

EDITORIAL

Restoration ecology of arid lands (RE-AL)

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This issue of *Restoration Ecology* inaugurates a thematic series on arid land (dryland) restoration. This initiative is a collaborative effort between the Society for Ecological Restoration and the Kuwait Institute for Scientific Research in conjunction with our publisher, Wiley. For the next 5 years, up to two thematic issues will be published per year in addition to the six regular issues. Our aim is to improve understanding of restoration in arid environments (i.e. hyper-arid, arid, semi-arid, and dry sub-humid ecosystems) around the world but with special emphasis on Arab countries. The arid-lands thematic issues aim to improve capacity to reduce biodiversity and ecosystem loss, alleviate poverty, strengthen social capital, and build more resilient social-ecological systems free of the threat of land degradation and desertification. As typical of *Restoration Ecology*, the thematic series will include high-quality papers that address critical research issues, consider practical solutions, and provide policy guidance for the restoration of arid lands. Future issues may, like this one, consider a variety of topics from different perspectives or, as in our special issues and sections, include papers primarily focused on a particular topic.

Why focus on arid lands? These lands cover 41% of the world's terrestrial surface and occur on all continents (Safriel et al. 2005). Characterized by low annual precipitation and high potential evapotranspiration, drylands are defined as areas for which the ratio of these two measures or the aridity index is <0.65 . As aridity increases, vegetation can change from woodland, mixed shrub, savannah, grassland, to desert. Drylands have expanded over the last 60 years and with continued climate change are expected to increase further. Over 2 billion people, largely in developing countries, live on arid lands and are particularly dependent on ecosystem services for their livelihoods (Safriel et al. 2005). Consequently, land degradation, which reduces primary productivity that supports agriculture and livestock, makes communities less resilient to environmental and human disturbances. Severe degradation can lead to desertification and the total loss of ecosystem services. The consequences of desertification on ecological functions such as nutrient cycling can persist for centuries (Ye et al. 2019). Understanding how past land uses affects current and future ecosystems will be necessary to determine appropriate restoration interventions.

Arid lands are particularly susceptible to changes in precipitation, and with climate change both severe droughts and extreme rainfall events will occur. For example, in the southwestern North America, a megadrought occurred between 2000 and 2018, which

was only the second driest period since 800 BP (Williams et al. 2020). About 47% of drought severity was explained by anthropogenic changes in temperature, relative humidity, and rainfall. On the other hand, extreme annual rainfall events predicted large wildfires 2 years later in the Simpson Desert of Australia (Verhoeven et al. 2020). Increased variability in the magnitude and frequency of extreme rainfall expected with climate change may significantly alter fire return intervals and severity. Both lack of rainfall and extreme rainfall events pose important questions for land use and management of arid lands.

The challenge of climate change will clearly be substantial for arid lands. Current projections under business as usual models indicate major increases in areas where the mean temperatures exceed that characteristically inhabited by humans (Xu et al. 2020). At some point, land abandonment and migration to other lands will drive further land conversion. Ecological restoration and other restoration interventions must be scaled up to support the sustainable development goals. Projects like the Great Green Wall of the Sahel in Africa and Kuwait Environment Remediation Program provide many opportunities for understanding what works and what does not (Sacande & Berahmouni 2018). Such large-scale restoration initiatives require consideration of different ecosystems (e.g. desert to forest), working with diverse stakeholders, including local communities and indigenous peoples, clarifying resource rights, applying best practices for selecting and propagating seeds and plants (Gann et al. 2019). The lessons learned throughout project development need to be communicated and used to improve future work.

Additional disturbance factors, including the current COVID-19 pandemic, may negatively impact restoration of vulnerable arid ecosystems. We anticipate that the ongoing research and ecological restoration activities currently have been disrupted across ecosystems, and may take some time to resume, especially in arid regions. Because arid land ecosystems are highly degraded, concerted efforts are needed to develop and transfer innovative technologies for restoration of these ecosystems in the post COVID-19 pandemic period. The present pandemic also provides a unique

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opportunity for the scientific community to remind people of the links between functional, resilient ecosystems and human well-being. This dedicated thematic series will contribute significantly in accelerating the development of innovative technologies and approaches for restoration in the arid environment.

The number of publications addressing arid-land restoration increased between 2005 and 2015, but they represent a very small percentage of total publications on restoration (Svejcar & Kildisheva 2017). A quick search on articles in *Restoration Ecology* using “dryland” or “arid” as keywords yielded relatively few papers that directly address arid-land restoration. Between 2005 and 2019, 52 papers considered various topics including soil amendments, stabilization, and microbial communities; planting methods; and seed selection and preparation. In most years, there were four or fewer publications with the exceptions of 2016 ($n = 13$), which included papers in a special issue, and 2019 ($n = 13$).

By launching this thematic series, we hope to encourage authors engaged in all aspects of arid-land restoration to publish their work in *Restoration Ecology*. We particularly want to support restoration ecologists and practitioners in developing countries, particularly in Arab countries, who might not otherwise publish their work. Suggestions for special sections or issues can be directed to the editorial office.

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