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Rocky Mountain Research Station

Science You Can Use *(in 5 minutes)*

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Stepping Stones: How Will the World's Protected Areas Support Species Undergoing Climate-Induced Range Shifts?

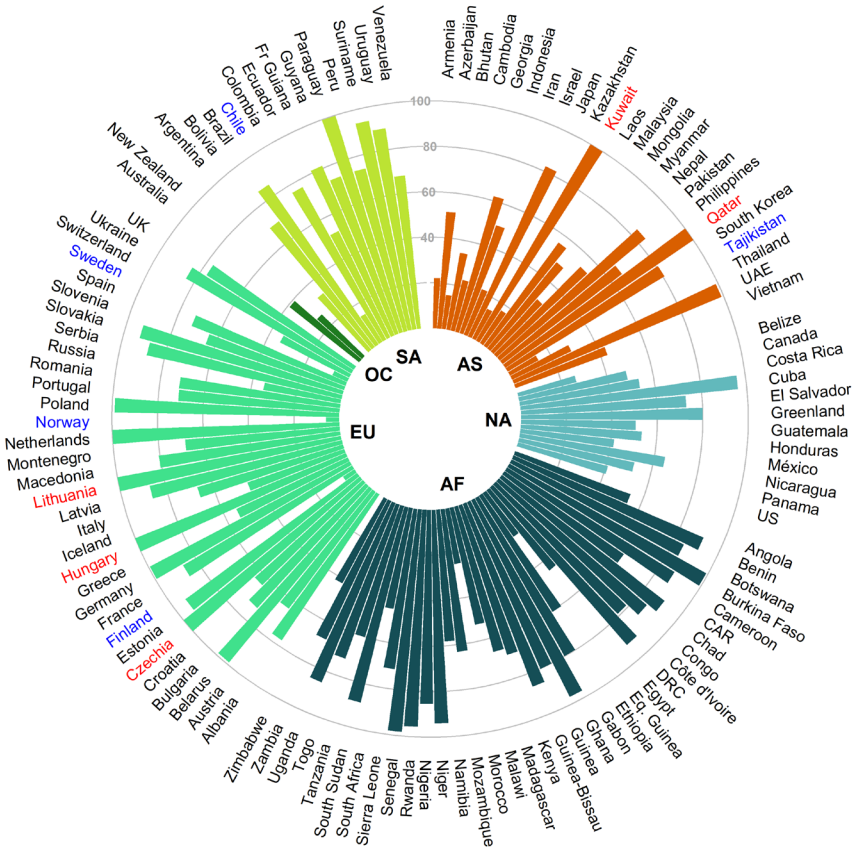
Across the globe, a network of national parks, nature reserves, and wilderness areas provides necessary refuge for the world's biodiversity, and yet these spaces are themselves susceptible to the effects of climate change. As the planet warms, species may need to adjust their ranges, moving among protected areas over time to maintain similar climate conditions.

Sean Parks, a research ecologist with the USDA Forest Service Rocky Mountain Research Station, Aldo Leopold Wilderness Research Institute, and his colleagues recently analyzed a global network of 30,000 protected areas to determine how well these spaces will function as "stepping stones" for species on the move. "It's been suggested that protected areas can serve as safe harbors for species moving or shifting in response to climate change," Parks says. "But we're finding that may not always be the case."

The team modeled where contemporary climates will be located in the future under a 2°C warming scenario. Generally, warmer climates are extending into higher elevations and edging toward the poles. By taking a "species-agnostic" approach, Parks's study represents potential shifts in distribution for "the full suite of species that make up biodiversity," including everything from plants and animals to fungi and microorganisms.

A Breakdown in the Network

The model showed that, as the planet warms, 67 percent of protected areas will achieve so-called climate connectivity failure, meaning that many species will not be able to pass between adjacent protected lands as they adjust their ranges. In the



An analysis of 118 countries reveals the percentage of protected lands that will achieve climate connectivity failure under a 2°C warming scenario. Countries in blue and red have the lowest and highest proportion of at-risk protected lands, respectively.

United States, for example, 61 percent of protected areas exhibit climate connectivity failure, compared with 81 percent in France and 19 percent in Norway.

There are several factors that can limit species' ability to disperse between protected areas, including instances in which locations are too far apart or separated by habitats a species cannot pass through—such as a desert between two mountain ranges—or those in which species would have to move through highly developed areas. Further, as the planet warms, certain climates may simply disappear, giving species nowhere to go. This last point, Parks says, was especially evident in the data.

Plans for the Future

Following the 2022 United Nations biodiversity conference, COP15, more than 190 countries pledged to conserve 30 percent of the planet by the year 2030. As a result, conservation management officials from around the world will be contemplating where to establish new protected areas over the next several years. The results of the study, Parks says, suggest that climate-wise connectivity between protected areas can be considered alongside assessing which areas are most in need of protection. He says, "You can be strategic about it, to prioritize and maximize the probability that species can shift their ranges and more effectively use protected areas as stepping stones under climate change."

In some cases, it may not be possible to ameliorate all the factors that lead to climate connectivity failure, even if more protected land is set aside. To help species shift their ranges, Parks says, "we may to take a long, hard look at assisted migration or assisted colonization." Such policies have been contentious in the past, but Parks stresses that bold actions may be needed to prevent extinctions.

Key Management Considerations

- Approximately two-thirds of the protected areas in a network of 30,000 sites will achieve climate connectivity failure under a 2°C warming scenario, meaning that species may not be able to successfully shift their ranges in response to climate change by moving between protected spaces.
- Effectiveness of newly established protected areas can be greatly increased if management officials consider the ability of species to move between neighboring protected areas.
- As the global conservation community considers how best to meet its climate commitments, bold land management strategies may be needed, including, for example, expanding the protected area network and assisted colonization or migration for species unable to move between protected areas.
- Data from this study are available for managers seeking to integrate landscape connectivity into their assessments. Parks can be contacted at sean.parks@usda.gov for more information.

Further Reading

Parks, Sean A.; Holsinger, Lisa M.; Abatzoglou, John T.; Littlefield, Caitlin E.; Zeller, Katherine A. 2023. Protected areas not likely to serve as steppingstones for species undergoing climate-induced range shifts. Global Change Biology.

Parks, Sean A.; Holsinger, Lisa M.; Littlefield, Caitlin E.; Dobrowski, Solomon Z.; Zeller, Katherine; Abatzoglou, John T.; Besancon, Charles; Nordgren, Bryce L.; Lawler, Joshua J. 2022. Efficacy of the global protected area network is threatened by disappearing climates and potential transboundary range shifts. Environmental Research Letters. 17: 054016.

Dobrowski, Solomon Z.; Littlefield, Caitlin E.; Lyons, Drew S.; Hollenberg, Clark; Carroll, Carlos; Parks, Sean A.; Abatzoglou, John T.; Hegewisch, Katherine; Gage, Josh. 2021. Protected-area targets could be undermined by climate change-driven shifts in ecoregions and biomes. Communications Earth & Environment. 2: 198.

Lead Scientist

Sean A. Parks is a research ecologist with the Rocky Mountain Research Station, Aldo Leopold Wilderness Research Institute. While much of his work focuses on the ecology of wildfire and fire behavior, Parks is also interested in modeling landscape connectivity under climate change.