“Toward a new framework for restoring lost wildlife migrations” Summary

Wildlife migrations are crucial ecological phenomena that shape biodiversity, nutrient flow, predator-prey dynamics, and habitat resilience. Yet around the world, these migrations are vanishing due to habitat fragmentation, climate change, species interactions, and human-induced changes. In “Toward a new framework for restoring lost wildlife migrations,” Barker et al. (2023) provide a much-needed roadmap for reintroducing migration once it has been lost. They argue that while many conservation efforts aim to prevent migration loss, little guidance exists for how to restore migration when it has already disappeared. One of the most innovative aspects of Barker et al.'s work is their focus on behaviorally complex migration systems, especially in species where migratory routes and patterns are socially learned rather than genetically encoded. The authors emphasize that human intervention may be necessary to facilitate social learning, particularly during early developmental stages. This insight challenges traditional notions of “hands-off” conservation and opens the door to more active management approaches that incorporate an understanding of species’ cognitive and cultural dimensions. Barker et al. also highlight the importance of restoring landscape connectivity, a strategy that can have cross-species benefits. For example, restoring stopover sites or seasonal range corridors may not only benefit a single target species but also facilitate migration recovery across an entire community of animals. However, they caution that migration restoration must be pursued with consideration of ecological trade-offs, cost, feasibility, and the risk of unintended outcomes.

“Grizzly bear predation links the loss of native trout to the demography of migratory elk in Yellowstone” Summary

In contrast, Middleton et al. (2013) focus on the ecological consequences of migration disruption, rather than its restoration. Their study in Yellowstone National Park provides a compelling example of indirect trophic cascades that emerge when migration patterns and food webs are disrupted. Specifically, they document how the introduction of invasive lake trout led to the decline of native cutthroat trout, which were historically a critical springtime food source for grizzly bears. As the trout disappeared, grizzlies turned to a more accessible alternative: elk calves from migratory herds. This shift in grizzly bear foraging behavior had profound demographic effects. The authors found that grizzly predation on elk calves increased significantly, resulting in a 16% drop in calf recruitment among migratory elk populations. Notably, this decline was not due to an increase in grizzly numbers, but rather a change in diet composition and seasonal hunting patterns. This reveals how bottom-up disruptions, such as the loss of a prey species, can lead to unexpected top-down consequences, like altered predator-prey dynamics and declining ungulate populations. Middleton et al.'s study also has practical implications for management. The authors argue that instead of focusing solely on reducing predator numbers, managers should enhance alternative food sources for apex predators like grizzlies. In other words, ecosystem-based management, which considers the full food web, may be more effective than species-specific interventions. The authors' nuanced understanding of predator foraging behavior, seasonal availability of prey, and the cascading effects of invasive species provides a template for adaptive and evidence-based wildlife management.

“Thinking Like a Mountain” & “Burning Cascade Head” Combined Summary

Leopold’s essay “Thinking Like a Mountain” from *A Sand County Almanac* (2020) offers

a philosophical reflection on the ecological consequences of predator removal. Through his personal account of shooting a wolf and witnessing its death, Leopold recognizes the complex role of predators in maintaining balance. Without wolves, deer populations grew unchecked, causing overgrazing and long-term ecosystem degradation. His idea of "thinking like a mountain" urges ecological humility and a long-term view, aligning with the scientific findings of Barker et al. and Middleton et al. by advocating for ecosystem-level awareness in management decisions. Kimmerer (2013), in *Braiding Sweetgrass*, bridges Indigenous knowledge and Western ecological science in the chapter "Burning Cascade Head." She describes how traditional burning practices maintained prairie and oak ecosystems and fostered reciprocal relationships between humans, salmon, and land. The burning guided salmon upstream, promoted nutrient cycling, and enhanced biodiversity by sustaining fire-dependent species. Kimmerer critiques colonial disruptions that suppressed fire and dismantled Indigenous stewardship, calling for the regeneration of meaningful, respectful ceremony and ecological reciprocity. She emphasizes that science practiced with humility and reverence can complement Indigenous knowledge systems to heal ecological and cultural wounds.

Final thoughts

The collective insights from these works highlight that ecological restoration requires both technical and cultural approaches. Migration restoration must address both the biological mechanisms and the landscape context (Barker et al., 2023). Similarly, Middleton et al. (2013) demonstrate that understanding food web dynamics is essential for effective carnivore and prey management. Kimmerer's work underscores the importance of cultural practices, like fire, that support ecosystem health and social cohesion, calling for the integration of Indigenous land stewardship in modern conservation. Leopold's reflections remind us that ecological outcomes

unfold over time and require restraint and foresight.

Emerging Questions

- How can policies integrate learned behaviors and social structures in species when planning reintroductions?
- How can restoration projects respectfully incorporate Indigenous ceremony without appropriating culture?

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