TASKS FOR VEGETATION SCIENCE – 46

Sabkha Ecosystems

Volume III: Africa and Southern Europe

edited by

M. Öztürk, B. Böer, H.-J. Barth, S.-W. Breckle,

M. Clüsener-Godt and M.A. Khan

Springer

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M. Öztürk • Benno Böer
Hans-Jörg Barth • Siegmar-Walter Breckle
Miguel Clüsener-Godt • M. Ajmal Khan
Editors

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Editors
Prof. M. Öztürk
Ege University
Fen Fakultesi A Blok
Botany Department E Blok
35100 Bornova, Izmir
Turkey
munirozturk@gmail.com

Benno Böer
UNESCO Office
Doha
Qatar

Hans-Jörg Barth
Department of Physical
Geography
University of Regensburg
Regensburg
Germany
hans-joerg.barth@geographie.
uni-regensburg.de

Siegmar-Walter Breckle
University of Bielefeld
Department of Ecology
Wasserfuhr 24-26
D-33619 Bielefeld
Germany
sbreckle@gmx.de

Miguel Clüsener-Godt
Acting Chief, Ecological Sciences &
Biodiversity Section
Division of Ecological and Earth Sciences
UNESCO
1 rue Miollis
F-75732 PARIS Cedex 15
France
m.clusener-godt@unesco.org

M. Ajmal Khan
University of Karachi
Institute of Sustainable Halophyte
Utilization
75270 Karachi
Pakistan
majmalk@uok.edu.pk

ISBN 978-90-481-9672-2 e-ISBN 978-90-481-9673-9
DOI 10.1007/978-90-481-9673-9
Springer Dordrecht Heidelberg London New York

Foreword

Africa is one of UNESCO's priorities. This has a lot to do with the availability of critical resources that are absolutely essential for the daily livelihood, or shall we say, survival of families, such as drinking water, fuel and food. It has also to do with the availability and accessibility of scientific knowledge as well as education, both of which are critical factors for empowering people to enhance their living standards and escape the trap of poverty.

The Sabkha Ecosystem series deals with the globally important scientific problem of how to utilise abundant saline soils and water for fodder and food production, and is consistent with science-based ecosystem management.

Sabkha – the Arabic term for flat salt deserts, a term which has been accepted by multi-disciplinary scientists – occur globally in abundance, especially in the northern and southern dry desert belts. These areas are hundreds of thousands of square kilometres in size, and people make little use of them for agricultural production due in part to their excessive salinity. On the one hand this is good, because it allows for these geologically interesting ecosystems to remain largely untouched. They do actually have an ecosystem function and biodiversity value, even though they may appear on first sight as just barren wastelands. They also have a scientific, education, and heritage value. At the same time, there is evidence that biosaline agriculture in coastal sub-tropical and tropical dry desert sabkhat can make use of abundant seawater for the irrigation of halophyte cash crops, such as mangroves, seagrasses, algae, and other types of plants. The editors have demonstrated this clearly in Volumes I and II, as well as during the "1st International Symposium on Sabkha Ecosystems" which was co-organised by UNESCO in Tunis in 2006.

Using seawater for biosaline agriculture is certainly most challenging. Highly complex questions arise on issues such as practicability, marketing, corrosion, soil salinisation, irrigation techniques, drainage, seed ecology, root systems, element concentration analyses of soil, water, and biota, and this ranges all the way to salinity conversion tables, and soil fertility, nutrients, as well as farmers' cultural acceptance of science-based innovations, and finally to investment, and profit.

This means biosaline agriculture using high-saline, and even full-strength seawater, as an irrigation source is not an easy task. However, it offers multiple promising prospects. Herbivorous seacows, and various species of marine turtles and fish for example, use seagrasses as their staple food supply. The feeding ecology of terrestrial livestock however, does not allow them to graze on those valuable plants under the seawater surface. Is it possible then to produce them in land-based coastal systems, similar to rice-fields, harvest them, rinse the salt off, and use them as a cash fodder crop for camels, sheep, goats, and cattle?

There are many scientific questions that need to be addressed and experiments that need to be conducted, in order to provide answers to these questions. Mangrove leaves and seeds can provide good fodder for camels. Certain other halophytes from among the more than 2,000 known salt-tolerant plant species have huge economic potential. This can be of benefit for African Members States that suffer from a lack of freshwater resources, as well as for other countries.

It is with the above thoughts in mind that I encourage the stakeholders in biosaline agriculture development as well as in nature conservation and environmental management related to salt deserts to read and study the contributions from this new volume on sabkha ecosystems. It is a small, yet significant science-based contribution to find an answer to an old question: How can we use saline water, and salty soils for agricultural productivity?

Prof. Dr. Walter Erdelen
UNESCO Assistant Director-General for Natural Sciences

Kingdom of Saudi Arabia
Ministry Of Defense & Aviation
Presidency of Meteorology & Environment
P M E

Preface

We, as the people of the world, are facing real environmental challenges today which must be taken seriously. These challenges are numerous and can no longer be ignored. Some of the most pressing challenges are freshwater scarcity, groundwater depletion and salinization, climate change, loss of biodiversity and fertile soils, and food supply in competition with biofuels. This is not science-fiction – this is real and present danger to us, and to our children.

UNESCO has already produced two volumes on Sabkha Ecosystems, dealing with the sabkhas of the Arabian Peninsula and adjacent countries, as well as West and Central Asia. This is a laudable effort, trying to make scientific information available on various aspects of sabkhas including how to utilize sabkhas for biosaline productivity, and describing the educational, heritage, and ecosystem value of sabkhas.

Sabkhas belong naturally to many dry areas in the world, including the dry zones of Africa and Southern Europe, and their agricultural potential is considered quite low. However, with research and development in saline irrigation and good drainage it is possible to convert at least coastal sabkhas into agro-systems with mangrove, seagrass, and algal biomass. This can contribute to land-based fish and shrimp production, livestock fodder, carbon sequestration, and production of charcoal and biofuels on currently non-productive soils. It would also provide jobs and income in dryland agriculture using high-saline irrigation and drainage, assisted by a non-corrosive irrigation system and solar energy for seawater pumps.

There are examples and success stories with biosaline productivity. However, more needs to be done to obtain knowledge on seawater-based seagrass productivity in coastal seagrass-terraces, as well as mangrove and salt marsh crops as livestock fodder. It is therefore important to continue research and experiments into this field since it can potentially make hundreds of thousands of square kilometers of salt-deserts green using saline soils and seawater for the production of cash-crop-halophytes.

In this context, sabkha development can make a significant contribution to reduce dependency and wastage of freshwater in agriculture, which is globally the highest freshwater consumer.

I highly welcome this new volume entitled "*Sabkha Ecosystems Vol III: Africa and Southern Europe*", and encourage further studies into this subject, with a particular view towards enhancing professional environmental management, and impact assessments.

Turki Bin Nasser Bin Abdulaziz Al-Saud
President, Presidency of Meteorology and Environment (PME)
Chairman, Council of Arab Ministers Responsible for Environment (CAMRE)

P.O.Box 1358 Jeddah 21341. Saudi Arabia Tel:6536000, Fax:6511424 www.pme.gov.sa

Acknowledgements

Invaluable contributions of 40 scientists from Africa and Southern Europe covering both scientific as well as practical concepts regarding Sabkhas is highly appreciated, their sincere efforts made it possible to produce this volume. We gratefully acknowledge the financial assistance given to us by the UNESCO Office Doha-Qatar. Our special thanks go to the production editorial team of Springer-Verlag for their close collaboration, flexibility as well as professional handling during the compilation of this book.

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Sabkha Regions of Tropical East Africa

Shahina A. Ghazanfar and Henk J. Beentje

Abstract Sabkhat in the region of tropical East Africa (treated here as Uganda, Kenya and Tanzania) are comparatively small in area and limited mostly to lake basins in the Eastern Rift and a few coastal areas. A relatively large inland sabkha lies in North Kenya, west of Lake Turkana, associated with the Chalbi Desert (a former lake). The chief plants of saline flats that surround the saline lakes in Kenya and Uganda include *Cyperus laevigatus*, *Sporobolus spicatus* and *Dactyloctenium* spp. The coastal sabkhat, flooded only at spring tides, are occupied by monospecific stands of stunted *Avicennia marina*. At the more open parts of the *Avicennia* fringe *Arthrocnemum indicum*, *Paspalum vaginatum*, *Sesuvium portulacastrum*, *Sporobolus virginicus*, *S. spicatus*, *S. kentrophyllus*, *Pedalium murex* and *Suaeda monoica* form the main associates. In the inland sabkhat low rainfall and high potential evaporation have resulted in an arid and saline landscape dominated by grasses *Aristida adscensionis*, *A. mutabilis*, *Drake-Brockmania somalensis*, *Sporobolus consimilis*, *S. virginicus and Psilolemma jaegeri*, and the subshrubs *Duosperma eremophilum* and *Indigofera spinosa*. *Lagenantha nogalensis* occurs on gypsophilous soils and *Dasysphaera prostrata* on saline soils at the edges of Lake Turkana and the Chalbi Desert. Stunted woody vegetation is dominated by *Acacia reficiens* and in drainage channels by *Salvadora persica*. Floristically the coastal sabkhat of tropical East Africa fall in the Zanzibar-Inhambane regional mosaic and the inland sabkhat in the Somalia-Masai regional centre of endemism. There are no endemic genera in the coastal sabkhat, but all of the nine East African mangrove species occur in Kenya, Tanzania and Mozambique. In the inland sabkhat, the Somalia-Masai regional centre of endemism includes the endemic genera *Drake-Brockmania* and *Dasysphaera*. There is no arid-zone agriculture in the inland sabkhat region and nomadic pastoralists, depending on their livestock for subsistence, are the main occupants; *Duosperma* and *Indigofera* are amongst some of the important food plants of livestock (camels). Salt deposits are harvested from the extensive flats surrounding the saline and soda lakes, and the mangrove is an important economic resource as a nursery for fish and crustaceans, as well as a source of poles, timber and firewood. Over-harvesting of wood and conversion to saltpans and aquaculture, housing and industry is a threat to many parts of the mangrove area. There are no strict nature reserves in the inland sabkhat of tropical East Africa designated for the protection of arid landscapes and its flora; however the Mount Kulal Biosphere Reserve in northern Kenya covers the salt desert and lake ecosystems; Lake Manyara and Amboseli Biosphere Reserves also partly cover the saline and alkaline ecosystems. Mangrove areas are included in Watamu Marine National Park, Kiunga National Marine Reserve and Ras Tenewi Marine National Park in Kenya, and in Mafia Island Marine Park, Jozani National Park and Sadaani Game Reserve in Tanzania. Other areas of East African mangrove are included in forest reserves, with varying degrees of protection.

1 Introduction

Sabkhat in the region of tropical East Africa (treated here as Uganda, Kenya and Tanzania) are comparatively

S.A. Ghazanfar (✉) and H.J. Beentje
Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB
e-mail: s.ghazanfar@kew.org

M. Öztürk et al. (eds.), *Sabkha Ecosystems*, Tasks for Vegetation Science 46,
DOI 10.1007/978-90-481-9673-9_1, © Springer Science+Business Media B.V. 2011