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ECOLOGICAL RESTORATION IN
A CHANGING BIOSPHERE^{1,2}

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ABSTRACT

Restoration efforts will affect large areas of the planet and hundreds of millions of people over the coming decades, but what will these actions look like, and what will they achieve? Debate continues about what constitutes appropriate restoration targets in our human-dominated and ever more rapidly changing world, and the outcome of this debate will impact the actions taken to conserve biodiversity, sequester carbon, and improve human livelihoods at large spatial scales. This special issue brings together eight scientific, historical, and journalistic perspectives to address these two critical questions about ecological restoration in a rapidly changing biosphere.

Key words: Climate change, ecological restoration, novel ecosystems, scaling up, tropical forest restoration.

In the post-COP22 world, in which all three of the United Nation's Rio Conventions call for the scaling up and mainstreaming of ecological restoration (United Nations Convention on Biological Diversity, 2012; United Nations Convention to Combat Desertification, 2015; United Nations Framework Convention on Climate Change, 2015) and dozens of governments have made ambitious restoration commitments (IUCN, 2016), it is clear that restoration programs will affect hundreds of millions of hectares—and as many people—over the coming decades. At the same time, we find ourselves in an era of unprecedented change, during which climate, ecological baselines, and future land-use changes

are highly uncertain (Steffen et al., 2015). This situation raises a crucial question: what will large-scale restoration activities look like in the coming years?

Unsurprisingly, opinions differ about the future of restoration and how to scale up and integrate restoration efforts with larger programs in an era of major anthropogenic changes. Hobbs et al. (2011: 442; italics added) observe that “...*the basic principles and tenets of restoration ecology and conservation biology are being debated and reshaped.* Escalating global change is resulting in widespread no-analogue environments and novel ecosystems that render traditional goals unachievable. Policymakers

¹ This and the following eight articles are the proceedings of the 63rd Annual Systematics Symposium of the Missouri Botanical Garden, “Ecological Restoration in a Changing Biosphere.” The symposium was held 7–8 October 2016, at the Missouri Botanical Garden in St. Louis, Missouri, U.S.A.

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and the general public, however, have embraced restoration without an understanding of its limitations, which has led to perverse policy outcomes.”

This perspective has received both considerable attention (Ecological Society of America, 2016) and pointed criticism (Murcia et al., 2014). Aronson et al. (2014: 647; italics added) retort that “. . .restoration includes a wide range of practical possibilities for dealing with transformed ecosystems, including rehabilitation, reclamation, and remediation. Some will bring the ecosystem back to its historical trajectory, some will bring back only some attributes, but the intention is that the end product is better than the degraded ecosystem. *Importantly, a label such as novel ecosystem implies no need for further intellectual exertion—and ignores the growing science of the young discipline of ecological restoration.*”

Debate continues about what we are trying to restore (Hobbs, 2016; Kattan et al., 2016; Miller & Bestelmeyer, 2016), with implications far beyond academia. Billions of dollars are now being spent to rehabilitate and restore degraded ecosystems, sometimes at large scales, and the science of restoration ecology must adapt for integration into larger planning and management schemes that will include conservation, management, and restoration.

On 8 October 2016, we convened a panel of six scientists, one historian, and a journalist, all with long-standing involvement in the field of restoration ecology. The goal was to discuss ecological restoration in a changing biosphere at the 63rd Annual Fall Symposium at the Missouri Botanical Garden. Each speaker has contributed a paper to this special issue.

The first set of papers focuses on the following question: has global change outpaced and rendered obsolete the so-called “classical” ecological restoration approach? Aronson et al. (2017) say no, far from it; for example, the historically based reference system—a pillar of ecological restoration to date—is more valid than ever and can indeed be adapted to landscape and higher levels of complexity. These authors emphasize that while restoration ecology has produced many useful ecological models, participation and consensus-building among stakeholders are crucial at higher levels of integration. Falk (2017), in contrast, says yes: global change calls for a radical rethinking of ecological restoration. He focuses on ponderosa pine forests in the southwestern United States, which are undergoing a major climate change-induced biome shift from forest to shrub land, and he concludes that a shift toward resilience-based management is necessary to supplement traditional ecological restoration. Meine (2017) takes the middle ground through a historical analysis; he notes that

Aldo Leopold (1887–1948) would likely have concluded that a simple “yes” or “no” was inappropriate and that ecological novelty is neither novel nor absolute.

Whereas the first group of papers asks *what* we should restore, the second group focuses more on *how* we will restore it at larger spatial and temporal scales. Brancalion and van Melis (2017) suggest that to bridge the gap between science and practice, we must innovate: rather than refining current approaches, restoration ecologists must look outside of their disciplinary silos for fresh solutions to contemporary dilemmas. One source of new insights will be joint research between scientists and practitioners. To this end, Holl (2017) presents several new directions for tropical forest restoration research (graduate students, take note!). She emphasizes that to best inform practice, research projects should be conducted at large spatial and temporal scales in conjunction with stakeholders, and the resulting knowledge should be shared across regions. Chazdon (2017) argues that natural regeneration is the most important method for scaling up efficient forest and landscape restoration, and she emphasizes the need to identify priority areas where natural regeneration is maximally feasible and minimally competitive with alternative land uses. Finally, Reid et al. (2017) argue that however we restore ecosystems, we should plan to make them last. The longevity of restored ecosystems, these authors suggest, is variable, often finite, and determined to some degree by stakeholder preferences, environmental attributes, and the umbrella of governance. These papers emphasize tropical forest restoration, particularly in Latin America, which is appropriate given this biome’s global importance, but the topics addressed will be of interest to readers with experience in many different ecosystems.

The last word (for this special issue, at least) is left to Paddy Woodworth (2017), an international journalist with broad and optimistic perspectives on ecological restoration (Woodworth, 2013). Looking across the contributions, he observes that the words we choose have meaning and cautions against the use of the word “restoration” for anything less than the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Society for Ecological Restoration, 2004).

We hope that readers from many backgrounds, including researchers, practitioners, and policy-makers, will find this special issue worth pondering as they move forward with our collective task to progress toward a more sustainable, just, and desirable future.

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