

Wastewater Treatment, Plant Dynamics and Management in Constructed and Natural Wetlands

Jan Vymazal
Editor

Wastewater Treatment, Plant Dynamics and Management in Constructed and Natural Wetlands

 Springer

Editor

Dr. Jan Vymazal

ENKI, o.p.s.

and

Institute of Systems Biology and Ecology

Czech Academy of Sciences

Dukelská 145

379 01 Třeboň

Czech Republic

ISBN 978-1-4020-8234-4

e-ISBN 978-1-4020-8235-1

Library of Congress Control Number: 2008921925

© 2008 Springer Science+Business Media B.V.

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

Printed on acid-free paper

9 8 7 6 5 4 3 2 1

springer.com

Preface

At present, constructed wetlands for wastewater treatment are a widely used technology for treatment of various types of wastewaters. The International Water Association (then International Association on Water Pollution Research and Control) recognized wetlands as useful tools for wastewater treatment and established the series of biennial conferences on the use of wetland systems for water pollution control in 1988. In about 1993, we decided to organize a workshop on nutrient cycling in natural and constructed wetlands with the major idea to bring together researchers working on constructed and also natural wetlands. It was not our intention to compete with IWA conferences, but the workshop should rather complement the series on treatment wetlands by IWA. We believed that the exchange of information obtained from natural and constructed wetlands would be beneficial for all participants. And the time showed that we were correct.

The first workshop took place in 1995 at Třeboň in South Bohemia and most of the papers dealt with constructed wetlands. Over the years we extended the topics on natural wetlands (such as role of wetlands in the landscape or wetland restoration and creation) and during the 6th workshop held at Třeboň from May 30 to June 3, 2006, nearly half of 38 papers presented during the workshop dealt with natural wetlands. This workshop was attended by 39 participants from 19 countries from Europe, Asia, North and South Americas and Australia. The volume contains 29 peer-reviewed papers out of 38 papers which were presented during the workshop.

The organization of the workshop was partially supported by grants No. 206/06/0058 “Monitoring of Heavy Metals and Selected Risk Elements during Wastewater Treatment in Constructed Wetlands” from the Czech Science Foundation and Grant. No. 2B06023 “Development of Mass and Energy Flows Evaluation in Selected Ecosystems” from the Ministry of Education, Youth and Sport of the Czech Republic.

Praha
August 2007

Jan Vymazal

In Memoriam for Olga Urbanc-Berčič



Olga Urbanc-Berčič (1951–2007)

Olga Urbanc-Berčič was a biologist in the real sense of the word. She regarded her profession as a vocation which influenced her whole life. In 1975, after her diploma she got a post on the National Institute of Biology in Ljubljana in the laboratory for electronic microscopy. Some years later she joined the group researching freshwater and terrestrial ecosystems in the same institution. In 1988 she finished her Master's with a thesis titled "The use of *Eichhornia crassipes* and *Lemna minor* for wastewater treatment". In 2003 she successfully defended her Ph.D. thesis titled "The availability of nutrients in the rhizosphere of reed stands (*Phragmites australis*) in relation to water regime in the intermittent Lake Cerknica". Her service to her professional interests was totally unselfish. She was involved in many different projects, but most of all she liked the research dedicated to wetlands and aquatic plants. We were a perfect team for many years. I will never forget the fruitful time we spent in the field sampling and researching. The results of her research are

summarised in numerous scientific and professional publications. Her studies of the role of water-level fluctuations in nutrient cycling led to a wider understanding of wetland functions. Her work additionally clarified the importance of macrophytes in aquatic systems. She was active in different non-governmental organisations, being the president of the Slovenian Ecological Society for many years. As a warm-hearted, generous, enthusiastic and positively oriented person she was a link among people and an efficient advocate of nature. On a cold, grey Wednesday in February, we accompanied her to her last home. Her death was a great loss for family, friends, colleagues and the community. We will miss her, but her work and her spirit will live with us forever.

Selected Bibliography

Olga Urbanc-Berčič authored more than 100 contributions in international and Slovenian research and popular journals, monographs and conference proceedings. The following list contains only a short selection of her publications.

- Cimerman, A., Legiša, M., Urbanc-Berčič, O., & Berberovič, R. (1982). Morphology of conidia of citric acid producing *Aspergillus niger* strains by scanning electron microscopy. *Biol. Vestn.*, 30(2), 23–31.
- Urbanc-Berčič, O., & Gaberščik, A. (1989). The influence of temperature and light intensity on activity of water hyacinth (*Eichhornia crassipes* (Mart.) Solms.). *Aquat. Bot.*, 35, 403–408.
- Urbanc-Berčič, O., & Blejec, A. (1993). Aquatic macrophytes of lake Bled: Changes in species composition, distribution and production. *Hydrobiologia (Den Haag)*, 262, 189–194.
- Urbanc-Berčič, O. (1994). Investigation into the use of constructed reedbeds for municipal waste dump leachate treatment. *Wat. Sci. Tech.*, 29(4), 289–294.
- Urbanc-Berčič, O. (1995). Aquatic vegetation in two pre-alpine lakes of different trophic levels (Lake Bled and Lake Bohinj): Vegetation development from the aspect of bioindication. *Acta Bot. Gall.*, 142, 563–570.
- Urbanc-Berčič, O. (1995). Constructed wetlands for treatment of landfill leachates: Slovenian experience. In J. Vymazal (Ed.), *Nutrient cycling and retention in wetlands and their use for wastewater treatment* (pp. 15–23). Třeboň, Czech Republic: Institute of Botany; and Praha: Czech Republic: Ecology and Use of Wetlands.
- Gaberščik, A., & Urbanc-Berčič, O. (1995). Monitoring approach to evaluate water quality of intermittent lake Cerknica. In: *Proc. 2nd International IAWQ Specialized Conf. and Symp. on Diffuse Pollution: Brno & Prague, Czech Republic, August 13–18, 1995, part 2*, pp. 191–196.
- Urbanc-Berčič, O., & Gaberščik, A. (1995). Potential of the littoral area in lake Bled for reed stand extension. In R. Ramadori, R. Cingolani, & L. Cameroni, (Eds.), *Proc. Internat. Seminar Natural and Constructed Wetlands for Wastewater Treatment and Reuse: Experiences, Goals and Limits* (pp. 95–99). 26–28 October 1995. Perugia: Centro.
- Urbanc-Berčič, O., & Griessler Bulc, T. (1995). Integrated constructed wetland for small communities. *Wat. Sci. Tech.*, 32(3), 41–47.
- Gaberščik, A., & Urbanc-Berčič, O. (1996). Monitoring approach to evaluate water quality of intermittent lake Cerknica. *Wat. Sci. Tech.*, 33(4–5), 357–362.
- Gaberščik, A., & Urbanc-Berčič, O. (1996). Lakes of the Triglav national park (Slovenia): Water chemistry and macrophytes. In A. Gaberščik, O. Urbanc-Berčič, & G. A. Janauer, (Eds.), *Proc. Internat. Workshop and 8th Macrophyte Group Meeting IAD-SIL* (pp. 23–28) September 1–4, 1996. Bohinj, Ljubljana, Slovenia: National Institute of Biology.

- Urbanc-Berčič, O., & Gaberščik, A. (1996). The changes of aquatic vegetation in lake Bohinj from 1986 to 1995. In A. Gaberščik, O. Urbanc-Berčič, & G. A. Janauer (Eds.), *Proc. Internat. Workshop and 8th Macrophyte Group Meeting IAD-SIL* (pp. 69–72). September 1–4, 1996, Bohinj, Ljubljana, Slovenia: National Institute of Biology.
- Urbanc-Berčič, O., & Kosi, G. (1997). Catalogue of limnoflora and limnofauna of Slovenia (Katalog limnoflore in limnofavne Slovenije). *Acta Biol. Slov.*, 41, 149–156.
- Urbanc-Berčič, O., & Gaberščik, A. (1997). Reed stands in constructed wetlands: "Edge effect" and photochemical efficiency of PS II in common reed. *Wat. Sci. Tech.*, 35(5), 143–147.
- Urbanc-Berčič, O. (1997). Constructed wetlands for the treatment of landfill leachates: The Slovenian experience. *Wetlands Ecol. Manag.*, 4, 189–197.
- Germ, M., Gaberščik, A., & Urbanc-Berčič, O. (1997). Environmental approach to the status of the river ecosystem. In M. Roš (Ed.), *Proc. 1st Internat. Conf. Environmental Restoration* (pp. 269–274) July 6–9, 1997. Cankarjev dom, Ljubljana, Slovenia: Slovenian Water Pollution Control Association.
- Gaberščik, A., Urbanc-Berčič, O., Brancelj, A., & Šiško, M. (1997). Mountain lakes – remote, but endangered. In M. Roš (Ed.), *Proc. 1st Internat. Conf. Environmental Restoration* (pp. 452–456) July 6–9, 1997. Cankarjev dom, Ljubljana, Slovenia: Slovenian Water Pollution Control Association.
- Urbanc-Berčič, O., Bulc, T., & Vrhovšek, D. (1998). Slovenia. In J. Vymazal, H. Brix, P. F. Cooper, M. B. Green, & R. Haberl, (Eds.), *Constructed wetlands for wastewater treatment in Europe* (pp. 241–250). Leiden, The Netherlands: Backhuys Publishers.
- Brancelj, A., Gorjanc, N., Jačimovič, R., Jeran, Z., Šiško, M., & Urbanc-Berčič, O. (1999). Analysis of sediment from Lovrenška jezera (lakes) in Pohorje (Analiza sedimenta iz Lovrenškega jezera na Pohorju). *Geogr. Zb.*, 39, 7–28. http://www.zrc-sazu.si/giam/zbornik/brancelj_39.pdf.
- Germ, M., Gaberščik, A., & Urbanc-Berčič, O. (1999). Aquatic macrophytes in the rivers Sava, Kolpa and Krka (Vodni makrofiti v rekah Savi, Kolpi in Krki). *Ichthyos (Ljublj.)*, 16, 23–34.
- Urbanc-Berčič, O., & Gaberščik, A. (1999). Seasonal changes of potential respiration of root systems in common reed (*Phragmites australis*) grown on the constructed wetland for landfill leachate treatment. In J. Vymazal, (Ed.), *Nutrient cycling and retention in natural and constructed wetlands* (pp. 121–126). Leiden, The Netherlands: Backhuys Publishers.
- Germ, M., Gaberščik, A., & Urbanc-Berčič, O. (2000). The wider environmental assessment of river ecosystems (Širša okoljska ocena rečnega ekosistema). *Acta Biol. Slov.*, 43, 13–19.
- Gaberščik, A., Urbanc-Berčič, O., & Martinčič, A. (2000). The influence of water level fluctuation on the production of reed stands (*Phragmites australis*) on intermittent lake Cerkniško jezero. In S. Cristofor, A. Sârbu, & M. Adamecsu, (Eds.), *Proc. Internat. Workshop and 10th Macrophyte Group Meeting IAD-SIL* (pp. 29–33). August 24–28, 1998. Danube Delta, București, Romania: Editura Universității din București.
- Germ, M., Gaberščik, A., & Urbanc-Berčič, O. (2000). The distribution of aquatic macrophytes in the rivers Sava, Kolpa and Krka (Slovenia). In S. Cristofor, A. Sârbu, & M. Adamecsu, (Eds.), *Proc. Internat. Workshop and 10th Macrophyte Group Meeting IAD-SIL* (pp. 34–40). August 24–28, 1998. Danube Delta, București, Romania: Editura Universității din București.
- Urbanc-Berčič, O., & Gaberščik, A. (2001). The influence of water table fluctuations on nutrient dynamics in the rhizosphere of common reed (*Phragmites australis*). *Wat. Sci. Tech.*, 44(11–12), 245–250.
- Gaberščik, A., & Urbanc-Berčič, O. (2001). Reed dominated intermittent lake Cerkniško jezero as a sink for nutrients. In J. Vymazal (Ed.), *Transformations of Nutrients in Natural and Constructed Wetlands* (pp. 225–234). Leiden, The Netherlands: Backhuys Publishers.
- Urbanc-Berčič, O., Gaberščik, A., Šiško, M., & Brancelj, A. (2002). Aquatic macrophytes of the mountain lake Krnsko jezero, Slovenia (Vodni makrofiti Krnskega jezera, Slovenija). *Acta Biol. Slov.*, 45, 25–34.
- Urbanc-Berčič, O. (2003). Charophytes of Slovenia, their ecological characteristics and importance in aquatic ecosystems (Parožnice (Characeae) Slovenije, njihove ekološke značilnosti ter pomen v vodnih ekosistemih). *Hladnikia (Ljublj.)*, 15/16, 17–22.

- Gaberščik, A., Urbanc-Berčič, O., Kržič, N., Kosi, G., & Brancelj, A. (2003). The intermittent lake Cerknica: Various faces of the same ecosystem. *Lakes Reserv.*, 8, 159–168.
- Urbanc-Berčič, O., & Gaberščik, A. (2003). Microbial activity in the rhizosphere of common reed (*Phragmites Australis*) in the intermittent lake Cerkniško jezero. In J. Vymazal (Ed.), *Wetlands: Nutrients, metals and mass cycling* (pp. 179–190). Leiden, The Netherlands: Backhuys Publishers.
- Urbanc-Berčič, O., & Gaberščik, A. (2004). The relationship of the processes in the rhizosphere of common reed *Phragmites australis*, (Cav.) Trin. ex Steudel to water fluctuation. *Int. Rev. Hydrobiol.*, 89, 500–507.
- Germ, M., Urbanc-Berčič, O., Gaberščik, A., & Janauer, G.A. (2004). Distribution and abundance of macrophytes in the river Krka. In I. Teodorivič, S. Radulovič, & J. Bloesch (Eds.), *Limnological Reports* (pp. 433–440). Novi Sad, Serbia: International Association for Danube Research – IAD.
- Kuhar, U., Gaberščik, A., Germ, M., & Urbanc-Berčič, O. (2004). Macrophytes and ecological status of three streams in the river Drava plain. In I. Teodorivič, S. Radulovič, & J. Bloesch (Eds.), *Limnological reports* (pp. 441–447). Leiden, The Netherlands: International Association for Danube Research – IAD.
- Germ, M., Urbanc-Berčič, O., & Kocjan Ačko, D. (2005). The response of sunflower to acute disturbance in water availability (Odziv sončnic na akutno pomanjkanje vode). *Acta Agric. Slov.*, 85, 135–141.
- Urbanc-Berčič, O., Kržič, N., Rudolf, M., Gaberščik, A., & Germ, M. (2005) The effect of water level fluctuations on macrophyte occurrence and abundance in the intermittent Lake Cerknica. In J. Vymazal (Ed.), *Natural and constructed wetlands: Nutrients, metals and management* (pp. 312–320). Leiden, The Netherlands: Backhuys Publishers.
- Kržič, N., Germ, M., Urbanc-Berčič, O., Kuhar, U., Janauer, G.A., & Gaberščik, A. (2007) The quality of the aquatic environment and macrophytes of karstic watercourses. *Plant Ecol.* (Dordrecht), 192(1): 107–118.
- Germ, M., Kreft, I., Stibilj, V., & Urbanc-Berčič, O. (2007) Combined effect of selenium and drought on photosynthesis and mitochondrial respiration in potato. *Plant Physiol. Biochem.* (Paris), 45(2): 162–167.

Contents

Preface	v
In Memoriam for Olga Urbanc-Berčič	vii
Contributors	xv
1 Reed Stand Conditions at Selected Wetlands in Slovenia and Hungary	1
Mária Dinka, Edit Ágoston-Szabó, Olga Urbanc-Berčič, Mateja Germ, Nina Šraj-Kržič, and Alenka Gaberščik	
2 Water Quality and Macrophyte Community Changes in the Komarnik Accumulation Lake (Slovenia)	13
Brigita Horvat, Olga Urbanc Berčič, and Alenka Gaberščik	
3 Latitudinal Trends in Organic Carbon Accumulation in Temperate Freshwater Peatlands	23
Christopher Craft, Chad Washburn, and Amanda Parker	
4 Buffering Performance in a Papyrus-Dominated Wetland System of the Kenyan Portion of the Lake Victoria Basin	33
Herbert John Bavor and Michael Thomas Waters	
5 Changes in Concentrations of Dissolved Solids in Precipitation and Discharged Water from Drained Pasture, Natural Wetland and Spruce Forest During 1999–2006 in Šumava Mountains, Czech Republic	39
Jan Procházka, Jakub Brom, Libor Pechar, Jana Štíchová, and Jan Pokorný	
6 Dynamics of Litterfall and Decomposition in Peatland Forests: Towards Reliable Carbon Balance Estimation?	53
Raija Laiho, Kari Minkkinen, Jani Anttila, Petra Vávřová, and Timo Penttilä	

7	Near Infrared Reflectance Spectroscopy for Characterization of Plant Litter Quality: Towards a Simpler Way of Predicting Carbon Turnover in Peatlands?	65
	Petra Vávřová, Bo Stenberg, Marjut Karsisto, Veikko Kitunen, Tarja Tapanila, and Raija Laiho	
8	Leachate Treatment in Newly Built Peat Filters: A Pilot-Scale Study	89
	Pille Kängsepp, Margit Kõiv, Mait Kriipsalu, and Ülo Mander	
9	Monthly Evapotranspiration Coefficients of Large Reed Bed Habitats in the United Kingdom.	99
	Katy E. Read, Peter D. Hedges, and Phil M. Fermor	
10	The Hydrological Sustainability of Constructed Wetlands for Wastewater Treatment.	111
	Peter D. Hedges, Phil M. Fermor, and Jiří Dušek	
11	Factors Affecting Metal Accumulation, Mobility and Availability in Intertidal Wetlands of the Scheldt Estuary (Belgium)	121
	Gijs Du Laing, Annelies Van de Moortel, Els Lesage, Filip M.G. Tack, and Marc G. Verloo	
12	Reed Bed Sewage Treatment and Community Development/Participation	135
	Sean O'Hogain	
13	The Constructed Wetland Association's Database of Constructed Wetland Systems in the UK.	149
	Paul Cooper	
14	Nitrogen Removal by a Combined Subsurface Vertical Down-Flow and Up-Flow Constructed Wetland System	161
	Suwasu Kantawanichkul, Kiattisak Pingkul, and Hiroyuki Araki	
15	Statistical Analysis of Treatment Performance in Aerated and Nonaerated Subsurface Flow Constructed Wetlands	171
	Scott Wallace, Jaime Nivala, and Troy Meyers	
16	Constructed Wetland Břehov: Three Years of Monitoring	181
	Lenka Kröpfelová	

17	Factors Affecting the Longevity of Subsurface Horizontal flow Systems Operating as Tertiary Treatment for Sewage Effluent	191
	David Cooper, Paul Griffin, and Paul Cooper	
18	Investigations on Nitrogen Removal in a Two-Stage Subsurface Vertical Flow Constructed Wetland	199
	Günter Langergraber, Christoph Prandtstetten, Alexander Pressl, Kirsten Sleytr, Klaus Leroch, Roland Rohrhofer, and Raimund Haberl	
19	Removal of Heavy Metals from Industrial Effluents by the Submerged Aquatic Plant <i>Myriophyllum spicatum</i> L.	211
	Els Lesage, Charity Mundia, Diederik P.L. Rousseau, Anelies M.K. van de Moortel, Gijs du Laing, Filip M.G. Tack, Niels De Pauw, and Marc G. Verloo	
20	Cold Season Nitrogen Removal in a High Loaded Free Water Surface Wetland with Emergent Vegetation	223
	Christer Svedin, Sofia Kallner Bastviken, and Karin S. Tonderski	
21	The Role of Vegetation in Phosphorus Removal by Cold Climate Constructed Wetland: The Effects of Aeration and Growing Season	237
	Aleksandra Drizo, Eric Seitz, Eamon Twohig, David Weber, Simon Bird, and Donald Ross	
22	Performance of Reed Beds Supplied with Municipal Landfill Leachate	251
	Ewa Wojciechowska and Hanna Obarska-Pempkowiak	
23	Enhanced Denitrification by a Hybrid HF-FWS Constructed Wetland in a Large-Scale Wastewater Treatment Plant	267
	Fabio Masi	
24	Growth Dynamics of <i>Pistia stratiotes</i> in Temperate Climate	277
	Silvana Perdomo, Masanori Fujita, Michihiko Ike, and Masafumi Tateda	
25	Fractionation, Biodegradability and Particle-Size Distribution of Organic Matter in Horizontal Subsurface-Flow Constructed Wetlands	289
	Jaume Puigagut, Aracelly Caselles-Osorio, Nuria Vaello, and Joan García	

26	Wastewater-fed Aquaculture, Otelfingen, Switzerland: Influence of System Design and Operation Parameters on the Efficiency of Nutrient Incorporation into Plant Biomass.	299
	Andreas Graber and Ranka Junge-Berberović	
27	Is Concentration of Dissolved Oxygen a Good Indicator of Processes in Filtration Beds of Horizontal-Flow Constructed Wetlands?	311
	Jan Vymazal and Lenka Kröpfelová	
28	Pollutant Transformation Performance and Model Development in African Wetland Systems: Large Catchment Extrapolation	319
	Herbert John Bavor and Michael Thomas Waters	
29	Sulfur Cycling in Constructed Wetlands	329
	Paul J. Sturman, Otto R. Stein, Jan Vymazal, and Lenka Kröpfelová	
	Index	345

Contributors

Edit Ágoston-Szabó

Institute of Ecology and Botany, Hungarian Danube Research Station, H-2163
Vácrátót, Hungary

Jani Anttila

Peatland Ecology Group, University of Helsinki, Department of Forest Ecology,
Helsinki, Finland

Hiroyuki Araki

Institute of Lowland Technology, Saga University, Saga, Japan

Sofia Kallner Bastviken

IFM-Biology, Linköping University, SE-581 83 Linköping, Sweden

Herbert John Bavor

Centre for Water and Environmental Technology – Water Research Laboratory,
University of Western Sydney – Hawkesbury, Locked Bag 1797, Penrith South
DC, NSW 1797, Australia

Simon Bird

University of Vermont, Department of Plant and Soil Science, Hills Agricultural
Building, 105 Carrigan Drive, Burlington, VT 05405, USA

Jakub Brom

Laboratory of Applied Ecology, Faculty of Agriculture, University of South
Bohemia, Studentská 13, České Budějovice, CZ-370 05, Czech Republic;
ENKI o.p.s., Dukelská 145, Třeboň, CZ-379 01, Czech Republic

Aracelly Caselles-Osorio

Environmental Engineering Division; Hydraulics, Maritime and Environmental
Engineering Department; Technical University of Catalonia, Jordi Girona, 1-3,
08034-Barcelona, Spain; Department of Biology, Atlantic University, km 7
Highway Old Colombia Port, Barranquilla, Colombia

David Cooper

ARM Ltd, Rydal House, Colton Road, Rugeley, Staffordshire, WS15 3HF,
United Kingdom

Paul Cooper

ARM Ltd, Rydal House, Colton Road, Rugeley, Staffordshire, WS15 3HF,
United Kingdom; Independent Consultant, PFC Consulting, The Ladder House,
Cheap Street, Chedworth, Cheltenham, GL54 4AB, United Kingdom

Christopher Craft

School of Public and Environmental Affairs, Indiana University, Bloomington IN
47405-1701, USA

Mária Dinka

Institute of Ecology and Botany, Hungarian Danube Research Station, H-2163
Vácrátót, Hungary

Aleksandra Drizo

University of Vermont, Department of Plant and Soil Science, Hills Agricultural
Building, 105 Carrigan Drive, Burlington, VT 05405, USA

Jiří Dušek

University of South Bohemia, Faculty of Biological Sciences, Branišovská 31,
370 05 české Budějovice, Czech Republic

Phil M. Fermor

Middlemarch Environmental Ltd, Triumph House, Birmingham Road, Allesley,
Coventry CV5 9AZ, United Kingdom

Masanori Fujita

Deanery, Kochi National College of Technology, 200-1 Monobe Otsu,
Nanmoku, Kochi 783-8508, Japan

Alenka Gaberščik

Department of Biology, Biotechnical Faculty, University of Ljubljana,
Večna pot 111, Ljubljana, Slovenia

Joan García

Environmental Engineering Division; Hydraulics, Maritime and Environmental
Engineering Department; Technical University of Catalonia, Jordi Girona, 1-3,
08034-Barcelona, Spain

Mateja Germ

National Institute of Biology, Večna pot 111, 1000 Ljubljana, Slovenia

Andreas Graber

University of Applied Sciences Wädenswil, Institute of Natural Resource
Sciences, Section Ecological Engineering, Gruental, CH - 8820 Wädenswil,
Switzerland

Paul Griffin

Severn Trent Water Ltd., Technology and Development, Avon House, Coventry,
CV3 6PR, United Kingdom

Raimund Haberl

Institute of Sanitary Engineering and Water Pollution Control, University of Natural Resources and Applied Life Sciences, Vienna, Muthgasse 18, A-1190 Vienna (BOKU), Austria

Peter D. Hedges

School of Engineering and Applied Science, Aston University, Aston Triangle, Birmingham, B4 7ET, United Kingdom

Brigita Horvat

Department of Biology, Biotechnical Faculty, University of Ljubljana, Večna pot 111, Ljubljana, Slovenia

Michihiko Ike

Department of Environmental Engineering, Graduate School of Engineering, Osaka University, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan

Ranka Junge

University of Applied Sciences Waedenswil, Institute of Natural Resource Sciences, Section Ecological Engineering, Gruental, CH - 8820 Waedenswil, Switzerland

Pille Kängsepp

Institute of Molecular and Cell Biology, University of Tartu, Riia 23, Tartu, 51010, Estonia; School of Pure and Applied Natural Sciences Kalmar University, Kalmar 39182, Sweden

Suwasa Kantawanichkul

Department of Environmental Engineering, Chiang Mai University, Chiang Mai 50202, Thailand

Marjut Karsisto

Finnish Forest Research Institute, Vantaa Research Unit, Finland

Veikko Kitunen

Finnish Forest Research Institute, Vantaa Research Unit, Finland

Margit Kõiv

Institute of Geography, University of Tartu, Vanemuise 46, Tartu, 51014, Estonia

Mait Kriipsalu

Institute of Forestry & Rural Engineering, Estonian University of Life Sciences, Kreutzwaldi 64, Tartu, 51014, Estonia

Lenka Kröpfelová

ENKI, o.p.s., Dukelská 145, 379 01 Třeboň, Czech Republic

Raija Laiho

Peatland Ecology Group, Department of Forest Ecology, University of Helsinki, Finland

Gijs Du Laing

Laboratory for Analytical Chemistry and Applied Ecochemistry, Department of Applied Analytical and Physical Chemistry, Ghent University, Coupure Links 653, B-9000 Gent, Belgium

Günter Langergraber

Institute of Sanitary Engineering and Water Pollution Control, University of Natural Resources and Applied Life Sciences, Vienna, Muthgasse 18, A-1190 Vienna (BOKU), Austria

Klaus Leroch

ÖKOREAL GmbH, Carl Reichert-Gasse 28, A-1170 Vienna, Austria

Els Lesage

Laboratory for Analytical Chemistry and Applied Ecochemistry, Department of Applied Analytical and Physical Chemistry, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium

Ülo Mander

Institute of Geography, University of Tartu, Vanemuise 46, Tartu, 51014, Estonia

Fabio Masi

IRIDRA Srl, via Lorenzo il Magnifico 70, Florence, 50129, Italy

Troy Meyers

Mathematics Department, Luther College, Decorah, Iowa, USA

Kari Minkkinen

Peatland Ecology Group, University of Helsinki, Department of Forest Ecology, Helsinki, Finland

Annelies M.K. van de Moortel

Laboratory of Analytical Chemistry and Applied Ecochemistry, Department of Applied Analytical and Physical Chemistry, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium

Charity Mundia

Laboratory of Analytical Chemistry and Applied Ecochemistry, Ghent University, Coupure Links 653, 9000 Ghent, Belgium

Jaime Nivala

North American Wetland Engineering LLC, 4444 Centerville Road, Suite 140, White Bear Lake, Minnesota 55127, USA

Hanna Obarska-Pempkowiak

Gdansk University of Technology, Faculty of Civil and Environmental Engineering, Narutowicza 11/12, 80-952 Gdansk, Poland

Sean O'Hogain

School of Civil, Structural and Building Services Engineering, Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland

Amanda Parker

U.S. Environmental Protection Agency, Washington, DC, USA

Niels De Pauw

Laboratory of Environmental Toxicology and Aquatic Ecology, Ghent University,
J. Plateauststraat 22, 9000 Ghent, Belgium

Libor Pechar

Laboratory of Applied Ecology, Faculty of Agriculture, University of South
Bohemia, Studentská 13, České Budějovice, CZ-370 05, Czech Republic;
ENKI o.p.s., Dukelská 145, Třeboň, CZ-379 01, Czech Republic;
Institute of System Biology and Ecology, Academy of Sciences of the Czech
Republic, Dukelská 145, Třeboň, CZ-379 01, Czech Republic

Timo Penttilä

Finnish Forest Research Institute, Vantaa Research Unit, Vantaa, Finland

Silvana Perdomo

Limnosistemas, Avda. Costanera Mz 205 S2, El Pinar, Canelones, Uruguay

Kiattisak Pingkul

Department of Environmental Engineering, Chiang Mai University, Chiang Mai
50202, Thailand

Jan Pokorný

ENKI o.p.s., Dukelská 145, Třeboň, CZ-379 01, Czech Republic;
Institute of System Biology and Ecology, Academy of Sciences of the Czech
Republic, Dukelská 145, Třeboň, CZ-379 01, Czech Republic

Christoph Prandtstetten

ÖKOREAL GmbH, Carl Reichert-Gasse 28, A-1170 Vienna, Austria

Alexander Pressl

Institute of Sanitary Engineering and Water Pollution Control, University of
Natural Resources and Applied Life Sciences, Vienna, Muthgasse 18, A-1190
Vienna (BOKU), Austria

Jan Procházka

Laboratory of Applied Ecology, Faculty of Agriculture, University of South
Bohemia, Studentská 13, České Budějovice, CZ-370 05, Czech Republic

Jaume Puigagut

Environmental Engineering Division; Hydraulics, Maritime and Environmental
Engineering Department; Technical University of Catalonia, Jordi Girona, 1-3,
08034-Barcelona, Spain

Katy E. Read

Middlemarch Environmental Ltd, Triumph House, Birmingham Road, Allesley,
Coventry CV5 9AZ, United Kingdom

Roland Rohrhofer
ÖKOREAL GmbH, Carl Reichert-Gasse 28, A-1170 Vienna, Austria

Donald Ross
University of Vermont, Department of Plant and Soil Science, Hills Agricultural Building, 105 Carrigan Drive, Burlington, VT 05405, USA

Diederik P.L. Rousseau
Department of Environmental Resources, UNESCO-IHE, P.O.Box 3015, 2601 DA Delft, The Netherlands

Eric Seitz
University of Vermont, Department of Plant and Soil Science, Hills Agricultural Building, 105 Carrigan Drive, Burlington, VT 05405, USA

Kirsten Sleytr
Institute of Sanitary Engineering and Water Pollution Control, University of Natural Resources and Applied Life Sciences, Vienna, Muthgasse 18, A-1190 Vienna (BOKU), Austria

Nina Šraj-Kržič
Department of Biology, Biotechnical Faculty, University of Ljubljana, Večna pot 111, 1000 Ljubljana, Slovenia

Otto R. Stein
Center for Biofilm Engineering, Montana State University, Bozeman, MT 59717, USA; Department of Civil Engineering, Montana State University, Bozeman, MT 59717, USA

Bo Stenberg
Department of Soil Sciences, SLU, Skara, Sweden

Jana Štíhová
Department of Applied Chemistry and Chemistry Teaching, Faculty of Agriculture, University of South Bohemia, Studentská 13, České Budějovice, CZ-370 05, Czech Republic

Paul J. Sturman
Center for Biofilm Engineering, Montana State University, Bozeman, MT 59717, USA

Christer Svedin
IFM-Biology, Linköping University, SE-581 83 Linköping, Sweden

Filip M.G. Tack
Laboratory for Analytical Chemistry and Applied Ecochemistry, Department of Applied Analytical and Physical Chemistry, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium

Tarja Tapanila
Finnish Forest Research Institute, Vantaa Research Centre, Finland

Masafumi Tateda

Department of Environmental Technology, College of Technology, Toyama Prefectural University, 5180 Kurokawa, Kosugi-machi, Imizu-Gun, Toyama, Japan

Karin S. Tonderski

IFM-Biology, Linköping University, SE-581 83 Linköping, Sweden

Eamon Twohig

University of Vermont, Department of Plant and Soil Science, Hills Agricultural Building, 105 Carrigan Drive, Burlington, VT 05405, USA

Olga Urbanc-Berčič

National Institute of Biology, Večna pot 111, 1000 Ljubljana, Slovenia

Nuria Vaello

Environmental Engineering Division; Hydraulics, Maritime and Environmental Engineering Department; Technical University of Catalonia, Jordi Girona, 1-3, 08034-Barcelona, Spain

Petra Vávřová

Peatland Ecology Group, University of Helsinki, Department of Forest Ecology, Helsinki, Finland; Finnish Forest Research Institute, Vantaa Research Unit, Vantaa, Finland

Marc G. Verloo

Laboratory of Analytical Chemistry and Applied Ecochemistry, Department of Applied Analytical and Physical Chemistry, Ghent University, Coupure Links 653, B-9000 Ghent, Belgium

Jan Vymazal

ENKI, o.p.s., Dukelská 145, 379 82 Třeboň, Czech Republic; Institute of Systems Biology and Ecology, Dukelská 145, 379 01 Třeboň, Czech Republic

Scott Wallace

North American Wetland Engineering LLC, 4444 Centerville Road, Suite 140, White Bear Lake, Minnesota 55127, USA

Chad Washburn

School of Public and Environmental Affairs, Indiana University, Bloomington IN 47405-1701, USA

Michael Thomas Waters

SMEC International, P.O. Box 1052, North Sydney, NSW 2060 Australia

David Weber

Vermont Agency of Agriculture Food & Markets. 116 State Street, Drawer 20 Montpelier, VT 05620–2901, USA

Ewa Wojciechowska

Gdansk University of Technology, Faculty of Civil and Environmental Engineering, Narutowicza 11/12, 80-952 Gdansk, Poland