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WETLANDS IN AGRICULTURAL LANDSCAPES: PRESENT STATE AND PERSPECTIVES IN EUROPE

International Conference
České Budějovice, Czech Republic
11 – 16 October 2015

Ministry of the Environment
of the Czech Republic

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Book of abstracts

Ministry of the Environment
of the Czech Republic

The conference has been organised in the framework of predefined project: Conservation, Research and Sustainable Use of Wetlands of the Czech Republic (2014–2017)

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BOOK OF ABSTRACTS

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- Ministry of the Environment of the Czech Republic
- Crop Research Institute, Prague
- University of South Bohemia in České Budějovice

Cooperation:

- Norwegian Environment Agency
- Ramsar Secretariat

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Dear participants,
Friends of wetlands,

You are opening the book of abstracts of lectures and posters presented at the international conference “Wetlands in Agricultural Landscapes – Present State and Perspectives in Europe”.

The Conference is organised by the Ministry of the Environment of the Czech Republic in cooperation with the Crop Research Institute, Prague and the University of South Bohemia in České Budějovice in the framework of the Czech-Norwegian project “Conservation and Wise Use of Wetlands in the Czech Republic”.

Wetlands and agriculture are closely interlinked. How to find the right balance? It all comes down to ensuring that wetlands are used wisely, to finding sustainable management solutions for the benefit of agriculture and wetlands.

We would like to bring together wetland conservationists and scientists on the one hand and agriculturalists and agricultural scientists on the other, in order to discuss and try to find and propose solutions to problems in which their interests overlap. The topics include both theoretical knowledge and practical experience concerning the creation, restoration, conservation and wise management of wetland ecosystems in interaction with the agricultural management of the surrounding landscapes in Europe.

We would like to confirm the importance of wetlands for the biodiversity of intensely-agriculturally-managed areas and present possibilities of sustainable agricultural management of lacustrine, riverine, saline and brackish wetlands and rewetted peatlands (so-called paludiculture). Simultaneously we would like to underline the irreplaceable role of wetlands in stabilizing the water regime and mitigation of undesirable climate change (especially drought) effects in agricultural regions. We also would like to present examples of wetland plants and animals potentially suitable for the selection or breeding of novel wetland crops or animals of economic importance and to mention effects of both organic and mineral fertilizers and agricultural pesticides on wetlands and the mitigation of their ecologically-undesirable effects. In the same time we want to highlight effect and importance of restoration and creation of different types of wetlands situated in predominantly agriculturally-managed regions. Last but not least we would like to discuss the position of wetlands in the legislation and agricultural policies of the European Union and individual European countries (also including non-EU ones).

We are very glad that you are interested in wetlands in agricultural landscapes and that you will share your knowledge and experience together with others experts.

Libuše Vlasáková

National Focal Point of the Ramsar Convention
Ministry of the Environment
Chair of Organizing Committee

Hana Čížková

University of South Bohemia in České Budějovice
Chair of Scientific Committee

PROGRAMME

Sunday 11 October

17:00 – 18:00 Registration

18:00 – 20:00 Welcome drink

Monday 12 October

8:00 – 9:00 Registration

9:00 – 10:00 **OPENING CEREMONY**

10:00 – 10:30 Coffee break

10:30 – 11:00 **OPENING LECTURE: Global fertility loss of dehydrated landscapes the main reason for climate change?**
Ripl, W.

11:00 – 12:00 **WATER AND CLIMATE**
Chairs: Jan Pokorný and David Harper

Assessment of sustainable landscape management and role of wetlands, using thermal remote sensing data
Pokorný, J., Hesslerová, P., Huryna, H.

Landscape Revitalisation and Integrated River Basin Management Programme for the Slovak Republic – 18 months of implementation
Kováč, M., Kravčík, M. et al.

Wetlands in agriculture area of Naivasha Lake catchment (Forest, Papyrus, small farms) – does vegetation waste or attract water?
Harper, D., Pokorny, J., Morrison, R. et al.

12:00 – 13:30 Lunch

13:30 – 15:00 **WATER AND CLIMATE cont.**

Modernization of irrigation: A bad trade for nature and society
Hernandez, E., Fernandez, A., Fuentelsaz,F., Peiteado, C., Seiz, R.

The role of river floodplains in flood mitigation – Central European experience
Pithart, D., Dostál, T., Weyskrabová, L.

Restoring Peatlands in Russia – for fire prevention and climate change mitigation: the experience of large scale rewetting project
Sirin, A., Suvorov, G. , Medvedeva, M., Maslov, A., Makarov, D., Vozbrannaya, A., Valyaeva, N., Glukhova, T., Tsyganova, O., Markina, A., Minayeva, T., Silvius, M., Bednar, J., Schrier, A., Joosten, H., Couwenberg, J., Gummert, I. Peters, J.

15:00 – 15:30 Coffee break

15:30 – 17:00 **AGRICULTURAL POLLUTION**
Chairs: Jan Vymazal and Karin Tonderski

Keynote lecture 1. Nitrogen and phosphorus removal in agricultural wetlands
Tonderski, K., Geranmayeh, P., Johannesson, K., Ulén. B., Weisner, S.E.B.

Keynote lecture 2. Constructed wetlands for removal of pesticides from agricultural runoff
Vymazal, J.

Integrated buffer zones – a new tool for nutrient retention of agricultural drainage and surface water
Strand, J.A., Feuerbach, P., Kronvang, B., Hoffmann, C.C., Jensen, H.

17:00 – 17:30 Coffee break

17:30 – 19:00 **AGRICULTURAL POLLUTION cont.**

Level-adjusted constructed wetlands (LACWs) – a new concept of viewing nutrient leakage
Strand, J.A., Weisner, S.E.B., Feuerbach, P.

Assessing the eutrophication problems of the shallow Lake Lesser Prespa in Greece – a landscape approach
V.Maliaka, V., Fritz, C., Van Oosterhout, F., Lürling, M., Smolders, A.J.P.

Fishpond sediment – A new perspective of nutrients recycling in agricultural landscapes
Potužák, J., Duras, J., Pokorný, J., Kröpfelová, L., Šulcová, J., Chmelová, I., Novotný, O.

Root oxygen release a key for healthy paludicrops and cushion plants dominating biogeochemical carbon and nutrient cycling
Christian Fritz, C., Dollu, B., Grootjans, A., Smolders, F., van Dijk, G., Pancotto, V.

20:00 – 22:30 Welcome reception

Tuesday 13 October

8:30 – 10:00 **BIODIVERSITY**
Chairs: M. Finlayson, J. Jalbert

Keynote lecture 1: Issues associated with wetland biodiversity and agriculture globally, and extent of agriculture in Ramsar wetlands
Finlayson, M.

Keynote lecture 2: Agriculture and wetlands in the Mediterranean basin, an overview
Jalbert, J.

Wet meadows restoration and management at Lesser Prespa Lake, Greece
Logotheti, A., Koutseri, I., Malakou, M.

10:00 – 10:30 Coffee break

10:30 – 12:00 **BIODIVERSITY cont.**

Peatlands in steppe and forest-steppe regions under changing climate and human activities
Sirin, A., Minayeva, T., Ilyasov,D., Suvorov, G., Martynenko, V., Kuznetsov, E.

Importance of wetlands within arable land for breeding of Northern Lawping
Zámečník, V.

Towards agricultural practices favorable to wetlands natural resources, lessons learned from Doñana, Spain
Fuentelsaz, F.

Ricefields winter flooding for waterfowl in Europe: a management to be promoted?
Pernollet, C.

Biodiversity of wetlands on arable land in Znojmo region (Czech Republic)
Němec, R.

12:00 – 13:30 Lunch

13:30 – 15:00 **PALUDICULTURE**
Chairs: Jan Květ and Wendelin Wichtmann

Keynote lecture 1: Peatlands and paludiculture
Hans Joosten – presented by W. Wichtmann

Keynote lecture 2: Wetland crops in Europe?
Květ, J., Čížková, H., Eiseltová, M., R. Edwards, K.R.

Wetland Energy – Biomass from rewetted excavated peatlands for briquettes production
W. Wichtmann, W., Romanovski, C., Golovati, S., Butzhko, A., V. Pashinskym, Rakovich, V., Liashchynskaya, N., Sosinov, O., Yanka Kupala, Y., Zalesski, I.

Potential Paludiculture Plants – A system approach illustrating paludiculture diversity
Abel S., Joosten H.

15:00 – 15:30 Coffee break

15:30 – 17:00 **PALUDICULTURE cont.**

Principles of biomass harvesting in wet and rewetted peatlands
Christian Schröder

Paludiculture in a drained Mediteranean peatland: Energy yields from anaerobic digestion of Common Reed (Phragmites australis L.)
Dragoni, F., Giannini, V., Bonari, , E., Silvestri, N.

Combustibility of biomass from perennial crops cultivated on a rewetted Mediterranean peatland
Giannini, V., Dragoni, F., Bonari, E., Oehmke, C., Wichtmann, W., Silvestri, N.

Biomass pellets from rewetted fens: Production, combustion and economic feasibility
Claudia Oehmke, C., Dahms, T.

Chances and challenges for paludiculture in the Netherlands
Geurts, M., Fritz, C., Lamers, L.P.M.

Wetland energy – sustainable development of former excavated peatlands in Belarus
Haberl, A., Wichtmann, W., Rakovich, V., Sivagrakov, A., Tanovitskaya, N., Kundas, S., Rodzkin, A., Zalesski, I., Burlo, A., Liashchynskaya, N.

17:00 – 18:30 **POSTER SESSION**

Wednesday 14 October

8:30 – 16:30 **FIELD TRIPS**

18:30 – 22:00 **REGIONAL EVENING**

Thursday 15 October

8:30 – 10:00 **CONSERVATION, RESTORATION AND CREATION OF WETLANDS**
Chairs: M. Eiseltová, B. Madsen

Keynote lecture: What nature has joined, man should not tear asunder
Madsen, B. L.

Reestablished wetlands in stream systems: a threat to salmonid fish?
Ebert, K. M.

Cnidion dubii meadows in Lower Odra Valley National Park, Germany – chances for development
Wojciechowska, M., Tanneberger, F.

Fitness, plasticity, and the role of the diaspore bank of the semiaquatic Cyperus fuscus in near natural and secondary habitats
Böckelmann, J., Bernhardt, K. G., Tremetsberger, K., Šumberová, K.

10:00 – 10:30 Coffee break

10:30 – 12:00 **CONSERVATION, RESTORATION AND CREATION OF WETLANDS cont.**

LIFE for wetlands in agricultural landscapes – examples and best practice
Trokanova, L.

Restoring a raised bog – a view from a biodiversity and climate perspective
Hahn, P.

Wetlands restoration in farmland of Danube lowland in Slovakia
Tuhárska, K., Sobeková, K.

Can we mitigate the non-point pollution in agricultural landscapes by rewetting of peatlands?
Zak, D., Cabezas, A., Augustin, J., Gelbrecht, J., McInnes, R.

Large branchiopods in periodically flooded field wetlands: a challenge for nature conservation in ephemeral agricultural habitats
Sychra, J., Merta, L., Zavadil, V.

12:00 – 13:30 Lunch

13:30 – 15:00 **LEGISLATION AND POLICY**
Chairs: Peter Pouplier and Libuše Vlasáková

Key lecture: Framework for wetlands in Denmark – policy, legislation and present challenges
Kirkebaek, M.

EU policy : obstacles and incentives to wetland rehabilitation and paludiculture
Coelho, V.

Financial instruments in nature and landscape management in the Czech Republic
Trnka, P.

Open discussion

15:00 – 15:30 Coffee break

15:30 – 17:00 **STAKEHOLDERS'S VIEWS ON WETLANDS**
Chairs: Francisco A. Comín and Hana Čížková

Keynote lecture. Integrating wetland conservation and restoration into agricultural practices to promote sustainable development of agricultural landscapes
Comín, F. A., Čížková, H.

Pond Conservation meets Ecosystem Services in Southern Sweden
Stewart, R. I. A., Andersson, G. K. S., Brönmark, C., Klatt, B. K., Hansson, L. A., *Zülsdorff, V., Smith, H. G.*

Norfolk Ponds Project: Stakeholder's views of farmland ponds
Greaves, H., Sayer, C.

Landowners and volunteers as stakeholders in stream management
Kaare Manniche Ebert

Open discussion

Friday 16 October

8:30 – 10:30 **REPORTS BY SESSION CHAIRS**

10:30 – 11:00 Coffee break

11:00 – 12:30 **CLOSING SESSION**

12:30 – 14:00 Lunch

WATER AND CLIMATE

Opening lecture
GLOBAL FERTILITY LOSS OF DEHYDRATED LANDSCAPES THE MAIN REASON FOR CLIMATE CHANGE?

Wilhelm Ripl

Professor emeritus, Technische Universität Berlin

Eight years ago, the film of Al Gore „An inconvenient truth“ appeared. This time it was attempted to shake up the world´s companies and societies about the consequences of climate change or global warming. The so-called “IPCC” (Intergovernmental panel climatic change) was established by the United Nations with the task of investigating the causes of climate change and global warming. In climate conferences held annually, attempts were made to pinpoint as the main cause the rise in atmospheric dry greenhouse gases such as CO_2 and CH_4 and try to reduce these emissions by fiscal measures. I want to show in my presentation that other hypotheses for man-made climate change are likely to be better and also in line with the observations made.

The most important factors influencing climate seems to me rather the manmade disturbance of the dissipative medium water cycle with the dissipative structures of vegetation than a change in the radiation balance.

The presence and distribution of the various dissipative structures (as energy-distributing organisms) and the most important dissipative medium water which is capable of evaporation and condensation. The main cooling agent on our planet is water because it needs c. 2500 kJ energy during the evaporation of one liter or 1 mm of water/m^2. The condensed water can evaporate again minute droplets of water (fog) with a high surface energy and produce rain somewhere in low pressure areas, but also percolate through the upper soils reacting with matter. Percolation transports bases and the soluble plant nutrients with the rivers to the sea, while water evaporated by the active vegetation hardly changes the amount of nutrients and base substances in the soil. In both cases the condensation does not result in either heating or radiation back to the universe. The radiation in and out- balance maybe happen in unknown time spans but never at the same time and unknown space distributions. However, this is the basis of IPCC`s global warming modelling approach

Ground water levels decrease during summer in drying out unsaturaded soils.

Invading O_2 oxidizes humic-soil substances, reduced sulfur compounds and ammonia to form strong acids which dissolve minerals and form soluble salts. In autumn when ground water-levels rise, nutrient compounds dissolve and are discharged into the rivers. Studies on a piece of intact forest showed that the soluble mass transport has risen from c. 15 to 20 kg/ha per ha and year in agricultural areas up to 1500 kg/ha and year.

If the water level and the evaporation capacity of the landscape is deteriorated and the daily dew drops (1-2 mm) and cooling fails landscape becomes overheated, high-pressure conditions occur, thunderstorms, heavy winds and excessive rainfalls are the result in confined low pressure areas.

Cooling is located closer to the ecotones (boundaries between water and land). Hot offshore winds warm the sea surface and lead to the melting of the arctic ice-water

interface. Mountain glaciers are melting, however, due to reduced water vapor transport and lowered summer precipitation in the form of snow.

The frequency of the water cycles of a virgin forest increases about 10 times and thus enlarges the dissipation- and cooling effect.

The hypothesis if not falsified as the IPPC`s greenhouse-gas hypothesis already seems to be, suggests that on a global scale the local municipal water- and agricultural water management is responsible for the irreversible ecological damage and climate change, however, mitigation is possible and feasible by paying the land-users for achieving good water management measured as minimized differences between daily maxima and minima temperatures on their properties, while maximized differences indicate poor water management where land owners pay for climate damage with money collected from the companies and communities which produce overheated landscapes.

ASSESSMENT OF SUSTAINABLE LANDSCAPE MANAGEMENT AND ROLE OF WETLANDS, USING THERMAL REMOTE SENSING DATA

P. Hesslerová, J. Pokorný

ENKI, o.p.s. Třeboň, Czech Republic

The introduction focuses on the importance of surface temperature as an important characteristic of solar energy transformation in the landscape with respect to its management. This theoretical background is demonstrated by several studies, which emphasize the role of wetlands in agriculture landscape as elements mitigating surface temperature. We show the possibilities of surface temperature measurement using thermal imaging techniques onboard different remote sensing systems as well as field measurements.

LANDSCAPE REVITALISATION AND INTEGRATED RIVER BASIN MANAGEMENT PROGRAMME FOR THE SLOVAK REPUBLIC – 18 MONTHS OF IMPLEMENTATION

M. Kováč [1], **M. Kravčik** [2]

[1] ***Former government plenipotentiary responsible for the program, Bratislava, Slovakia***

[2] ***Ľudia a voda, o.z., Former executive manager of the governmental program, Košice, Slovakia***

The Landscape Revitalisation and Integrated River Basins Management Programme for the Slovak Republic was approved by the Slovak Government on October 27, 2010 (government resolution number 744) as the reaction on massive floods that affected Central Europe and Slovakia in 2010.

The program was set up on the governmental framework document Principles, rules and framework conditions for preventative measures against floods, decreasing flood risk, risk of drought and other risks related to a sudden, natural disaster, and integrated management of river basins" approved on August 27, 2010 (government resolution number 556) that fosters application of integrated water resources management principles in practise based on new water paradigm approach – www.waterparadigm.org

The Landscape Revitalisation Programme`s main tool for solving ecosystem problems and reduction of flood and drought risks is improvement of rainwater retention capacity of the landscapes, primarily, in the territory where rainwater falls or in damaged parts of the countryside. Four percent of the national goal – 250 million m^3 – was achieved via creation of more than 80 000 different local water retention measures within 18 months of the program implementation in 488 towns and municipalities. Natural and local materials – soil, wood, stone – were mainly used to build the measures.

7 700 seasonal jobs were created via these projects. Local people get chance to participate on reducing the local flood and drought risks. They showed ability to be the engine of the landscape revitalisation, to understand the local environment and to find nature friendly solutions. Local communities recognized positive multiplied environmental, social and economic benefits of such approach.

New capacity of 10 million m^3 is now periodically (several times a year) used for enlarging the infiltration and evapotranspiration using rain water and slowing runoff of the rain water in the water basin. Financial aid from public sector 4 € per one cubic meter of newly created water retention element in the landscape was provided.

Program documents are available on official Office of the Government website *http://archiv.vlada.gov.sk/krajina/ or http://www.rokovania.sk/Rokovanie.aspx*

Complex records and documentation of the program outputs is provided in book Po nás púšť a potopa – After us the desert and the deluge? See *http://ludiaavoda.sk/data/files/44_kravcik-after-us-the-desert-and-the-deluge.pdf*

Foundation for Support of Civil Society (NPOA) monitored outcomes of the program. The monitoring confirmed very good effectiveness of the measures, multiplied benefits

and reduction of local flood damages up to 5 times in financial terms. This way of local floods reduction is up to 10 times cheaper than traditional regulation of rivers. See: *http://crvs.sk/wp-content/uploads/2014/03/HodnotenieDopadov_Vysledky.pdf*

AGRICULTURE AND WETLANDS IN LAKE NAIVASHA (KENYA) REGION

D. M. Harper [1], **J. Pokorny** [2], **E. H. J. Morrison** [1], **P. Hesslerová** [2], **N. Pacini** [3]

[1] ***Aquatic Ecosystem Sevices Ltd and University of Leicester, Leicester***

[2] ***ENKI, o.p.s., Třeboň, Czech Republic***

[3] ***Department of Environmental and Chemical Engineering, University of Calabria, Rende, Italy***

Population growth in East Africa is linked with deforestation and transformation of wetlands into agriculture land. Original tropical forest cover of Kenya has been reduced to less than 3 % of the country. Kenya now experiences climate change, manifest as weather extremes and irregularities of dry and rain seasons. Our principal question is whether the observed regional climate changes have been caused by global climate change, itself caused by an increase of green house gases, or whether they are caused by drainage and new landscape management practices, which have removed vegetation biomass and reduced evapotranspiration.

Satellite and thermovision pictures showed marked differences in surface temperature of forested and open agricultural areas in the Eastern Rift Valley, Lake Naivasha catchment. Furthermore, large littoral stands of papyrus at the lake were 20 oC cooler due to evapotranspiration (ET) than agricultural land and grassland. Measures of the temperature distribution inside a papyrus stand (of 4 age classes) at the lake shore showed low temperature gradients inside it. Water evaporated only from the top of the papyrus stand, thus ET was controlled by plants, whereas evaporation from open water, a physical process only, could be higher than ET from papyrus. During the night papyrus leaves (filamentous), insulated from the ground, cool rapidly and serve as surfaces on which water vapour condenses. Air pressure drops due to the condensation of water vapour and air from surroundings is sucked in. Thus, we suggest that papyrus does not waste water from the lake and that conversion of papyrus into arable land results in a dramatic increase of surface temperature and water vapour losses from lake area/region, because water vapour is carried up by hot air to high altitudes and cannot return at night. This process in papyrus stand is very similar to that shown by forests in our earlier studies. Limited case studies by a few farmers at Naivasha (Sarah Higgins, arable; Jospat Macharia, subsistence) also show that permanent vegetation keeps local humidity, even in drought periods and can thus compensate for lack of precipitation after forest clearance.

MODERNIZATION OF IRRIGATION: A BAD TRADE FOR NATURE AND SOCIETY

E. Hernandez, A. Fernandez, F. Fuentelsaz, C. Peiteado, R. Seiz

WWF Spain

Spain faces severe droughts and water scarcity meanwhile 66 % of water is consumed in irrigation leading to water bodies' overexploitation, wetland desiccation, biodiversity and economic losses. Up to 2.900 M€ of public funds have been invested to promote more efficient water use in irrigation and to save 1.800 hm^3/year, further investments are planned.

WWF has developed its own analysis on the role of irrigation modernization in addressing water scarcity and improvement of the water bodies' status according to Water Framework Directive (WFD). The main findings and proposals are:

1. Improve transparency on water and coordination between administrations. The lack of information and official assessments impedes assuring the contribution of the modernization of irrigation projects to the WFD objectives. Better coordination between agriculture and water authorities is needed to integrate both water and farming planning for a more sustainable rural development.

2. Use adequately the concept of water saving. To estimate water saving is necessary to take into account water consumption at the river basin level and at the plot level, water abstraction from the water bodies and water returns from the fields.

3. Avoid increasing water consumption. The modernization has implied a higher water consumption and less water resources available at the river basin level, due to the improvements in efficiency of irrigation techniques, increases in the irrigated surface or changes to thirstier crops.

4. Minimize the increase of energy consumption (pumping). The investments have led to higher energy costs for farmers and against the EU climate change objectives.

5. Avoid public funding of illegal exploitations. The modernization of illegal exploitations has led to account reductions in water consumption as water savings. Closing illegal water abstractions and legal water use should be an exante condition to get public money.

6. Mandatory water permits review. There is no a general review of the water permits to reduce water rights in accordance with the expected savings. This has led to further intensification of water use and has impeded to allocate water savings for nature.

7. Ensure cost recovery. Not applying correct water pricing has led to inefficient water use.

To the absence of water savings by the modernization of irrigation, the threat of new irrigated areas must be added. More than 700.000 new hectares will endanger Spanish freshwater ecosystems. Nevertheless the modernization of irrigation can be carried out in a different way following the principles of public money for public goods and polluter pays. But a new rural development model based on a green economy that ensures the future of our ecosystems and rural areas is needed.

THE ROLE OF RIVER FLOODPLAINS IN FLOOD MITIGATION – CENTRAL EUROPEAN EXPERIENCE

D. Pithart, T. Dostál, L. Weyskrabová

Beleco z.s.

Due to the increasing frequency of extreme hydrological events, the role of floodplain ecosystem to mitigate floods is beeing discussed within the comunity of water management and ecologists. To avoid both underestimation from water management perspective and too optimistic expectations from the ecological point of view, three Czech river floodplain segments have been tested for their potential to mitigate flood waves – as the decrease of culmination and its translation in time. The principal methodology was 2D hydraulic modelling; near-nature segments have been compared to transformed floodplains with regulated river beds. Moreover, different management scenarios have been included in models. The mitigation floodplain effect is also compared to the effect of both existing and proposed hydroaccumulations – namely the case study of river Drava floodplain (Croatia), where the chain of hydropowers has been proposed, is summarised here. The contribution gives some realistic figures what can be expected from this ecosystem service provided by floodplains, where are its limits, what factors influence it, how can be this service assesed also in a monetary way and what difficulties should we face if we are determined to promote it.

RESTORING PEATLANDS IN RUSSIA – FOR FIRE PREVENTION AND CLIMATE CHANGE MITIGATION: THE EXPERIENCE OF LARGE SCALE REWETTING PROJECT

A. Sirin [1], **G. Suvorov** [1], **M. Medvedeva** [1], **A. Maslov** [1], **D. Makarov** [1], **A. Vozbrannaya** [1], **N. Valyaeva** [1], **T. Glukhova** [1], **O. Tsyganova** [1], **A. Markina** [1], **T. Minayeva** [2], **M. Silvius** [2], **J. Bednar** [2], **A. Schrier** [2], **H. Joosten** [3], **J. Couwenberg** [3], **I. Gummert** [3], **J. Peters, Michael** [4]

[1] ***Institute of Forest Science Russian Academy of Sciences, Russian Federation***

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Since 1990 large areas of peatlands that were drained for agriculture and for peat extraction in European Part of Russia were left abandoned with CO_2 emissions and high fire risk. Re-wetting could return peat soils to their original water-logged state, prevent their vulnerability to fires and peat oxidation, bring back important ecosystem services such as biodiversity and water regulation. The project Restoring Peatlands in Russia – for fire prevention and climate change mitigation" financed under the International Climate Initiative (IKI) by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) is aimed among other its objectives to prove positive effects for climate change mitigation and adaptation from restoration of several dozen thousand hectares of such drained abandoned peatlands. The activity is linked to the governmental programme (2010–2013) of rewetting, which Moscow Province started after severe fires in 2010. More than 73 thousand hectares of fire vulnerable transformed peatlands were assessed for the effectiveness after the large-scale rewetting in relation to GHG reduction as well as to habitat restoration for biodiversity conservation. The process tries to find answers to a question whether large-scale rewetting activities could achieve integrative goals on climate change mitigation, biodiversity and stakeholders interests for peatlands in Russia. Different methods based on remote sensing techniques were developed to map peatlands related to different land categories, to assess and monitor their conditions and fire hazard status and to test the effectiveness of restoration measures applied in relation to fire prevention and GHG assessment. In addition, emission factors (EFs) and carbon data were evaluated. For pilot areas direct monitoring of water level, GHG fluxes are carried out, including overburdens and ditches. Special attention was given to asses carbon loss related to peat fires. 2013 Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) was applied to develop EFs for peatland land/vegetation classes. The scientific and practical results of this large-scale project could be expanded to other restoration projects, help further development of methodologies for GHG inventories under UNFCCC and IPCC, and support integration of restoration projects into an economically derived climate change mitigation and adaptation national programs.

AGRICULTURAL POLLUTION

Keynote lecture 1
NITROGEN AND PHOSPHORUS REMOVAL IN AGRICULTURAL WETLANDS

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In Sweden, several thousand hectares of wetlands have been created and restored as part of work to achieve the Swedish Environmental Objectives “Thriving wetlands” and “Zero eutrophication”. Wetlands are also considered to be a cost-efficient means to contribute to achieving the nitrogen reduction goals agreed in the Baltic Sea Action Plan. For phosphorus removal, previous studies have concluded that the knowledge base is substantially smaller, and that more studies are needed. In this paper, we present a compilation of Swedish data, and include results from current research done in small wetlands designed for efficient phosphorus removal. Those are located in areas with clay soils, resulting in high P but relatively low N concentrations in runoff water. Results from water sampling in the first years after construction indicated a P removal of about 86 kg ha^{-1} yr^{-1} in one wetland but low removal in the other. N removal was around 200–400 kg ha^{-1} yr^{-1}.

Factors influencing the N and P removal have been analysed using data from a limited number of wetlands, where monitoring has been done with different methodological approaches. In addition, a few different statistical models were used to estimate the expected P and N removal effects of wetlands created with financial support from the Swedish Rural Development Programme in 2007–2013. The results suggest that in individual well designed and located wetlands, a removal of 100 kilo phosphorus and 1 000 kilo nitrogen per hectare wetland area and year can be obtained. The models were used to scale up to the 5 261 hectare wetland area that have been granted financial support during 2007–2013 in the Rural Development Programme. In total, those wetlands will result in a reduced transport to local watersheds of about 25 tons of phosphorus and 200 tons of nitrogen per year. This is lower than the estimated potential for wetland N and P removal, mainly due to their location in the landscape. Hence, the results show that the effect on the transport of nutrients from agricultural landscapes could be substantially increased with a better location and design of wetlands.

Keynote lecture 2
CONSTRUCTED WETLANDS FOR REMOVAL OF PESTICIDES FROM AGRICULTURAL RUNOFF

Jan Vymazal

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Pesticides are used in modern agriculture to increase crop yields, but they may pose a serious threat to aquatic ecosystems. Pesticides may enter water bodies through diffuse and point sources, but diffuse sources are probably the most important. Among diffuse pollution, surface runoff and erosion, leaching and drainage represent the major pathways. The most commonly used mitigation techniques to prevent pesticide input into water bodies include edge-of-field and riparian buffer strips, vegetated ditches and constructed wetlands. The first attempts to use wetland macrophytes for pesticide removal were carried out as early as the 1970s, but only in the last decade have constructed wetlands for pesticide mitigation become widespread. The paper summarizes 47 studies from 13 countries in which removal of 87 pesticides, including 35 herbicides, 27 fungicides and 25 insecticides, were monitored. The survey revealed that constructed wetlands with free water surface are the most commonly used type but subsurface flow constructed wetlands have been used recently as well. The literature survey indicated that removal of pesticides is generally effective, but the efficiency varies widely among pesticides and also among systems for a particular pesticide There are many processes which are responsible for pesticide mitigation such as hydrolysis, photolysis, sedimentation, adsorption, microbial degradation or plant uptake, however, the extent of these processes depends on local conditions, and it is difficult to single out the most important ones. There is a strong evidence to suggest that the presence of vegetation enhances pesticide retention/removal but the available information is only very limited. The results of the survey revealed that highest pesticide removal was achieved for pesticides of the organochlorine, strobilurin/strobin, organosphosphate and pyrethroid groups while the lowest removals were observed for pesticides of the triazinone, aryloxyalkanoic acid and urea groups. The removal of pesticides generally increases with increasing value of KOC but the relationship is not strong.

INTEGRATED BUFFER ZONES – A NEW TOOL FOR NUTRIENT RETENTION OF AGRICULTURAL DRAINAGE AND SURFACE WATER

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The new environmental tool, Integrated Buffer Zones (IBZ), was tested regarding nutrient retention, and infiltration capacity.

Three experimental IBZs have been constructed, one in Sweden (2013) and two in Denmark (2014). During an 18-day sampling period in May 2014, in the Swedish facility, water flow was measured continuously in the inlet and outlet, and water samples for nutrient analyses were taken in the inlet, the outlet and in groundwater pipes.

Preliminary results show a high and stable infiltration capacity of 2 mm/hour during the 18-day period, equivalent to 0.4 m^3/hour (surface area; 200 m^2). P-retention measured as difference in concentration between inlet and in ground water pipes was >90 %.

During 2015 additional sampling will be done in all 3 experimental facilities.

IBZs are planned to be used at smaller drainage areas close to the recipients where constructed wetlands are not an economical or practical option. An IBZ is constructed with a 5 m wide aquatic wetland part where drainage pipes are cut, and an at least 5 m wide infiltration bank (total width; 10 m at least). No water enters the stream directly from the field, neither through drainage pipes nor by surface run-off. Usually all water passes through the infiltration bank. Nutrients are retained by denitrifikation, sedimentation, adsorption and plant uptake in the wetland part of the IBZ and through filtration in the infiltration bank. To further increase infiltration, trees are planted on the infiltration bank to improve soil permeability.

Other ecosystem services gained from IBZs are e.g. habitat creation and dispersal corridors (increased biodiversity in the agricultural landscape) and as direct benefits for the farmers; biomass production, controlled drainage and nutrient re-cycling.

The innovative environmental tool of IBZ is technology neutral and do not affect the farming practices of nearby fields negatively.

The work is supported by the foundation BalticSea2020 through the project 'Integrerade skyddszoner (IBZ)' in Sweden and the 'Strategic Research Foundation/Innovation Fund Denmark project 'BUFFERTECH – Optimization of Ecosystem Services Provided by Buffer Strips Using Novel Technological Methods' (Grant No. 1305–00017B).

The BalticSea2020 foundation has one overarching goal: to turn around the negative environmental trend of the Baltic Sea by 2020.

Buffertech conducts research into how we can optimize the ecosystem services of buffer strips by constructing them in a differentiated and cost-effective way with the use of innovative management methods and technological solutions.

http://www.balticsea2020.org/english/alla-projekt/overgodning/eutrophication-ongoing-projects/268-integrated-buffer-zones

http://www.buffertech.dk/en/

LEVEL-ADJUSTED CONSTRUCTED WETLANDS (LACWS) – A NEW CONCEPT OF VIEWING NUTRIENT LEAKAGE

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Constructed wetlands (CWs) have been shown to be a cost-efficient environmental tool for reducing the transport of diffused leaked nutrients from arable land to recipients. In Sweden, approximately 10 000 hectares of wetlands have been constructed since 1990. The multi-functionality of CWs is also well-known and other ecosystem services apart from nutrient retention are e.g. flood dampening, production, biodiversity, irrigation and recreation.

However, the leaked nutrients are often viewed as an environmental problem, and not as the resource they really are. Efficient nutrient retention in CWs is often achieved by maximizing the wasteful process of denitrification (leading to a removal of nitrogen from the system) or by maximizing sedimentation (i.e. to lock particle-bound phosphorous in the CW) without plans to use the nutrient rich sediments.

The Rural Economy and Agricultural Society of Halland and Halmstad University have constructed a pilot facility to evaluate a new concept for purification of diffuse leakage from arable land. The pilot facility is a ´level-adjusted wetland´ which is a new type of wetland with focus on recirculation of nutrients, where the problem of nutrient leakage is attacked from a different perspective. In this pilot project the new level-adjusted wetland is optimized for re-circulation of nutrients within the wetland as opposed to earlier focus which have been on the resource wasteful process of denitrifikation.

The efficiency is expected to be high when permanently low water levels, that follow the raise in bottom level as sedimentation proceeds through the years, optimize sedimentation and where flow peaks can be infiltrated in specially designed infiltration banks. The wetland is constructed so that the contained nutrients easily can be extracted and used as fertilizers on adjacent fields.

The project is part of the efforts to find sustainable production methods for the agriculture and to contribute to our national environmental goals and the water Framework Directive.

ASSESSING THE EUTROPHICATION PROBLEMS OF THE SHALLOW LAKE LESSER PRESPA IN GREECE – A LANDSCAPE APPROACH

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Inputs of nutrients such as Nitrogen (N) and Phosphorus (P) are essential for profitable agriculture. However, their export via watershed runoff can accelerate the eutrophication of receiving fresh waters and the occurrence of associated periodic surface blooms of cyanobacteria (blue-green algae), especially during the summer months. Outbreaks of cyanobacterial blooms may pose a serious health hazard to animals and humans due to the co-presence of cyanotoxins such as microcystins which are produced by these algae. Eutrophication is identified as the main cause of impaired surface water quality of the shallow Lake Lesser Prespa – a Ramsar wetland of international importance in Greece. The constant fertilization of bean monocultures within the lake's watershed is considered to be a critical source of nutrients which affects the trophic status of the lake. Since 2013, a regular water monitoring program is carried out in order to develop a database over temporal and spatial scales that allow an adequate interpretation of landscape-scale of the biogeochemical processes influencing eutrophication of the lake. Results show that nitrate rich water is draining from the agricultural fields mainly through a drainage tile system especially during the periods of furrow irrigation while soil phosphorus have built up to levels that often exceed crop needs. Besides, perennial or temporary drainage streams along the tributary system are found to carry increased amounts of nutrients and thus contribute further to the cumulative nutrient input to the lake. Monitoring results from the lake system reveal elevated levels of chlorophyll and high densities of cyanobacteria during summer while an experimental approach shows that particularly nitrogen addition stimulated cyanobacterial growth and elevated concentrations of microcystins. In addition, investigations of the lake sediments suggest an internal nutrient release while oxygen depletion and even complete anoxia has been sporadically found within the deeper water layers. Supplementary research and experiments are in progress in order to understand the complex pathway of nutrient transport along the watershed-lake system and the critical interactions within the lake. Understanding the functioning of the system with regard to eutrophication processes will help in designing and implementing early nutrient management measures to diminish the nutrient input towards the lake and therefore will help to regulate the intensities of cyanobacterial blooms.

FISHPOND SEDIMENT – A NEW PERSPECTIVE OF NUTRIENTS RECYCLING IN AGRICULTURAL LANDSCAPES

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Fishponds are the most frequent type of stagnant water bodies of the Czech Republic. They naturally have a high retention potential for nutrients coming from non-point, diffusion and small point sources. High amounts of soil erosion particles and nutrients generated from these sources are deposited in fish ponds and ponds are thus available to nutrient recycling in agriculture landscape. Crucial role plays fish pond sediment, mostly containing high amount of nutrients. These nutrients (especially phosphorus) represent potential eutrophication risk for surface waters in the lower part of a river basin. From this point of view, fish pond harvesting is an important moment when high amount of suspended solids and particulate phosphorus is transported downstream. Current areal rape and corn growing together with unsuitable agricultural management and characteristic of field structure highly increase erosion of agricultural land. This situation results in high loss of soil particles rich in nutrients and decrease of soil organic matter as well as general soil fertility. It is therefore important to focus on possibilities to return nutrient rich fish pond sediment back in the field and refresh nutrient cycle in the landscape. New approach of nutrient recycling and effective landscape management will be discussed. Simultaneously, trial study of possible technological process of nutrient recycling from the fish pond sediment using suction dredger and geotextile bags will be presented. Proposed concept could reduce high level of surface waters eutrophication, decrease of water reservoirs infilling and also eliminate nutrients and soil particles loss from agricultural landscapes.

Acknowledgements: Research was supported by TA04020123-Technological process of recycling nutrients from the fishpond sediments using suction dredger, integrated station for flocculant dosing and geotextile bags for local application in micro-catchment.

ROOT OXYGEN RELEASE A KEY FOR HEALTHY PALUDICROPS AND CUSHION PLANTS DOMINATING BIOGEOCHEMICAL CARBON AND NUTRIENT CYCLING

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• Water-logging is a major threat to plant health and causes substantial methane emissions from crops and natural vegetation. Flood adapted plant species influence soil processes by releasing root exudates and degradable litter. This can increase methane production and nutrient availability. In contrast, little is known to what extent root derived oxygen caps methane and nutrient release. Our research tested which growth conditions are necessary to maintain oxygen release at sufficient rates to dominate rhizosphere processes such as methane oxidation and phosphorus adsorption.

• Root-methane-soil interactions were studied by comparing methane emissions, stock and oxygen availability in depth profiles below stands of cushion plants and paludicrops. We followed rhizosphere nutrient-availability along depth profiles in Ethopia, Argentina and the Netherlands. We investigated nutrient cycling by 15N field experiments and N:P ratios of plant organs.

• Cushion plants, Eriocaulon schimperi and Astelia pumila, formed extensive root systems up to 150 cm deep. Root biomass (3590 g.DW.m^{-2}) dominated the belowground biomass of cushion plants but resulted in a higher nutrient demand. Roots of paludicrops, Typha spec. and Phragmites spec., were in general shallow (< 70 cm) and root proliferation was sensitive to vertical nutrient availability. In contrast, soils surrounding cushion plant roots were depleted in methane and plant-available nutrients. Main finding is that methane emissions were then cut to zero high root densities promoting soil oxygen (> 1.5 mg.l^{-1}). High soil N:P ratios and low temperatures seemed major controls on root density and rhizosphere oxygenation. Increase in shallow root length was associated with higher 15N recycling

• Our study shows that roots of cushion plants and wetland biomass crops (Paludicrops) can dominate biogeochemical processes at the ecosystem scale given certain growth conditions. Oxygen release from the dense root biomass was sufficient to cause a thorough soil oxidation. Soil nutrient ratios seem promising in reducing greenhouse gas emissions from water-logged fields by tuning the root system architecture.

BIODIVERSITY

Keynote lecture 1
ISSUES ASSOCIATED WITH WETLAND BIODIVERSITY AND AGRICULTURE GLOBALLY, AND EXTENT OF AGRICULTURE IN RAMSAR WETLANDS

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Following the Millennium Ecosystem Assessment which identified the key role played by agriculture in the loss and degradation of wetlands the Ramsar Convention has initiated consideration of the links between

wetland biodiversity and agriculture globally. This includes identifying a set of questions that need to be addressed to understand the complex interactions given continued intensification and extensification of agriculture in its many forms. These cover social and institutional issues as well as the main drivers of adverse change, such as water pollution, land clearance and erosion. The Convention has investigated the importance of pesticides in wetlands, but not without dissension, and the importance of rice fields as wetlands. Further support was given to an analysis of case studies whereby local people depended on wetlands for subsistence. At the same time the importance of agriculture in wetlands has been shown by an analysis of the extent of agricultural activities in Ramsar listed wetlands. These analyses are combined to provide some guidance on how wetland conservation and the importance of agriculture can be considered given expected demands for food and fibre globally.

Keynote lecture 2
AGRICULTURE AND WETLANDS BIODIVERSITY IN THE MEDITERRANEAN BASIN, AN OVERVIEW

Jean Jalbert

Tour du Valat, research centre for the conservation of Mediterranean wetlands, Arles, France

Agriculture started some 11,500 years ago on the edge of the Mediterranean basin, in the Fertile crescent, and rapidly spread to the whole Mediterranean basin, modifying profoundly the landscapes and the biodiversity. As a result of the human interactions with the ecosystems, it is estimated that only 5 % of the Mediterranean area are not modified natural habitats.

Over the last century, the agricultural development had a major negative impact on Mediterranean wetland biodiversity through two main modifications:

- water abstraction: agriculture accounts for 82 % of the water abstracted in the southern rim of the Mediterranean basin, where water is scarce and coveted, and one third of this volume never reaches the crops they were intended to irrigate;
- land reclamation: agriculture is the main factor of wetland loss through the conversion of natural wetland habitats into farmland.

Agricultural development and intensification has been documented as one of the major threats to Important Bird Areas (IBA) and Important Plant Areas (IPA) in the Mediterranean.

However, a number of traditional or innovative agricultural practices prove to be favourable to wetlands biodiversity. Such examples can be found throughout the Mediterranean basin and have to be promoted.

WET MEADOWS RESTORATION AND MANAGEMENT AT LESSER PRESPA LAKE, GREECE

Logotheti, A., Koutseri, I., Malakou, M.

Society for the Protection of Prespa

Lesser Prespa Lake is surrounded by intensive bean cultivations; a monoculture first created in the mid 1970's through radical changes in the local primary sector such as the construction of a surface irrigation system. These changes led to the abandonment of the traditional management of the littoral zone of the lake, which decreased the total surface area of the wet meadows – the vital biotopes of the Prespa Lakes ecosystem. Wet meadows are important spawning grounds for fish and amphibians and serve as the main feeding grounds for aquatic bird species such as herons, Dalmatian pelicans and Pygmy cormorants. During 2002 to 2007, the Society for the Protection of Prespa implemented a LIFE project in order to improve the conservation status of the Dalmatian pelican and the Pygmy cormorant through the restoration and management of the wet meadows around the Lesser Prespa Lake (LIFE2002NAT/GR/8494). To achieve this goal, effective water management of Lesser Prespa Lake was a prerequisite, so as to ensure the maintenance of a high water level during spring. By reconstructing the sluice between Great and Lesser Prespa Lakes, water flow was regulated for both ecological and irrigation purposes, achieving proper functionality and efficient water management. Additionally, grazing with water buffalo and cattle, reed cutting, or a combination of grazing and cutting was applied systematically during the five years of the project. By 2007, 100 ha of wet meadows had been restored, up from just 33 ha recorded and existing in 2000. Moreover, the restoration and management of wet meadows has contributed to the re-nesting of the Glossy Ibis after 35 years of breeding absence in the area. In order to ensure the continuation of the management activities, a guideline document was written in 2007 with instructions on the restoration and management of the wet meadows around Lesser Prespa Lake. These instructions are followed annually and the results are presented to the Wetland Management Committee (WMC) every year. The role of the WMC has been catalytic for the effective management of the area because issues such as the management of water, vegetation, birds and fisheries, are discussed with the local stakeholders, who together make recommendations for the next hydrological year. Decisions are taken jointly to assure the conservation of the ecological values of the lake while taking into account the human activities carried out around the Lesser Prespa Lake.

PEATLANDS IN STEPPE AND FOREST-STEPPE REGIONS UNDER CHANGING CLIMATE AND HUMAN ACTIVITIES

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Peatlands are highly integrated and important natural ecosystems with specific regulation functions, characteristic biodiversity, high value for environment and welfare. These ecosystems are especially important in steppe and forest-steppe regions. They store water and regulate hydrology in headwa-ters and valleys of rivers and streams. Peatlands keep specific flora and fauna and support biodiversity far beyond their borders by regulation adjacent environment and providing temporary habitats for non mire species. Lands with wet conditions and relatively fertile peaty soils are characterized by higher vegetation productivity. This makes them attractive pastures especially under drying conditions but with much less resilience to stock as compared to mineral soils. Peatlands located in subhumid con-ditions are the key objects to be affected by desertification processes. The peatlands of steppe and forest steppe zone, originated under more favorable climatic conditions in the past are degrading progressively in many regions during the last decades, which is clearly seen in different regions of Northern Eurasia and correlates with the overall trend of peat increment decrease during warm periods within last 3 millenniums (Klimanov and Sirin, 1997). It is expected that carbon sink will likely decline under future climate conditions due to enhanced decay rates of soil organic matter and limited plant C uptake. Increased temperatures and transpiration rates will make soils much drier and desiccation of peat surfaces will make them more susceptible to erosion. During droughts, the upper peat layers are eroded by wind and during intense rainfall peat is moved down slope by water erosion with further release as CO_2 or CH_4 to the atmosphere. Human activities could increase the vulnerability of peatlands to climate change. The climate driven desertification of mires is strongly supported by over-pasturing, which leads to disturbance of plant and soil cover, and consequently to the mires drying up, peat degradation and fires. Wise use of peatlands, spatial planning, protection of mires within SPAs as well as restoration measures for disturbed peatlands could support their adaptation to climate change and mitigated it by saving carbon storage in peat and control GHG emissions. In steppe and forest-steppe regions peatlands are often not recognized as specific ecosystems and rising awareness about them is the key issue to save them for future.

IMPORTANCE OF WETLAND HABITATS WITHIN ARABLE LAND FOR BREEDING OF NORTHERN LAPWING

Václav Zámečník

Czech Society for Ornithology

Northern Lapwing is the most common breeding wader in the Czech Republic, despite this species is facing strong decline in numbers – from 1982 till 2014 by more than 80 %. That's why Czech Society for Ornithology decided to focus more in detail on this species to 1) get actual data about Lapwing breeding sites and 2) to explore new ways of protection.

One of the first steps was the establishment of working database aimed to register breeding grounds of Lapwing in the Czech Republic 2012. Volunteers were advised to search for breeding sites and visit them three times during breeding period (laying of eggs, hatching of chicks/laying of alternative clutches and hatching of chicks from alternative clutches). Totally, more than 3500 observations were inserted from 2012 till 2015 from around 1200 localities. Number of volunteers participating in the Lapwing monitoring was over 220. All these data have been put together with other evidence to explore breeding habitat of Northern Lapwing in the country.

Preliminary data shows that Lapwings prefer fields with presence of water or wet shallow depressions at the expense of dry flat fields. Around 70 % of recorded breeding sites were indicated by volunteers as at least partly waterlogged. Also numbers of estimated nests confirm that Lapwings concentrated more in those fields in groups with average of 3 nests compared to 2.3 nests in dry fields. More than 90 % of breeding sites with known history were occupied regularly and/or irregularly, regularly and/or annually breeding ground generated more than half of them. Also in this case, the waterlogged fields were preferred to dry fields – these represented around 75 % of regularly occupied breeding sites.

These findings were used for designing of new agri-environmental scheme for the protection of Lapwing breeding on arable land. Breeding sites of high importance were chosen with combination of three main conditions – minimum number of breeding birds, regularity of Lapwing breeding and presence of water. Farmers should be paid to leave the breeding sites out of management till mid-June and for cropping of special seed mixture beneficial for pollinators and other wildlife from mid-June till mid-July. This mixture should be ploughed at the end of the year. Establishment of small wetlands within farmland is strongly welcomed as it has positive impact not just for breeding lapwings but also for many other species.

TOWARDS AGRICULTURAL PRACTICES FAVORABLE TO WETLANDS NATURAL RESOURCES, LESSONS LEARNED FROM DOÑANA, SPAIN

E. Hernandez, F. Fuentelsaz, C. Peiteado

WWF Spain, Madrid, Spain

Donana is one of the Europe's most biodiverse enclaves, a strategic location for the routes of migratory birds, which makes it one of most valuable Ramsar site.

In Doñana, agriculture is an important socio-economic activities, with traditional crops such as grapes and olives, and others recently introduced, such as rice, citrus and crops that are farmed under plastic (strawberry, raspberry and blueberry etc.).

Meanwhile, intensive and mismanaged farming is the source of a number of environmental problems that threaten the biodiversity of the Doñana Natural Area and the future of farming itself, increasing the impacts of climate change and the need for adaptation.

WWF has elaborated a Handbook to explain some practical measures that could be implemented on farms surrounding wetlands to ensure the protection of natural resources. The main practices proposed by WWF are:

1. Ensuring the legality of farms. It is essential to have the appropriate licenses and authorizations for the use of water for irrigation, and also to comply with all current regulations on environmental matters.

2. Identify the natural values of the property. It is important to locate the property in relation to nearby protected areas and identify its natural values (trees, hedges, ponds, nests, etc.).

3. Improve the natural soil fertility. It is important to know the soil characteristics and, consequently, add organic matter through fertilizers, ground cover and plant remains, prioritizing their use against chemical fertilizers, improving soil structure to stop erosion and increase its water holding capacity.

4. Promote non-irrigated crops and Reduce water consumption in irrigated. It is important to achieve sustainable water use, optimizing irrigation and taking measures to prevent water pollution.

5. Avoid pesticides and promote natural biodiversity. Pesticides have an impact on the environment and also on human health. There are more natural ways to combat pests. A live agroecosystem is essential to increase biodiversity, and to get agronomic and environmental benefits

6. Optimize waste management. It is essential to establish the correct management of waste (plastics, packaging, cardboard, oil…).

7. Establish measures for adaptation and mitigation of climate change. Promoting the efficient use of energy and the protection of natural resources, among other measures

WWF Spain is convinced that there is another model to continue developing productive agriculture, while ensuring the conservation of natural resources in the long term. A model that combines corporate responsibility and respect for the environment, it also represents an excellent opportunity to market to an increasingly sensitized society, which demands quality products that are environmentally friendly.

RICEFIELDS WINTER FLOODING FOR WATERFOWL IN EUROPE: A MANAGEMENT TO BE PROMOTED?

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Ricefields provide foraging habitat to waterfowl, food availability being considered to depend on post-harvest practices. Generally, winter flooding of post-harvest rice fields has been identified as the most suitable waterfowl-friendly management that provides mutual benefits for ducks and farmers (e.g. studies in U.S and Japan). Whether similar mutually-beneficial outcomes exist in Europe was tested here. We first assessed if the average duck numbers at the flyway scale in five major European rice production regions were positively affected by winter flooding. Total wetland area (i.e., natural wetlands plus flooded ricefields) explained the number of ducks in a given winter quarter, but the proportion of ricefields flooded during winter varied considerably between countries (0.2–62 %), owing to the implementation of specific agri-environmental schemes in Spain. We then carried out an empirical study addressing seed availability and nocturnal duck use of c.a. 50 post-harvest ricefields with different agricultural practices in Camargue, France. An average of 350 kg/ha (± 58 SE) of rice and 142 kg/ha (± 21 SE) of weed seeds remained after harvest. Flooding was the main determinant of nocturnal duck use of the fields (23.5 ducks/ha ± 2.3 SE vs. 0.3 ± 0.1 SE if unflooded). We also experimentally tested the effect of wing-clipped ducks on the weed seed bank and straw stalk reduction, as well as the effect of winter flooding on the viability of weed seeds across the whole winter. The presence of waterfowl enhanced straw trampling and decomposition, but did not have any detectable effect on the weed seed bank. Flooding itself led to weed seed deterioration, which was species-dependent, red rice (*Oryza sativa* L.) being most affected by the practice. We completed a cost-benefit analysis (C/B) to evaluate whether winter flooding in France would be economically realistic considering constraints such as water pumping costs, agronomic and environmental advantages, and found that the alternative chopping-flooding-ploughing would be twice more profitable to farmers and more than four times more profitable for society than the traditional burning-ploughing (Ratio C/B for farmers: 1.02 vs. 2.08; for society: 0.78 vs. 4.19). Our study suggests that promoting winter flooding of ricefields in Europe would benefit both farmers and wintering ducks, is economically realistic, and should be promoted by agro-environmental policy wherever possible.

BIODIVERSITY OF WETLANDS ON ARABLE LAND IN ZNOJMO REGION

R. Němec

South Moravian museum in Znojmo, Znojmo, Czech Republic

Pulsatilla o.s., Znojmo, Czech Republic

Wetlands on arable land are specific habitats dependent on climatic conditions and an-thropogenic interventions. They develop in years with extraordinary high amounts of precipitation. This habitat often occurs in lowland basins and depressions, but it can also appear on slopes. Regular ploughing in years with low precipitation is another important factor enabling the establishment and maintenance of these kinds of wetlands. Znojmo region compared to the rest of Czech Republic is remarkable for its high diversity of natural conditions (climate, geological composition, soils), which is reflected in diversity of wetlands on arable land and their biota.

The main part of the research of vascular plants of the wetlands on arable land in the Znojmo region took place in 2009–2011. The years 2009 and 2010 were extraordinary precipitation-rich. A total of 243 wetlands were documented in the study area during field research. During the research was found 40 species listed on the national Red List, 7 of which are specially protected by the Czech government. Species of vascular plants in this habitat are characterized by high seed production, which retain a long germinability. Species of vascular plants growing in these types of wetlands in the Znojmo region can be divided into three groups. The first group includes annual and perennial sub-halophilous species (e. g. *Carex distans*, *C. secalina*, *Juncus ranarius*, *Veronica scardica*) occurring frequently in areas of former salt marshes. The second group includes species typical of exposed shorelines and bottoms of ponds and other water bodies (e. g. *Cyperus fuscus*, *Limosella aquatica*, *Veronica catenata*). The third group consists of weeds and other species that occur in habitats near to wetlands on arable land. Wetlands on arable land are important habitats also for bryophytes (e. g. *Riccia cavernosa*), birds (e. g. *Vanellus vanellus*), amphibian (e. g. *Pelobates fuscus*), large branchiopods (e. g. *Triops cancriformis*) or insects (e. g. *Chlaenius spoliatus*).

This type of habitat in agricultural landscapes represents a very valuable refuge for biota. To preserve wetlands on arable land, blocking of succession and maintenance of a favourable water regime is necessary. The most appropriate management seems to be common agricultural use in the years with usual amounts of precipitation. In the years with high precipitation, the area of wetland should be kept for one or two growing seasons without agro-technical interventions.

PALUDICULTURE

Keynote lecture 1
PEATLANDS AND PALUDICULTURE

Hans Joosten, Wendelin Wichtmann

Ernst Moritz Arndt University Greifswald and Michael Succow Foundation for nature protection, Greifswald, Germany

Conventional peatland agriculture and forestry is based on drainage, which enhances peat oxidation, causes massive greenhouse gas emissions and eventually destroys the peatland subsistence base. In contrast, paludicultures use biomass from wet and rewetted peatlands under conditions that maintain the peat body, facilitate peat accumulation and provide the associated natural peatland ecosystem services. In the temperate, subtropical and tropical zones, i.e. those zones of the world where plant productivity is high, peat is generally formed by roots and rhizomes, and peatlands by nature hold vegetation of which aboveground parts can be harvested without substantially harming peat conservation and formation.

Besides traditional yields of food, feed, fibre and fuel, the biomass can be used as a raw material for industrial biochemistry, for producing high-quality liquid or gaseous biofuels and for further purposes like extracting and synthesizing pharmaceuticals and cosmetics. Some outstanding examples are introduced, including low-intensity grazing with water buffalos, biofuels from fens, common reed as industrial raw material and sphagnum farming for horticultural growing media.

Paludicultures may support substantial co-benefits, including the preservation and sequestration of carbon, regulation of water dynamics (flood control) and quality, and conservation and restoration of typical peatland flora and fauna. They can provide sustainable income from sites that have been abandoned or degraded.

In many cases, paludicultures can compete effectively with drainage-based peatland agriculture and forestry, certainly when external costs are adequately considered. Various technical and political constraints, however, still hamper large-scale implementation of this promising type of land use.

Keynote lecture 2
WETLAND CROPS IN EUROPE?

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European crop farming is mainly based on plant species originating from relatively dry areas. Wet (waterlogged and/or inundated) fields have therefore been often drained to make them suitable for these crops. The situation is similar with managed European grassland (meadows and pastures). Irrigation systems are designed so that the water supply merely reduces or removes the losses of soil moisture resulting from evapotranspiration under the given climatic conditions. Hardly any serious attempts have been made to keep European agriculturally used land wet or water-logged while supporting productive agriculture. It is desirable to develop, hopefully relatively soon, by a combination of breeding and gene manipulation, new wetland crops (tolerant of water-logging or even temporary inundation) for the Temperate Zone, particularly cereals, with a nutritional value similar to that of rice. Such a development would help keep more water in the soil in agriculturally managed areas of Europe and other temperate territories and would contribute to maintaining a relatively humid and thus favourable mesoclimate in agriculturally managed landscapes. European nature offers several plant gene pools to that might be bred for high grain yields and suitable biological and agronomic features, enabling their economically feasible cultivation in wetlands. In Europe, it may be worthwhile to explore especially the breeding potential of grasses of the genus Echinochloa for this purpose. All such attempts must comply with the “wise use” (= sustainability) concept of wetlands use and management postulated by the Ramsar Convention. The present importance of wetlands for crop farming and grassland management is illustrated by the production potential and use of both spontaneously occurring and cultivated reed canary grass (Phalaris arundinacea).

WETLAND ENERGY – BIOMASS FROM REWETTED EXCAVATED PEATLANDS FOR BRIQUETTES PRODUCTION

W. Wichtmann [1], A. Haberl [1], C. Romanovski [2], S. Golovati [2], A. Butzhko [2], V. Pashinsky [2], V. Rakovich [3], N. Liashchynskaya [4], O. Sosinov [5], I. Zalesski [6]

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The Europe Aid funded project "Wetland Energy" implemented in Belarus by the project proponent the Michael Succow Foundation for the Protection of Nature (MSF) in a partner consortium with the International Sacharov Environmental University (ISEU), the Institute for Nature Management (IfNM) of the National Academy of Sciences, and Ltd Lida peat briquetting Factory (LPF) initiated a promising wet land use management in degraded peatlands (Paludiculture) for the generation of energy fuels from rewetted peatland sites.

Vegetation-ecological field surveys at the project pilot sites at Sporovsky Zakaznik, in Brest region and on grounds of LPF, in Grodno region yielded suitable species composition and biomass production rates of the reed and sedge dominated sites for the production of renewable energy fuels. A monitoring scheme had been set up for the vegetation and site development under regular mowing with site adapted harvesting technology. Laboratory analysis at ISEU and IfNM tested the quality of the biomass from the wet peatland sites regarding suitability for combustion and contents of ingredients. First results show that biomass from reed stands growing in rewetted, formerly partly excavated peatlands are suitable as a raw material for the production of briquettes and pellets. The lower calorific values are slightly lower but comparable to those of peat briquettes. Compared to peat the ash content of the biomass is lower. This demonstrates that in the production of energy briquettes and pellets peat could be easily replaced by biomass from reeds from rewetted peatlands.

POTENTIAL PALUDICULTURE PLANTS – A SYSTEM APPROACH ILLUSTRATING PALUDICULTURE DIVERSITY

Susanne Abel, Hans Joosten

Ernst-Moritz-Arndt University – Partner in the Greifswald Mire Centre, Greifswald, Germany

Paludiculture ('palus' – latin for 'swamp') is the productive use of wet peatlands in a way that the peat body is preserved. Paludiculture can combine the provision of essential ecosystem services of mires as carbon store, water regulator and biodiversity conservation with the production of useful biomass.

Various options for site-adapted land use on wet and rewetted peatlands have recently been developed and tested. These 'paludicultures' revitalize traditional forms of land use through new utilization schemes (e.g. reed cutting for insulation boards), or provide innovative products for growing market demands (e.g. biofuels). Next to the few well-established paludiculture plants, a wealth of wetland species is promising for paludiculture. The identification and description of such crops is essential for the wide implementation of paludiculture. The Database of Potential Paludiculture Plants (DPPP) was established to gather information on the variety of wetland plants with a potential for paludiculture. To date the database contains information on 1128 plant species, including 346 herb and forb, 410 tree, 145 grass, 184 shrub and 41 fern species as well as one genus of moss. The species are divided into seven utilisation categories: food, fodder, medicine and poison, raw material for industrial processing, fuel, decoration (ornamental plants, fragrance) as well as agricultural conditioner and substrate. For some 250 plant species the current potential for paludiculture is considered to be good because already a market exists for products made of the aboveground parts.

Paludiculture is a new and diverse land-use concept, with fundamental differences in design and implementation depending on the species cultivated and the crops produced. In practice it is useful to classify paludiculture systems on the basis of harvest time and permanence of the culture and to distinguish between: 1. annual plantings with one or more harvests; 2. permanent cultures with annual or periodic harvest; 3. Short-lasting perennial cultures with a final single harvest; 4. long-lasting perennial cultures with a final single harvest and 5. mixed cultures. The systems differ, amongst other issues, in their potential to preserve the peat body or to sequester new peat.

PRINCIPLES OF BIOMASS HARVESTING IN WET AND REWETTED PEATLANDS

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Peatland drainage causes peat degradation which results in high greenhouse gas emissions and a continuous subsidence of land. To avoid further land degradation the rewetting of peatlands is essential. New land use concepts like paludiculture; the use of wet and rewetted peatlands for agriculture and forestry, can raise new perspectives both for landowners and land managers, but also new challenges. The machine accessibility in wet or rewetted peatlands is restricted by the low bearing capacity of the soil. In fact there are many individual site specific technical solutions available, but it remains to be seen if these technologies are suitable for biomass removal at a larger scale. Repeated vehicular crossing for biomass removal can easily destroy the sward and make future harvesting impossible. This paper assesses the number of transportation trips needed for different harvesting approaches related to the productivity of sites, the cargo volume and the working width of the harvesting machinery. Whilst the potential for developing and improving the harvesting technology is still high, current data clearly reveal that harvesting technique, logistics and site infrastructure have to be considered in a fully integrated manner in order to realise land use change toward paludiculture at a large scale.

PALUDICULTURE IN A DRAINED MEDITERRANEAN PEATLAND: ENERGY YIELDS FROM ANAEROBIC DIGESTION OF COMMON REED (*PHRAGMITES AUSTRALIS* L.)

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Anaerobic digestion (AD) is one of the most mature technologies for biomass conversion. Currently, biomass from arable crops, and particularly from maize silage, is the reference feedstock for AD in Italy and Europe. However, these crops need relevant inputs and are poorly suited to marginal soils. Moreover, with the global increase in population, and thus in demand for food, feed, energy and raw materials, more productive land areas will be required. On the other hand, the cultivation of biomass on wet and rewetted lands (paludiculture) can comply with climate protection, water and nutrient regulation, as well as nature conservation. The aim of this study is to explore the potential for anaerobic digestion of common reed biomass (*Phragmites australis* L.), as a species that can be grown under conditions unfavorable to most other crops, combining bioenergy production with wetland management objectives.

The research was carried out within a project started in 2012 on a former drained peatland in the Massaciuccoli Lake Basin (Tuscany, Italy), where paludiculture was tested as a restoration strategy to mitigate eutrophication and subsidence. Common reed was harvested at five different times (May-September) before full senescence, aiming to maximize nutrient removal and to enhance biomass digestibility. Total solids (TS), volatile solids (VS) and ash content of the feedstock were determined, then biomethane potential was assessed by batch assay. Digestion parameters (e.g. Biochemical Methane Potential) were related to biomass quality (e.g. C/N ratio, fiber components) and the expected methane yields per hectare were determined according to biomass yields.

Overall, common reed showed good suitability to AD and the expected retention times were in line with those observed in other lignocellulosic feedstocks. Nonetheless, biomethane yields per unit area (2100–2500 Nm^3 CH_4 ha^{-1}) were markedly lower than those observed for substrates commonly used in AD. However, given the paludicultural context, several other aspects should be assessed (e.g. harvest timing with regard to crop lifespan and nature conservation, management of nutrients contained in digestion byproducts). Although it cannot be considered along the same lines as conventional biogas making, biomethane production from common reed is an interesting option, provided that sustainability is ensured and peatland restoration goals are achieved.

COMBUSTIBILITY OF BIOMASS FROM FIVE PERENNIAL CROPS CULTIVATED ON A REWETTED MEDITERRANEAN PEATLAND

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This study compared the combustibility of biomass of three perennial rhizomatous grasses (PRGs): Arundo donax, Miscanthus x giganteus, Phragmites australis, and two woody crops managed for short-rotation-coppice (SRC): Populus x canadensis 'Oudemberg' and Populus alba 'Dimitrios' tested as potential paludi-crops.

The project was carried out from 2012 on a former drained peatland in the Massaciuccoli Lake Basin (Tuscany, Italy), whose rewetting and cultivation (paludiculture) was tested as a possible restoration strategy to reduce eutrophication and subsidence phenomena.

Since the nutrient removal from the system was considered the priority leading to management choices, early harvesting of biomass was considered (September for PRGs and December for SRC).

Ash and water contents, concentrations of chloride (Cl), sulphur (S), nitrogen (N), phosphorus (P), carbon (C), hydrogen (H), calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na) were analyzed to evaluated the quality of that early-harvested biomass during the 2nd and the 3rd year after plantation.

From a general overview on all the parameters analyzed, SRCs seemed the most suitable for combustion.

All the tested crops showed significant lower critical element concentrations and ash content in the 3rd year after plantation, highlighting a general improvement of biomass quality.

SRCs showed lower values for all the above-mentioned parameters than PGRs in both years.

PRG biomass quality from the 3rd year after plantation was similar to grassland biomass harvested in summer (wet meadows).

Combustibility performances could be improved finding an optimal mixture between SRC and PGR biomass.

Although the concentrations of the most important critical elements (Cl, N, S) are higher than expected for all the crops, the calculated higher heating value (HHV) were promising.

BIOMASS PELLETS FROM REWETTED FENS: PRODUCTION, COMBUSTION AND ECONOMIC FEASIBILITY

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In Western Pomerania (NE Germany) the drainage of peatlands for agriculture causes an enormous amount of greenhouse gas emissions. Conversely, rewetting of peatlands preserves peat soils as a carbon storage. At the same time, plant biomass can serve as a regional renewable resource for bio-energy production. Compared to loose or baled biomass, pellets show better properties regarding storage, transport, handling and fuel homogeneity.

In this study biomass pellets of Sedges (Carex spp.) harvested in August, winter cutted Common Reed (Phragmites australis) and Reed Canary Grass (Phalaris arundinacea) were produced. Productivity and plant characteristics as well as combustibility were obtained. At lab scale mono as well as mixed pellets with pine chips were produced. At large scale 21t biomass was pelletized with a mobile mill. For all pellet types parameter of DIN EN 14961 for non-woody pellets were analysed. Combustion tests were run with pellets of Common Reed and Sedges on two small (< 100 kWth) and two large boilers (300/450 kW).

Finally, biomass pellets will be compared with fossil fuels from an economic perspective by taking into account the costs of harvesting, pelletizing, logistics and combustion.

CHANCES AND CHALLENGES FOR PALUDICULTURE IN THE NETHERLANDS

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In the future more and more peatlands will be rewetted and used for sustainable, climate smart agriculture. This rewetting restores a large set of ecosystem services, but at the same time adverse effects such as increased methane emissions and release of phosphorus have been linked to high water levels and the formation of shallow lakes. Therefore the European CINDERELLA project has started this year to broaden the scientific base of paludiculture and to inform stakeholders, researchers, famers and practitioners all over Europe.

Our goals within the project are to quantify the effectiveness of measures that reduce methane release and nutrient losses, establish paludiculture pilots and to create awareness in the Netherlands. This is will be done in co-operation with a landscape management organization (Landschap Noord-Holland) and a company specialized in innovative harvesting techniques in wetlands (Hanze Wetlands).

Experiments and field measurements will be performed to optimize water level, harvesting techniques and consequently nutrient turnover in rewetted peatlands. In the first year we will plant the first pilot site with Phragmites australis and Typha latifolia on peat meadows with different water levels. We will also focus on two important bottlenecks concerning the initiation of paludiculture.

Firstly, we have to know which soil quality is suitable for paludiculture. The peat soil must be in a certain optimal nutrient range after rewetting. When nutrient availability is too low, it will give poor yields, but when nutrient availability is too high, there will be a release of nutrients to the surroundings. To tackle this, we will gather data on nutrient availability in peat soils and do additional soil analyses in a nutrient gradient to find an easy to measure soil indicator for the release of P and N after rewetting. When this is combined with biomass production data, we will also get a soil indicator for optimal productivity at a certain water level.

Secondly, the young plant stage is an important issue. We will do experiments to optimise the germination of seeds, and to find optimal soil quality (nutrients and toxins), water level, and plant density during the initial stage.

The research in the first year will give a first overview of the chances and challenges for paludiculture in the Netherlands. Because an important part of the peatlands are below sea level, especially here paludiculture will be a valuable landuse to counteract the ongoing land subsidence and to reduce the increasing water management costs.

WETLAND ENERGY – SUSTAINABLE DEVELOPMENT OF FORMER EXCAVATED PEATLANDS IN BELARUS

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In the recent years globally public awareness increased for the environmental problems connected to drainage based peatland utilization. Rewetting and wet peatland management found general acceptance as efficient tools to mitigate greenhouse gas emissions and soil degradation in drained peatlands. Globally projects in many countries (e.g. Germany, Indonesia, and Canada) focus on the implementation of peatland rewetting in combination with innovative site adapted forms of land use on organic soils (Paludicultures).

In Belarus utilized and drained peatlands for agriculture, forestry and peat excavation sum up to 1,505,000 ha, more than 50 % of the total peatland area of the country. Nowadays 122,200 ha of these are cutover and abandoned from peat excavation; only 36,800 ha are still under exploitation yielding 4.4 Mill t of energy peat. A governmental modernization programme of the national energy sector promoted an increase to 8.8 Mill t until 2020 (Tanovitskaya 2011). This trend implies the urgency for alternative concepts for increasing the domestic energy supply with sustainable and renewable energy resources instead of the renaissance of a fossil energy resource – peat in Belarus.

The Europe Aid funded project Wetland Energy implemented by the Michael Succow Foundation for the Protection of Nature (MSF) initiates since 2012 in a partner consortium with the International Sakharov Environmental University (ISEU), the Institute for Nature Management (IfNM) of the National Academy of Sciences, and Ltd. Lida peat briquetting Factory (LPF) a promising Paludiculture approach for the generation of energy fuels from rewetted peatland sites. On grounds of LPF suitable wet sites with spontaneously developed reed beds harvesting biomass for the production of pellets and briquettes and sites for future rewetting and reedbed establishment had been identified by the project. LPF has invested in new and adapted technology and will together with the project partners optimise the harvest under wet conditions and the pelletting and briquetting of the biomass in the former peat based production line for energy pellets and briquettes.

CONSERVATION, RESTORATION AND CREATION OF WETLANDS

Keynote lecture
WHAT NATURE HAS JOINED, MAN SHOULD NOT TEAR ASUNDER

Bent Lauge Madsen

Retired senior biologist at Ministry of the Environment, Denmark (Retired 2001)

"Nature, to be commanded, must be obeyed" stated Francis Bacon in 1620. Regardless of this wisdom, few, if any, streams in the Danish fertile lowland have evaded man's desire to rule them against the stream's own wishes (its own rules of behaviour). As a consequence, many detrimental side effects such as deteriorated habitats, excessive flooding-events, and unstable stream channels, are well known. Rather than dwell on such problems, I will present some solutions. Over the last 35 years, in many Danish streams, we have turned the tides of deterioration. Still, we are not at the end of our endeavour, rather we are at the end of our beginning.

A vast body of legislation regulates streams in Danish agricultural landscapes. Up until 1982, the focus had been on the protection of man and property, with efficient drainage as the top priority. But then Denmark decided, long before the EU Water Framework Directive, that streams should be something more than just gutters to take water away. In 1982, the Danish government adopted a new water course legislation that drew attention to the nature of streams, considering both physical as well as biological stream structures. Stream quality assessment should henceforth encompass five dimensions: clean water, sufficient discharge, varied in-stream physical qualities, and lateral and longitudinal continuity. Crucial to the implementation of such a vision is that stakeholders should fully participate in all stream projects: landowners, regional politicians, river-keepers, recreational users, etc. We convert our knowledge into ambitious but realistic objectives, formulated in unequivocal, measureable, and visible terms. An example would be the expected numerical increase in a trout population compared to an optimal population. Ambitions must be realistic with respect to the present constraints: some stream and floodplain changes are irreversible.

The science and skills behind re-establishing in-stream habitats are already well known. We know the habitat requirements for trout, for example. We know the interaction between fluvial forces and a stream's own 'ecological engineers'. Evidence of a stream's own capacity for self-healing and self-sustainability is accumulating: assist the current flow to create and hone the in-stream quality.

However, not just in-stream qualities are at stake. The involvement of the totality of the stream - its catchment - most realistically the floodplain, is essential. We are now in the process of re-joining the longitudinal and transversal continuities that mankind has torn asunder in the past. The greatest challenge is to gain an acceptance for the transition of floodplain areas: from farming land use to hydrological land use. The increasing public awareness of the fact that: many small flooding events upstream can prevent large flooding from happening downstream goes hand in hand with the saying of Francis Bacon and the Danish visions from 1982: obey the stream's own rules.

RE-ESTABLISHED WETLANDS IN STREAM SYSTEMS: A THREAT TO SALMONID FISH?

Kaare Manniche Ebert

Danish Sportfishing Association

During the last century, Danish intensive farming had greatly deteriorated stream habitats for the former dominant sea trout (Salmo trutta, Linnaeus 1756). Forty years ago it had almost vanished from Danish streams. Since then, an intensive and concerted effort has turned the tide: weirs and dams that barred its reproduction journey from sea to stream have been removed by their thousands. Lost spawning areas have been re-established. Habitats for young sea trout have been re-created: for example, by remeandering straightened streams, laying down gravel and some bigger stones, and by performing a modified cutting of weeds

The main objective has been to re-establish sustainable trout populations. However, alternative objectives have dawned: streams are more than simply biodiversity, they are conduits for water and nutrients.

Streams transport substantial amounts of nitrate - leaching from agricultural fields - to the estuaries and open sea. While nitrate has no negative effect as such within Danish streams, it is a limiting nutrient in the marine environment, resulting in eutrophication and oxygen depletion. The nitrate-rich stream water has a short retention time because the streams are short; no place in Denmark is farther than c. 60 km from the sea. The denitrification process, which removes nitrate to the atmosphere as nitrogen, is poor. In order to increase the retention time for enhancing nitrate removal, we have been re-establishing former meadow lakes in the stream, or we have constructed new lakes and wetlands.

However, permanent meadow lakes in the stream system have an adverse effect on our upcoming trout populations: when the young trout (as smolt) pass a meadow lake on their migration to the sea, they get confused and stop migrating. In the meadow lake they fall victim to pike, cormorants and other piscivorous birds. We have cases where more than 90 % of a migrating generation has vanished in this way.

The value of meadow lakes, not only for nitrate removal, but also for the prevention of floods, is undisputed. However, we are looking for solutions that minimize the losses during smolt migration. The only promising approach so far has been to narrow the water inlet to the wetland and to place the connection between the stream and wetland in such a way that migrating smolt can only swim into the lake with great difficulty, and thus remain in the main stream current. In one case, we have seen a new survival rate of 99 %.

CNIDION DUBII MEADOWS IN LOWER ODRA VALLEY NATIONAL PARK, GERMANY – CHANCES FOR DEVELOPMENT

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Cnidion meadows in central Europe mainly occur in the valleys of lowland rivers characterized by strong annual water-level fluctuations. In the past, these meadows were largely under low-intensity use (mowing and grazing); today, many river valleys are regulated, the area of naturally-flooded habitats has markedly decreased, and Cnidion meadows are endangered and in need of protection. The floristic definition of Cnidion meadow is different in Germany and Poland: it makes the Odra river valley an interesting model to compare the approaches to Cnidion meadows in these two countries.

Our research is part of a testing and developing project for the conservation of characteristic birds and vegetation of alluvial meadows (2011-2015). Here, we present data on the floristic condition of Cnidion meadows in the Lower Odra Valley National Park (Germany). Their fragments of different floristic quality occur in three polders, which are flooded in winter, pumped out in spring and rather dry in summer. To detect plots of the best value they were compared to meadows from two Polish Natura 2000 sites: Middle Odra Valley (Dolina Środkowej Odry) and Lower Odra (Dolna Odra). These meadows are subject to unregulated flooding. In total, 139 floristic relevés (25 m2) were analyzed. We also included various environmental data (e.g. elevation, P content in the soil) and the previous land use.

Cnidion meadows in the lower Odra valley (both Polish and German sites) show floristic differences to those in the middle Odra valley. Some of the plots in the National Park have no Cnidion meadow characteristic species, but they are suitable as potential sites.

The transfer of Cnidion diaspores has been tested on 7 transects. Diaspores of *Allium angulosum*, *Cnidium dubium*, *Galium boreale*, *Gratiola officinalis*, *Inula britanica*, *Sanguisorba officinalis*, *Veronica longifolia* and *Scutellaria hastifolia* have been used. Before sowing, the soil was prepared by harrowing. Cnidion transfer sites were mown or grazed in the second year after sowing. Recruitment was very diverse depending on site conditions (fertility of soil, length of flood, plants with dense stolon expansion from nearby sites, height of litter layer, weather conditions). Compared to other studies, these results confirm the significance of open patches of bare soil in the sward of the meadow in seed recruitment.

FITNESS, PLASTICITY, AND THE ROLE OF THE DIASPORE BANK OF THE SEMIAQUATIC CYPERUS FUSCUS IN NEAR NATURAL AND SECONDARY HABITATS

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Cyperus fuscus is a small, annual sedge originally growing on muddy river banks. The species itself is not very rare, but it is a typical representative of the rare and declining plant communities of dwarf rushes (Isoëto-Nanojuncetea). These habitats are flooded during periods of high water levels. In periods of drying up, the fast-growing species emerge out of the soil diaspore bank. Near-natural habitats on the river banks and sandy or muddy deposits are threatened in Europe, but traditionally-used man-made fish ponds, with a main distribution in the Bohemian Massif, and even artificial fish storage ponds, can be suitable secondary habitats for these species. Our aim is to shed light on the role of the diaspore bank in the life cycle of C. fuscus and the importance of secondary habitats.

We investigated 38 localities pertaining to three habitat types (near-natural, fish ponds, and fish storage ponds) in the Czech Republic, Poland, Austria and Slovakia. We collected 36 plants from every study site and measured their biomass and other traits relating to fitness, and collected soil samples from two depths. A germination experiment and an environmental manipulation experiment were performed to investigate genetic differences among sites or habitat types. To this aim, we grew plants of *C. fuscus* from the two soil depths (diaspore bank), as well as field-collected ripe seeds, from every site. These plants were self-pollinated for one generation. The germination test was performed on 225 selfed mother plants. A total of 1350 plants were used in a flooding experiment with three different water levels to examine the plasticity of growth of this flood-tolerant species and the potential genetic fixation of growth features among plants from different habitat types and origin (soil seed bank versus recent above-ground population).

Fish ponds are very suitable habitats for *C. fuscus*, with plants from fish ponds performing as well as those from near-natural river habitats. Plants from fish storage ponds have a poorer performance, a difference that holds true for traits measured in the field as well as in the experiment. Moderate flooding positively affects the growth of *C. fuscus*. Moreover, plants from near-natural habitats, which face more irregular changes of water level than the anthropogenic habitats, respond better to frequently changing water levels. Seeds from the diaspora bank showed a higher germination speed then the above-ground fraction but didn´t differ in growth.

Whether these differences are genetically fixed is the subject of further investigations.

LIFE FOR WETLANDS IN AGRICULTURAL LANDSCAPES – EXAMPLES AND BEST PRACTICE

L. Trokanova

LIFE Programme Communications Team

NEEMO-AEIDL, Brussels, Belgium

Established in 1992, the LIFE programme is the European Union's funding instrument exclusively devoted to the environment. The LIFE Nature and Biodiversity strand has co-financed more than 1,400 projects, providing more than € 1.5 billion in funding, and mobilising a further €1.3 billion in other contributions. This continuous source of targeted financing has radically changed the capacity of many countries to designate and manage Natura 2000 network sites, to support EU Biodiversity Strategy and to implement EU water policy and legislation.

Some 400 projects co-financed by LIFE have targeted wetland habitats and bird species included in the EU Habitats and Birds Directives. Indeed, wetlands have been one of the habitat types most-frequently targeted by LIFE. In addition, more than 1000 other LIFE projects have addressed threats (to water quality and water levels) and management issues in wetlands. LIFE project actions on wetlands range from river basin management (Water Framework Directive - WFD) to restoration and management of protected sites and habitats. Most LIFE projects targeting habitat restoration have enabled the concerned sites to achieve favourable conservation status.

The LIFE 2014-2020 Regulation (EC) No 1293/2013 establishes the Environment and Climate Action sub-programmes of the LIFE programme for the next funding period, 2014–2020, with the budget set at €3.4 billion in current prices. The 'Environment' strand of the new programme covers three priority areas: environment and resource efficiency; nature and biodiversity; and environmental governance and information. The 'Climate Action' strand covers climate change mitigation; climate change adaptation; and climate governance and information. The LIFE programme for Environment and Climate Action plays a catalyst role to promote the implementation and integration of environmental and climate objectives in other policies and EU Member State practice.

The new LIFE programme for Environment and Climate Action highlights wetlands as a priority for funding, specifically targeting improvement of the conservation status of Natura 2000 network sites, WFD implementation and Climate Change Adaption strategies.

This communication will present some nature conservation examples and best practice from successful projects addressing wetland issues in agriculturally-managed landscapes in the European Union, with the aim of contributing to their active dissemination and the new LIFE programme approach for 2014-2020.

RESTORING A RAISED BOG – A VIEW FROM A BIODIVERSITY AND CLIMATE PERSPECTIVE

P. Hahn

Danish Nature Agency, Ministry of Environment, Denmark

Active raised bogs have declined significantly in area and number in north-western Europe as a result of large-scale peat exploitation.

Lille Vildmose in Northern Denmark comprises the largest, intact, lowland raised bog in north-western Europe. Due to extensive peat mining and drainage for agricultural purposes in the preceding centuries, the area of active raised bog has been reduced from 5500 ha before exploitation to 2000 ha today. Subsequently, a widespread lowering of the groundwater table has led to large-scale invasion of trees, grasses, scrubs and herbs - and a direct desiccation of the remaining intact bog. However, Lille Vildmose still holds an important flora and fauna characteristic of large bogs.

A Nordic-Baltic wetland initiative funded by the Nordic Council of Ministers emphasizes that peatlands in the Nordic Baltic region, as elsewhere in the world, store large amounts of carbon and that the restoration of drained peatlands makes an important contribution to mitigate greenhouse gases.

Since 2011 a range of restoration activities funded by the EU LIFE+ programme have been carried out in Lille Vildmose with the aim of conserving the remaining intact bog and restoring the natural hydrology in the drained and exploited area. Parallel to this project, Lille Vildmose was in 2013 designated as a Wetland of International Importance (Ramsar Site), using for the first time a criterion highlighting the important role of peatlands in climate regulation.

The presentation of the LIFE+ project in Lille Vildmose will give an insight into some of the technical actions for conserving and restoring the raised bog and put biodiversity and climate regulation into perspective.

WETLANDS RESTORATION IN FARMLAND OF DANUBE LOWLAND IN SLOVAKIA

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The Danube lowland has changed significantly during the 20th century due to agricultural and water-management interventions. Vast wetlands that once covered an area of the inner Danube Delta in the vicinity of the river's branched fluvial system were drained through networks of drainage/irrigation channels, ploughed up and turned into arable land. Nowadays, the remnants of wetlands provide refuges for endangered flora and fauna in this region. Restoration works were thus carried out by the Regional Association for Nature Conservation and Sustainable Development (BROZ), within two LIFE projects, focused on the conservation of feeding and nesting habitats of various bird species and the marsh habitats of endemic species to Danube lowland, e.g. Mehelyi's root vole (*Microtus oeconomus mehelyi*).

This presentation will summarize the practical measures that have been taken, the cooperation with stakeholders, as well as the problems encountered and their solutions. We will present four model sites as examples of successful restoration; these are chosen from different types of habitats, from lowland wet meadows and pastures to reed beds and marshes, to present different implementations of restoration methods and approaches to nature conservation.

CAN WE MITIGATE THE NON-POINT POLLUTION IN AGRICULTURAL LANDSCAPES BY REWETTING OF PEATLANDS?

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The eutrophication of lakes and rivers is still a serious problem in most regions of Europe due to non-point source phosphorus (P) and nitrogen (N) pollution from intense agricultural land use. One strategy to improve water quality, as required by the EU Water Framework Directive, is to restore natural nutrient sinks like minerotrophic peatlands, i.e. fens. Originally, they covered about 495,000 km^2 of Europe, or 5 % of the total land area. An even higher proportion, more than 10 %, was found in northern Germany, where fens once acted as important buffer zones between agriculturally-used mineral soils and water ways. In order to restore their functions as sinks for nutrients and carbon, as wells as habitats for rare plant and animal species, more than 20,000 ha of degraded fens have been rewetted in NE Germany. However, due to non-reversible changes of peat characteristics and substantial soil subsidence, rewetted fens often become eutrophic shallow lakes with an average depth of less than 1 m. During the last 15 years we have made a number of field and lab investigations in numerous different degraded and natural fens to evaluate the effect of fen rewetting on the restoration of lost ecosystem service functions. On the one hand, we found that rewetted fens immediately become N sinks: nitrate removal was exceeding markedly the release of reduced inorganic and organic N forms. On the other hand, rewetted inundated fens were characterized by elevated mobilization of P, dissolved organic carbon and methane - counteracting their re-establishment as P and C sinks. However, we also found that helophytes may compensate for the high P mobilization in water-saturated peat soils and that a major proportion of P and C will be trapped in newly-formed sediments. This new process of matter retention was found to sequester ten times more P, C, and N compared to peat growth (the major retention process in naturally percolating fens.) One effective strategy to accelerate the former nutrient-poor conditions and to minimize methane emissions is the removal of the upper degraded peat layer before fen rewetting; however, it would add tremendous costs. Overall, the findings of our research are helpful to make some predictions on the succession of nutrient and carbon dynamics in rewetted peatlands and to advise water authorities how to achieve restoration goals.

LARGE BRANCHIOPODS IN PERIODICALLY-FLOODED FIELD WETLANDS: A CHALLENGE FOR NATURE CONSERVATION IN EPHEMERAL AGRICULTURAL HABITATS

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Periodically-flooded pools on arable soil are suitable habitats for many interesting organisms, including plants, invertebrates, amphibians or birds. Among these organisms, large branchiopods (Branchiopoda: Anostraca, Notostraca, Spinicaudata) belong to the one of the rarest and most endangered animal groups in the whole of Europe. In the Czech Republic, the occurrence of six species of large branchiopods is known from ephemeral field wetlands. In order to survive long-term in these unstable habitats they have some unique adaptations, such as rapid life cycles or effective mechanisms of spread.

What is their current situation? Today, one major threat for them is the absence of disturbances (ploughing, trampling by livestock, traditional human management) in key habitat areas, such as in larger river floodplains or military training areas. The most problematic issues on areas of arable farmland are: field drainage schemes; filling-in of field depressions; absence of ploughing; and the use of chemicals.

How should conservation agencies act to improve the long-term survival of such rare ephemeral organisms? Although large branchiopods are protected by law and classified as threatened in the red-data lists, their conservation in wetlands in agricultural landscapes is quite problematic, since it is usually not possible to protect their localities by site protection and, furthermore, they require specific management. There is therefore an urgent need for further research into their biology and ecology in these conditions. An agro-environmental programme targeted towards suitable management for the protection of large branchiopods on arable farmland in Europe is thus necessary – in order to help preserve the occurrence of these “pilgrims in time and space” both now and in the future.

LEGISLATION AND POLICY

Keynote lecture

FRAMEWORK FOR WETLANDS IN DENMARK – POLICY, LEGISLATION AND PRESENT CHALLENGES

M. Kirkebaek

National wetland administration, Copenhagen Denmark

Construction of wetlands have now been going on for several years in Denmark. After a longer period where many wetlands were drained in order to improve agriculture production, wetlands have since 1989 been used to create new nature values, improve possibility for outdoor activity and solve problems with nutrient leaching from agriculture. A legislative set-up has been established and improved over the years. In combination with different levels of funding from the state and political back-up, many wetlands have been established on voluntary basis. Also EU-funding has been activated in later years in order to implement the EU-waterframework directive (WFD). New challenges and agendas are now popping up. This speaker looks into the developing story of wetlands in Denmark and gives an overview of the future challenges and possibilities. Based on experiences it also gives some thought on what should be in place in order to succeed in making a large scale wetland initiative succeed.

EU POLICY : OBSTACLES AND INCENTIVES TO WETLAND REHABILITATION AND PALUDICULTURE

V. Coelho, M. Silvius, B. Tinhout

Wetlands International – European Association, The Netherlands

Wetlands are of tremendous importance to sustain biodiversity, produce food and raw materials and regulate the water and carbon cycles. These remarkable ecosystems, however, have often been regarded as wastelands and been converted to conventional agricultural use, which requires drainage.

Peatlands are wetlands with carbon-rich organic soils. Agriculture, as well as forestry and mining, has so far degraded about 25 % of the natural peatlands on Earth, with most of this degradation typically stemming from drainage. Drained peatlands lose their intrinsic properties in terms of water storage and regulation, and emit enormous quantities of CO_2. Unlike the emissions associated with forest clearance, which are largely instantaneous, the emissions from drained peatlands continue for as long as the peatland remains drained and the peat keeps oxidizing. This can continue for decades and even centuries.

Globally, drained and degraded peatlands contribute circa 5 % of all anthropogenic CO_2 emissions. In the European Union (EU) agriculture on drained peatlands represents only 2 % of the agricultural land, but it accounts for over 70 % of agricultural soil GHG emissions.

EU policies on agriculture, climate and energy are inadequate to prevent peatland drainage and degradation. The Common Agricultural Policy (CAP) actively prevents the rewetting and restoration of drained peatlands, as these would then no longer be considered to be in good agricultural condition". Climate and energy policies create additional demand for bioenergy, but fail to prevent agricultural expansion into peatlands inside and outside Europe – meaning that some of the bioenergy currently used and subsidised in the EU actually causes more GHG emissions than fossil fuels.

Apart from the climate impacts, peatland drainage also leads to soil subsidence. In lowlands in Western Europe this has led to high costs to protect these areas from flooding by building polders and dikes in combination with pump-operated drainage systems.

Paludiculture is a sustainable alternative that combines peatland rewetting for climate change mitigation and productive use. Over the past decades several forms of paludiculture have been piloted in Europe: Sphagnum (as an alternative for peat in growing media), Alder and willow (timber or biomass), Typha (fodder or insulation material), elephant grass and sedges (fodder or biomass), cranberries and wild rice (food). These have shown potential to enhance financial and environmental returns from investing in peatlands with lower costs for water management and infrastructure maintenance. What is missing is a policy framework to incentivise the upscaling and market penetration of these pilot initiatives.

FINANCIAL INSTRUMENTS IN NATURE AND LANDSCAPE MANAGEMENT IN THE CZECH REPUBLIC

P. Trnka

Nature Conservation Agency of the Czech Republic, Prague, Czech republic

Operation Programme Environment (OPE)

The Operational Programme aims to protect and ensure the quality of the living environment of the Czech population, promoting the efficient use of resources, eliminating the negative impacts of human activities on the environment and climate change mitigation. For the next few years nearly €2.637 billion from the Cohesion Fund and the European Regional Development Fund have been earmarked for applicants.

Priority Axis 1 Improving water quality and reducing flood risks and Priority Axis 4 Protection and care for nature and landscape.

Applications may be submitted only in the framework of open tenders announced for the corresponding specific objective according to the nature of the project. Individual tenders for funding applications are announced by the Ministry of Environment (through the State Environmental Fund of the CR and the Czech Nature Conservation and Landscape Agency).The programme is open to municipalities, organizations, state and local governments, research and scientific institutes, educational establishments, legal and physical entities and non-profit organisations. A full list for eligible applicants concerning individual types of supported projects and activities, the conditions for funding applications and more detailed information is provided in the OP Environment 2014–2020 Programming Document.

LIFE + Programme

Priority Area I – Nature and Biodiversity

The subvention programme/subsidy scheme focuses on comprehensive, innovative, multi-year projects aiming at Natura 2000 sites: eligible applicants/beneficiaries include a wide range of legal persons.

Landscape Management Programme (LMP)

Sub-programme for endangered wild animal management and ill, injured or orphaned wild animal care

The subvention programme/subsidy scheme is targeted mostly to smaller non-investment actions with the possibility of multi-year contracts, focusing on SPAs and specially protected wild animal and plant species. The State Nature Conservancy authorities, land owners and tenants are eligible to apply for the subsidy. The LMP is partly focused on the whole Czech Republic´s territory and on a wide range of applicants/beneficiaries.

Landscape Natural Function Restoration Programme (LNFRP)

The subvention programme/subsidy scheme is focused on smaller (even multi-year) investment actions, where some parts of the subsidy aim at SPAs and specially protected wild animal and plant species, while other at the whole Czech Republic´s territory. For financing measures focused on SPAs and specially protected species, the State Nature Conservancy authorities are eligible. In addition to the above mentioned subvention programmes/subsidy schemes, the Flood Control Measures II and Fish Pond and Water Reservoir Restoration, Mud Removal and Recovery subvention programmes/subsidy schemes should also be mentioned.

Rural Development Programme

Priority Area/Axis II – Agri-environment schemes, forest environmental measures, payments within the Natura 2000, the EU ecological network composed of the most significant areas of conservation of species and habitat types and payments on agricultural and forest lands

The axis is targeted at non-investment actions within the period of up to 5 years, repeated every year and on payments for compensations for damages caused by nature conservation provisions in agricultural, forestry and fishpond management. The support is focused on the whole Czech Republic´s territory on the one hand; on the other hand it aims at rich-grasslands that are set within the Land Parcel Identification System (LPIS) and on Natura 2000 sites. The eligible applicants/beneficiaries are agricultural and forest managers.

Fishery Operation Programme

Priority Area/Axis II – Aquaculture

The subvention programme/subsidy scheme aims at compensatory payments, eligible applicants/beneficiaries are fishpond owners. The target is to maintain the fish production on a current level by using more environment-friendly methods and to enhance conditions for fish farming and water quality.

A “signpost” with the detailed and permanently updated information on all subvention programme/subsidy schemes in nature conservation and landscape protection in the Czech Republic can be found at www.dotace.nature.cz.

STAKEHOLDERS, VIEWS ON WETLANDS

Keynote lecture

INTEGRATING WETLAND CONSERVATION AND RESTORATION INTO AGRICULTURAL PRACTICES TO PROMOTE SUSTAINABLE DEVELOPMENT OF AGRICULTURAL LANDSCAPES

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Reversing the inverse relationship between the decreasing global wetland extent and the increasing global agricultural area is an urgent need because both types of ecosystems have essential roles for the sustainability of the planet. Wetlands accumulate important carbon stocks, between other key functions, and agriculture provides food for the world population. Both wetland and agricultural areas experiment heterogeneous dynamics throughout the world. An increasing number of developing countries incorporate wetlands as protected areas and continue suffering adverse biophysical and socio-economic conditions for agricultural practices. In other areas of the world intense chemical fertilization, land cover homogenization, and groundwater abstraction, contribute to the loss of wetland area and quality. However, some initiatives have demonstrated the value of developing agriculture integrating wetlands and biodiversity conservation for the benefit of the population development and the sustainability of land and resource use. Wetlands are used in Uganda to provide food for populations and alternative products which diversify the socio-economic activities contributing to poverty alleviation and development. Mangrove restoration is performed in tropical and subtropical countries with the work of local people who get jobs and ensure food and raw material provision. Fish ponds in central Europe have been successfully managed for fish provision and other services for centuries. In contrast, extensive zones of the European continent, including large wetland areas, have been drained and desiccated for agricultural purposes but the results are far from the expected socio-economic sustainability because the security for food provision and to obtain economic benefits depends on many global factors. Increasing deforestation in the tropical South American basins threatens wetlands and the populations living on them. The global recovery of wetland functions and values would be a very positive income of ecosystem services for the humanity. Integration of wetland conservation and restoration in agricultural areas and practices can be performed at low direct cost, it can provide jobs for local people, diversify the economic activities of a region and ensure complementary ways of development. Between 3–5 % of the land in intensive agricultural areas would be enough to decrease the impacts of intensive agricultural practices, while the improvements of biodiversity and landscape diversity would contribute to provide a full set of balanced services. Furthermore, the integration of wetland conservation and restoration into land planning and use would contribute to establish a sustainable and desirable future in front of the uncertain impacts of climate change and other global changes agricultural based societies.

POND CONSERVATION MEETS ECOSYSTEM SERVICES IN SOUTHERN SWEDEN

Rebecca I. A. Stewart [1, 2], **Georg K. S. Andersson** [1], **Christer Brönmark** [2], **Björn K. Klatt** [1], **Lars-Anders Hansson** [2], **Valentina Zülsdorff** [2], **Henrik G. Smith** [1]

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Many small farmland ponds are built for purpose, such as nutrient retention, conservation of biodiversity or both, yet they are also relatively neglected habitats. Little is known about the potential for ponds to deliver ecosystem services across the aquatic-terrestrial boundary and whether they influence populations of beneficial terrestrial insects and thus, crop yield for landowners and farmers.

We present two studies designed to test how ponds might provide ecosystem services across the aquatic-terrestrial boundary in the agricultural landscape; we conducted a pollination field experiment, to assess whether the presence of a pond affects the abundance of pollinators and has an effect on quality and quantity of crop yield. We compared the abundance of bees and syrphid flies and the quality and quantity of strawberries (Fragaria x ananassa) between pond-dominated habitats, a heterogeneous habitat dominated by natural vegetation and a control, homogeneous habitat dominated by cropland. Secondly, using the same study design, we sampled spiders, their webs and the prey community with the aim to identify and quantify the spiders and their prey, next to ponds, in wheat fields and in natural vegetation.

In the pollination study, results show that the abundance of bees and syrphid flies was significantly affected by pond and vegetation habitats, relative to the control habitat. The quantity and quality of strawberries was also significantly higher in the complex vegetation and pond habitats, compared to the control habitats. Results from the biological control study show an increased number of spiders that prey on pest species next to ponds compared to vegetation alone.

The results from both studies strengthen arguments for the creation, maintenance and conservation of small freshwater habitats in the agricultural landscape. Hence, we advocate that the management of ponds in the agricultural landscape should be considered to be a multi-functional tool that is useful to stakeholders, beyond nutrient retention or water storage and one that could further increase productivity of insect pollinated crops.

NORFOLK PONDS PROJECT: STAKEHOLDER'S VIEWS OF FARMLAND PONDS

H. Greaves, C. Sayer

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Norfolk holds more ponds than any other English county with an estimated 23,000 present. Most of these ponds are located in farmland, and have their origins as marl or clay pits and in some cases livestock-watering ponds dug in the 17th to 19th centuries.

Ponds can provide vital clean freshwater environments in farmland and are vital habitats for aquatic biodiversity covering plants, invertebrates, amphibians, fishes, and mammals. Recent pond studies conducted by University College London (UCL) also show high quality ponds to be important for farmland birds, likely through the provision of insect food.

While the wildlife benefits of farmland ponds are significant, they remain threatened by land reclamation, widespread encroachment of trees and scrub, pollution and invasive species. Indeed ponds in Norfolk's farmland have been greatly neglected over the last 50 years and many have become overgrown with trees or have been in-filled to create more agricultural land.

In light of these issues, in June 2014 the Norfolk Ponds Project (NPP) (www.norfolkfwag.co.uk/norfolk-pond-project/) was launched. Working as a collective on the project, project partners (University College London, Norfolk Wildlife Trust, Natural England, FWAG, Norfolk Rivers Trust, Norfolk Non-native Species Initiative, Norfolk Biodiversity Partnership, Norfolk County Council Monuments Management Project and the Norfolk Freshwater Study Group) aim to reverse the decline of Norfolk's ponds so that agricultural landscapes contain a mosaic of clean water ponds with fewer ponds overgrown by trees and bushes. Three of the ways it seeks to achieve this are by:

1) Providing advice to landowners on how best to restore and manage ponds in farmland;

2) Educating the public and farmers on the value of ponds in farmland through site visits and open days, and;

3) Establishing community pond restoration projects that re-connect landowners and people with Norfolk's ponds.

In order for the above aims of the NPP to be achieved, it is necessary to be aware of the views of stakeholders (both landowners and the local public) from the outset. This has been achieved initially through an online questionnaire and feedback at farm workshops. Although responses from both stakeholder groups suggest similar positive views of ponds and pond management, results also imply subtle differences between farmers and the public, namely in contrasting views of the barriers preventing pond restorations – with implications for the future direction of the project.

LANDOWNERS AND VOLUNTEERS AS STAKEHOLDERS IN STREAM MANAGEMENT

Kaare Manniche Ebert

Danish Sportfishing Association, Denmark

Regulation, dredging and weed cutting left most of Denmark's meandering streams as poor habitats. Many species of invertebrates have disappeared, but the most visible sign of the impoverishment is the decline of brown trout and sea trout (*Salmo trutta*, L. 1756) which has declined to less than 20 % of its original population. The trout is depending on good environmental conditions in the streams, thus it is a valuable indicator species for the environmental state. Sewage purification alone did not bring trout back. They need a varied physical structure, which is inherent in the undisturbed stream.

30 years ago, the Danish state and the local municipalities initiated the work to seriously restore the streams. Prior to this was a revision of the law: Streams should not be conduits for water only, but good habitats for wildlife also. Thousands of dams and weirs have been removed, streams are remeandered, and the regular weed cutting has been modified to meet the trout's needs. Dredged riffles have been reestablished as spawning sites.

The political support was fueled by a common desire to bring the streams most visible inhabitant back. Since landowners own the fishing rights their positive response are important for the realization of the projects. Their active involvement has been crucial for our progress.

Volunteers are increasingly involved in the projects. Anglers have since the 1990'ties been focused on improving the streams. They annually make between 50 or 100 restoration projects in the smaller streams. These streams are of unique importance, since they are the nursery grounds of the trout. Here a relatively small effort may result in a substantial increase in trout population. We have seen increases from 50 % up to 500 %.

To further fuel the public interest, Danish Angling Association and a local club have created an educational programme about biodiversity and restoration for kids. The intention behind letting children do restoration is based on the belief that action leads to attitude". The results are immediately obvious to the pupils: the water has a new sound, the gravel bottom is lighter and loosely packed and in the future, they will be able to see more insects, fishes and birds. The teachers are also satisfied. They have observed that when the children both work with their muscles and their brain, there is a positive effect in the process of learning.

POSTERS

CARP PONDS AND THE EU WATER FRAMEWORK DIRECTIVE

C. Bauer, A. Hutmann

Federal Agency for Water Management, Institute for Ecology and Aquaculture, Austria

Ponds in Austria are essentially man made water bodies mostly constructed for carp farming. Their value as landscape elements and wetland ecosystem is widely recognised and especially the large ponds with their extended reed belts are designated NATURA 2000 areas. However, this environmental importance is a secondary function. Moreover, many large ponds have been constructed more than hundred years ago by impounding small rivers and creeks or by using large quantities of water abstracted from running waters. This often resulted in an interrupted continuum and a migration barrier for water organisms and a severe lack of water flow in the river downstream of the pond. This way of pond construction is not up to the environmental standard of today and the existing ponds clearly do not achieve the EU Water Framework Directive objective of good ecological status". But on the other hand, these ponds are often protected areas which provide habitats for endangered species like otter (Lutra lutra), marsh harrier (Circus aeruginosus) and osprey (Pandion haliaetus) as well as the special fauna and flora of a wetland ecosystem. It is likely that the restoration of the river continuum will lead to the degradation of these ponds. So there are several environmental as well as economical and social interests which may collide with each other. The presented poster intends to show the conflicting interests concerning the protection of fish ponds on the one hand and restoration requirements of rivers on the other hand on the basis of a chain of ponds connected to a small river system in the North of Austria.

WETLANDS FOR CLEAR WATER

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Eutrophication is the most severe ecological problem of the Baltic Sea. Baltic rivers carry large amounts of nitrogen and phosphorus, more than 50 percent originating from agricultural lands. Eutrophication of the Baltic Sea leads to algal blooms which deteriorate marine habitats through drastically decreased water transparency and oxygen depletion. The HELCOM Baltic Sea Action Plan addresses the need for action in the programme's "clear water" objective. In the context of river basin management for Baltic Sea tributaries, wetlands can play an important role in reducing diffuse (non-point) nutrient inputs from agriculture.

In southern Sweden, a large number of created wetlands have been integrated into the agricultural landscape with the aim of reducing eutrophication in lakes and the sea. The goal set by the Swedish Board of Agriculture was to create a total wetland area of 12,000 ha by 2010.

Research on over a thousand wetlands constructed between 1996 and 2002 has shown that wetlands in the right location can retain up to 1,000 kg of nitrogen per ha wetland area and year. The average nutrient retention capacity is less than 100 kg N per ha and year, which is only 50 % of the goal stated by the Swedish Board for Agriculture. Wetlands function as nutrient traps as incoming water is purified by denitrification processes - where nitrate is transformed into nitrogen gas, and phosphorus sinks to the bottom of the wetland. Additionally, constructed wetlands contribute to increased biodiversity, provide storage of water for irrigation, or act as storage basins to reduce flooding. To be cost-effective, constructed wetlands need to be properly located.

Gradual intensification of land use since around 1700 has resulted in environmental problems, caused primarily by the drainage, destruction and eutrophication of habitats. In 1996 the area became part of the federal program "Establishing and Securing Conservationally Important Components of Nature and Landscapes of National Importance" (www.uckermaerkischeseen.de). Up until 2011, a large number of nature conservation measures have been instated; these have increased the water retention capacity of the landscape and have thus stabilized the water balance of wetlands increasingly strained by climate change.

RESTORATION ON HRDIBOŘICKÉ RYBNÍKY SITE

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Hrdibořické rybníky (fish ponds) are situated in the agricultural floodplain landscape of central Moravia near the river Blata. The site consists of two ponds created by peat mining exploitation and the surrounding meadows and alluvial forests. Hrdibořické rybníky are protected as national nature monument, a high conservation status site with a high priority of protection.

During the 1980s, the site was damaged by the disturbance of its water regime, some parts were ploughed up, and mowing of the remaining meadows abandoned. The arable land within the protected area was grassed over in the 1990s. Together with the inappropriate *Festuca arundinacea* used for the grassing, manure was applied to the meadows and as a result the species richness declined.

With the aim of recreating species-rich habitat, a regional species mixture was sown in this low-diversity grasslands; moreover, hay from nearby rich meadow were distributed to selected plots.

Regular management to maintain suitable habitat at the Hrdibořické rybníky site has been on-going since 1998. An irrigation system was built for the National Protected Area Hrdibořické rybníky in 1997 in order to improve the water regime of the site. Self-seeded shrubs and trees were cleared or cut down from potentially suitable parts of the site in 2009 and 2010.

Since the ground water level was not stabilized, hydrological and hydro-geological studies were also carried out in 2010 in order to determine the main aboveground and underground water flows and other influences to the water regime.

In 2012, the site was colonized by a beaver (*Castor fiber*) family. After building up a beaver dam on the intake channel the ground water level increased significantly over the whole site. This increase of water level caused a shift in vegetation from wet meadows to swamp vegetation.

The site Hrdibořické rybníky is also very important as the last locality of the plant species *Angelica palustris*; the species persisted there until 1986. Attempts to restore a population of *Angelica palustris* have been continuing since 1990. It has been systematically replanted in this area since the 1990s using authentic plant material which has survived in an ex-situ rescue culture from the end of the late 1980s.

Regular mowing of meadow biotopes has contributed to the establishment of better ecological conditions for *Angelica palustris* and since 2003 a spontaneous population of this species is occuring at this site.

DIACHRONIC AND BIOGEOGRAPHIC STUDY OF HYDROPHILIC VEGETATION OF WETLANDS NORTH EASTERN ALGERIA

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Because of their biogeographical and geomorphological context, the northeastern Algeria wetlands present high species and community richness. A preliminary report (in 2000) revealed the major interest of the Jijel eco-complex of wetlands (Kabylia), which notably houses: otter (*Lutra lutra*), Mediterranean turtle (*Mauremys leprosa*), European pond turtle (*Emys orbicularis*), purple gallinule (*Porphyrio porphyrio*), little bittern (*Ixobrychus minutus*), kingfisher (*Alcedo atthis*), ferruginous duck (*Aythya nyroca*), reed warbler (*Acrocephalus scirpaceus*), as well as the endemic fish *Pseudophoxinus callensis*.

The vegetation study showed the existence of four main communities, distributed along hydrological gradients and disturbance. On the other hand, the complex influence of hydrology allowed the local development of five rare plants, classed vulnerable (*Nymphaea alba*, *Persicaria amphibia*, *Rumex palustris*) or near threatened (*Baldellia ranunculoides*, *Helosciadium crassipes*) on the red list of wetland plants of North Africa. Indeed, the influence of human disturbance is revealed by a diachronic (historical) study using aerial photographs and satellite images over three decades: the results show a deterioration of riparian wooded areas at the expense of farming.

The results obtained reveal worrying threats over the short term: overgrazing has resulted in the lake being invaded by sand eroded from coastal dunes; agriculture has induced illegal cutting, water pollution and excessive groundwater pumping; finally, hunting and fishing are illegally practiced at the site. The awareness of the public authorities is required in order to: (1) completely protect the wetland with the aim of restoring a riparian forest belt; and (2) initiate a campaign for increasing local population awareness, and their involvement in conservation programmes.

DEVELOPMENT OF WATER PARAMETERS IN LOWER-AUSTRIAN FISH PONDS OVER THE LAST 30 YEARS

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Fishponds play an important role in the landscape and culture of north-western Lower Austria. Ponds are closely connected to their environment, therefore, existence and cultivation of ponds are dependent on environmental changes. Our objective was to assess possible effects of environmental changes on ponds. We analyzed data of temperature, pH, oxygen, ammonium and total phosphorous of pond water over a time span of 30 years (1983–2012). Data-sets of 25 representative ponds were used for our analysis (n = 1824). Our results show an increase of temperature over the investigated time frame, especially from April to June (+2.68°C, +2.59°C and +2.53°C, respectively). The pH value follows a clear trend, decreasing from a mean of pH 8.2 in 1983 to pH 7.0 in 2012. Particularly in the last ten years, measured values > pH 8.5 became rare. Ammonium and total phosphorous also decreased. Mean concentrations currently are about 0.05 – 0.2 mg l^{-1}. Overall, the results of this study show that ponds have to deal with changing water temperature and chemistry. Causes and effects of this development on pond aquaculture are discussed.

THE INFLUENCE OF PALUDICULTURE IMPLEMENTATION ON CARBON AND GREENHOUSE GASES BALANCES OF NATURAL FENS

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Until now, the most common way to use wetlands is draining with further it utilization for agriculture or peat extraction aims. The consequences of wetland drainage are a progressive peat mineralization that leads to peat loss and a negative climate impact caused by a strong emission of the greenhouse gases CO_2 and N_2O. At the same time, the implementation of the Paludiculture could be a possible way which allows using wetland areas economically with avoiding the negative effects of drainage. However, there is a little information about the actual effect of the Paludiculture on the greenhouse gas fluxes, the peat carbon budget, and the climate balance so far.

Therefore, we investigated the influence of winter mowing (paludiculture implementation) on carbon and greenhouse gases balances of natural fens. For these purposes we performed closed-chamber measurements of carbon dioxide, methane, and nitrous oxide exchange at four natural fen sites in SW Belarus region. Each site was represented by different vegetation type (*Phragmites australis*, *Carex elata*, *Carex rostrate* and *Phalaris arundinacea*) and includes three control plots and three plots where biomass harvest was performed in late November once per year.

For CH_4 emission a noticeable impact of mowing became evident at sites with *Carex* dominated vegetation in the beginning of vegetation season: for a short time the emissions at the harvested plots nearly doubled those from the control. This event, however, did not have a strong influence on the annual methane emissions. N_2O emissions were very small and no clearly influenced by mowing. The annual rates of carbon dioxide fluxes did not show any clear reaction on the mowing at all. Furthermore, we will report about the effects of the biomass removal on the current net CO_2 exchange, the annual gas flux rates, the peat carbon budget and the climate balance.

The study was conducted in the framework of the EU-AID project Wetland Energy – Sustainable Use of Wet Peatlands in Belarus".

WETLANDS IN AGRICULTURAL LAND – A STUDY OF BARRIERS OF MORE EFFICIENT PROTECTION

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Protection of wetlands is an important issue for both the environmental and agri-environmental policies. Small wetlands on arable land or grasslands produce many public goods": high species diversity including endangered and rare species, plant and insect communities adapted to the special conditions, soil and plant community capable to keep water and mitigate local floods and local draught and to decrease nutrient pollution of surface water, etc.

Protection of wetlands is recommended or required by a number of key strategy documents. But the wetland protection on agricultural land means usually a problem for farming in common practice. There are more varieties of solution already implemented: ponds and large wetlands in agricultural land is protected by the law and restrictions defined by Cross-compliance" rules (in case of damage the farmer loses part or all of required agricultural subsidies). Smaller wetlands are not protected directly but as a habitat of some rare species. Creation, maintenance and restauration of such wetlands can be supported by various national and European programmes. Small amphibian" ponds and small streams and high diversity grasslands may be maintained with a support of national landscape programmes of Ministry of environment and the 4th axis of Operation Programme of Environment which is focused to more complex activities. In certain cases (namely for technical assessment) is possible to use non-productive investments (Land consolidation of the Rural Development Programme). Maintenance of wet meadows (both productive and not-productive) is supported by 3 special managements of Agri-Environmental-Climatic Schemes of the Rural Development Programme and fields with nests of typical bird species of agricultural landscape, Vanellus vanellus, can be maintained with support of one new management in AECM Schemes.

What has not been solved sufficiently up to now is how to protect or manage small periodically flooded places in arable field. Such wetlands can be a pool of biodiversity in an intensively farmed region, but there is a lack of stimulation for farmers to maintain them and a restriction of any disturbation (by ploughing etc.) may not act well and, furthermore sometimes is positive. The study is based on the institutional analysis and the aim is to find main barriers and possible solutions. The method is based on study of documents and in-depth interviews of policymakers and farmers.

ATTITUDE OF CZECH FARMERS TO WETLANDS

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The attitude to wetlands by farmers and agricultural managers was studied using a questionnaire campaign. Three respondents returned back filled quastionnaires, which yielded a return ratio of 20 %. They proportionally covered all types of farms occurring in the Czech Republic in respect of area (categories from < 10 ha to > 500 ha), main type of management (standard, organic), main type of production (plant, animal. mixed), production region (sugar beet, maize, wheat, potato, pasture) and property (land owners, leaseholders). The attitude of farmers who responded to the questionnaire was neutral to mildly positive. No results were found among the groups in respect of area or property, respectively. The results indicate that at least part of the farmers may be open to inclusion of wetlands into agricultural management provided suitable technology and financial reward are available.

EUTROPHICATION EFFECTS ON PLANT-SOIL INTERACTIONS IN WET GRASSLANDS

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Increased nutrient additions, leading to eutrophication, is a continuing problem for many wet grassland ecosystems. It is well established that eutrophication leads to changed plant and animal species composition and diversity. However, the impact on soil processes and the interactions between plant and soil processes is unclear. Great uncertainty also exists concerning how soil type may affect these eutrophication effects. A field experiment was established in 2006 to determine the effects of different levels of nutrient additions on plant-soil interactions in two wet grasslands, one on mineral soil and the other on organic soil. Results will be shown (both plant and soil processes) for two wet grasslands, one with mineral soil and the other with organic soil, which were subjected to different levels of nutrient addition from 2006 to 2013.

INDIRECT MEASURING OF INFILTRATION RATE IN AN INTEGRATED BUFFER ZONE

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An Integrated Buffer Zone is a new environmental tool to combat eutrophication of streams and other recipients. One major mechanism by which the concept works is infiltration through soil. In order to evaluate the concept it is thus necessary to be able to measure infiltration and changes in ground water levels, and to be able to get samples of interstitial water. We here demonstrate a method to get necessary data in field experiment facilities.

We used portable flow meters mounted on the inlet and outlet pipes in order to get good data on the amount of water entering and leaving the experimental facility. By over charging" the facility hydrologically we ensured that the difference between inlet and outlet was caused by infiltration plus evapotranspiration. Since we had an hourly data logger on the flow meters we got good data on evapotranspiration by the resulting diurnal changes. Thus we could subtract evapotranspiration and got reliable data on infiltration rate.

We installed ground water pipes in two rows behind the ditch and infiltration zone. By level measuring of water levels we got data on ground water levels. Furthermore we could extract infiltrated water from the ground water pipes in order to analyze for nutrients.

The system have proved very reliable in two sampling campaigns in 2014 and 2015.

RISK TO PROTECTED WETLANDS AND DRINKING WATER RESERVOIRS BY EROSION RUNOFF, SEDIMENT TRANSPORT AND PHOSPHORUS LOAD – SEVERAL EXAMPLES FROM THE CZECH REPUBLIC GIS SOLUTION

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Flash floods do not introduce harm only to residents (death from drowning) and to infrastructure (damage by water torrents or sediment accumulation), but also for conserved wetlands and drinking water reservoirs. Wetlands are transition zone between terrestrial and freshwater ecosystems, and thus create effective barrier to sediment transport naturally (e.g. littoral zone in fishponds). While in a diversified and balanced landscape are they attacked by sediment transport only occasionally, in the case of landscape mosaic violation (Czech Republic has the largest fields among the Central European states and primary and secondary streams were narrowed, pawed and deepened systematically) danger to these buffers is intensified by orders. In the case of bad management they frequently cease to exist (e.g. digging of sediment onto bank of pond). Situation is more complicated in the case of reservoirs. They were built by artificial damming of deep, canyon-shape river valleys, at first. When electric power generation or flood protection is necessary part of their management, frequent and intensive water level oscillation eliminate any growth of littoral vegetation. It results in easy and direct inflow of sediment and suspended solids into the water body. Phosphorus contained on particles of erosional runoff has no barrier to enter pelagic zone, then and becoming part of its cycle it strongly enhance eutrophication, finally.

In the presented project we have choose several examples of protected wetlands and reservoirs, in which watershed erosion (by RUSLE) and sediment transport (by WATEM/SEDEM) was modelled. Expected climate change (scenario 2050 and 2100 for R-factor) was also compared to present stage of erosion in the Czech Republic. Modelling of rainfall intensity, duration and frequency predicts increase in the R-factor of 30–40 % in scenario for a farer future.

Our software solution enables user to select from toolkit of anti-erosional measures, interactively. Putting them in map and simulation of its effect on critical points by pre-prepared and generalised computing is allowed. At the poster we present preliminary results of wider national security project (No. VG20122015092), which we thank for financial support.

SPHAGNUM FARMING ON DEGRADED BOGS – SUSTAINABLE AGRICULTURE ON PEATLANDS

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Conventional agriculture on peatlands is based on drainage leading to aerobic conditions in the peat. As a result the peat mineralized and the stored carbon emitted as CO_2 in huge amounts. Thus, in the temperate zone about 1 to 2 cm of peat soil is lost annually.

Perspectives for continuing conventional cultivation of bog grasslands are poor. Alternative drained land use practices (e.g. maize cultivation) are even more environmentally detrimental. These drained peatlands need urgent rewetting to reduce emissions. Sphagnum farming seems to offer the necessary sustainable perspective for agricultural use.

Sphagnum farming is paludiculture on degraded bogs. Sphagnum farming combines the production of a raw material for horticultural substrates to substitute peat with the provision of essential ecosystem services of mires as carbon store, water regulator and biodiversity conservation.

A field experiment on four hectare former bog grassland in Northwest Germany demonstrated impressively the feasibility of Sphagnum farming on rewetted degraded bogs.

WETLAND ENERGY – BIOMASS FROM REWETTED EXCAVATED PEATLANDS FOR BRIQUETTES PRODUCTION

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The Europe Aid funded project Wetland Energy" implemented in Belarus by the project proponent the Michael Succow Foundation for the Protection of Nature (MSF) in a partner consortium with the International Sacharov Environmental University (ISEU), the Institute for Nature Management (IfNM) of the National Academy of Sciences, and Ltd Lida peat briquetting Factory (LPF) initiated a promising wet land use management in degraded peatlands (Paludiculture) for the generation of energy fuels from rewetted peatland sites.

Vegetation-ecological field surveys at the project pilot sites at Sporovsky Zakaznik, in Brest region and on grounds of LPF, in Grodno region yielded suitable species composition and biomass production rates of the reed and sedge dominated sites for the production of renewable energy fuels. A monitoring scheme had been set up for the vegetation and site development under regular mowing with site adapted harvesting technology. Laboratory analysis at ISEU and IfNM tested the quality of the biomass from the wet peatland sites regarding suitability for combustion and contents of ingredients. First results show that biomass from reed stands growing in rewetted, formerly partly excavated peatlands are suitable as a raw material for the production of briquettes and pellets. The lower calorific values are slightly lower but comparable to those of peat briquettes. Compared to peat the ash content of the biomass is lower. This demonstrates that in the production of energy briquettes and pellets peat could be easily replaced by biomass from reeds from rewetted peatlands.

EFFECT OF DRY LAND RESTORATION ON WATER CYCLE AND CLIMATE – POSITIVE EXAMPLES

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Desertification refers to the problem of land degradation in arid, semi-arid, and dry sub-humid regions due to loss of vegetation, loss of soil moisture, and water erosion. Deterioration in soil and plant cover has adversely affected nearly 52 % of the land areas, especially cultivated landscape. According to FAO, nearly 200 000 km^2 of agricultural land loses its economic efficiency annually from which about of 60 000 km2 is converted into desert. Addressing the desertification problem requires an integrated approach. Rehabilitation and recovery techniques help stop land degradation and restore already degraded land. We demonstrate several practical solutions of large-scale restoration of degraded arid land based on the retention of rainwater and support of wetland and other permanent vegetation with the following examples:

1) Darewadi, India: the watershed development project was implemented by WOTR under leadership of Herman Bacher from 1996 to 2009. As a result of the watershed project in this area, more than 1500 ha of drained land has been restored, rainfall increased from 200 to 500 mm, and the water in wells and the ground water level raised from -6 to -2.5 m;

2) Rajasthan, India: the project was co-founded by Rajendra Singh. The method is based on revival of traditional water reservoirs. The technique has provided irrigation water to an estimated 140,000 ha since 1985. Shallow aquifer recharged from 100 – 120 m to 3 – 13 m. The area under single crop increased from 11 % to 70 % out of which area under double cropping increased from 3 % to 50 %. The forest cover, which was around 7 % increased to 40 % through agro-forestry. The project benefits more than 700 000 people;

3) Tarwyn Park, New South Wales, Australia:Peter Andrews developed his method of Natural Sequence Farming. The method emulates role of natural water courses in an effort to reverse salinity, slow erosion and increase soil and water quality to enable native vegetation to restore riparian zone. He started up as a sheep farmer and racehorse breeder. He wanted healthier, faster horses and realized that they had a better chance if they grazed on paddocks with plenty of plant species. P. Andrews observed how Australian floodplains worked and developed method how to bring rain water back to aquifers and to restore small water cycle.

WATER PURIFICATION SERVICE OF WETLAND VEGETATION IN TREATING AGRICULTURAL WASTE WATER

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Wetland ecosystems may play a sustainable role in supplying Ecosystem Services at different scales. In particular, water purification service by nutrient and sediment removal is a major, especially in areas where surface and groundwater are affected by diffused pollution from intensive cropping agro-systems inputs. Wetland vegetation already showed major nutrient entrapment and retention efficiency; they can trap and retain 80–90 % of sediments from runoff and eliminate 70–90 % of nitrogen entering to the system (Borin et al. 2001; Borin et al. 2007). The aim of this work is to assess the water purification performance of both semi-natural and constructed surface flow wetland systems over a period of two years (2014–2015). The integrated wetland system is set up on 5 phytoremediation sub-basins vegetated with macrophyte species (*Phragmites australis*, *Mentha aquatica*, *Juncus articulatus* and *Typha latifolia*) and on a three downstream canal floating systems testing different macrophyte species (*Iris pseudacorus*, *Carex riparia*, *Lythrum salicaria*). Preliminary results of first season (2014) showed a relevant decrease in $N–NO_3$ concentration from 0.95 ppm (inlet) to 0.29 ppm (outlet) in the sub-basins at the end of monitoring season while changes in concentration in downstream canal were not relevant due to establishment of floating systems. In April 2015 vegetation has been re-established in floating systems. Preliminary results for the second season witnessed increase in $N–NO_3$ concentration at the sub-basins inlet from 0.55 ppm during periods of inactivity (November 2014) to 5.23 ppm during the peak of agricultural season and rainfall in March 2015. N–NO3 concentration in the sub-basins outlet decreased notably during the period of agricultural activity to 0.09 ppm indicating maximum efficiency of semi-natural wetland systems. Concentrations of $N–NO_3$ were not detectable in all sub-basins late in April 2015. For the downstream canal, $N–NO_3$ concentrations showed also noticeable increase during March 2015 (1.87 ppm) resulting from agricultural activities.

PISCICULTURE IN ARMENIA: SUCCESSES AND CHALLENGES

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The history of pisciculture in Armenia is going back to 1920's when two fish breeding factories were established in Lake Sevan Basin for artificial reproduction of endemic Ishkhan (Salmo ischkhan). Started in 1960's a number of fish breeding farms were established in Ararat Valley. In 1980's fish ponds with the water surface more than 6,000 ha had an annual commercial fish production (mainly Carp) exceeding 5,000 tones; the production of Rainbow Trout was about 100 tones. In 1990's with the shift from the former socialist system to the market economy a number of large fish farms increased significantly thanks to private investments and extensive use of groundwater. Over the recent years the annual commercial fish production is 5,000–6,000 tones, of which ⅔ are trout (mainly Rainbow Trout but also Ishkhan and Brown Trout) and sturgeons (mainly Siberian Sturgeon), and only ⅓ are Cyprinidae (Carp, White and Black Amur, Silver and Bighead Carp). The value of annually produced fish estimated 6 mln. Euro which seems to be exsighting success.

However, its becomes evident that extensive use of artesian waters has brought to depletion of ground waters and a number of villages suffered severe water shortages for several years. To compensate the water shortages in Ararat Valley, in June 2014 by the initiative of the Government , the Parliament of Armenia has passed the law allowing the increase of water intake from Lake Sevan from 170 to 270 mln. m3. In November 2014 the Minister of Nature Protection signed an order to implement temporary limitations and moderations to water users' water abstraction amount and regime. Investigation revealed a number of illegal wells which were locked. Nevertheless, several years are important for restoration of groundwater stocks in Ararat Velley.

Another negative aspect of fish farming intensification is the shift from breeding of Cyprinidae to much more profitable Trout and Sturgeons. In other words this is the shift from biodiversity rich large soft bottom ponds with submerged and merged aquatic vegetation to small concrete pools. As a result, the suface of large soft bottom ponds during the last 20 years decreased 2.5 times and currently is ca. 2,500 ha.

An example of such negative change are Armash fish ponds, one of 17 Armenian Important Bird Areas, home for about 220 bird species, including the globally threatened species Marbled Teal and White-headed Duck. Here due to water level drop the number of breeding birds during the last 2 years decreased at times; no breeding of globally threatened species observed.

CONSERVATION, MANAGEMENT AND RESTORATION OF CARPATHIAN NON-FOREST WETLANDS

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Non-forest wetland habitats of different types are among the most precious and typical ecosystems of the Carpathian mountains. Wetlands in the Carpathians are usually small in surface area and many habitat types are threatened by human activities like drainage, intensive grazing, or cessation of traditional management practices. The Carpathian Wetlands Initiative (CWI) was established as a Regional Initiative of the Ramsar Convention on Wetlands to support improved implementation of the Ramsar Convention and the Carpathian Convention in conservation, management and wise use of wetlands in this region through international cooperation and common activities. These activities include: a wetland inventory; coordination of research; facilitation of bilateral consultations in shared wetlands and catchments in common objectives and principles of their management; wetland restoration strategies; projects; sharing experience; education and training. The CWI has been involved in several studies on the natural assets of the Carpathians during recent years and produced the Carpathian Wetland Handbook (Šeffer et al. 2014), and information and data for development of common integrated management measures for key natural assets in the Carpathians (Appleton & Meyer 2014). These studies concluded that the conservation status of wetlands in the Carpathians is critical, particularly at lower elevations, and they urgently need active implementation of effective protection management and restoration measures (Galvánek & Kadlečík 2014). Many sustainable practices have been traditionally used on Carpathian wetlands, and while some of these persist, others are disappearing. Presently, conservation managers are attempting to maintain, extend and adapt traditional practices that conserve biodiversity, and develop and implement new techniques and activities. Some general wetland management objectives and specific conservation management measures have been suggested, including: passive (minimal intervention) management for certain natural sites (e.g. raised bogs, swamps); establishing wetland buffer zones (in wetlands surrounded by intensively-used agricultural land); allocation and management of water for maintaining the ecological functions of wetlands; management of water pollution; the limiting of peat exploitation and restoration of peatlands; protection of karst areas by restricting intensive agriculture; restriction of afforestation on wetlands (especially wet grasslands and peatlands); exclusion or restriction of grazing around springs on sensitive wetland sites; maintenance and extension of mowing and grazing of wet grasslands; introduction of mulching on an experimental basis as an alternative to grazing and cutting; removal of trees and shrubs on abandoned non-forest wetland habitats; measures and programmes to remove or control invasive alien species; restoration of hydrological regimes and river dynamics; management techniques to prevent erosion and sedimentation; integrated water resources management; introduction of regional (Carpathian-wide) measures for improved wetland management.

THE GROWTH AND MICROTOPOGRAPHIC DISTRIBUTION OF BRYOPHYTE COMMUNITIES IN A TUFA-FORMING SPRING FEN

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Tufa-forming spring fens, that are among the most endangered and distinct wetland types in the world, can be characterized by abundant flow of groundwaters, that keeps the water level constantly high. These wetlands were formerly drained and used as pastures, but abandoned mainly in the middle of 20th century due to low productivity. Today they are valuable and diverse Natura sites, where moss layer has a crucial importance on maintaining the plant communities. We established 10 m vegetation transects (100 times 10x10 cm squares) in two calcareous fens in North Estonia to study (1) the species diversity, (2) distribution on the microtopographic gradient, and (3) according to the tufa content. Tufa-formation was present in one study site. The main focus of the study was on bryophytes. Our results revealed that tufa-formation increases the number of species 30 %. The species with the biggest coverage in a tufa-forming spring fen was *Campylium stellatum*, in a similar fen without tufa *Scorpidium scorpioides*. Higher microforms were covered with less tufa, and the coverage of both species was decreased. Growth measurements by painting showed the biggest bioproduction of *Campylium stellatum* about 2 cm above the water tabel, and 1 cm below the water table for *Scorpidium scorpioides*. The bioproduction of *Scorpidium scorpioides* shoot was in average twice as big as of *Campylium stellatum* shoot. However, due to four times bigger shoot density the bioproduction of *Campylium* per area unit was twice as big as of *Scorpidium*. Tufa had a positive effect on calcicole *Campylium stellatum*. Nevertheless, phosphorus is the growth-limiting element of *Scorpidium scorpioides*, but the coprecipitation of phosphorus with tufa makes it non-available for plants, therefore tufa is hindering the growth of *Scorpidium*. After all, the growth of *Campylium* is limited by the calcium content, *Scorpidium* by the available phosphorus. The results concerning these species can be applied in protective activities and at the restoration of degraded sites.

DIURNAL ACTIVITY BUDGET OF WINTERING FERRUGINOUS DUCKS *AYTHYA NYROCA* IN (ANATIDAE) IN JIJEL ECO-COMPLEX OF WETLANDS, NORTHEAST OF ALGERIA

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Redjla (36°49′ N; 05° 91′E, 45 ha) and El-Kennar (36°48′ N; 05° 57′E, 36 ha) are two fresh water marshes in Jijel eco-complex of wetlands, north east of Algeria. Our study was carried out over one wintering season (from December 2013 to December 2014). Diurnal time-activity budgets were determined for wintering ferruginous duck *Aythya nyroca*, a resident throughout the year. We have used standardised equipment and methods.

The maximum number of ferruginous ducks was 420 individuals recorded in Redjla marsh. This figure includes the total number of these birds in two populations living on the sites: the first one is a nesting sedentary population consisting of about 30 pairs and the second one, more numerous, frequents the center of this wetland only in wintering seasons. Resting and feeding were the most frequent activities of ferruginous duck on the two marshes sites, whereas flying was marginal. Resting accounted for the most common use of time, ranging from 31 % in Redjla marsh to 34 % in El-Kennar marsh. It is followed by activities as follows; swimming (27.04 and 26.36 %), cleaning (10.33 % and 9.97 %), and finally, flying or disturbance were rare (0.5 % and 0.47 %). In Jijel eco-complex of wetlands, birds maintained a high level of feeding activity during the early morning throughout the winter, whereas afternoon feeding activity was marginal. Current study has revealed the role of this wetland in diurnal recovery of ferruginous ducks Human encroachment on wetland habitat, habitat degradation and illegal hunting in protected areas are the major threats to the persistence of the species and probably similar threatened species in Algeria.

POSSIBILITIES OF LANDSCAPE AND RARE WETLANDS REHABILITATION IN THE NAGYBERK (BALATON REGION, HUNGARY)

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In order to have clear landscape rehabilitation targets for wetland areas in the Nagy-berek, their history, the processes inducing change, their sociological and economic background, and their present conservation status must be studied. Thus past land-use patterns have been used in order to recognise the natural processes involved and the experience of people inhabiting the given landscape, throughout the Carpathian basin. Before the water regulation schemes of the 19th century, the landscape of Lake Balaton's southern shore area was dominated by wetlands ('berek' in Hungarian). One of their characteristic habitat types were the token floating, swamp islands. The aims of our study were to: (1) localize both the long-ago and recent floating swamp islands of the eastern part of the Nagy-berek; and (2) to reveal the possibilities for rehabilitation based on the current landscape conditions. The remnants of floating swamp islands were mapped out, based on literature data and field surveys, in water-covered peat depressions, and reed and sedge areas, between 2010 and 2014. Our results indicate that there were significant areas of floating swamps c. 80-100 years ago. Elements of the original ecosystem could still be found in the Nagy-berek. These wetland habitats form mostly an unconnected mosaic and are degraded, but floating swamps are still represented. Areas where the conditions for floating swamp development still prevail could be secured with more appropriate, fluctuating water cover. Water regulation of the area could be solved by the construction of 'management units', which take account of and provide the necessities for recent land use and farming; however, with areas adjoining several management units, then the original, pre-regulation states could be rehabilitated. An appropriate and 'natural-like' water regulation could result in an improvement in the status of the swamp areas and ensure the conditions for floating-island development. The Nagy-berek area might be a good candidate for at least partial landscape rehabilitation, based mostly on the enhancement of natural processes. The monitoring of the floating swamp islands could be an effective indicator of the success of rehabilitation.

DECREASE IN BREEDING POPULATION SIZE AS THE RESPONSE TO EUTROFICATION AND HIGH FISH STOCK DENSITY IN FISHPOND HABITATS IN THE CENTRAL EUROPE

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The changes in breeding population size of waterbirds reflect changes in feeding conditions in eutroficated fishponds.

Fishponds and fishpond systems are a man-made wetland ecosystem created since early Middle Ages, which replaces the original wetland habitats that existed in Central Europe. Nowadays, fishponds represent the most common wetland type in the Czech Republic, with about 20 000 fishponds covering 50 000 ha. Fish production (mostly Common Carp Cyprinuscarpio) was about 50 kg/ha until the end of the 19th century, increasing to more than 1 000 kg/ha since 1950s.

More recently, the important grazing effect of fish (especially Carp) has been recognised as a factor affecting benthic and plankton communities, the extent of littoral vegetation, and consequently water transparency and chemistry. As a result, there is an overgrowth of phytoplankton, water turbidity increases, and the light cannot penetrate to the deeper water layers where anaerobiosis may occur.

Therefore, feeding specialization seems the most important factor affecting inter-specific differences in long-term trends (1981–2013)of breeding populations in South Bohemia (Czech Republic), ranging from significant increase in herbivorous, such as Red-crested Pochard, Greylag Goose and Mute Swan to significant decrease in benthophagouswaterbirds such as Common Pochard, Tufted Duck, Goldeneye and Little Grebe. The highest rate of decrease was found in Tufted Ducks which numbers decreased up to 12.9 % from 1981 to 2013.

The long-term investigation of individually marked diving duck (Tufted Duck and Common Pochard) females confirmed decrease in reproductive success (number of fledglings per female) in these species. The survival of duckling is negatively affected by high grazing effect of Carps stocked in fishponds. Moreover, reproductive success (esp. record of female rearing ducklings) was found as the most important factor affecting breeding fidelity. The probability of apparent survival was 0.955–0.960 in both species in case of females successfully rearing duckling, whereas only 0.441–0.493 in case of duck females without ducklings. Thus, more than 50 % of unsuccessful females emigrate from the breeding area. Surprisingly, hatching success does not affect the fidelity ratio (i.e. apparent survival probability). Moreover, probability to repeat the breeding success in the following breeding season is 53.1 % in Common Pochard and only 31.5 % in Tufted Duck. We assess that low breeding success affect high level of emigration and consequently decrease in breeding population size of diving duck in Central European fishpond regions.

HOW TO LOCATE THE WETLANDS ON ARABLE LAND USING GIS

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Wetlands on arable land are specific habitats dependent on climatic conditions and anthropogenic interventions and it is difficult to recognize them in landscape because they do not develop every year (they usually develop only in years with extraordinary high amounts of precipitation). We use recent aerial photographs and old botanical maps in GIS (Geographic Information System) to locate wetlands on arable land in Znojmo region (Czech Republic). During confirmation of their real placement (by field work) we found some species new for our region. The database of 243 these wetlands with botanical attributes and the thematic map with all localities are the main outputs of our wetland research from the years 2009–2011.

VEGETATED DITCHES FOR THE MITIGATION OF PESTICIDES RUNOFF IN PO VALLEY

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Introduction

Risk mitigation measures for pesticides are increasingly important. Recent studies showed that constructed surface flow wetland in Italian agro-systems can reduce the pollution of watercourses from watershed of hundreds of hectares (Pappalardo et al., 2015). Indeed, in fragmented croplands as in Po Valley, there is an urgent need for the mitigation of agricultural runoff from a large number of small farms. Vegetated ditches are common in Po Valley and can provide the important ecosystem service of runoff mitigation for the protection of watercourses (Bennet et al., 2005). According to recent studies, a vegetated ditch is an off-field mitigation measure" with an effectiveness of 50 % (Gregoire et al., 2009).

Aim of the study was to assess the mitigation effect of a vegetated ditch on a simulated heavy runoff containing three herbicides, and to highlight herbicides release after two subsequent floods.

Materials and methods

The trial was conducted in the Exp. Farm of the Padova Univ. The vegetated ditch under study was 400 m long and with a low slope (0.3 %). In ordinary conditions the ditch is without free water, and only after a rainfall a depth of 5–10 cm of water flows slowly to outlet. The sides of the ditch were completely covered by a 150 cm tall vegetation, the bottom part was partially covered by *Phragmites australis* and *Scirpus* sp. In April 2015 a heavy runoff simulation was performed, and the ditch was flooded with water containing mesotrione, metolachlor and terbuthylazine. After 1 hour samples of water were collected. After 21 and 42 days the flooding was repeated with pure water, and water collected again.

Results and discussion

Preliminary results showed that one hour after flood, in the vegetated ditch the runoff concentration in water was reduced by 80–99 %, being most of herbicides likely adsorbed by sediments. Concentrations were decreasing with distance to inlet, suggesting an effectiveness of mitigation length-dependent. Vegetated ditches of 50–100 m allows a significant mitigation of agricultural runoff from croplands of 10–50 hectares, providing low-cost solutions that can easily implemented in environmental schemes.

PEATLANDS OF HORNA ORAVA AND THEIR PROBLEMS

I. Šustr

Protected Landscape Area Horná Orava, Slovak Republic

The northernmost territory of the Slovak Republic, Horná Orava (Upper Orava), belongs to the three most important peatland areas of the country. A large proportion of peatlands were destroyed in the past by their conversion to agricultural land (mainly during the 1960s and 70s), by peat extraction, or by the flooding resulting from the Orava dam (1953). However, today, there are still preserved bogs, transition mires, fens and large complexes of waterlogged peat forests.

These non-forest wetlands (transitional bogs, fens and wet meadows) were regularly farmed and scythed (mown) in the past. Then, extensive 'amelioration' modifications of the surrounding agricultural landscape occurred; these had an indirect impact on the hydrological regime of even those wetlands that were not intended as part of the amelioration scheme. The drying out of bogs, or bogs affected by peat extraction, resulted in species being lost or changes in species composition undertaken. Such sites with a modified water regime have spontaneously overgrown with seedling trees which suppress the original bog species. The establishment of 'small-scale protected areas' and, later on, the large-scale Protected Landscape Area Horná Orava, prevented any further intrusion and use of these wetlands. It is now known that these protection measures were largely counterproductive, as the management of these areas has to be carried out by the Administration of PLA Horná Orava itself.

The cutting and reduction of fast-growing tree species is the most common conservation management for these sites. However, the management was only done irregularly and especially in the most valuable parts of the peatlands - which did not bring the desired effect. It is in the Nature Conservancy's interest to maintain these habitats; however, regular mowing and other necessary management interventions are necessary. A more effective and cheaper way of saving these irreplaceable ecosystems would involve some form of partnership with owners and users of these sites.

RICH WATER WORLD: CONSTRUCTING A NOVEL TYPE OF WETLANDS FOR SELF-SUSTAINING REGIONS

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Due to climate change, the frequency of weather extremes including severe rainfalls and droughts is rapidly increasing. To cope with the resulting regional water quantity issues, wetlands are being constructed all over the world. However, water storage and water retention on (former) agricultural lands often leads to severe environmental eutrophication due to the strong accumulation of nutrients as a legacy of heavy soil fertilization. Our program Rich Water World (RWW) aims to integrate multiple ecosystem functions such as water storage, water retention, agriculture, nature development and recreation by applying an integral system approach combining the different ecosystem services with biogeochemical water purification. The goal is to reduce concentrations of nitrogen (N) and phosphorus (P) in the surface water so that it becomes suitable for its desired end-use for agricultural, ecological or recreational purposes. In contrast to existing biological water purifications systems such as constructed wetlands with helophyte vegetation, the novel biocascade water purification system in RWW has a regenerative character, in which P does not permanently accumulate in the system. This is established by applying knowledge about biogeochemical soil processes related to alternating flooding and desiccation in combination with water quality, and the use of aquatic plant species as ecosystem engineers. RWW has realized the biocascade system at field scale on two locations in the Netherlands. At Radboud University experimental facilities, a biocascade has been built with focus on phosphorus removal. For comparison, a conventional reed filter was constructed next to the biocascade. Since July 2014, a continuous flow of water containing 10 µmol P L^{-1} and 50 µmol N L^{-1} was added to both systems at a rate of 150 L h^{-1}. Our preliminary results show that both systems similarly removed 96 % of the N added. However, while the conventional reed filter removed only 27 % of the P added, the biocascade removed 75 % during the growing seasons of 2015, without an iron sand filter. These promising results show that the biocascade indeed seems fit for returning used water into the natural environment without adverse ecological effects such as algal or cyanobacterial blooms. We will now test the regenerative phase after the natural iron trap in the soil top layer has become P-saturated. This will be carried out by lowering the redox potential, remobilizing P and subsequent removal of P by biological uptake using aquatic macrophytes, simultaneously sequestering atmospheric carbon and producing a green fertilizer containing recycled P.

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