RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration

RE-AL THEMATIC SERIES

FOREWORD ARTICLE

Restoration ecology of arid lands (RE-AL) thematic series

Samira A. Omar[1,2]

Realizing the importance of science, practice, and policy of ecological restoration in arid environments and the fact that land degradation is manifested by the climate change phenomena that will likely accelerate losses of ecosystem services and community resilience, both the Society for Ecological Restoration (SER) and the Kuwait Institute for Scientific Research (KISR) in conjunction with *Restoration Ecology* (RE) publisher, Wiley are presenting this thematic series of RE with primary focus on arid lands. Over 2 billion people live on arid lands that are dependent on ecosystem services for their livelihoods and this is expected to increase further soon. Our aim in publishing this thematic issue is to share knowledge, improve capacity to reduce biodiversity and ecosystem losses, alleviate poverty, strengthen social capital, and build more resilient social-ecological systems free of the continuous threat of land degradation and desertification.

Two thematic issues are published per year and made accessible by Wiley Online Library © 1999–2022 John Wiley & Sons, Inc. The first issue of this thematic series was published in July 2019. Experts from the arid environments (i.e. hyperarid, arid, semiarid, and dry subhumid ecosystems) around the world, particularly in the Arab region, are encouraged to publish in this thematic issue to address land degradation problems and to recommend practical solutions. In addition, restoration ecologists and practitioners in lower-income countries are given opportunities to publish in this thematic issue to encourage their contribution to the scientific arena and to share their practical experience in alleviating land degradation and desertification problems within their countries/region.

Ecological restoration in the Arab region has been most challenging due to the extreme climatic conditions, demographic changes, environmental constraints, and climate change threats. Most of the Arab countries are within the arid region, including the Sahara Desert in the African continent covering about 3.6 million square miles and the Arabian Desert in West Asia covering 1.0 million square miles. These are hyperarid regions with minimal and sporadic rainfall and frequent dust storms. Thus, vegetation is rare, yet some distinct communities of plants and animals that can tolerate these erratic conditions dwell there. Livestock grazing has been practiced for thousands of years and domestic animals such as camels are common animals that graze around in large areas and cluster around water points and oases in remote deserts.

The population of the Arab world reached more than 444.5 million people in 2021 (World Bank Group 2022). Egypt contributed to about 23.5% to this figure. Most of the population are urban dwellers; however, some still live a simple life in deserts. The climate change phenomena are causing more drought, famine, and desertification in the region. Large areas need to be restored and revegetated to reduce carbon emissions and alleviate sand encroachments onto cities.

Revegetation and afforestation have been practiced in large areas in the Arabian region; however, irrigation and scanty rainfall remain the most challenging problems. Some successful stories, though, have been reported in the region such as establishment of protected areas to preserve biodiversity and restore some degraded ecosystems such as in Saudi Arabia and Oman. There are 380 protected areas that are well preserved in West Asia Region (UNEP-WCMC and IUCN 2022). These areas are important sources of native seeds for growing plants that are tolerate to climatic conditions and good for restoration of degraded lands. For example, Kuwait has been implementing large-scale restoration programs due to the massive environmental damages from detonation of oil wells in 1991. These restoration programs were awarded by the United Nations Compensation Commission (UNCC) in 2005. Large areas that were once covered with oil pollution have been restored to their ecological functions by using native plants that do not require much water (Omar & Roy 2023).

This thematic issue of the "Restoration Ecology" provides good opportunity for publishing studies in the Arab region and other arid lands in the world that can be shared online and practiced for restoring different types of ecosystems.

The RE-AL February issue 2023 presents different biomes and steppes in the world, such as sage brush, native grasslands, Great Basin Deserts, mesquite, bunchgrasses, and floodplains. The first article (Copeland et al. 2022) describes the importance

Author contributions: SAO conceived and wrote the manuscript.

[1]Environment & Life Sciences Research Center, Kuwait Institute for Scientific Research, PO Box 24885, Safat 13109, Kuwait
[2]Address correspondence to S. A. Omar, email somar@kisr.edu.kw

doi: 10.1111/rec.13843

of management decisions, such as seed sources and planting date, on reducing seedling exposure to weather freezing and drought barriers and thus improving the dryland restoration seedings. Results suggested that management actions can play a role comparable to site environmental variables in reducing exposure of vulnerable seedlings to adverse weather conditions.

The second article (Zhao et al. 2022) presents the role of mowing on restoration and sustainable use of degraded grasslands. The authors used structural equation modeling to evaluate the direct and indirect effects of mowing disturbance on community biomass and plant nutrition. They found that annual mowing reduced community biomass particularly the dominant plants biomass in addition to functional diversity, and nutrient status. They further found that biannual mowing maintains the functional diversity and could provide better conservation of grassland ecosystems, forage production, and nutrition. Appropriate frequency of mowing could provide economic benefits and facilitate the maintenance of community function compared to using enclosure to restore grasslands.

The third article (Svejcar et al. 2022) is related to plant recruitment in drylands and species seedling establishment by two methods: drilling and broadcast seeding. The study was conducted on Bluebunch wheatgrass (*Pseudoroegneria spicata*) in the sagebrush steppe biome across three seeding years, three landscape aspects, and two soil types. The authors concluded that drill seeding had greater recruitment than broadcast seeding and that the study demonstrated a need for restoration plans that account for spatiotemporal variation in seeding success.

The fourth article (Bishop et al. 2022) is an in-depth study on the native plants of the Great Basin that is undergoing dramatic changes in vegetation structure due to human activities and climate change. The authors explored timing of seeding in postfire environment and shifts in precipitation that may influence postfire rehabilitation success. They planted seeds in randomized block design imposing two experimental treatments, experimental fire, and timing of seeing (forbs, grasses, and shrubs) with simulated precipitation. The plant measurements included seedling emergence counts, plant density, biomass, and aboveground plant tissues and total seed production per core (soil in cylinders). The study shows that seeding timing with changing climate conditions are likely to exist in arid ecosystems and constrain the establishment of desirable species.

Future restoration initiatives require scientific evidence as well as input and approval from local communities. This was presented in the fifth article entitled "Socio-ecological evidence highlights that native *Prosopis* species are better for arid land restoration than non-native ones" (Sharifian et al. 2022). The results of the study showed that areas with native *P. cineraria* had higher native vegetation cover, density, and diversity as compared to sites with the non-native *P. juliflora*. Likewise, the social results showed that pastoralists perceived the native tree to be better for local ecosystem services and livelihood as well as lower invasion potential.

The effect of seed predators, such as granivorous ants, was explored in the sixth article (Martyn et al. 2022). These ants move applied seeds offsite reducing restoration success. They consume, move, and restore thousands of seeds and show preferences for seeds based on weight, size, nutrients content, and novelty. The study examines which seed traits most influence seed predation rates in southwestern Arizona, U.S.A. This study helps in understanding the influence of predation on restoration efforts in arid lands. Some of the conclusions are important for decision makers such as considering using larger-seeded species in restoration mixes, reducing the amount of processing of the seeds to maintain seed coatings and use seeds should be away from ant nests.

The timing of seeding and the impact of temperature on seed germination are studied in the semiarid cold deserts in the western United States. The seventh article (Baughman et al. 2022) presents an interesting study on the benefit of delaying germination to reduce barriers to seeding success, such as cold winter temperature. The authors tested whether hydrophobic seed coating reliably delayed germination to increase seedling establishment of a native bunchgrass. They concluded that their treatment consistently reduced pre-winter germination, but only improved emergence when pre-winter germination of untreated seed was high.

The final article (Zivec et al. 2022) deals with restoration of large agricultural abandoned lands in south-eastern Australia. The authors investigated the regenerative capacity of old-fields of semiarid floodplains in a year-long seeding emergence experiment. The experiment showed that leaf litter is vital in storing seeds for woody recruitment, kangaroos and emus are likely important for transporting seeds, and that soil is important for storing a high diversity of plant species. Land managers can promote regeneration within semiarid floodplains systems by protecting native vegetation.

These articles represent different research outcomes that have practical implications on restoration of arid and semiarid lands. It is the interest of the SER to encourage publications with focus on arid lands as presented in this thematic issue of RE-AL.

LITERATURE CITED

Baughman OW, Kerby JD, Boyd CS, Madsen MD, Svejcar TJ (2022) Can delaying germination reduce barriers to successful emergence for early-germinating, fall-sown native bunchgrass seeds in cold deserts? Restoration Ecology xxx:e13761. https://doi.org/10.1111/rec.13761

Bishop TBB, Lee Molinari R, St Clair SB (2022) Postfire restoration seeding success increases with early fall seeding and simulated precipitation in the Great Basin Desert of North America. Restoration Ecology xxx:e13752. https://doi.org/10.1111/rec.13752

Copeland SM, Bradford JB, Hardegree SP, Schlaepfer DR, Badik KJ (2022) Management and environmental factors associated with simulated restoration seeding barriers in sagebrush steppe. Restoration Ecology xxx:e13722. https://doi.org/10.1111/rec.13722

Martyn TE, Kwapich CL, Kline A, Gornish ES (2022) Granivorous ants prefer small and unprotected seeds—implications for restoration in arid ecosystems. Restoration Ecology xxx:e13759. https://doi.org/10.1111/rec.13759

Omar SA, Roy WY (2023) Kuwait desert bloom. Kuwait Oil Company and Kuwait Institute for Scientific Research. Ross Publishing, Richmond, Virginia

Sharifian A, Niknahad–Gharmakher H, Foladizada M, Tabe A, Shackleton RT (2022) Socio-ecological evidence highlights that native *Prosopis* species are better for arid land restoration than non-native ones. Restoration Ecology xxx:e13756. https://doi.org/10.1111/rec.13756

Svejcar LN, Kerby JD, Svejcar TJ, Mackey B, Boyd CS, Baughman OW, Madsen MD, Davies KW (2022) Plant recruitment in drylands varies by site, year, and seeding technique. Restoration Ecology xxx:e13750. https://doi.org/10.1111/rec.13750

UNEP-WCMC and IUCN (2022) Protected planet: the World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM), November 2022. UNEP-WCMC and IUCN, Cambridge, United Kingdom. http://protectedplanet.net/

World Bank Group (2022). Population Total, Arab World. https://data.worldbank.org/indicator/SP.POP.TOTL?locations=1A

Zhao T, Zhang F, Suo R, Zhen J, Qiao J, Zhao M, Bai K, Zhang B (2022) The importance of functional diversity in regulating forage biomass and nutrition: evidence from mowing in semiarid grasslands. Restoration Ecology xxx:e13742. https://doi.org/10.1111/rec.13742

Zivec P, Sheldon F, Capon S (2022) Regenerative capacity of old-fields on semi-arid floodplains in the northern Murray–Darling basin. Restoration Ecology xxx:e13781. https://doi.org/10.1111/rec.13781

Coordinating Editor: Stephen Murphy

Received: 5 December, 2022; First decision: 5 December, 2022; Accepted: 5 December, 2022