

Science You Can Use *in 5 minutes*

Fresh Thinking for Freshwater Species: Expanding the management decision space

Protected areas are considered an antidote to biodiversity loss, but have not protected all biodiversity equally. Freshwater biodiversity has declined globally by 84 percent since 1970—more than twice the rate of marine and terrestrial species. Legacy effects from logging, mining, livestock grazing, dams, and fish stocking have affected freshwater ecosystems across the landscape including federally-protected areas.

“Even in wilderness areas, freshwater species are negatively impacted by resource extraction activities that occurred last century. Invasive species and shifting climates are adding more pressure,” says

Kellie Carim, a Forest Service research ecologist at the Aldo Leopold Wilderness Research Institute in Missoula, Montana. Carim and colleagues from the University of Montana examined challenges and opportunities for responding to freshwater biodiversity loss in protected areas like wilderness.

The Wilderness Act tasks managers with protecting the “natural character” of wilderness, as well as maintaining wilderness as “untrammeled”, or free from human manipulation and controls.

This makes intervention to protect biodiversity difficult. Carim and colleagues outlined

how the Resist-Accept-Direct (RAD) framework may help managers navigate these conflicting mandates and balance tradeoffs more deliberately. By encouraging managers to consider a wider range of management approaches, RAD expands the decision-making space. Their work shows that managers are already making Resist, Accept, and Direct decisions, often without recognizing them as such.

Consider fish stocking — once celebrated for supporting recreation across public lands. Today it is recognized as a driver of native species decline in many protected areas. How managers respond illustrates all three RAD approaches. Where nonnative fish threaten native species, managers may choose to **resist** — removing nonnative fish and reintroducing natives to restore historical conditions. Where stocking has failed and warming waters make restoration unlikely, managers may **accept** — discontinuing intervention, and instead monitoring what emerges to learn about shifting conditions and to inform next steps. And where historical conditions are no longer achievable, but



Chiricahua leopard frogs are listed as Threatened due to disease, drought, and non-native predators like bullfrogs. Mitigating these threats in protected areas is difficult without intervention. The RAD framework assists managers in identifying conservation actions that best meet ecological and socio-cultural values of a given species and protected area. USFWS photo by Jim Rorabaugh.

fishing remains a significant social and cultural value, managers may **direct** — stocking with regionally native sport fishes better suited to the current conditions.

“Without ‘Direct’, your choices become very limited,” Carim says. “Resisting may not be possible, and accepting can feel like giving up. ‘Direct’ encourages exploration of other ways to uphold our most important ecological and socio-cultural values.”

Central to this decision space is who defines those values. “When we talk about social and cultural values, that includes not just stakeholders or interested parties but rightsholders — specifically Indigenous peoples who have generations of knowledge on how these ecological systems work and what historical states looked like,” Carim says.

Managers need to know if an approach is working or when it may be time to pivot. The necessary information is often difficult to collect in wilderness, where even installing a temperature sensor can feel at odds with the Wilderness Act. But without this information, decisions default to a best guess rather than evidence.

Freshwater ecosystems operate on a larger scale than any single protected area, and aquatic species don’t recognize wilderness boundaries. Collaboration across agencies and land designations is critical, Carim says, to maintain the suite of values protected areas provide to freshwater biodiversity and the American public.

Further Reading

Carim, K.J. et al. 2026. [Conserving freshwater biodiversity in U. S. protected areas - management intervention and the RAD framework](#). Environmental Management. 76: 43.

Rushing, J.F.; Hollingsworth, T.; Hefty, K.E.; et al. 2026. Wicked problems in practice: [Responding to ecological transformation in wilderness](#). Ambio.

Management Considerations

- The Resist-Accept-Direct framework— or RAD — provides managers of protected areas with a structure for deliberately weighing three approaches to freshwater biodiversity loss: (1) resisting change through active intervention, (2) accepting change when intervention is not feasible, warranted, or fully understood, and (3) directing change toward a new but ecologically grounded outcome.
- In protected areas, “direct” is an underused but legitimate third option — one that can open new paths forward when resisting is no longer feasible and accepting has become a default rather than a deliberate choice.
- The full suite of ecological, economic, and social and cultural values — including the knowledge and rights of indigenous peoples — can inform the most appropriate approach for a given circumstance.
- Knowing when a chosen approach is no longer working and when to pivot, depends on monitoring and research that can be difficult to conduct in highly protected areas.
- Freshwater systems operate at scales larger than any single protected area, making collaboration across boundaries critical.



Walleye are a freshwater fish native to much of North America. Native fish are experiencing declines, even in protected areas. The RAD framework can assist managers in discovering a broader set of options to conserve native fish in protected areas. USFWS photo by Sam Stukel.

Featured Scientist

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