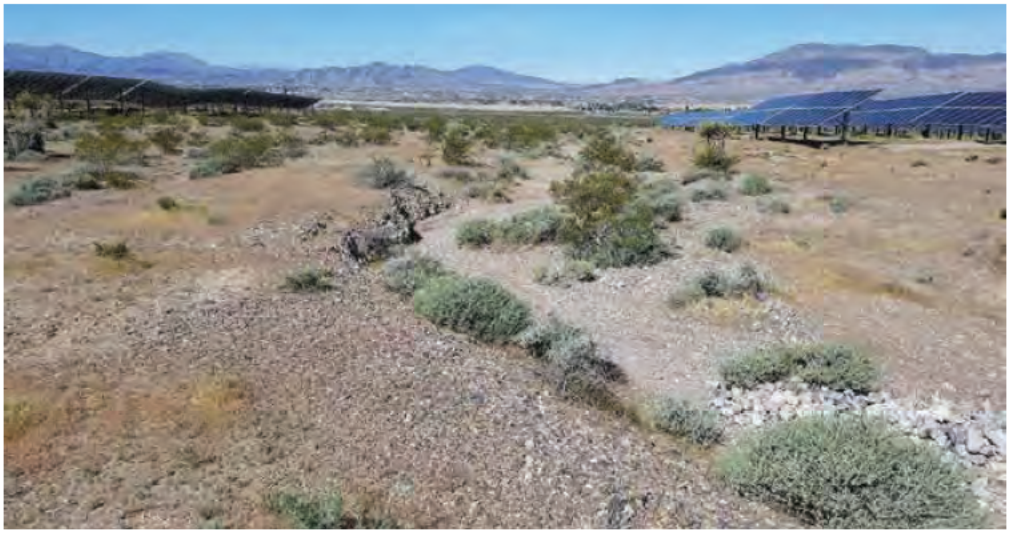

Credit: Michael Burroughs/USFWS

Areas of native vegetation left in place during construction of solar-energy facilities provide habitat for wildlife.

livestock grazing would lessen the need for removing tall vegetation. This practice would support both energy and food production and reduce the need to further develop undisturbed lands while generating an additional income stream for the land owner or providing a renewable source of electricity for the ranch. Additionally, re-vegetating land or maintaining native plants underneath solar panels might prevent the loss of the soil's carbon fixation capacity.

Another important consideration for locating wildlife-friendly, solar-energy facilities is maintaining habitat connectivity as much as possible, although the quality of the habitat may not be totally preserved. Many desert plants accustomed to high levels of direct sunlight may not thrive in the shaded conditions under solar panels, and disturbances associated with the facility's construction and operation could facilitate establishment of invasive plant species such as red brome (*Bromus rubens)* that outcompete native vegetation. Human activities also may attract novel species or additional predators to the site, which could have unintended consequences by altering species interactions or predator-prey dynamics.

Nevertheless, maintaining some degree of habitat connectivity will almost certainly benefit some wildlife species in the Mojave Desert. The facility described here is an important first step, and research results will help to answer questions about how specific species may be affected. Lessons learned could be incorporated into decisions about the siting and design of future solar energy facilities in the Mojave.

As the solar-energy field continues to evolve, considerable opportunity exists today for the alignment of energy development goals and wildlife habitat preservation. As this project demonstrates, interest in establishing wildlife-friendly solar energy facilities has grown along with increased developments in the Mojave Desert, and this trend is likely to continue into the future. ■

Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

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