

M3: Management

THE SOMERSET LEVELS, UK. RESOLUTION OF CONFLICT IN WETLAND MANAGEMENT

Armstrong A., Bradley Ch.

The Somerset levels and moors are an internationally important wetland in the Southwest of England. Behind a coastal barrier zone of dunes, two zones, one of marine silt and behind this lowland peat has accumulated over the Holocene. Much of the peatland was historically flooded, but has been subject to successive drainage and water control measures. Until the 1970s, land ownership was fragmented, and the area dominated by low level grazing of wet grassland of high ecological value.

A major conflict arose in the 1970s with proposals to improve the drainage, in response to government policy, formulated at a national level without regard for local ecological needs. In the 1980s the Nature Conservancy Council reacted to a proposal to improve the drainage of West Sedgemoore, by designating it a protected site. This led to "head-on" conflict between the farming community and the conservationists, that was only decided when a government minister confirmed the NNC designation giving protection status to the area. This decision was far from local democracy. Subsequently, the conflict has been "put on hold" by the economic state of farming, as the farming community was unable to pay the high price for intensive drainage works. Consequently, the introduction of the Environmentally Sensitive Areas payments at the end of 1980s enabled farmers to improve their economic status by accepting a form of "conservation payment".

The ESA scheme has widespread adoption in the Somerset Levels, with as much as 50% of the potential area in one level of agreement. Three tiers of agreement are available to the farmers on a voluntary basis:

- Tier 1 protects the grassland
- Tier 2 requires the maintenance of high water levels in summer
- Tier 3 requires active intervention to raise water levels to the surface during the early spring, thus attempting to improve the ecological value of the designated areas.

The introduction of the ESA, the active promotion of water management by the Environment Agency, and the overall move towards a conservation approach to water management has appeared to resolve the conflicts. However, it is far from clear that the farming community is committed to conservation aims. As long as it is economically acceptable, then conservation payments are accepted, but if the economics situation were to shift (if for example the world price of food increases dramatically) then pressures on these wetlands will return.

**EFFECTS OF SALINITY INTRUSION IN MANGROVE WETLANDS ECOSYSTEM
IN THE SUNDARBANS: AN ALTERNATIVE APPROACH FOR SUSTAINABLE
MANAGEMENT**

Islam S. N., Gnauck A.

The wetlands area has often been estimated to account for nearly 50% of the territorial land including estuaries and mangrove swamps along the coastal belt of Bangladesh which is the largest living wetlands in the world. The Sundarbans Ramsar site wetlands are the part of Ganges delta, includes extensive mangrove forests and major river deltas flowing into the Bay of Bengal. It is the hotspot of biodiversity and contain of ecological and economical significance. Besides this wetlands help in the storage of flood water, provide a rich source of fishing, shrimp cultivation, mangrove resource collection and agriculture expansion causing water regime modification. A large part almost 45% of coastal mangrove wetlands has disappeared with in the last three decades. Such degradation and shortage of upstream sweet water flows and high salinity intrusion has brought about a biodiversity loss, degrading water quality, top dying process, reduction in fish habitat, and increase in the flood-proneness of certain floodplains. The high salinity intrusion is one of the main threats to wetlands biodiversity and ecosystems. Biodiversity conservation and ecosystems management policies must there fore be based on a proper appreciation of the social implications of proposed actions. The community as a whole may participate in and all classes benefit from, biodiversity conservation and improvement of the mangrove wetlands. The simulation and Saline water modelling in integrating GIS would be the alternative approach for sustainable management. The paper has prepared based on primary and secondary data sources. The objective of this paper is to understand the significance of coastal mangrove wetlands biodiversity and ecosystems. Critical analysis on ecological and economical benefits, and make recommendations for some practical solutions centred on management and conservation of the Sundarbans mangrove wetlands.

ECOLOGICAL REHABILITATION OF THE SCHELDE ESTUARY (THE NETHERLANDS-BELGIUM): LINKING ECOLOGY, SAFETY AGAINST FLOODS AND ACCESSIBILITY FOR PORT DEVELOPMENT.

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The Long Term Vision for the Schelde estuary (LTVS) was determined as "the development of a healthy and multi-functional estuarine water system that can be utilized in a sustainable way for human needs". This Dutch-Flemish managerial plan sets quality targets for the condition of the estuary by the year 2030 and the management measures to achieve them. Targets were developed and integrated from three central perspectives: accessibility of the ports, safety against floods in the densely populated catchment and ecosystem health. This study focuses on the ecological rehabilitation of the estuary and the creation of sustainable nature, seeking possible alliances with security measures against floods, navigation requisites for port activities and enhancement of the estuaries educational and recreational values. The estuary and its valley are subdivided into ecological relevant zones. For each zone goals in terms of physical, chemical and ecological processes are prioritized. Evaluation methods and key parameters are proposed for most attributes of the estuarine functioning. Rehabilitation measures with maximal contribution to the priority goals are identified for each zone. Spatial analysis of the study area indicates optimal areas for the implementation of these measures. To exemplify the array of possibilities on an ecosystem level two different rehabilitation plans are proposed. The potential contribution to the rehabilitation of the estuary is compared for both alternatives.

**THE MEDITERRANEAN DISTURBANCE WETLANDS MANAGEMENT IN
ALGERIA: A CASE STUDY ON CHOTT ECH CHERGUI**

Masgidi M., Islam S. N.

The Chott Ech Chergui, the second largest Chott (the depression surrounding a salt marsh or lake) in North Africa, is an extensive closed depression containing permanent and seasonal saline, brackish, and freshwater lakes and pools, as well as hot springs. The Ramsar Office has approved 855,500 hectares of Saida (name of the wetland area) as wetlands of international importance in 2001. The site is representative of the Mediterranean region in the diversity of habitats which are included, from evergreen steppe areas to the surroundings of the Chott and the "Sebkhas" (salted lakes) which are completely without vegetation, such as purely aquatic lake and marsh vegetation. Many threatened and vulnerable plant species are present here, as well as at least two vulnerable species of Anatidae (biological family) and it is an important nesting and wintering site for several species of migratory waterbirds. The area is used by agriculture, including livestock production, particularly sheep and camels. The thermal springs offer possibilities for tourism. Overgrazing, poaching, desertification, and deforestation for firewood are seen as potential threats of this Ramsar site's biodiversity and ecosystems. The Mediterranean wetlands habitat is affected by human activities ranging from coastal protection and agricultural use to industrial, recreational and nature protection claims. Salt marsh grazing by livestock will play a key role for the maintenance of stop-over areas for migratory birds and is a significant management tool at restored salt marshes. The wetlands problems often originate from human ideas and values. So, sustainable natural resource management and local participation in policy making and management process would be the fundamental solution for wetland management and protection of its ecosystems.

The objective of this paper is to obtain understanding about Mediterranean wetlands characteristics and their importance in the local economy and ecology. The discussion will be limited within adequate management strategies and recommendations for future development of Chott Ech Chergui wetland in Algeria.

THREATS AND MANAGEMENT IN THE DANUBE DELTA

Galatchi L.D., Tudor M.

As a result of the human activity along the Danube River, changes have occurred in the hydrologic regime as well as in the quality of water. These have had a negative influence on the ecosystems found in the Danube Delta and on the north - western coast of the Black Sea.

The embankment works executed in the '60s on approx. 800 km along the Romanian border in order to obtain new land have practically led to the disappearance of the flooding areas. As it happens in large systems, the ensuing effects appeared much later and were obviated by:

- eutrophication of Danube Delta waters, and partly of those in the north-west Black Sea, due to the elimination of the filtering effect caused by intensive agriculture and non-filtered streams from towns along the rivers (possible only in the presence of the flooding areas);
- changes in the specific diversity of fish and the dramatic decrease in fish populations with great economic value (especially carp), due to a lack of shallow water zones in the flooding areas, which is needed for their reproduction.

Another factor, whose detrimental effects were not initially considered, has been the building of dams and water reservoirs for the electric power supplies. Their appearance has led to changes in the flood patterns and to a fall in the quantity of alluvia carried by the Danube, due to water decantation. It has also caused major distortions in the Romanian coastal ecosystems. Another effect caused by dams was the disruption of migration paths for the reproduction of valuable sturgeon species.

The Danube Delta is the largest humid zone in Europe. It has been included on the list of International Natural and Cultural Heritage, and in the Ramsar Convention. As a direct effect of the flooding areas disappearance, the Danube Delta's capacity to retain nutrients has increased sharply since the '80s. It is currently affected by eutrophication, which has led to the reduction or loss of low water macrophytes, to changes in the range of periphytic and epiphytic algae, and to the spreading of rival species favoured by the nutrients in excess.

Apart from the losses caused by eutrophication, the Delta's biodiversity is affected by the changes in the habitats, by changes in the hydrological patterns. The latter are due to the creation of man-made channels or meander interruption, by transforming large areas into agricultural or fishing zones, or by the change in water quality (transformation of the Razelm lagoon into a fresh water lake).

HABITAT MANAGEMENT IN THE "MIRE" LIFE PROJECT SITES IN LATVIA

Pakalne M., Luce I.

From 2004 - 2008 the LIFE project "Implementation of the Mire Habitats Management Plan" is carried out financed by the European Commission LIFE-Nature programme. The project includes 4 sites – Cena Mire, Stikli Mire, Klani Mire and Veseta Floodplain Mire with the total area of 10808 ha. The sites are nationally and internationally important and include diverse vegetation types and habitats as well as protected plant and animal species.

The project sites include raised bog and fen vegetation of *Oxycocco-Sphagneteta*, *Scheuchzerio-Caricetea fuscae*, as well as forest *Vaccinio-Picetea*, *Alnetea glutinosae*, lake vegetation of the *Littorelletea uniflorae*. The raised bogs in the project sites have both: a typical hummock - hollow complex and includes labyrinths of bog pools and ridges, as well as have areas damaged by drainage, peat extraction and fires. Drainage ditches in certain areas still causes damage the mire hydrological regime and has resulted in the degradation of the raised bog vegetation.

The project includes management actions, like rising of the water level, removing of shrubs and management of boreal forest habitats. The management actions will be carried out in the raised bogs, transition mires as well as spring fens and forests. Monitoring of the habitat and site hydrology as well as of the management actions has been started.

In the project sites vegetation, hydrological, paleobotanical and geological studies are carried out, as well as management plans are being elaborated that are the basis for all the management actions.

More research was carried out in Cena Mire that included mire vegetation studies and evaluation of correlation with environmental factors as well as paleobotanical studies. Research of Cena Mire testifies that mire has originated in the depression of the Baltic Ice Lake by land paludification about 5000 ago. To characterise mire vegetation of Cena Mire 114 relevés were made from which 19 were compared with 19 water sample chemical analysis. As Cena Mire receives nutrients only from the precipitation, the level of the concentration of the chemical elements (Na, Ca, K, and Mg) was low but was different in various mire habitat types.

CAN CATTLE GRAZING MAINTAIN FLOOD PLAIN AND PEAT GRASSLAND IN THE LOWER BASIN IN THE BIEBRZA RIVER VALLEY?

Van Braeckel A., Bokdam J.

Abandonment of agricultural use caused open peat grassland to evolve into more monospecific tall sedge and reed vegetation, scrub and woodland and led to a general decline of openness-dependent biodiversity. Through appropriate management, this development might be stopped in the remaining grassland and even restoration departing from tall sedge, reed vegetation, scrub or woodland might be possible. Potential measures are cutting, burning, haying and grazing by livestock or wild herbivores or combinations.

To estimate the potentials of grazing to maintain openness, we studied habitat and diet selection of dairy cattle in the mineral flood plain and the adjacent peatland-dry hillock mosaic of the lower basin in the Biebrza valley. To reconstruct cattle terrain use, we estimated faecal pellet density using a plotless sampling method. In peatland and dry hillocks, habitat use and diet selection were determined by direct observation.

When all landscape elements were within reach of the herbivores, terrain use was highly concentrated in the short mineral floodplain grasslands (*Lolio-Potentillion*). The adjacent peatland formed a less attractive, secondary pasture ground. Here cattle use was restricted to recently mown tall sedge communities.

If mineral flood plain was virtually unreachable, then most of the peatland was grazed. The peatland experienced longest absolute grazing time, but when area was taken into consideration, dry hillocks were strongly preferred. Hillock grassland was the most preferred grazing habitat. Within the peatland zone, peat grassland (*Caricion fuscae*) was highly preferred above tall sedge, reed, scrub and woodland communities. Haying substantially intensified the grazing impact on peat grassland and decreased the use of hillocks at the end of the summer.

From the strong flood plain grassland preference we conclude that grazing, even with moderate stock densities (0,5 animals / ha), can maintain the *Lolio-Potentillion* grassland. Impact on rough vegetation and woody invaders in peatland will be limited, since these apparently have low grazing attraction. While peat grassland benefits from grazing, we expect that regressive grazing influence is strongest on encroaching reed vegetation, while invasion of tussock forming species will be lower. Haying of the area can increase both accessibility and palatability of tall sedges, increasing the grazing impact substantially.

**APPLICATION OF SALIX SPECIES AND MEADOW PLANTS FOR
RENATURIZATION OF DEGRADATED PEAT BOG FIELD EXPERIMENT
(GOSLUB IN THE BZURA RIVER VALLEY)**

Drobniewska A., Michalska-Hejduk D., Sumorok B., Koperski P.

The priority Directive which obligated Poland is Water Framework Directive (2000/60/WE). Moreover Poland takes part in the establishment of European Ecological Programme "Nature 2000", which gives some remarks on the necessity of sustainable development through National management of environmental resources and landscape shaping.

The case study area is the part of degraded peat bog in the Bzura River valley (located within the area belonging to "Nature 2000" – PLH100006). The study area have been dehydrated and transformed into meadows and plough land.

Fluctuation of ground water level is dynamic. During the winter and spring water state above ground level but during the summer season the ground water level is lower 1.5 m – 1.6 m. The variable hydrological balance is cause of evolving of sparse phytocenosis of dry-wet meadow with dominance of *Deschampsia caespitosa* in a mosaic with phytocenosis of *Caricetum gracilis* and *Phalaridetum arundinaceae*.

The hydrological condition of area is making worse during the last years. These conditions not promote to traditional arable crops. The increase of interest of alternative crops is the result of sustainable development approach for land restoration which put forward possibilities to connection of conserving and agricultural roles on the study area.

According the sustainable development approach one of ways of the rational management and landscape planning is creation of cultivation of autochthonic and energetic strains of *Salix* sp. on the degraded wetlands.

On the area was planting strains of *Salix viminalis*: *Torhild*, *Sven* and *Olof*, and *Salix alba*, *Salix caprea* – native species. For characterization of vegetation were prepared 15 phytosociological records located by each piezometer.

The first conclusion was absence increase of *Salix viminalis* on the study area with *Caricetum gracilis* and *Caricetum gracilis* with *Phalaris arundinacea*, and only one area where was observed increase of *Salix viminalis*: is a plot of dry-wet meadow with *Deschampsia caespitosa*. Moreover native species have had higher survival rate and higher biomass. The highest of biomass gave the *Salix caprea* in *Caricetum gracilis* phytocenosis.

The primary results suggested the possibility cultivate *Salix* sp on the area located into the natural habitats. Beside this approach gives possibilities of utilization of *Salix* species as economy as alternative source energy and environmental implementation.

**DEGRADED FEN SYSTEMS IN POLAND: IN SEARCH OF SUSTAINABLE
MANAGEMENT OPTIONS**

Kotowski W.

Fens used to cover nearly 4% of Poland's territory, being among the major ecosystems in lowland river valleys. Due to agricultural drainage and other changes on the landscape-scale c. 86% of these ecosystems have been drained in Poland and, in majority, transformed into permanent grasslands. These areas have been used with differing intensity until the early 1980s, when crisis of agriculture caused withdrawal of farmers. Some of these areas are still distinguishable for their high biodiversity, whereas others are covered by species-poor vegetation with many ruderal species. Neglected, these meadows have undergone succession towards shrub and forest communities. Recently, however, some of them are again being reclaimed for intensive agriculture. Both of these processes pose threat to the remaining natural values, leading to a decrease of biodiversity and further degradation of organic soils. Given the background of situation in drained fens in Poland, I address the question of best land-use practices on degraded fens, analysing several case areas. Possible options are (combinations of) the following approaches: allowing natural succession, rewetting, promotion of low-intensity mowing and grazing, biomass cropping for energy production. It is concluded that only by integrated management of various resources, the future use of drained fens can be sustainable, contributing to soil and water protection, biodiversity conservation, landscape values and other services.

THE EARLY EFFECTS OF REINTRODUCING MOWING MANAGEMENT AND REMOVING SHRUBS ON FEN AND MEADOW VEGETATION

Dzierża P., Kotowski W.

As the use on fens in Poland in the last century was most often connected with their reclamation and extensive meadow use, the occurrence of most species on those habitats depends on regularly applied management. Characteristic fen species are bound to nutrient-poor soils with high moisture. However, as an effect of agricultural development, less productive land, like wet meadows, is being abandoned and after several years overgrows with shrub vegetation. Still working but left unmanaged, reclamation systems on formerly used land cause constant dewatering of most of fen ecosystems in Poland. As an effect, many fen meadow species are becoming endangered.

Therefore, restoring meadow use on fens is more and more often a question of nature protection rather than need of agriculture.

Aiming at checking the possibility of restoring biodiversity on fen meadows and time in which rare species reappear on restored areas, two degraded, formerly valuable ecosystems have been chosen. Both of them are situated in central Poland, near Warsaw. The litter meadow on shallow peat in the reserve Kalinowa Łąka had been abandoned for 15 years. The restoration area on another site, Bagno Całowanie, had been severely drained and the fen moss ecosystems haven't been managed for about 50 years. Both areas have overgrown with willow shrubs (*Salici pentandro-cinereae*) and ruderal vegetation. After that time the shrubs were removed and the mowing management was restored. On Bagno Całowanie, outflow ditches were blocked to increase the groundwater level. Restoration effects were monitored by identifying the occurrence of target species formerly present on the areas and in the surrounding. On Bagno Całowanie, also non-target species were monitored.

The monitoring on the mown area shows different restoration effects, which are dependent on the time of abandonment and shading, as well as the time of management reintroduction. Whereas in Kalinowa Łąka the rare plants' species reappeared and the number of rare species is still growing after 5 years from the meadow restoration, on Bagno Całowanie the restoration success in the first year is much smaller.

CONSERVATION AND MANAGEMENT OF RICE FIELD BIODIVERSITY

Shimoda M.

Rice fields are the most widely distributed wetlands in Japan. After World War II, chemical fertilizers, herbicides and pesticides rapidly came into widespread use. Traditional small, irregular fields were converted into large, dry square fields for mechanized farming. Planted acreage has decreased continually since 1970, when the Japanese government started its set-aside program. Rural landscape and wildlife have been dramatically affected. Many species previously common in rural areas are now on the Red List.

In this paper, I will describe the flora and vegetation of wet fields in an area called Nakaikemi in central Japan, discussing also the conservation and management of rice field biodiversity.

Nakaikemi is a 25-hectare basin with deep peat beds cultivated as rice fields for 200 to 300 years. Most of these fields were extremely muddy and wet, making them difficult to develop into large dry fields with concrete ditches. Abandoned fields began increasing around 1970. Though inconvenient for modern agriculture, these fields provide good habitat for aquatic and wetland life. Nakaikemi's biota includes many rare or threatened species.

More than 30 Red List plants have been confirmed in Nakaikemi, half of them once considered harmful rice weeds. Diverse flora developed on recently abandoned or fallow fields, but in areas without management, many rare plants disappeared as tall reedy invaders took over.

To experimentally conserve and restore rice field biodiversity, management and monitoring surveys were conducted in a 4-hectare area in Nakaikemi. Local farmers performed the management tasks based on usual practices. Many Red List plants quickly grew in planted fields weeded by hand and in fallow fields plowed but not planted. The diverse species characteristic of cultivated and recently abandoned fields germinated in old abandoned fields after surface vegetation was removed.

Our findings demonstrated that appropriate management is required to conserve the biodiversity of secondary wetlands and that rich species diversity can be restored in species-poor abandoned fields from existing seed banks.

Intensive management in Nakaikemi was effective but required manpower and money. Effective, practical management and monitoring methods will be required nationwide if we are to conserve our valuable plant heritage.

**AN EVALUATION SYSTEM FOR TECHNICAL WATER MANAGEMENT
SCENARIO'S FOR THE BIEBRZA RIVER VALLEY, NE-POLAND**

Bleuten W., Vreugdenhil A., Okruszko T.

The Biebrza National Park includes a large peatland area in the Biebrza river valley, in NE Poland. Among nature conservationists the area is famous for its waterfowl habitat and for the near natural condition of the peatland vegetation. The area was partially drained by digging shortcut canals for land reclamation and improvement of the transportation possibilities of timber over water at the end of the 19th and beginning of the 20th century. Later, within parts of the peatland drainage networks consisting of small canals and ditches were developed. As a result in some areas of the Park the groundwater levels are gradually lowering, resulting in an undesired change of the peatland vegetations by eutrophication and by that threatening the habitat conditions. Objective of this paper was the development of a new integrated tool for evaluation of technical management scenarios by the BNP. The tool will be based on a groundwater model, which uses the cellular automate PCraster for dynamic modelling of overland flow, channel water levels and as a GIS tool during pre- and post-processing MODFLOW files for prediction of patterns of groundwater depth, water fluxes and nutrient availability patterns.

**IMPACT OF WATER MANAGEMENT ALTERNATIVES TO SECURE
FAVOURABLE STATUS IN ZUVINTAS LAKE AND AMALVAS WETLAND IN
LITHUANIA**

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The Zuvintas Lake, located in southern Lithuania in the catchment of the Dovine River is one of the biggest lakes and oldest nature reserves of the country. Despite the inflow of nutrients and related eutrofication, the Zuvintas Lake is still one of Lithuania's most significant nature reserves and both the Lake as well as the adjacent wetlands is a potential Site of Community Interest (SCI) according to the Habitats Directive. Once designated as SCI Lithuania is obliged to maintain the conservation status of the site and species for which the site is designated and to make sure that the favourable conservation status is achieved or maintained. There are three main parts of the Zuvintas Biosphere Reserve: 1) the Zuvintas Lake itself, 2) the adjacent bogs and fen meadows and 3) the Amalvas wetland.

The changes in the hydrology of the Dovine River Basin, because of a large scale melioration and water management works carried out in the 20th century, are the main causes for the decreasing biodiversity of the Zuvintas Lake. These works included the building of dams at the outlets of various lakes (including the Zuvintas lake) to retain spring water, regulation of the river Dovine itself, melioration of the Amalvas wetland downstream of the Zuvintas Lake and intensive agriculture and fish-breeding activities upstream Zuvintas. The biodiversity of the Amalvas wetland have significantly been impacted by drainage and melioration works during the last thirty years as well.

The basic impediment to find a solution for the ongoing deterioration of the Zuvintas Lake and adjacent wetlands has been the lack to see the Lake as an integrated part of the Dovine River basin and to acknowledge that solutions for the Zuvintas Lake have to be found at a basin level. Therefore, the main objective of this research has been to evaluate the impact of various water management alternatives of the Dovine river on the Zuvintas Lake and Amalvas wetland benefiting to the favourable conservation status of the area. Various scenarios including the removal of some sluice-gates have been analyzed to get insight in the impact of changes of the river regime on the water levels in the Zuvintas Lake and adjacent wetlands.

For such a complex system as the Dovine basin it required the use of a combined groundwater and surface water model to predict the effect of measures. For such situations the SIMGRO model was developed. The model simulates the flow of water in the saturated zone, the unsaturated zone and the surface water. The model is physically-based and therefore suitable to be used in situations with changing hydrological conditions. Different scenarios were defined to represent the changes in water management practices and land use. From these simulations results will be presented.

**PROTECTION OF WETLANDS AS AN ELEMENT OF WATER MANAGEMENT
IN RURAL AREAS**

Mioduszewski W., Hardej M.

Natural retention capacities of the river catchments have diminished markedly due to decreasing area of forests, disappearance of small water bodies and wetlands, covering the ground surface with impermeable materials (roads, squares) and due to draining systems. These reasons are assumed to increase the rate of water cycling and transport of chemical substances in catchments and thus to increase the frequency of extreme phenomena like floods and droughts.

It is necessary to improve the structure of water balance by enlargement of potential retention capacities of small river catchments. Basic target in this aspect is the protection and reconstruction of wetlands or, in other words, of water-related ecosystems.

This paper presents basic actions associated with the protection and restitution of wetlands undertaken in recent years. Legal, organisational and financial conditions determining the maintenance of wetlands in a good ecological status are described.

Most often the aim of these actions is to protect wildlife in wetlands. Nevertheless, they play a positive role for the structure of water balance. The importance of wetlands as water suppliers is commonly acknowledged though there are difficulties in the quantitative evaluation of the effect of wetlands on surface and ground water resources.

National parks and the legal system of nature protection play a positive role in wetland protection. It is, however, necessary to undertake broad action to disseminate the idea of the protection and restoration of wetlands with particular reference to legal and economic instruments as stimulators for the creation and restitution small wetlands in agricultural landscape.

The creation of a small number of large wetlands will not exert a significant impact on water budget in the country. Many such areas, providing appropriate water management, would improve water quality and enlarge water resources available to agriculture and other users.

MANAGEMENT OF LITORAL ZONE OF LOWLAND RESERVOIR FOR ENHANCEMENT OF NITROGEN REMOVING VIA DENITRIFICATION

Bednarek A., Zalewski M.

High ratio of agricultural area within the catchment (64%) to reservoir surface result in high loads of nutrients into the Sulejów Reservoir. The main pathway for pollution inflow are tributaries. The main sources of nitrogen in the catchment are nitrate fertilisers, manure storages and communal point source of pollution. The most important natural process of nitrate removal is denitrification. The ability of denitrifying bacteria to reduce high levels of ambient nitrate can even limit primary production. Thus enhancement of denitrifiers activity, naturally occurring in sediments, is considered as efficient and the low-cost tool preventing eutrofication. Denitrification rate was measured at 12 sites in the sediments of the Sulejow Reservoir. The technique applied was in situ chamber method and the rate of a process was calculated basing on the total N₂ flux out of the sediment. Production of nitrous oxide was not observed, possibly due to the pH of overlying water (> 7,3). The in situ denitrification rate ranged from 0 to 833 mol N₂ m⁻² h⁻¹, and was mainly determined through organic carbon availability in the sediment structure

($r^2 = 0.84$ $p < 0.05$). Such high values are characteristic for eutrophic reservoirs. Additionally the number of denitrifying bacteria in the sediment was estimated at a level of 0.05% to 15.8% of total mikroflora by MPN method and at 4.6% to 26% using the plate counting method. The most frequently isolated bacteria were identified as members of genera: *Pseudomonas*, *Alcaligenes* and *Bacillus*, with domination of *Pseudomonas* genus and species *P. fluorescens* and *P. stutzeri*.

Due to the denitrification process, highly unfavourable phenomenon such as toxicity nitrite accumulation may occur in the bottom sediment of the reservoir. The participation of nitrite-accumulating bacteria in Sulejow Reservoir is alarmingly high – close to 50% of the bacteria isolated from the natural mikroflora, with strains of *P. stutzeri* predominating. Because of this farther enrichment of surface waters with nitrate fertiliser compounds might endanger the balance of natural environments by accumulation of toxic nitrite products due to denitrification process.

Presented results suggest that autochtonic mikroflora can be used to remove nitrogen from eutrophic reservoirs. Considering the literature data it was concluded that in Sulejow Reservoir littoral zones make a significantly high contribution to whole reservoir denitrification.

**CONTROLLED RUN-OFF FROM AGRICULTURALLY USED PEATLANDS IN
THE NOTEC RIVER VALLEY AND ITS EFFECT ON WATER STATUS OF
PEATLANDS**

Smarzyńska K., Łabędzki L.

Peatlands in river valleys have been utilized by agriculture for centuries, with hay-making and grazing as the main land use types. Traditional management led to the development of many unique ecosystems transformed to different habitats, often degraded. Their protection and human economy in the harmony with nature is a very important problem.

The upper Notec river catchment has been chosen as an example, on which a simple method of controlling run-off from agricultural peatlands as a way of their proper protection will be shown.

The upper Notec river catchment occupies an area of 4089 km². It is located in the physico-geographical region called the Wielkopolskie Lakeland. Peatlands cover 42% of the upper Notec river valley.

Apart from the antropogenic reasons of overdrying (irrigation-drainage ditches), frequent atmospheric, hydrologic and soil droughts in the region have their share in the degradation of peatlands. This region is one of the driest in Central Europe. The average annual precipitation rate for this area is about 550 mm and average sum of precipitation in the growing season is only 270 mm. Besides the average mean daily values of air temperature are high and air humidity – low. These conditions cause severe and frequent droughts and scarcity of water resources. The soil is overdried, which is one of the main threats to agriculturally used peatland sites. The agricultural use of wetland areas in the upper Notec river catchment led to their transformation into extensively managed wet and moist grasslands and, more intensively managed, slightly moist and dry grasslands. Some peatlands are completely degraded and have been turned into arable land. This caused degradation of organic matter of soil, natural plant communities and whole natural ecosystem.

The proper water management in the river valley is important for protection or restoration of peatland sites. Controlled run-off can be one of means to counteract this drainage of organic soils. This technique is recommended for farmers as a cheap and simple measure in the Notec river valley.

Field investigations carried out in 2002-2004 in peatland sites showed positive effect of controlled run-off and groundwater lowering in spring on forming soil moisture and groundwater table depths. The results show that controlling groundwater table depths in meadow sites with organic soils in the river valley with the method of controlled run-off ensures soil moisture in the range required for peatland protection as well as reduces frequency and duration of soil drought and delays the drought occurrence. Drainage in spring due to controlling of run-off from grassland makes groundwater level and organic soil moisture decrease slower in the river valley, preserving organic mater and maintaining high level of moisture in the soil hydrogenic sites.

**MEASUREMENTS AND AKWA-M®-WATER BALANCE SIMULATIONS WITHIN
A PROTECTED LARGE WETLAND AREA WITH LIMITED SURFACE WATER
SUPPLY - WATER BALANCE PERSPECTIVES UNDER CLIMATE CHANGES**

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The nature conservation project Teichgruppe Niederspree-Hammerstadt is located in the north-eastern part of Saxony and comprises an area of 52 km²; interconnected ponds and wetlands cover about 7 km² of the total area. The ponds, which are partially used for fishing and the wetlands are habitat to many valuable species to be protected by nature conservation. The water feeding of ponds and wetlands depends mainly on highly variable surface water inflow from the corresponding watershed with an area of 360 km². The ponds and wetlands are partially surrounded and influenced by agricultural drainage systems constructed around 1970 by collectivised socialist agriculture. Land use attitudes have changed since 1990.

About 230 ground- and surface-water measuring points have been established within the project area. Discharge measurements started 1963; climatic and groundwater level information dates back to the year 1950. A detailed monitoring programme within the project area began in 1998.

Based on these field data we are investigating the interaction between surface water inflow, pond and wetland water levels, infiltration of pond water into the underlying aquifers and pond water management practices with the help of our water balance model AKWA-M® and other surface-groundwater models. The effects of drainage system closure can be shown by field experiments and previous simulation respectively. The water balance simulation shows clearly the shift of the area outflow due to the pond and ground water storage.

Furthermore we describe the strategy for pond water management under time variable surface water inflow targeting on optimal water levels within the protected wetland areas consistent with the further existence of fishing. The climate change prognosis for Saxony around the years 2040 - 2059 is used to simulate the possible water balance of the watershed and the project area. Results of the simulations are compared with the actual water balance situation. Strategies for compensating the decreasing inflow are presented and supported by the expected probabilities (quantity, time distribution, water level). Due to the actual changing agricultural land use as a consequence of the stepwise altering economic conditions, the future land use and water management policies within such watersheds should consider primarily ecological targets rather than pure agricultural or forest production targets.

IMPACT OF PEAT EXCAVATION ON THE GORBACZ NATURE RESERVE

Ilnicki P.

The southern edge of the large "Michałowco-Imszar" peatland (ca 60 km²), located in the Podlaskie province, is formed by raised peat. Horticultural peat has been excavated in that area since 1966. In the area of 48.3 ha the excavation ceased in 1998, while in 16.53 ha it was started in 2004. The Gorbacz peatland nature reserve, established in 1966, is located to the north-east of the excavation area. It covers the area of 113.73 ha. The whole peatland was incorporated in 2004 in the "Puszcza Knyszyńska" special bird protection area Natura 2000, extending over approx. 132 thousand hectares. Peat excavation is connected with deep internal drainage of the peatland and complete destruction of the existing plant communities. It causes a potential threat to the natural and seminatural plant communities and for the overgrowing lake, found in the reserve. In the years 1981-2004 numerous studies were conducted in the Imszar bog, the aim of which was to determine the effect of peat excavation on water conditions in the nature reserve. This study is a synthesis of the results of all the studies conducted so far. It makes it possible to determine the actual effect of anthropopressure on the natural environment in the reserve. It covers the stratigraphy of the peat deposit as well as climatic, hydrographic, hydrological and natural conditions in the Imszar bog (ca 450 ha). The results present data collected during several decades of observations. This makes it possible to draw reliable conclusions. Problems of this type are also found in other excavated bogs in Poland and in other European countries.

FLUVIOGENIC FENS OF THE NAREW VALLEY: VEGETATION MANAGEMENT PROBLEMS IN HYDROLOGICALLY AFFECTED LANDSCAPE UNDER NEW SOCIO-ECONOMICAL CIRCUMSTANCES

Szewczyk M.

The section of the upper Narew River valley protected as Narwiański National Park is known for a unique system of anastomosing riverbeds, which supports extensive area of wetlands. The frequency and duration of floods have changed in the last decade due to alteration of the hydrological regime, at the same time the mowing management of sedge-beds disappeared almost completely. The distribution of plant communities and soils in 1970s and 2003 has been compared on the background of hydrological conditions monitored over 30 years. A comparison of vegetation data showed that the area of tufted sedge communities *Caricetum elatae*, which used to be the dominant vegetation type in the park, decreased drastically. At the same time we observed an expansion of *Caricetum gracilis* and an invasion of *Phragmites australis*. The hydrological and soil investigations revealed a significant lowering of the groundwater level during the growing season in the last decade, which is mainly due to the decreased duration of floods. This resulted in the desiccation of peat soils. Our results show that even within the range of hydrological conditions supporting wetland communities, some changes can largely affect species composition and conservational values.

To reverse the unfavourable changes or, at least, prevent their further occurrence, hydrological restoration as well as management re-introduction is necessary. However, the attempts to re-establish vegetation management are constrained by a number of socio-economical constraints. Those include the local depopulation, change of job preferences, highly fragmented structure of land and unclear ownership situation. Such obstacles not only limit chances for implementing the management plan of the National Park but also hamper implementation of the agri-environmental schemes, a financial instrument designed to support this type of management.

A METHODOLOGY FOR IMPROVING MANAGEMENT OF CONTROVERSIAL WETLAND

Merot P.

Valley bottom wetlands (VBWs) included in agricultural landscapes are often neglected in national and regional wetland inventories. These VBWs are located in catchments of order 1, 2 or 3 according to Strahler. These zones appear as narrow strips along the rivers and then also named riparian wetlands, widening out as spoon-shaped basins at the catchment head. Although these areas are small, and scattered in the rural landscape, they strongly influence hydrology, water quality and biodiversity over the whole catchment area. VBWs are often considered as controversial wetlands. Awareness is increasing of the functional role of wetlands, in parallel with their progressive disappearance in intensive farming landscapes.

From a management perspective, the status of these wetlands in rural landscapes is still an open question, whether involving all or part of the multiple functions. Land planners and users are often concerned with quite diverse and indeed diverging interests as regards wetlands. The need to improve tools for controlling wetland management is a primary consideration for decision-makers and land-users.

The aim of this talk is twofold 1) To interpret among wetland classifications and to improve the consistency between different approaches for characterising wetlands; 2) To propose a methodology that associates and organises into a hierarchy wetland delineation and wetland functions.

This methodology is based on the functional analysis of Potential, Existing and Efficient riparian Wetlands (the PEEW Approach). Several indicators are proposed to check the validity of such an approach. Potential wetlands can be delineated by means of a topographic index using topographic and pedo-climatic criteria that are computed from a Digital Elevation Model and easily accessible databases. Existing wetlands can be identified from observed surface moisture, the presence of specific wetland vegetation or soil feature criteria. Efficient wetlands can only be defined through a given function, such as flow or pollutant regulation, or biodiversity control. An analysis of areas at the limits between potential, existing and efficient wetlands highlights land cultivated or drained in the past, and which nowadays represent negotiating areas where intended management actions can be implemented.

This methodology, established for valley bottom wetlands, was also recently used for facilitating the management of a marshland, as it will be shown.

A SYSTEM OF HYDROLOGICAL AND CLIMATOLOGICAL BUFFER-ZONES FOR MIRES

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In Europe, there are various concepts for hydrological buffer-zones for mires. Some buffer-zones are inside the mires, some outside. The hydrological processes, which shall be influenced by the buffer-zones, and the aims of mire-protection are different. Nevertheless, not all important processes and aims of protection are included in the existing conceptions. The water-, nutrient- and energy-supply of different mire types depends of their surroundings, e.g. catchment-areas, geology, local mesoclimate and immission-conditions. The catchment-areas can be subdivided into surface-water- and groundwater-catchments. The groundwater-catchments can belong to different aquifers, which in a different way are connected with different parts of mires. We show some examples from Northern and Southern East-Germany. In these catchment-areas, there are different land-use types and land-use-changes going on. It must be identified, how this is connected with mire hydrology and ecology. After identifying and calculating hydrological processes, one can say, how the surroundings must be protected.

The mire microclimate depends on the mesoclimate of the surroundings. The relationship between a mire and its surroundings is realised via air-transport (advection) and radiation. The climate of the surroundings and the processes of advection and radiation are the extern regulators of mire-evapotranspiration. Depending on evapotranspiration, the water-quality and/or the vegetation in a mire can change. In dry climates, dry seasons or under possible climatic changes the oasis-effect plays an important role on mire-evapotranspiration. We will present a simple method of calculating the oasis-effect. If we calculate the influence of different surroundings to oasis-effect, we can identify management options for so called climatic-buffer-zones.

We distinguish 3 types of hydrological and 3 types of climatological buffer-zones for mires. In mire protection and revitalisation projects one must identify processes of water, nutrient and energy exchange with each possible buffer-zone. We will give some examples, how buffer-zone-management is compatible to the local water-, forest- and nature-protection-legislation, to NATURA 2000 and EU-Water Framework Directive.