Introduction

Wetlands are unique habitats that are flooded either permanently or seasonally during the year and are considered to be among the most diverse ecosystems, hosting an important and unique biodiversity of flora and fauna (Ramsar, 2007). These fragile ecosystems provide a large panorama of ecosystem services including water purification, flood control, carbon fixation, food and cultural benefits (Mitsch et al., 2015). Despite the importance of wetlands for both humans and wildlife, they continue to be among the most threatened ecosystems in the world (Brooks et al., 2002). Recent studies have shown that the surface area of natural Mediterranean wetlands has continued to decrease over the last decades with a significant decline in both water quality and quantity (Mediterranean Wetlands Observatory, 2018). The degradation is caused by different factors including urbanization, increases in intensive agriculture, invasive species and climate change (Leberger et al., 2020; Taylor et al., 2021). Climate change is and will continue to be one of the biggest threats to wetlands around the world (Erwin, 2009). It is imperative to address these threats in order to provide appropriate management solutions that will promote the sustainability of wetlands in the future. In order to share experiences and improve wetland conservation, we have compiled research articles from pilot sites from Eurasia to North Africa that focus on each of these threats through a different lens.

First, using a more socio-economical lens, we demonstrate wetland dynamics using monitoring information and socio-economic data from cloud-based computing in a case study from Morocco. This study revealed that a combination of changes in climatic and land use changes affected the dynamic and recovery capacity. Through another case study from Morocco, we provide an overview on how socio-economic pressures have affected natural wetlands, their biodiversity and ecosystem services over the last 30 years. This is further demonstrated in a remote sensing case study from Turkey where the land use changes over time are monitored and analyzed to determine the past and on-going threats impacting the wetlands.

The threat of urbanization for wetlands is addressed through a case study from Sri Lanka. Here we look into the ecology, governance and sustainability of urban

wetlands. The results reveal that wetland losses have contributed to increases in frequency of flash flood events and inundation time.

Using a site from Morocco, we focus on groundwater and marine biodiversity. As in many wetlands located in arid climates, ground water is essential for supporting specific climate adapted species. This case aims to assess the species richness in the subterranean environment and then to develop and test a risk assessment and decision-making framework for managing groundwater-dependent ecosystems with declining water levels due to climate change, anthropogenic extraction, land use and land management. We then look into how invasive alien fish species are controlled in marine protected areas in Turkey. This study characterizes the current profile of the Turkish Seafood Market in relation to the risk level of alien species. The results demonstrate the efficiency of some actions and policies to fight alien species in Turkey.

Changes in hydrological and climatic conditions are further explored in the case study from Tunisia. This study investigates water cycle modifications through a perspective of water budgets within wetlands. Hydrological modifications are further studied in another case study from Tunisia, looking at the recorded climatic changes as well as the setting of millennial cycles. This work confirmed the usefulness of cycles found by color studies through the analyses of geochemical and magnetic measurements.

The articles and geographical territories covered in this book offer different perspectives and visions for addressing the climatic and environmental significance of wetlands. We acknowledge the importance of further research and information sharing on these topics in order to improve the conservation of wetlands in the future.

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REFERENCES

Brooks, T. M., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B., Rylands, A. B., Konstant, W. R., Flick, P., Pilgrim, J., Oldfield, S., Magin, G., & Hilton-Taylor, C. (2002). Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology*, *16*(4), 909–923. doi:10.1046/j.1523-1739.2002.00530.x

Erwin, K. L. (2009). Wetlands and global climate change: The role of wetland restoration in a changing world. *Wetlands Ecology and Management*, *17*(1), 71–84. doi:10.100711273-008-9119-1

Leberger, R., Geijzendorffer, I. R., Gaget, E., Gwelmami, A., Galewski, T., Pereira, H. M., & Guerra, C. A. (2020). Mediterranean wetland conservation in the context of climate and land cover change. *Regional Environmental Change*, *20*(2), 67. doi:10.100710113-020-01655-0

Mediterranean Wetlands Observatory. (2018). *Mediterranean Wetlands Outlook 2: Solutions for sustainable Mediterranean Wetlands*. Author.

Mitsch, W., Bernal, B., & Hernandez, M. (2015). Ecosystem services of wetlands. *Int. J. Biodivers. Sci. Manag.*, *11*(1), 1–4. doi:10.1080/21513732.2015.1006250

Ramsar. (2007). *Le Manuel de la Convention de Ramsar: Guide de la convention sur les zones humides* (4th ed.). Ramsar.

Taylor, N. G., Grillas, P., Al Hreisha, H., Balkız, Ö., Borie, M., Boutron, O., Catita, A., Champagnon, J., Cherif, S., Çiçek, K., Costa, L. T., Dakki, M., Fois, M., Galewski, T., Galli, A., Georgiadis, N. M., Green, A. J., Hermoso, V., Kapedani, R., ... Sutherland, W. J. (2021). The future for Mediterranean wetlands: 50 key issues and 50 important conservation research questions. *Regional Environmental Change*, *21*(2), 33. doi:10.100710113-020-01743-1 PMID:33776560