Solar

Wildlife and Solar Power

With thoughtful project design, utility-scale solar projects can support wildlife habitats and conservation while producing affordable American energy.

Key Takeaways

1. **Habitat Creation:** Solar projects can provide valuable habitats for wildlife and protect land from urban sprawl.
2. **Environmental Benefits:** Solar projects provide benefits that improve ecosystem health and support biodiversity, such as reduced pollution, reduced emissions, and land conservation.
3. **Minimized Impact:** Smart design and siting limits disruption to wildlife movement and minimizes habitat fragmentation.
4. **Positive Wildlife Interaction:** Studies show low wildlife mortality from solar projects, with many species safely coexisting with solar facilities.

Background

Potential benefits and impacts to wildlife and their habitats are a primary consideration during planning and development of utility-scale photovoltaic (PV) solar energy facilities. As part of the overall project development process, a structured, science-informed process is used to evaluate potential sites for risks to species of concern and their habitats.

The benefits of solar on wildlife and habitat include reducing air pollution, greenhouse gas emissions, and water use and pollution. Additional benefits may include reduced long-term soil and water runoff, increased shading, land conservation that prevents permanent land conversion due to sprawl or other commercial uses, water conservation and improved water quality, soil restoration and carbon sequestration, and the creation of habitat for various species of wildlife.

Negative impacts from solar projects are limited, especially when compared to global climate change, which is one of the greatest threats to wildlife and their habitats[1].

Habitat Benefits

Utility-scale PV solar projects positively influence wildlife and habitats in several ways:

- **Air Pollution Reduction:** Solar power reduces air pollution—including carbon dioxide, nitrogen oxides, sulfur oxides, and mercury—which harms both humans and wildlife and can impact the quality of important habitat.
- **Water Quality:** Solar has no negative impacts on water quality or availability when stormwater runoff is managed appropriately and since solar power does not require water for generation.
- **No Resource Extraction:** Solar operations avoid resource extraction, which is one of the largest contributors to habitat disruption.

Additional positive effects, depending on the site and the project, include:

- **Reduced Soil and Water Runoff**
- **More Shaded Area**
- **Land Conservation** from permanent land conversion (due to sprawl or other commercial uses)
- **Improved Water Quality and Conservation**
- **Soil Restoration** and **Carbon Sequestration**
- **Increase in Biodiversity** compared to previous use of landscape
- **Habitat** for various wildlife species

Habitat for Various Wildlife Species:

Studies establish the compatibility of PV solar facilities with a diverse range of wildlife species:

- **Pollinators & Insects:** A wide variety of pollinators and other insects use and benefit from restored vegetation at PV solar facilities. Studies have found that PV solar facilities can lead to an increase in the diversity and abundance of plants, grasses, butterflies, bumblebees, and birds[2,3,4,5,6,7].
- **Small Mammals:** Small mammals can be abundant within PV solar facilities, supporting predator-prey ecosystem dynamics[8].
- **Greater Sage-Grouse:** Groups of greater sage-grouse have been observed foraging and loafing within a PV solar facility in Wyoming[9].
- **More Species:** Land use practices aimed at increasing biodiversity at PV solar facilities can result in increased vegetation productivity compared to reference sites and support the presence of dozens of wildlife species, including many with special conservation status such as California horned lark, ferruginous hawk, loggerhead shrike, prairie falcon, American badger, and San Joaquin kit fox[10].

Potential Wildlife Considerations

While the few challenges from PV solar projects are minimal compared to climate change, developers still consider:

- **Land Footprint:** Solar requires approximately 6-10 acres of land to generate approximately 1 megawatt[11], so grid-scale projects may require hundreds or thousands of acres.
  - Site-specific design measures and vegetation management practices determine the type and quality of habitat available within the facility after construction and its accessibility to various wildlife species.
- **Wildlife Movement:** Solar projects may obstruct terrestrial wildlife movement across the landscape due to security fencing requirements, potentially affecting migrations of big game species such as pronghorn[12].
  - Facility siting and layout or design considerations by developers help avoid or reduce potential impacts to wildlife movement.

Wildlife Mortality: Low Risk

Wildlife mortality at PV solar projects occurs at very low levels, according to multiple studies using diverse methodologies. Further, it is often unclear if the small number of observed fatalities are caused directly by the facility or occur because of natural causes, such as a predator catching a bird and leaving feather spots on site.

For Example: Argonne National Laboratory has an ongoing study that uses a camera system and artificial intelligence to continually monitor and track daytime bird interactions with PV solar facilities in the desert southwest, Midwest, and northwest regions of the U.S.

- Over thousands of recorded avian interactions, **no birds have been recorded colliding with panels**[13].
- Further, this research has identified birds regularly interact safely with solar facilities, including landing on structures and walking on the ground.

For Example: A mortality monitoring study comparing fatality numbers at active PV solar facilities to background mortality at non-solar reference sites in the area found **no difference in estimated fatalities between the solar facilities and reference sites**[14].

Lake Effect Hypothesis: Fatalities of water-affiliated bird species observed at one of the first utility-scale solar facilities in the desert southwest led to the "lake effect" hypothesis, which suggests that certain birds mistake solar facilities for waterbodies and fly into panels.

- Further research has found that patterns in avian mortality at PV solar facilities are species-specific and dependent on the landscape in which the facility is located—meaning to the extent it exists, **the "lake effect" is unlikely to cause high avian mortality at most facilities** since they lack the specific species and landscape features that may be contributing to the effect[15].
- Additionally, a new study has revealed that eight analyses and 14 of 16 papers on the topic of lake effect relied on a dataset collected from a single fixed-tilt PV facility built prior to the commercial transition to using anti-reflective coating[16]. Despite this dataset not being representative of current solar facilities, it has been used to draw conclusions that have been broadly applied to all PV solar facilities. Data from modern solar facilities do not support the lake effect hypothesis as a common phenomenon.

Industry Actions to Reduce Impacts and Maximize Benefits

Solar developers typically follow a structured, science-informed process to evaluate potential sites for risks to species of concern and their habitats as part of the overall development process.

- **Developers collect and assess information** that allows them to make informed decisions about whether to (1) proceed with development, (2) collect additional information, or (3) adjust project plans in response to potential significant adverse effects on species of concern and their habitats.
- **Pre-construction assessments** are conducted to identify potential wildlife and habitat concerns.
- **Developers communicate with agencies** (like state wildlife agencies and federal agencies) for information, such as to help determine if protected species or their habitat may be present.
- **Opportunities to avoid**, minimize, and compensate for potential impacts are identified as necessary.
- **Post-construction site restoration is evaluated** against target metrics, which may range from revegetation and soil stabilization to the establishment of pollinator or other native habitat.

Developers consider habitat loss and/or degradation, habitat fragmentation, species displacement, behavioral changes, and potential direct effects to certain species as potential impacts.

Additional Measures Taken for Habitat Benefits

Though feasibility varies based on site and project details, measures may be proactively taken at certain PV solar projects to provide additive positive effects, including:

- **Planting Native Vegetation**
- **Establishing Pollinator Habitats**
- **Dual-use Development:** Solar facilities may host co-located activities like beekeeping or sheep grazing.

In many cases, decompaction and revegetation helps prevent erosion, manage stormwater, and may provide foraging and shelter opportunities for some species.

Beehive at Elizabethtown Solar Project, Pennsylvania Photo credit: AES

Ongoing Industry Research and Innovation

The solar industry continues to invest in research to improve the compatibility of solar facilities with wildlife and habitats.

Communications Framework for Industry & Agencies: ACP, the Association of Fish and Wildlife Agencies, and the Energy Wildlife Action Coalition jointly developed a Solar Communications Framework as a protocol for mutually beneficial communication between project proponents and state fish and wildlife agencies.

Mitigation Strategies: Where prudent and feasible, members of the solar industry are establishing establish pollinator habitat, designing wildlife-friendly fencing, and adjusting facility siting and layout to preserve movement corridors for terrestrial wildlife. The adoption and efficacy of these site-specific measures to increase the compatibility of PV solar power with wildlife and its habitat are continually improving with advances in techniques, technology, and science.

Research: The PV solar industry also continues to fund research to improve its interactions with wildlife and their habitats. The industry, partnering with the Renewable Energy Wildlife Institute, has pooled resources to create the Renewable Energy Wildlife Research Fund. The Fund supports independent research projects that produce scientifically robust solutions to enable the continued expansion of PV solar power, while also increasing our understanding of wildlife and habitat protection.

Current research includes studies underway on the effect of solar facilities on biodiversity (including songbirds and pollinators), wildlife use of solar facilities (including sage-grouse), and soil health impacts of solar facilities sited in agricultural lands. REWI has published a resource on Solar Energy Interactions with Wildlife and Their Habitats: A Summary of Research Results and Priority Questions which summarizes the state of the science, maintains the SolSource Database to leverage the data collected from PV solar power projects for research purposes, and hosts a renewable energy research hub.

Endnotes

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