RECLAMATION Managing Water in the West

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The Knowledge Stream Research Update

Effects of Climate Change on Riparian Vegetation Structure, Water Uptake, and Dependent Pollinators

How could climate change affect semiarid riparian habitats, and what measures can we take?

Bottom Line

Reclamation needs to understand how the environmental costs and benefits of its water management operations will change as local and regional environmental conditions change.

Better, Faster, Cheaper

Understanding the relationships between Reclamation's operations and ecological change enables Reclamation to develop strategies that can maximize benefits and avoid or minimize undesirable effects while meeting water and power delivery and other obligations.

Principal Investigators

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Questions

Riparian ecosystems (already greatly altered by water management, land development, and biological invasion) are being further altered by increasing atmospheric carbon dioxide (CO_2) concentrations and climate change, particularly in arid and semiarid (dryland) regions. Reservoir inflow timing and quantity, evaporative losses, and the timing and amount of downstream demand are also affected by this climate change. Thus, it is important for water resource managers to understand how climate change and climate-driven changes in streamflow are likely to affect habitat and what operational measures we can take if necessary to mitigate those impacts.

Analyses

This Science and Technology Program research project reviewed the scientific literature concerning likely effects of rising atmospheric CO₂ concentrations and climate change on riparian ecosystems in semiarid and arid Western North America.



Image shows the potential effects of elevated CO_2 , climate change, climate-driven streamflow, and plant community changes (rectangles) on riparian animals (ovals). Not all potential linkages discussed in the text are shown. Together, these effects will have complex, species-specific and community-specific impacts on riparian animal survival, recruitment, population dynamics, geographic distributions, community composition and structure, and trophic and symbiotic interactions.

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Reclamation and U.S. Geological Survey researchers:

- 1. Summarized expected changes in climate, hydrology, and water management.
- 2. Considered likely effects of those changes on riparian plants, animals, biotic interactions, and soil processes.
- 3. Identified knowledge gaps that hinder predictions of riparian ecosystem responses and sound water management planning and adaptation measures.

Answers

Together, climate change and climate-driven changes in streamflow are likely to:

- Reduce the abundance of dominant, native, early-successional tree species
- Favor herbaceous species and both drought-tolerant and late-successional woody species (including many introduced species)
- Reduce habitat quality for many riparian animals
- Slow litter decomposition and nutrient cycling

Potential Actions

Climate-driven changes in human water demand and associated water management may intensify these effects. On some regulated rivers, however, reservoir releases could be managed to protect riparian ecosystems. Outcomes of adaptation measures can be predicted by linking models of future climate scenarios, land cover, water demand, and water management.

Human adaptation measures—actions that increase resilience and reduce vulnerability of natural and human systems—will also shape riparian ecosystem responses to climate change. Adaptation options for riparian ecosystems will vary across watersheds and may include both proactive and reactive approaches. Proactive management is aimed at maintaining or increasing system resilience to climate change in advance of changes occurring. Examples include:

- Increase the scale of protected area networks and connected private lands
- Secure water rights for environmental flows
- Implement water conservation measures or cropping pattern adjustments
- Restore riparian vegetation to increase habitat connectivity
- Promote linkages between aquatic and terrestrial ecosystems
- Expand thermal refugia for wildlife
- Protect genetic diversity

"Semiarid and arid Western North America is environmentally diverse. However, many climatechange effects will vary in size or direction across the region. Immediate research priorities include determining riparian species' environmental requirements and monitoring riparian ecosystems to allow rapid detection and response to undesirable ecological change." Perry et al. 2011

More Information

Perry, L.G., D.C. Andersen, L.V. Reynolds, S.M. Nelson, and P.B. Shafroth 2012. Vulnerability of riparian ecosystems to elevated CO₂ and climate change in arid and semiarid western North America. Global Change Biology 18(3): 821-842. www.fort.usgs.gov/Products/ Publications/pub_abstract. asp?PubID=23228

Collaborators

U.S. Geological Survey

