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**Volume 238**

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Shuqing An • Jos T. A. Verhoeven  
Editors

# Wetlands: Ecosystem Services, Restoration and Wise Use

 Springer

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ISSN 0070-8356

Ecological Studies

ISBN 978-3-030-14860-7

<https://doi.org/10.1007/978-3-030-14861-4>

ISSN 2196-971X (electronic)

ISBN 978-3-030-14861-4 (eBook)

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Preface

The chapters in this volume reflect the scientific highlights of the 10th INTECOL International Wetlands Conference, held in Changshu, People's Republic of China, from September 19–24, 2016. INTECOL is the International Association of Ecology and organizes these wetland conferences every four years. More than 1500 professional wetland scientists (including practitioners and students) from over 72 countries have gathered in this meeting, representing a wide range of expertise in wetland science, technology, engineering, policy, and management. The conference had a strong focus on wetland ecosystem services, wetland conservation and wise use, and wetland restoration. The high-quality presentations and intensive networking during the conference resulted in an atmosphere of co-creation among scientists and practitioners from the Chinese government and from NGOs, among which are the Ramsar Convention, Wetlands International, the World Wide Fund for Nature, and the Society of Wetland Scientists. This high level of outreach from the scientific community to the world of practice and policy resulted in a final resolution under the name “The Changshu Declaration on Wetlands” (Turner et al. 2017).

The chapters in this volume particularly reflect the new scientific information underpinning the two most well-known wetland ecosystem services, i.e., water quality improvement in agricultural catchments and the cooling effect on regional and global climate. There is also much attention for the large recent investments in science and applications for wetland restoration and wise use, particularly in East Asia. Wetland parks and even Wetland villages have been designed and constructed in the Changshu region which are now used as examples for agricultural landscapes of China and beyond. There is also attention for conservation and wise use of wetlands bordering the Yellow Sea, where an international collaboration of China, the Republic of Korea, and the Democratic People's Republic of Korea has resulted in new common objectives.

We trust that this Ecological Studies volume will be appreciated by academics, students, and practitioners in the field of wetland ecology, management, and restoration, as well as consultants and professionals working in conservation, wise use, and environmental policy.

We gratefully acknowledge the contributions to the peer review process by Andrew Baldwin (University of Maryland, USA), Nick Davidson (Wigmore, UK), Andy Herb (AlpineEco Denver, USA), Patrick Megonigal (SERC, Edgewater, USA), Curtis Richardson (Duke University, Durham, USA), and Dennis Whigham (SERC, Edgewater, USA). We also thank the Government of the People's Republic of China, Nanjing University, Ramsar Administrative Authority of China, Changshu Government and Nanjing University Ecological Research Institute of Changshu, and the other organizations for hosting, sponsoring, and contributing to the 10th INTECOL International Wetlands Conference.



10th INTECOL International Wetlands Conference  
Changshu, PR China, September 19–24, 2016

Nanjing, China  
Utrecht, The Netherlands

Shuqing An  
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## Reference

Turner RE, Verhoeven JTA, Grobicki A, Davis J, Liu SR, An SQ (2017) The Changshu Declaration on Wetlands Final Resolution adopted at the 10th INTECOL International Wetlands Conference, Changshu, People's Republic of China, 19–24 September 2016. *Ecological Engineering* 101:1–2. <https://doi.org/10.1016/j.ecoleng.2016.12.016>

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