Content Pin Matra Report Man and Biebrza

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Preface – Martin Wassen

This is the final report of the PIN-MATRA project entitled 'Man and Nature at Biebrza; integration and dissemination of knowledge for sustainable nature management'. This project aims at bringing together existing knowledge and practical experience in a framework leading to the development of a Management Support System (MSS) and subsequently creates a network of scientists, nature managers and local stakeholders. Participants in the project were Biebrza National Park, as well as scientific partners and NGO's. The emphasize of the project is on communication, dissemination of knowledge and increasing awareness. The MSS contains data and models and in its design special attention is paid to the needs of stakeholders.

Biebrza is about one of the last undisturbed lowland river systems in Europe. The Biebrza river (N.E. Poland) and its surrounding wetlands form a large, fairly pristine area and is a hotspot for biodiversity, which is highly valued for especially flora, avifauna and mammals (beaver, wolf, otter, elk). The importance of the area has been internationally recognized since the beginning of the nineties. In 1993 the Biebrza National Park (BNP) was founded with financial support of the Polish, Dutch and Swedish Governments and the WWF. The area is a Ramsar Site and a Bird Site of European Importance.

Three subsequent projects were carried out jointly funded by the Dutch Ministry of Agriculture, Nature Management and Food Quality and the Ministry of Foreign Affairs in the framework of the Nature Management Action Plan for Central and Eastern Europe (PIN) and the MATRA–programme (for international cooperation with former East Bloc countries). These programmes describe the government's policy with respect to international nature management in central and eastern candidate countries during the transformation process.

The first project was entitled 'Assessment of the effects of changes in water management within the Central Biebrza Basin'. It addressed water management in a part of the basin, where drainage by channels led to the deterioration of nature. The project was carried out by a team of experts from Dutch and Polish universities and research institutes in cooperation with Biebrza National Park (BNP). The project was scientifically oriented, developing quantitative hydrological models (groundwater and surface water). These models were used in scenario studies. It became clear that solving the problem for nature within the boundaries of the park, would inevitably lead to floods on agricultural grounds located outside the park (Mioduszewski and Wassen, 1999). The lack of possibilities for simulating water quality was perceived as an omission and also the BNP had the wish to enlarge the geographic area the models applied to.

The second project entitled 'Hydrological system analysis in the valley of the Biebrza river' addressed these two weak points: the modeled area was extended to two-third of the park's area and an extensive water quality database was coupled in a GIS to the hydrological models (Mioduszewski and Querner, 2002). In the mean time the urgency of improved communication between the BNP and stakeholders was obvious. WWF-International took the initiative in a round table meeting in which bottlenecks in the communication of the park with the local community and with other stakeholders were recognized as a major problem, thus preventing acceptance of the park's nature conservation goals. A local branch of WWF was raised to facilitate the communication process and the present PIN-MATRA project (of which we report here) was started entitled 'Man and Nature at Biebrza; integration and dissemination of knowledge for sustainable nature management'. The project results were published on the web (http://levis.sggw.waw.pl/mss/eng/project_concept.htm) and in a report

written in Polish. Also, the results were communicated with stakeholders in the area and local and national policy makers and representatives of other Polish national parks in a final meeting held at BNP in Osowiec (Oktober 2004). The MSS is implemented at BNP where it is already frequently used.

The project was co-ordinated by Utrecht University in the Netherlands and by Warsaw Agricultural University in Poland. The project involved participants from: the Institute for Land Reclamation and Grassland Farming and was implemented by Biebrza National Park in close cooperation with two Polish NGO's: 'WWF-local Biebrza Branch' and 'Workshop of Living Architecture'.

We thank the Dutch Ministry of Agriculture, Nature Management and Food Quality and the Ministry of Foreign Affairs for their support. We are convinced that the project adds to effective nature management in the Biebrza region taking into consideration the interests of other stakeholders. The project also functions as an example of good practice for other national parks in taking serious participation of stakeholders in management and planning.

Introduction Jarek Chormanski

This project envisaged a supporting tool for governmental and non-profit nature organizations in the Biebrza region in their efforts for sustainable management of the Biebrza National Park. It also aims at establishing a Polish-Dutch network by means of which existing practical experience and knowledge on wetland conservation from the Polish and Dutch partners especially concerning Biebrza National Park can be exchanged.

The knowledge combined in the project serves as the base for a Management Support System (MSS) aiming at several functions: streamlining and formalisation of various knowledge sources; identifying gaps in knowledge; focusing monitoring programmes and adding to transparancy in decision making.

The MSS, due to the park's wishes and needs, was developed as a GIS database with the calculated results of selected scenarios. The final results of the project are database and just final results of scenarios. A part of constructing of the database was purchase of equipment: computer, software and hardware. Another part of implementation of MSS was training of local staff in data management, the use of the MSS and GIS. There were two courses of using ArcView GIS, provided by ESRI Company, and several trainings of the MSS and database management done by Warsaw Agricultural University staff.

The actual MSS consist of three parts: Data catalogue and GIS; Hydrological module; Ecological module. The first part - a data catalogue and GIS is already used by people for environmental management. Database catalogue contain several thematical databases mostly related to GIS by SQL language. The spatial part of database developed in GIS environment was included as ArcView GIS shape themes. When the MSS is operational the spatially explicit hydrological and ecological effects of certain water management and land use scenarios would be calculated, and visualized in GIS.
The hydrological module predicts the changes in water conditions as a function of changes in climate and nature management regime. The hydrological module consists of mathematical and statistical models of surface water and groundwater sub-systems.
The ecological module should predicts changes in plant communities and red list plant species belonging to these communities as well as birds finding a suitable habitat in these communities as a function of changes in abiotic conditions (soil and hydrological conditions) and nature management regime (hay-making, grazing, burning). The ecological module consists of statistical correlations and expert knowledge. Expert knowledge is used to define decision rules for relations due to the fact that the empirical model was calibrated with poor result, and for estimating the effect of complex processes. The MSS serves as a demonstration tool offering the opportunity to optimize water and vegetation management and giving more insight in knowledge gaps and lack of specific data. The modeling part of MSS including surface and ground water modeling, due to its difficulty was established in Warsaw Agricultural University and IMUZ, and only calculation results were included in database catalogue.

The MSS helped to select scenarios which are economically acceptable for the local stake holders and also add as much as possible to sustainable protection of nature values. During realisation of the project several scenarios were developed with help of MSS There are: Application of Agro-Environmental Programme in Biebrza National Park, Water management in Kapicki Canal, Tourist infrastructure planning in BNP.

The project brings together existing knowledge and practical experience in a framework leading to the development of a Management Support System and a network of scientists, nature managers and local stakeholders. This leads to a better communication and cooperation between nature management, agriculture and tourist organisations in land use planning within the present socio-economic context. An integral (different sectors and different disciplines) and area specific approach is followed, focused on the Biebrza wetlands, a large pristine area and hotspot for biodiversity. There were several meeting organized with local stakeholders and farmers to inform them about MSS, and specially about scenarios. Communication of the park with local stakeholders for agriculture, recreation and inhabitants was improved during this project. Meetings, workshops and mail communication aimed and awakened among farmers of consequences of their management for biodiversity and nature as well as about conflicting demands on land and water in the area. There were two workshops organized in BNP office in Osowiec together with local stakeholders and farmers in Oktober 2003 and second, in Oktober 2004, the closing workshop together with local stakeholders, governmental organisations, ngo‘s and peoples from other polish national parks which protects wetland ecosystems.

Although much knowledge is available in Poland and in the Netherlands about important aspects related to nature protection at Biebrza this knowledge is fragmented over several, research institutes and universities. The Website developed by responsibility of WWF disseminated knowledge about MSS and nature protection aspects by means of global communication. The WWF large experience in public relations and was used for public relation organisation. The web page was developed in both Polish and English languages.

During a project realisation it was a need of filling the knowledge gaps necessary to construct a Management Support System. The most imported there was identification of strict co-relations between hydrological, hydrogeological and soil conditions which change in time and place, as well as type and extensity of the land use in the valley and on the surrounding highland on the one hand and the conditions of environment and biological diversity of fauna and flora on the other hand.

Characteristics of Biebrza valley **Waldemar Mioduszewski**

Overview of the Valley

The Valley of Biebrza is situated in the Northeast Poland and is a part of the wide, marshy lowland called Biebrza Basin, which spreads from the Polish-Belorussian border to the Narew River. Its geological, geomorphologic, hydroclimatic, biological and anthropological properties give the Valley its unique and distinctive character which distinguishes it from the adjacent areas. One of the unique qualities of the area is its complex of marsh vegetation, which is the largest and most natural in the Eastern Europe. The plant cover is characterised by its diversity and the presence of various rare species. The Biebrza Valley is a very valuable habitat for water and marsh birds. Moreover, numerous mammals and other representatives of fauna inhabit the area. The preservation of the high natural value of this unique water-marsh area depends on the maintenance of high humidity of hydrogenic habitats and the characteristic wide, open meadows formed as s result of extensive agricultural exploitation. In order to fulfil such conditions the proper management of water resources is required (counteracting unfavourable results of the previous hydrotechnical and land reclamation work) and the periodic mowing of meadows in order to prevent the overgrowing of the valley with reed and bushes.

The Biebrza Valley is divided into 3 so-called basins: the Upper (Northern) Basin, the Middle (Central) Basin and the Lower (Southern) Basin.

The Upper Basin consists of two parts: a proglacial stream valley and a flat sandur, which are connected within one hydrological system. In the deep gully notches where the Biebrza River floats there are the outlets of groundwater from the upland of the middle-Polish glaciations, which results in the strong marshing and the formation of peat deposits, mostly mossy, with the considerable depth of 6-8m.

The Middle Basin is a broad, flat gully which became marshy mostly due to the waters from the Lakeland, both the ground and surface water. This basin is cut by several rivers, the Biebrza's tributaries, which flow along its southern border. Water and soil conditions, and hence also the habitation and the whole ecosystems, were modified (distorted) by the network of large canals built in the 19^{th} century. This Basin is the most complex, both in terms of its nature and economy, compared to the rest of the proglacial stream valley.

The Lower Basin is very marshy due to the incoming groundwater and rivers which flow into the Biebrza. The mixed hydrological system resulting from the manner of inflowing water to the Valley and the draining operation of the River resulted in the formation of specific zone system, which is parallel to the river and is unique for marshy valleys. This zone system is present both in vegetation complexes and in the soil hydrogenic formations.

Climate and Soil Conditions

In the Biebrza Valley, compared to the neighbouring areas, temperatures are lower (annual average of $7^{o}C$) due to the fact that the marshy base gets warm slower and less than the base of the adjacent mineral uplands. The snow layer covers this area for 80-100 days. The summer, which is characteristic for the areas subject to the impact of continental air, is warm but short, whereas the winter is frosty and long. The number of cloudless days is relatively small.

Due to the occurrence of ground frosts in the spring and autumn the period of vegetation on peat soils is shorter by 10-20 days and does not exceed 190 days – hence it belongs to the

shortest in Poland. This abridged period results also from the specific character of peat soils, which get warm and conduct heat slower.

The largest precipitation occurs in the summer period (July, August) and the annual precipitation varies from 550 to 700mm.

The Biebrza National Park covers the area of 58,322 hectares (Table 1). The area of the Park consists of mineral soils (4,891 hectares) and hydrogenic soils (53,441 hectares). The remaining area is covered by water (891 hectares).

Table 1. Soils of the Biebrza National Park (BNP)

Soils	Basins						Total BNP	
	Upper		Middle		Lower			
	ha	%	ha	%	ha	%	ha	%
Mineral	451	7.9	1 571	5.4	2 869	12.3	4 891	8.4
Hydrogenic	5 289	92.1	27 667	94.6	20 485	87.8	53 441	91.6
Total	5 740	100	29 238	100	23 354	100	58 332	100
% compared to total soil	9.9		50.1		40.0		100	

The hydrogenic soils which occur in the marshy and boggy hydrogenic areas are the main protected element of the Park. It is important not only to recognize their present state but also to forecast the reaction of such soils to any modifications of water conditions.

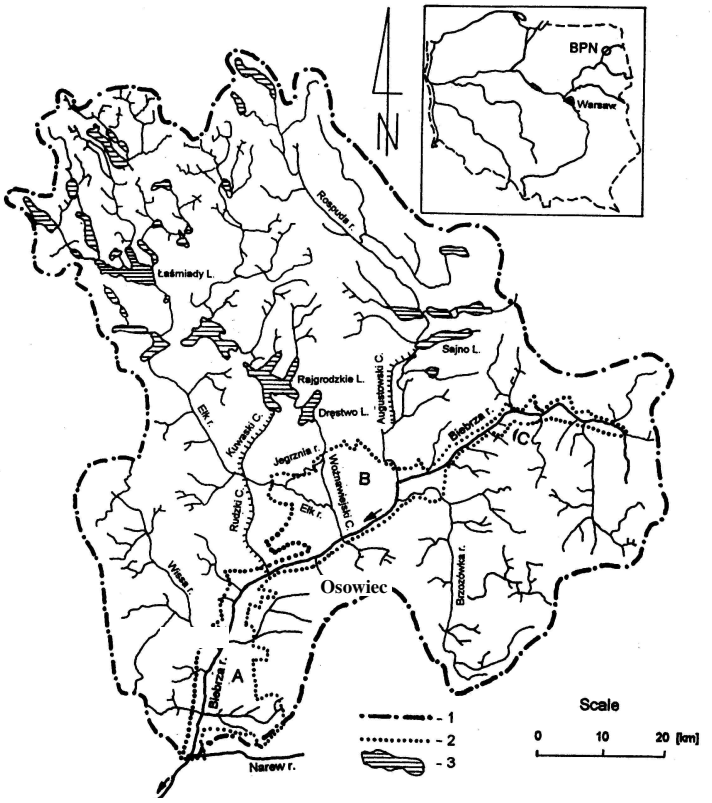


Figure 1. Catchment of the Biebrza River; *1* – catchment border*; 2* – borders of the Biebrza National Park; *3* – lakes; *A* – Lower Basin; *B* – Middle Basin; *C* – Upper Basin

Sformatowane: Punktory i numeracja

Hydrographical Network

The Biebrza River originates in the Jan Marshes south to Nowy Dwor in the form of leaks at the basis of the morainal hills at the height of 157.5 m above sea level. The estuary of the Biebrza to the Narew (206 km of the river run) is located at the Rus village, at the height of 99.9 m above sea level. The area of the river basin amounts to 7051.2 km^2, the length from the source to the estuary is 170.6 km. The drop of water level of the Biebrza River is irregular. The highest drop (13‰) occurs near the sources, the lowest drops (0,04 – 0,05‰) are observed in many sections in the area of the proglacial stream valley.

The Biebrza Basin is characterised by the high irregularity of the arrangement of tributaries. The right riverbank of the basin encompasses 75.5% of the total, whereas the left riverbank of the basin only 24.5%. The index of irregularity, which is the quotient of the two figures, amounts to 3.08.

There are numerous lakes which belong to the Suwalskie Lakeland and the Augustowska Plain in the Biebrza Basin (Figure 1). In total the lakes cover the area of 156.9 km^2, that is 2.3% of the basin area. The area of the Biebrza National Park encompasses approximately 8% of the area of the whole reception basin. Hence the importance of water management in the whole basin for the condition and the possibilities of protection of the natural characteristics of the Park.

Table 2. Medium Flows (SSQ) in the period 1971–1995 at selected Biebrza posts

Water Level Indicator	Area of the Reception Basin km^2	SSQ m^3/s
Sztabin	846.0	5.27
Dębowo	2322.4	14.0
Stare Dolistowo	3064.2	17.3
Osowiec	4365.1	26.6
Burzyn	6900.4	39.2

Table 1 presents the value of medium flow for chosen water level gauges in the sections of the Biebrza River. The largest tributaries are Rudzki Canal – Ełk (11.2m^3/s), the Netta (6.1m^3/s), the Jegrznia (5.6m^3/s), the Brzozówka (3.5 m^3/s) and the Wissa (2.8 m^3/s) Rivers.

The flow that is lower than hydrobiological and the reduced frequency of spring flooding exert negative impact on the natural value of the valley. At present the hydrobiological flow is satisfied with a large time and volume reserve. However, the observations indicate that the overdrying of the organic soil in the valley occurs, which results from e.g. anthropogenic actions.

Modifications of the hydrographical network

The first modification of the hydrographical network in the Biebrza Valley occurred before 1850, when the Augustowski Canal was built (1823-1838) followed by Rudzki and Woźnawiejski Canals and numerous other smaller canals and ditches. The canals were created between 1845 and 1861 as a result of wide-scale public work after the starvation in 1844 and the purpose of the work was to facilitate the agricultural use of marshy meadows for hay collection.

First comprehensive smaller hydraulic structures date back to the same period (the construction of the drainage and irrigation ditches). The wide range of land reclamation work was conducted in the years of 1950-1970 on the border of the present National park. The largest investment of the period was to drain Kuwasy Marsh of the area of above 10,000 hectares. In the years of 1952-1958 156 km of canals and ditches as well as 41.8 km of other hydraulic structures were built there.

The section of the valley protected by law that was subject to biggest modifications is the Middle Basin of the Biebrza River. The hydrographical network was rebuilt intensely in this region, primarily as a result of the reconstruction of the Woźnawiejski and Rudzki Canals. The reconstruction of the hydrographical network (construction of canals and ditches) resulted in the significant limitations and, in some areas, the liquidation of spring flooding in addition to the lowered level of groundwater.

Hydrotechnical work was done in the area of the Lower and Upper Basin of the Biebrza River to a much smaller extent. The Lower Basin has maintained its most natural character. Nevertheless, in the period from 1920 to 1930 a network of drainage ditches was made in this area, which replaced the numerous oxbows. In spite of the lack of maintenance and overgrowing, the ditches still accelerate the flow of water, particularly of the post-winter one.

Within the borders of the Biebrza National Park there are no large hydrotechnical constructions (except for the abovementioned canals) which might influence the water resources and the surface water regime. A large investment (outside the BPN) which might and should be used for the protection of the Park is Rajgrodzkie lake, with an artificial retention capacity of approximately 20 million m^3. This capacity was formed in order to irrigated a large drained peatland , i.e. Kuwasy system.

Irrigation – drainage system is often accompanied by the training of rivers performed in order to facilitate and accelerate the flow of water from drained areas. In the Upper Basin the training of sections of the following rivers has been conducted: the Nurka, Niedźwiedzica, Sidra, Lebiedzianka and Jastrzębianka Rivers. Also the upper Biebrza above the estuary of the Niedźwiedzica River has been trained. In the Middle Basin the following rivers have been trained: the Brzozówka, Szczeberka, Blizna and a part of Ełk. In the Lower Basin the Klimaszewnica, Kosódka and partly Wissa Rivers have been trained as well.

Water management in BNP

High water levels in the Biebrza River occur mostly in the spring period during snow melting. A large part of the valley is flooded and remains covered by water for a longer period (sometimes until the middle June).

The protection of the natural value of the area depends primarily on the state and quality of organic soils and water conditions. Therefore the protection of water and soil resources as well as the proper management thereof is the decisive factor for the possibilities of the protection of natural resources.

The appropriate water management should rely on the maintenance of such water conditions in the valley of the river (level of ground and surface water, soil humidity), which should provide for the optimisation of soil processes, create the proper condition for the local fauna and flora and stimulate the growth of biological diversity.

The protection of organic soil depends primarily on ensuring the proper humidity thereof so as to stop or significantly limit the process of degradation and mineralization of organic matter. The renovation of peat-formation (marsh) processes should be aimed at wherever it is possible due to natural, technological and economic considerations.

The basic actions within water management aimed at forming the optimum conditions for the maintenance of the high natural quality should encompass:

- limiting and checking the flow of surface water and stimulating the occurrence of spring flooding, e.g. by the proper use of the retention capacity of Rajgrodzki Lake;
- maintenance of high levels of groundwater in the valley by the liquidation of unnecessary canals and ditches, as well as by building gates and swelling thresholds on ditches and watercourses;
- the application of proper rules for the existing irrigation - drainage systems operation located in the protection zone of the Park and within the zone affected by the Biebrza River.

The reconstruction of the natural hydrographical network seems to be reasonable in the Lower Basin of the Biebrza River by rebuilding the so-called Rajgrodzki Water and the Modzelówka nodes. This refers in particular to increasing the water level in the Woźnawiejski Canal by limiting its flow capacity and the renewal of flow in the overgrowing riverbed of the Jegrznia and Ełk Rivers.

Database. Ignacy Kardel

Introduction

The works related to this part of the project were focused on the following goals:

- purchase of hardware and software necessary for installation of MSS
- creation from scratch of 11 topical databases whose aim is to make inputting data and reporting more efficient, and at the same to secure their correctness and integrity
- conversion of the existing descriptive and map data to databases
- linking data with maps
- training of employees appointed to use the system

The works were conducted in this particular sequence:

- Purchase of server, computers, plotter and relevant software
- Structure or catalogues and filenames was established
- Structure of databases was prepared
- Tabular data were imported into the databases
- A training course in using ArcView was organised for beginners
- Graphic user interfaces were prepared for the databases
- The databases were presented and released for testing
- About 50 improvements were introduced in the operation of the databases, in line with remarks from involved employees
- An initial trial installation of the already prepared part of MSS was performed on the BPN server
- A training course in using ArcView was organised for advanced users
- An introductory training in using MSS was conducted
- MSS was installed on the server and on client computers
- A supplementary training in operating MSS was conducted and a full video record of the said training was provided

Physical structure of MSS

The system was created according to the principle of multi-access on the basis of specified access rights, which resulted from the necessity to protect it against incompetence or from legal reasons related to the Act on Protection of Personal Data. The access is managed by the BPN network administrator from the level of the server, where all data are stored in the form of tables, as well as vector and raster maps. The graphical user interface was installed on the users' computers. Due to shortcomings in hardware, several interfaces were installed on a single machine. However, the system has been designed in such a way that many more computers can use it. The databases have been designed in the MS Access XP system which guarantees compatibility and easy development and operation even by BPN personnel not specialised in IT technologies. The system guarantees that in future it will co-operate with all known GIS platforms. The map data have been converted into a uniform format compatible with the products of the ESRI company. The ArcView program has been selected for handling the said data. The MSS database system has been designed in two languages, Polish and English, so as to make data exchange with other European partners easier at a later stage. Both of the selected programs (ArcView and MS Access) are compatible with most models, as they handle links with data in the ASCII format, which are the output of most of the said models.

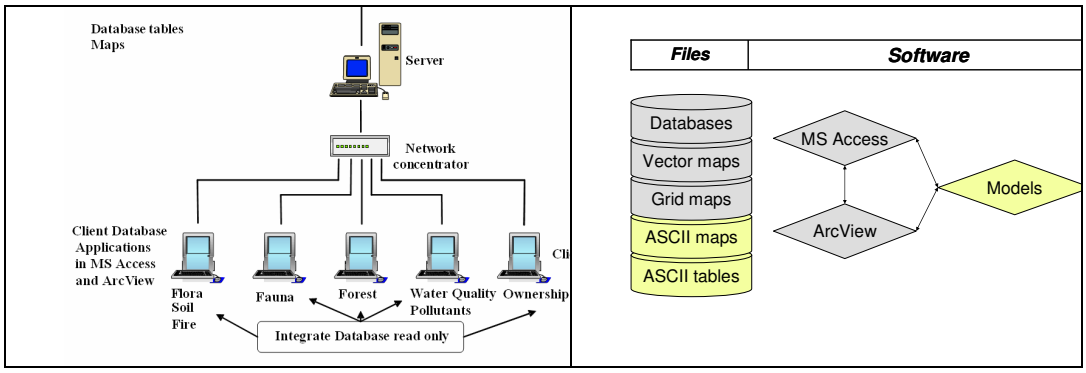


Fig. 1 Scheme of MSS physical structure

Logical structure of MSS

The logical structure of MSS assumes linking data gathered in the base and on maps with data obtained from models. The level of linking the said data is reduced to a 50x50 m grid to which information from different scenarios of models operation is linked and to which information from single databases is or can be linked. The proposed method of linking the said data allows for performing multi-criterion analysis both on a GIS platform and from the level of a database with the use of simple SQL language. Such a solution does not make the users dependant on a single GIS platform, which can be used only for data presentation. The results of hydrological scenarios for a dry, an average and a wet year prepared as a part of the project were linked to the basic map of grids, so the employees of the Park can use them for other analyses without the necessity to deal with generally complicated model interfaces.

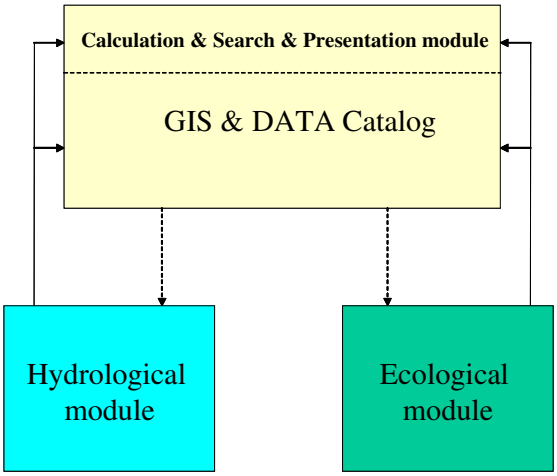
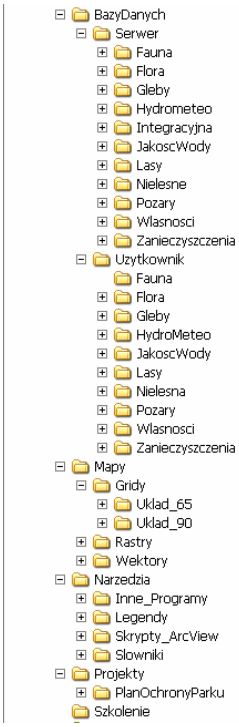


Fig. 2 Scheme of MSS logical structure

Data overview

The catalogue includes maps, tables and texts. The gathered data were ordered in a thought-over catalogue structure agreed upon with Park employees and installed on the server (see figure on the right). The maps catalogue includes:



- 169 shp-type vector maps
- 13 scanned images in the ecw format
- 6 grids in the ArcInfo format

The tables catalogue includes the following databases:
– Ownership,
– Protective treatments for non-forest ecosystems,
– Forests,
– Fauna,
– Flora and species conservation,
– Water quality,
– HydroMeteo,
– Pollution,
– Soils,
– Fires,
– Integration database for the databases mentioned above.

The technical documentation includes documents from the "Park protection plan" project and MSS operation documentation accompanied by two training videos.

Detailed characteristics of the databases content can be found in Table 1.

Table 1. Characteristics of technical parameters of the databases

Name Database	File size [MB]	Number of tables	Number of location	Type location	Number of records
Ownership	80	14	166700	poligon	800000
Protective treatments for non-forest ecosystems	2,1	17	6902	poligon	6902
Forests	5,5	54	4100	poligon	23000
Fauna	16	37	1487	grid, poligon, point	21666
Flora	0,4	18	0	grid, poligon, point	0
Water Quality	1,5	16	116	point	13786
Pollutants	0,9	18	48	point	206
HydroMeteo	6,6	10	122	point	1200
Fires	1,2	16	0	grid, poligon	0
Soil	1,7	10	1125	point	9156
Integrate	101	20	180600	grid, poligon, point	875916

Description of databases

Ownership database

This database contains information on plots situated within the BPN area. Information on owners, usage and territorial units (municipalities - *gminas*, districts, poviats) is kept for each plot.

Protective measures for non-forest ecosystems database

This database is adapted for storing information on performed and planned protective treatments.

Forests database

This database is adapted for storing information on forest sub-sections within the BPN area. It contains particularly information on general characteristics of more than 4400 forest sub-sections, forest valuation description, information on gaps, planned and performed protective and growing treatments, and on cuttings.

Fauna database

This database is adapted for storing historical information on location, number and living environment of vertebrates and invertebrates. It contains also information characterising species as far as relation to the human kind, zoography and ecological classification is concerned.

Flora and species conservation database

This database is adapted for storing information on occurrence and characteristics of plant species, as well as on planned and performed protective treatments.

Water quality database

This database is adapted for storing information on location and chemical and physical properties of tested water taken from ground bore-holes, as well as from lakes and rivers. It generally contains data from the area of BPN and from its protection zone.

Pollution database

This database is adapted for storing information related to observation of the following types of pollution:

- surface water pollution (direct sewage discharges),
- groundwater pollution (waste dumps, fertilisation, dunghills),
- air pollution,
- extraordinary environmental hazards.

Hydro-meteo database

This database is adapted for storing information related to the following observations made at weather stations, gauging stations and piezometers:

- location of gauging stations, piezometric series, piezometers in the said series, weather station (XYZ),
- levels of surface water and groundwater,
- surface water flows,
- precipitation quantity, air temperature and other meteorological data.

Soils database

This database is adapted for storing historical information on the following observations made in the course of making soil pits, as well as cyclical surveys of physical and chemical properties of soil at various depths. It particularly contains:

- XY coordinates of the surveyed point,
- plant coverage,
- water surface elevations,

- description of soil layers,
- soil type,
- physical and chemical properties of soil.

Fires database
This database is adapted for storing information on location of fires, causes for their occurrence, duration, number and type of fire brigades participating in extinguishing them, character and costs of damages caused by fire.

Integration database
This database is adapted for gathering current data (tables) which are the results of the basic queries mentioned above.

Conclusions

- In the course of the works the best results were obtained during meetings with persons responsible directly for a given database.
- The said meetings resulted in constantly growing awareness of a need to build a system characterised by:
  - Possibility to efficiently describe the results of daily works (observations, treatments, fires etc.)
  - Work planning
  - Keeping spatial statistics
  - Easy and automated process of providing data
  - Possibility to take multi-factor decisions joining data from several fields
- The system functionality was largely improved due to the fact that BPN has built a local network and sets up new computer workstations
- Further works should be focused on improving data quality and on data completing and updating.

HYDROLOGICAL MODEL

Introduction

The hydrological model consists of two independent models: the model of groundwater flow and the model of surface water flow in the area of the Biebrza River valley.

The regional model of groundwater is the basic tool for the simulation of the impact of the planned types of technical activities for improving of water condition in the valley and the occurring changes of exploitation due to natural and anthropogenic factors on water relations in the boggy valley of the Biebrza River. The model has been produced in the SIMGRO calculating programme [QUERNER, 1993], which provides for the simultaneous calculation of the filtration in the phreatic zone and non-phreatic zone as well as the flow of surface water [ŚLESICKA, QUERNER, MIODUSZEWSKI, 2002]. One of the advantages of the model is the possibility of making calculations of various water structures on watercourses or the modifications of vegetation in the valley and the surrounding upland [MIODUSZEWSKI, WASSEN, 2000].

Examples of simulation scenarios have been produced for the lower basin of the Biebrza River. The model encompasses 12,566 hectare of the river valley area including the surrounding upland. The calculation has been done for actual atmospheric conditions in the years of 1990-1995.

It has to be emphasized that the produced model is very complex and requires numerous data defining the initial and boundary conditions, which are sometimes hard to obtain. Therefore the model can be applied exclusively by teams who have received special training to operate the programme.

The model of the flow of river is based on two separate models: the model of the Middle Basin and the model of the Lower Basin. Both models are based on the one-dimensional St. Venant equation. The model of the Middle Basin uses the specially produced programme [KUBRAK, 1999] and the simulation for the Lower Basin has been made with HECRAS-UNET [HECRAS, 2000] software. The main purpose set for the surface water flow model has been to generate the hydrological data for the ecological module and the data for producing thematic maps with the range of flooding for the MSS module.

1. Groundwater module

The area subject to the module has been divided into 7854 nodes used for the simulation of the phreatic zone and 569 subregions for modelling groundwater and aeration zones. The model provides for the occurrence of two geological layers of various depths: surface and underneath aquifer. The upper layer consists of peat, silt, clay and sand formations, whereas the lower layer of sand formations. For the whole modelled area the actual landuse has been adapted. The valley of the river is partly used as meadows; in part it is overgrown with sedges. The areas which are excluded from the meadow exploitation are covered by deciduous forests. Reed rushes grow in the area along the river. The upland areas are the mosaic of farming land and coniferous forests. Only on small areas deciduous forests and built-up areas have been provided for. The depth of the root zone amounts from 0.25m in the area of meadows on peat soils to 0.69m in the forest areas on sand soils. For the modelling purposes the river network has been divided into the system of main courses and minor drainage ditch systems. The main watercourses have been modelled as a linear structures, whereas the minor drainage ditch systems have been modelled indirectly by considering their density of ditches in specific areas. The meteorological data from the IMiGW (Institute of Meteorology and Water Management)

at the village Biebrza have been adopted. The data, which have included precipitation (mm), air temperature (^{o}C), potential evapotransportation (indicator for a deciduous forest, for a pine forest and for black fallow). The data concerning the physical properties of the organic soil and the permeable base aquifer have been adopted based on research and data from literature [ŚLESICKA A., QUERNER E. P., MIODUSZEWSKI W., 2002., MIODUSZEWSKI W., WASSEN M., 2000.]
The boundary conditions for surface water have been adopted on the border of the modelled area in four points localized on the inflowing rivers. The actual flows on the following rivers have been adopted: the Biebrza, Rudzki Canal, the Wissa and the Narew Rivers. For groundwater the limitary conditions have been the inflow of groundwater from outside the modelling area for the western section and for the northeastern section. In other areas the border of the modelled area was conducted along the watershed. The level of groundwater was adopted as the initial level conditions.
The verification of the model has consisted in the calculation for the present condition of the hydrographical network, the development of the area and the comparison of the results of calculations with local measurements. The data of the groundwater level measured in piezometres and the values of the volume of flow measured at the Burzyn water level indicator have been used to verify the model.

Calculating scenarios
In order to examine the impact of various planned and hypothetical measures and various methods of the used of the area on the groundwater and the flow in the Biebrza River, more than a dozen calculating scenarios have been performed. The following presentation includes the selected seven scenarios:

Scenario 0, the present situation of land use and hydrologic network and the actual geological and hydrological conditions have been adopted therein. It has been used to verify the model and to compare the modifications resulting from the performance of different activities presented in the following scenarios.
Scenario I simulates the construction of weirs in the area of Bagno Ławka (Ławka Bog). One hydraulic structure has been located on each of the four main draining canals. The constant crest of the weirs is located at the height of 0.2m below the surface. This scenario has been set in order to examine the impact of single hydraulic structure on the hydrological situation of the area.
Scenario II provides for the construction of 63 small weirs on the net of drainage ditches and canals in the valley of the river at Bagno Ławka. Four structures have been simulated at the same places as in Scenario I and the weirs of 59 thresholds has been added. These are weirs, whose constant overflow crest is situated at the height of 0.2m below the area level. This scenario simulates the type of water management consisting in the maintenance of surface water at the constant level of 0.2m below the surface of the area practically in all canals of the Bagno Ławki area. The simulation is meant to indicate the impact of small weirs on ground and surface water.
Scenario III simulates the construction of two weirs in the riverbed of the Biebrza River at the height of 0.5m below the surface of the area. It has been assumed that the curve of the flow for such structures is identical to the curve for the riverbed of the Biebrza River. This scenario is aimed at showing the impact of swelling on large rivers.
Scenario IV models, similarly to Scenario III, the construction of weirs on the main riverbed of the Biebrza River at the height of 0.5m below the surface of the area. The structures have been situated at the same locations as in Scenario III. However, in Scenario IV their flow capacity has been changed. It has been assumed that such structured will narrow the riverbed and significantly reduce the outflow. This scenario has

been produced in order to examine the relationship between the type and construction of a structure and the level of groundwater in the vicinity of structures and the level of surface water. Scenarios III and IV are hypothetical scenarios and are not recommended due to ecological considerations.

Scenario V models a situation where the area of the river valley, at present covered by meadows, is entered by deciduous forests. Such a situation may occur if the meadows are not mown. This shall be followed by the entrance of bushes and next deciduous forests into the open areas. The scenario has been established for the purpose of examining the impact of the modification of the area exploitation from the meadow to forests on groundwater level.

Scenario VI simulates the situation which is opposite to Scenario V, as it assumes that all areas which are covered by deciduous forests are changed into mown meadows. This scenario is to show the impact of increased meadow areas on groundwater level.

The analysis of the scenarios

The introduction of Scenario I, i.e. local weirs, results in the increased level of groundwater within a small area, only in the vicinity of weirs, on average by 0.26m. When we introduced a larger number of hydrological construction, the effect on groundwater was much larger. Scenario II results in the increased medium annual level of groundwater in 33.6% area of the lower Biebrza valley. The average increase of the level of groundwater in this scenario amounts to 0.29m in the direct vicinity of the weirs.

Weirs on the riverbed of the Biebrza River would result in the raise of the level of groundwater in the direct vicinity of structures. A significant improvement of moisture is obtained when the high water level is maintained almost at the whole length of ditches and canals. The affected area of groundwater in Scenario IV, when the flow capacity has been significantly reduced, is much larger than in Scenario III and amounts to 37.1% of the area of the lower Biebrza valley.

In the course of the analysis of the modelling results of scenarios V and IV, which provide for the modification of the exploitation of the valley, a significant impact of the forests on the level of groundwater has been noticed. In Scenario V, which simulates the situation where the whole valley of the lower Biebrza River is covered by deciduous forest, the lowering of the groundwater level has been observed for most of the area where forests have been introduced. The level of groundwater has dropped in this area to 0.2m. The opposite situation has developed when in the areas covered at present by forests meadows have been introduced – the level of groundwater in these areas increased up to 0.4m.

Conclusions

- The impact of small individual weir on the groundwater level is local and insignificant from the point of view of improvement of the humidity of soil and restoration activities.
- The construction of a large number of small weirs structures and the maintenance of a high water level in the whole length of ditches and canals exerts significant impact on the level of groundwater, resulting in the increased, and consequently, improved humidity of the area.
- The change of the mode of exploitation of the area makes an important impact on the location of groundwater. In the case of forestation of the valley area the drop of the level of groundwater has been observed.

- It seems that the most beneficial method of improving water conditions in the Lower Basin of the Biebrza River is to reduce the inflow of the existing natural and artificial watercourses network.

2. Surface water flow model

a) Model of the flow of surface water in the area of the Middle Basin

The numerical model that describes of the Biebrza River flow in the area of the Middle and Lower Basin has applied two independent models. One of these models has been created by J. Kubrak [Kubrak J., 2000, Report on PIN MATRA] and implemented in the area of the Middle Basin. The analysed area contains the river network consisting of the main channel of the Biebrza River and flooding areas in the section Dolistowo-Osowiec, the Ełk and Jegrznia Rivers and the Woznawiejski Canal. This network is described in the model by 32 cross-sections, whose relative distances amount to approximately 3km. The boundary conditions have been defined by flow hydrograms at upstream cross-sections, which open the examined river network and the rating curve defined for the closing downstream cross-section at Osowiec gauge. The elaborated numerical model solves the full one-dimensional St. Venant equations, which describe an unsteady water flow in open channels. In the area of the Middle Biebrza it has been assumed that the flow of water in flooding areas is one-dimensional and in accordance with the direction of water flow in the main channel. The parameters of the model which define the resistance of the flow have been described by the Manning equation. The proper values of n coefficient for the channel of the analysed river segment have been described based on hydrometric measurements and the results of the model calibration. The analysed data encompassed several measurement campaigns conducted in the years of 1999-2004. The Manning coefficients for flooding areas has been selected based on numerical experiments, whose purpose was to use the model to reproduce the observed water levels at the Godniądz and Osowiec gauges for selected flood waves. The above model has been presented in detail in the paper by J. Kubrak [Kubrak J., PINMATRA 2000].

b) Model of the surface water flow in the Biebrza Lower Basin

The numerical model of an unsteady river flow in flood conditions encompassing the area of the Lower Basin has been produced by the HECRAS calculating software [HECRAS, 2001], which applies the UNET calculating module and solves the full one-dimensional St. Venant equations. In this case the river system has been described by the main channel and floodplain of the Biebrza River. The Rudzki Channel and the Wissa River have been treatment as lateral point inflow, defined by flow hydrograms at Przechody and Czachy gauges. The subcatchment inflow is defined by the hydrogram of flows, which is the difference between the downstream outflow hydrogram at the Burzyn gauge, which closes the Lower Basin and the upstream inflow hydrogram from the Middle Basin (Osowiec gauge) and Rudzki Channel (Przechody gauge) and the tributary from the Wissa River (Czachy gauge). The subcatchment inflow has been uniform distributed between the opening closing cross-sections. The geometry of the main river and the floodplain has been reproduced by 15 cross-sections, whose relative distances amount to approximately 3km. The upper boundary condition has been the flow hydrographs at Osowiec gauge, and the downstream is established rating curve at the Burzyn gauge. The Manning's coefficients have been defined in a similar manner as in the case of the Middle Basin and the measurement campaign conducted in 2001 has been applied for this

purpose. The numerical model has been calibrated and verified for the water level hydrographs at the Burzyn gauge for selected flood waves. Additionally, this model has been verified comparing model flood extension with flooding range obtained by the analysis of satellite images for specific records. The details elaborated numerical model of river flow in the Lower Basin has been described in the paper by Swiatek [SWIATEK, 2002].

The result of the simulation

Both in the case of the Middle and the Lower Basin the valley cross-sections geometry have been obtained from the Digital Elevation Model produced with ARCINFO software [CHORMAŃSKI, 2003]. Neither of the surface water flow models has provided for the interaction with groundwater model, although the obtained results of the models may be the boundary conditions for the groundwater model. Similarly, the groundwater level calculated with SIMGRO model may be the basis for the estimation of the inflow coming in the Biebrza river. The main task given for the models of surface water flow in the Lower and Middle Basin has been to produce the maps of the flooding area, which would be the thematic map layer in the MSS system and the input data describing hydrological condition for the ecological model and the groundwater model. For this purpose the calculating simulation has been conducted for historical data, encompassing the years of 1961-1996. For each hydrological year the floods including the vegetation periods from the early spring to autumn have been analysed. The surface water level calculated for each cross-section for a specific forecast time has been combined with the GIS analysis. In this way for each raster of DEM (25m x 25m) in the river valley the surface water level hydrographs has been defined. Adequately to the function of the MSS system, the map of the maximum range of flooding for each year has been produced as well as the additional information such as the period of flooding, the valley retention for the maximum flooding and the maximum depth of water in the flooding valley has been obtained. The supplementary information has also been the rating curves obtained from the model at the calculating nodes located in the main river. The water level hydrographs calculated at each raster of DEM model may include interesting data for the groundwater model. In the selected flooding areas, which have been the subject of the analysis for the ecological model, for the results obtained from the surface water flow model the basic statistical analysis of the flooding depth and the period of flooding has been performed. In this manner for the data encompassing 35 years the medium, minimum and maximum values have been calculated both for a year and in longer periods.

Conclusions

It has to be emphasized that during the flooding conditions, the elaborated 1D models of river and floodplain flow, are a very simplified and approximate tool. However, this tool does provide for the performance of analysis of the hydrological conditions and the performance of the impact of various factors. When it is necessary to produce a more detailed model for a smaller section of a river, the obtained results may serve as boundary conditions. The produced models should be developed in order to adequately describe the subcatchment inflow, taking into consideration the interaction between surface water and groundwater. Monitoring of water level in the floodplain should be developed in order to obtain data providing for the complete verification of the model with regard to the water levels in the valley and for the elaboration of the adequate hydrodynamic model, which would allow for the interaction of the river with the floodplain. Special attention should

be paid to the proper description of the impact of various plant communities on the flow conditions in the case of lowland flooding valley, such as the valley of the Biebrza River.

Scenarios Jarek Chormanski

During realisation of the project several scenarios were developed by BNP scientific workers. Scenario 3 was already realised with help of MSS. Scenario 1 is during realisation and Scenario 2 needs improvement of topographical database before it would be determined.

Scenario 1. Application of Agro-Environmental Programme in Biebrza National Park

The plant succession, caused mostly by the abandonment of the meadows, is one of the main threats to Biebrza valley nature values – it causes drainage. A total area of 15 150 ha of BNP is threatened by plant succession (Tree, shrub and reed). Including this, a total area of 30 444 ha should be mowed every year. A few projects are undertaken to restrain plant succession in Biebrza National Park. They have covered area of about 2 500 ha until now. Some parts of the land are still used by farmers, which are owners of about 40% of land in BNP: about 5000 ha in the wet year (2001) and about 11 000 ha in the dry one (2003). There is 17 278 private landowners in BNP who are potential beneficiaries of Agri-Environmental Programme. Farmers in BNP could receive subsidies for participation in two programs proposed for application in 2004-2006:

- Extensive meadows (P01)
- Extensive pastures (P02)

The main problem of Biebrza National Park is that parcels are divided into smaller pieces, which might cause a problem for the beginning of Agro-Environmental Programmes. Actions should be integrated because there are no subsidies for parcels smaller than 1ha. The MSS would help with finding owners of the In serching
Expected effects of Agro-Environmental Programme application:

- preservation or increase of meadows and pastures biodiversity;
- sustainable use of natural resources;
- reconciliation between farming income and preservation of agricultural land nature values;
- decrease of farmland pollution (water and soil preservation);
- production of healthier food;
- creation of condition to better recreation

If Agro-Environmental Programme will not be realized, there are three possibilities:

- Intensification of agriculture in the surrounding of BNP or even inside the park.
- No change in existing agricultural land use of Biebrza valley.
- Abandonment of agricultural land use of Biebrza valley and succession.

The task is still open. The effect of this scenario was considered. Scenarios depend more on changes of management than hydrology.

Scenario 2 Kapicki Canal

Hydrological scenario realised in the Central Basin. In the year 2000 the Biebrza National Park built 3 wooden weirs for increasing grand water table and stopping soil degradation. Action is concentrated on non-forest areas with land using. Only part of meadows is used – it depends on season (if it is dry or wet). For optimal utilization of weirs it is necessary to gain farmers' acceptation. The influence of the water management in Kapicki Chanel area on the souronding was analysed in two different variants:

1. Increase irrigation by closing weirs. It will cause change in plant species and land use. In short perspective we can expect better conditions for valuable animals, better land use conditions and some difficulties in using farm machines and later harvesting. Long time perspectives cause: willow will change into birch, birch into alder, non-forest plants depend on land use (if it'll be used or not), better conditions of valuable species habitats. Crops will increase but there might be problems at canal side (moisture will be too high). Farmers will harvest more hay in dry seasons than before.

2. Without closing weirs – changes in vegetation and change of using meadows. Short time perspective - smaller crops on meadows, in dry summer there might be no crops, conditions for valuable species might occur worse. Long time perspective – birch will decrease, but there will be increase of solix and willow. Non-forest land will be overgrown by trees and shrubs, no conditions for valuable species, lower crops.

Optimal effect for both men and nature is to balance interest of farmers and nature. Without farmers' acceptation further soil degradation and flora changes will take place. The MSS database helps with identification of farmers-owners of the land which would be influenced by water management in Kapicki channel. With databases it is possible to predict changes and problems in achieving aims (solutions). The MSS would be very helpful in scenario calculation but until the available topographical data are not enough accurate to realise this scenario.

Scenario 3 Tourist infrastructure and other infrastructure - e.g. where and what type of tourist activities could be planned.

In the Biebrza National Park and its protection zone, different investments are being projected and realized, which influence the Park nature in different way. Taking this into account and because of the fact that the Park area is very diversified, each investment (investment project) for which investors are applying, have to be treated and considered separately. This procedure needs a lot of consultation with all main services of the Park: phytosociology, ornithology, fauna protection specialist, water management specialist etc. This consultation makes the decision making process longer. The role of MSS is to help and accelerate the process of decision making. Moreover, all information and data, collected till this moment in the area of the Park nature, can be watched and analyzed together by use of MSS. Including MSS analysis during decision making process, decreases the risk of omission of the any important elements. Only one employee is engaged in analyzing the whole process.

The general goal of scenario:

- indication of methods and possibilities of using and managing the territory of the whole Biebrza National Park for tourist purposes; realised by inventory of tourist infrastructure, identification of development places excessively loaded with traffic and tourists, indication of areas available, non available and potentially available for tourist traffic,
- helping in making decision concerning investment localization in the Park and its protection zone boundary, realised by inventory of technical infrastructure, indication of areas which lack necessary technical infrastructure, identification of hazard areas

The database helps in having ideas about scenarios and options, in easy coming to priority areas, protected areas or other areas of interest.

Ecological Model

Determination of the Ecological Model in the Management System of Natural Resources of BNP

The general aim of ecological models is to forecast biodiversity modifications based on changes of abiotic conditions and landuse.

In the special context of the PinMatra project the purpose of the ecological model is to support an integrated management system of the Biebrza National Park with the tool enable to forecast the changes of biodiversity.
The tool is to facilitate the decision-making process. As far as the BNP services are concerned such facilitation may be aimed at preserving the natural value of the Biebrza Valley. With regard to the requirements of the local administration of the *gmina*, *powiat* and *voivodship* levels (3 levels of municipal administration), the ecological model may be used for optimisation of spatial planning, thus fulfilling the main postulates of sustainable development.
Hence the potential application of the ecological model may be considered with reference to three areas of management of the natural resources of the Biebrza Valley, namely:

1. strategic range – provides the identification of problems on the regional scale, enables the analysis of long-term forecasts and their use in spatial planning,
2. tactical range – allows for the identification of problems within the Biebrza Valley and planning and determining the main actions,
3. operational range – enablesthe identification of protective measures, including their spatial range, frequency, intensity, etc. with regard to individual spatial units identified in the Valley (e.g.: ecosystems, landscape units (*pol. ecochora*), plots of land, protected zones, etc.

Considering the specific conditions related to the origin of the most valuable wetlands ecosystems prevailing in the Biebrza Valley in the course of forming the ecological model two basic premises were accepted:

- the model must reflect the relations between the abiotic and biotic conditions, in particular with regard to water conditions,
- the model must contain information about the type of landuse, including its impact on the ecosystems present in the valley.

Selection of the Elements of the Natural Environment Essential for Modelling of the Biodiversity of the Biebrza Valley

The selection of elements that could support ecological model was discussed among all participants (representatives of BNP, academics of Alterra, Utrecht University, SGGW and IMUZ) during the first workshop, which took place in March 2002 in Warsaw.

As a result of the discussion the following landscape elements were defined as necessary and crucial for ecological modelling of the Biebrza Valley wetlands: actual vegetation, soil cover, water conditions and the landuse.

As far as the *actual vegetation* is concerned, special attention was paid to the indirect specification of the current habitat conditions (e.g. by using bio-indication) within the

nutrients nutrients availability, humidity and trophic conditions. The vegetation is also significant in the course of determining potential directions and trends of the habitats modifications and current landuse. It could help to estimate level of anthropogenic impact as well as the threats for individual plant communities and related animal populations.

The characteristics of the *soil cover* provide for the precise identification of the current soil processes, which illustrate -particularly within wetland habitats - the scope, type and direction of adverse impact of human activities on the landscape. Of particular significance is the possibility of defining threats for peat habitats as a result of drying and mineralization of upper soil layers, which may lead to eutrophication. Moreover, the diagnosis of the current condition of the soil cover allows for forecasting the directions of modifications as well as the estimation of the possibility of stopping or reversing the degradation processes.

The identification of *water conditions* taking into consideration both the properties of surface and ground water is the key issue for the wetland habitats, which gives the basis for decision-making within the preservation and restoration of hydrogenous habitats and their related vegetation communities and populations of animals. What is particularly important in the conditions of the Biebrza Valley is the recognition of the type of hydrological feeding, volume of hydrological feeding per individual fragments of the valley as well as the identification of the seasonal dynamics of the phenomenon. The analysis of modifications of flooding, fluctuations of the levels and flow of water in the main riverbed, as well as the fluctuation of the level of groundwater illustrates the current hydrological processes.

The landuse, in particular extensive grazing and mowing, is the precondition for the preservation of sedge and meadow communities. Providing the constant and appropriate management (farming) is the essential ingredient of protective measures and restoration.

Overview of Available Data Concerning Individual Elements of the Natural Environment of the Biebrza Valley

The second key element under discussion in the course of the first workshop within the ecological module was the availability of data collected in the Biebrza Valley and the scope of the use of such data in the course of modelling. Besides, the information gaps to be filled as a part of PinMatra Project were identified. The synthetic effect of the workshop has been presented in Table 1.

Table 1.

Available Source Materials	Types of Data	Scope of Use in Modelling
Map of actual vegetation	Vector layer with the database	- reference material in the course of verification of modelling results - illustration of the initial condition - auxiliary material for the verification of the soil map - necessity of on-site verification and supplementing
Vegetation relevees	Database and on-site materials	- input data for the ecological model - data used in the course of calibration - necessity of unifying and complementing the data and ensuring their compatibility with the format used by the model
Soil map	Vector layer with the database	- material illustrating the initial condition of the habitat - extrapolation of the results with the model calibration - source material for determining key habitat parameters of the habitat required for modelling - necessity of on-site verification

Ownership map	Vector layer	- producing the subject layer related to management changes
Ground water model		- calibration of the model - extrapolation of the calibration results - necessity of obtaining data from modelling for the whole valley
Surface water model		- calibration of the model - extrapolation of the calibration results - necessity of obtaining data from modelling for the whole valley
Depth of ground water occurrence	On-site materials	- calibration of the model
Biomass	Data obtained in the course of on-site operations	- calibration of the model
Archival air images from 1962/63	Analogous material	- preparation of information layer concerning different landuse types at the beginning of 60s - preparation of information layer concerning landuse changes - necessity of photointerpretation
Archival air images from 1979/80	Scanned and recorded material	- preparation of information layer concerning different landuse types at the end of 70s - preparation of information layer concerning landuse changes - necessity of photointerpretation
Archival air images from 1997	Orthophotomap	- preparation of information layer concerning different landuse typesat the end of 90s - preparation of information layer concerning landuse changes - necessity of photointerpretation
Observations of the landuse extend in the years of 2000-2001	Vector layers	- preparation of information layer concerning the current landuse in the middle 60s

Selection of the Ecological Model Fulfilling the Accepted Premises

The final effect of the first meeting within the ecological model was the determination of its type. Based on the analysis of the existing conditions, in particular including the available source materials, the main premises and aims accepted for the model, the technical-natural ecological model (NTM) was accepted as the main tool for forecasting the modifications of the biological and landscape diversity of the Biebrza Valley. Another significant criterion was the possibility of using experience and expertise as well as the didactic and practical assistance provided by the Dutch partners of the Project.

The model provides for the determination of the possibility of the occurrence of a specific vegetation communities depending on the changing habitat conditions. It was designed, produced and next tested in Dutch conditions and in Great Britain.

The correlation of biotic elements with abiotic ones in NTM model is based on the two main premises, which have been proven empirically:

1. biodiversity is largely dependant on the three properties of habitats: humidity, trophic conditions and nutrients availability,
2. both individual species of plants and whole vegetation communities have a significant bioindication value, in particular within the determination of: humidity, trophism and the nutrients availability.

The determination of habitat characteristics with flora and direct measurement allow for the use of NTM model in various geographical regions, as on the stage of calibration it should register the differences in the species content of communities due to e.g. varied climatic conditions.

As far as the Biebrza Valley is concerned, where the wetland communities dominate, an additional advantage of using the NTM model is the selection of habitat parameters. The correlation between humidity, habitat trophism and the nutrients availability and the vegetation in wetlands ecosystems is very clear.

Hence, with the available NTM model and various scenarios of different interference with the habitat conditions resulting from e.g. anthropopressure, it is possible to conduct the simulation concerning e.g.:

- modification of flora,
- change of spread of potential and optimal habitat of animals,
- landscape changes,
- proper operational measures adapted to expected changes,
- costs of environmental protection,
- requirements with regard to the landuse changes.

A significant disadvantage of the model is the lack of possibility of allowing directly for the management, which is an essential factor shaping the present landscape of the Biebrza River. In order to account for this important ecological factor, which is essential for valuable natural semi-natural wetland ecosystems, it was decided that in order to supplement the modelling of vegetation communities with NTM the information on the landuse changes in the Biebrza Valley in the last 40 years should be added. Hence it would be possible to identify the area, which had been continually used, the ones where the management ceased a long time ago and the ones, which have been abandoned recently. In the case of certain vegetation communities, e.g. Molinion meadows or low sedge communities, the allowance for this additional layer of information should modify the image of spatial diversification.

Collection, Ordering and Supplementing Data Facilitating the Formation of the Ecological Model

As the habitat characteristics allowed for in the model, i.e. humidity, trophism and the nutrients availability can be described with different variables, the decision was made to select and next to test the statistical relations between several variables.

As far as the determination of humidity conditions is concerned, the following factors were selected as potentially significant:

- average maximum level of groundwater in spring for many years, the values obtained from the modelling of groundwater (SIMGRO Model)
- average maximum level of groundwater in summer for many years (SIMGRO Model)
- length of flooding (obtained from modelling groundwater, surface water and on-site research)
- water capacity of surface formations (determined based on the valorization of the soil map).

Trophic conditions were defined by the reaction of soil and shallow groundwater.

The nutrients availability was determined with the content of nitrogen, which is readily absorbed by plants and determined based on:

- biomass of specific communities,
- specification of mineralization advancement of surface formations.

Input data for the ecological model may come both from the databases of natural environment characteristics within the humidity condition (results of monitoring by Park services, Meteorology and Water Management Institute, observations within research projects), trophism (results collected in the course of scientific projects, archival vegetation data), nutrients availability (data from research projects conducted in the Park), results of modelling ground and surface water, thematic layers produced within GIS for BNP and air or satellite images.

The input data for ecological modelling were divided into three groups. The first group consisted of the data used in the stage of the model calibration. The vast majority of these data came from the on-site research, which provided the following information:

- plant communities (vegetation relevees taken with Braun-Blanquet method in a uniform area of 4 m^2 which is representative for the community),
- productivity of communities (determination of biomass with a traditional method by weighing dried samples and taking digital pictures of vegetation type),
- pH of the first level of soil,
- current depth of ground water occurrence,
- types of surface formations,
- types of soils.

The data were obtained from 160 points registered in the area with GPS, and the points had been localized within 8 vegetation communities selected in advance.

Apart from the calibration of the model, on the early stage of work the data from a limited number of points provided for the selection of variables with statistical methods, which can be best used to describe the three habitat parameters. It was proven that the humidity conditions are described best by: time of flooding and volume of water in soil formations. They showed a strong correlation with the values attributed to mineralization of surface formations. In the case of trophism, the pH value of the top surface of soil did not show any anticipated relations, therefore this characteristic was not included in any further stages of work. One of the causes of this situation could be the insufficient population of the analysed data. Both biomass and the mineralization of organic formations described the nutrients availability, however due to the ease of former extrapolation of the calibration results and the possibility of applying scenarios for later analysis, the mineralization of surface formations was chosen.

The second group of data were archival materials (vegetation database), data from the models of surface and ground waters and the vector thematic layers (actual vegetation and soil cover). Generally speaking these data allowed for the extrapolation of the results obtained in the course of calibration of dependence between the parameters determined based on plant indexes (*Ellenberg* figures) and the results of direct on-site counts conducted for a limited number of points.

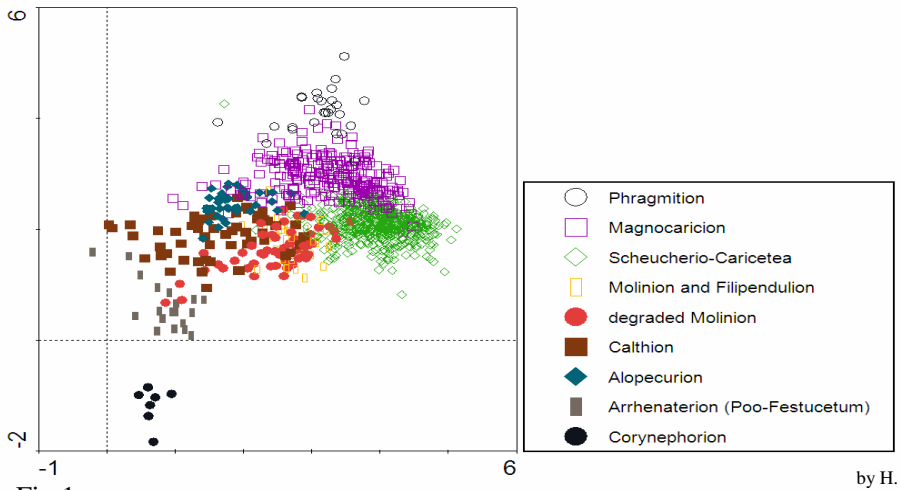
The collection of a proper number of relevees which would be representative for the plant communities occurring in the valley was the key issue which would determine the success of the construction and application of the model. In the course of work 934 archival relevees were collected, ordered and compared. The location of images was related with the Biebrza Valley or the surrounding wetland areas. Additionally, the database was supplemented with phytosociological materials obtained in the course of research projects conducted in the Park. The same PinMatra Project allowed for the collection and ordering of the vast majority of the phytosociological data related to the Biebrza Valley and the introduction thereof into the Turboveg Programme. The total number of phytosociological data at present amounts to about 1100 relevees, which has allowed for the attempt to apply the NTM model for the Biebrza.

To this purpose, owing to the partners from Alterra, the phytosociological data were adapted to the input data format of the NTM model. For each species found in the relevees a proper so-called Ellenberg figures were attributed to illustrate the individual habitat requirements with regard to humidity, trophism and nutrients availability (nitrogen). In this way it was also possible to obtain information on habitat requirements for individual selected vegetation communities.

In the course of NTM application any vegetation communities may be modelled. In the case of the Biebrza Valley, the following groups of communities were included in the determination of the flora due to the precursory character of the work, the specific character of flora (dominating grass ecosystems), character of source materials (to a large extent concerning meadow and sedge communities), current requirements for defining threats of vegetation communities covered by the agro-environmental programmes, and the methodological difficulties related to the inclusion of shrubs and forest communities in the ecological modelling:

- Phragmition
- Magnocaricion
- Scheuchzerio-Caricetea
- Molinion and Filipendulion
- degraded Molinion
- Calthion
- Alopecurion
- Arrhenatherion.

The communities were selected based on the analysis of all collected relevees conducted by experts and with specialised software in the course of several working meetings. Fig. 1 presents the diagram generated by TwinSpan programme, which was used to group communities. In spite of the determination of the abovementioned groups, the classification



by H. Van Dobben

Fig 1

remains open and can be subject to modification in the course of further work on the model.

The results of modelling of surface and ground water conduced within the earlier projects financed by the PinMatra Project provide for the spatial visualization of the modifications of humidity in the periods that are essential for vegetation (raster layers). Hence they provide for the extrapolation of the current humidity condition and later on provide the data with regard to specific, accepted scenarios.

As during the implementation of PinMatra Project (2001-2004) the Lower Basin and most of the Middle Basin were subject to hydrological modelling, for these fragments of the valley it was possible to apply the NTM ecological model.

The map of soil cover provides for the valorization of habitat with regard to the advancement of the mineralization process and the water capacity of organic formations. Appendixes 1-3 contain the soil valorization and the maps of hydrogenic habitats in the Biebrza Valley proposed in the course of the implementation of the project. They reflect the advancement of decay processes and the spatial diversity of the water capacity in soil formations.

As the map of soil cover illustrates the current condition of habitats due to humidity and nutrients availability, together with the visualization of results of the surface and ground water modelling it constitutes the zero condition, which is the reference for the forecast resulting from simulation with scenarios and NTM model. Therefore the verification of the existing source materials was such a significant task.

The work in this regard was conducted in 2001-2002 by combining the identification of soil cover and the habitat conditions with the collection of data for the calibration of the model and the verification of the actual vegetation map. In total 148 soil pits and probes were made.

As a result the revision of the range of soil units was made, which gave the material to illustrate the initial condition for the ecological model. The rules of verification of the soil map are presented in Appendix no. 4. ,while the soil map itself is presented in Appendix no. 5.

The map of actual vegetation in the case of ecological modelling should play the key role due to the possibility of verifying the modelling results. It was assumed that the verification stage would consist in the so-called reverse prediction, which should give the picture of the variety of vegetation communities similar to the one present on the map of actual vegetation made with traditional methods – with on-site identification and photo-interpretation of air images.

To this purpose one of the tasks executed in the course of on-site operations was the verification of the vegetation map including the correction of range borders of identified vegetation communities.

The two abovementioned groups of data were directly related to the NTM ecological model, whereas the third group of source materials was related to the management taken into consideration in the course of biodiversity modelling. Therefore, in order to obtain vector and next raster thematic layers concerning management changes, whose information might be possible to compare to the visual effects of modelling, the archival interpretation of the archival air images was conducted with NTM.

Air images came from two periods, i.e. the beginning of 60s and the end of 70s. These were contact prints in the scale of 1:20,000 and 1:10,000 which covered approximately 90% of the valley area (materials from the 60s) and the whole area of the valley (materials from the 70s).

The interpretation of the data was made with reference to the ownership divisions and its subject were the selected types of landuse. The classification included: wetland habitats used as meadows, swampy wasteland, built-up areas, forest communities, patches of shrubs, agricultural fields, roads, natural watercourses and melioration ditches as well as areas of exploring peat. The information encoded in the database provided for the identification of ownership lots, areas, where e.g. a specific landuse predominates or where shrubs communities occur, etc.

Appendixes 6-7 presents the effects of photo-interpretation of the archival air-images.

Construction of the Model and its Verification

The stage of the NTM model calibration provided for the attempt of a reverse prediction, which in turn allowed for the determination of the maximum probability of the occurrence of selected communities for the present habitat conditions. The confrontation of the map obtained as a result of modelling with the spatial diversification of communities visible on the actual vegetation map provided for the verification of:

- accepted premises of vegetation communities modelling in the Biebrza Valley,
- selection of parameters describing the humidity and nutrients availability,
- classification of plant communities,
- efficiency of prediction of individual communities,
- possibility of using the results of modelling within the measures related to the active protection of wetlands.

Due to the limitations resulting from the lack of hydrological data for the Middle and the Upper Basin the verification was conducted merely with reference to the Lower Basin, for which it was possible to collect all the data.

The result presented on figure 2 shows that the general scheme of spatial diversity reflects the spread of communities on the map of actual vegetation:

- the zonal character of vegetation is apparent,
- the largest areas are covered by tall-sedge and low-sedge communities, which predominate in the southern part of the Basin,
- the area of the meadows of Molinion and Arrhenatherion meadows is the smallest,
- the distribution of meadow communities is similar to the one visible on the map and is limited to the slopes of the Valley.

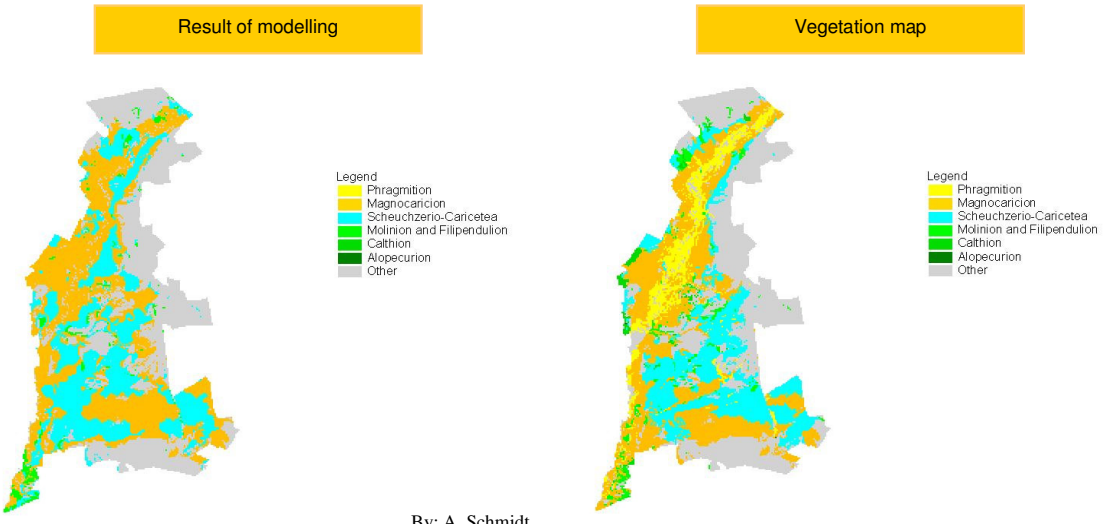


Fig. 2

In spite of the general similarity there are also differences, which show the necessity of revising the model or the application of more exact data at the preparation state. Some of the most important discrepancies include:

- The total lack of reed rushes, which were not identified by the model. As far as the near-riverside zone is concerned there is a tall-sedge rush, which due to the similar ecological conditions (both water conditions and the nutrients availability), where these communities occur, shows the insufficient diversity between the identified vegetation groups.
- The range of the tall-sedge reed on the map generated with the model is much larger than on the map of actual vegetation. As far as the near-riverside zone picture is false, for the southern part of the Lower Basin this regularity was confirmed with on-site observations – the low-sedge communities, due to the modifications of habitat conditions and lack of mowing, are entered by species typical for Magnocaricion community.
- Another difference between the model and the vegetation map is a much smaller range of meadow communities – meadows of Molinion and Arrhenatherion meadows – obtained as a result of modelling. This regularity was confirmed in the course of on-site operations, as the present ranges of meadow community patches on the map proved to be much larger than the ones marked on the map.
- The model does not show any mineral elevations, where meadow communities occur. Also the range of patches with low sedges is smaller in the model than in the vegetation map.

The above discrepancy reveals the necessity of another selection of variables to describe the habitat properties, the extension of the database used for the calibration of the model and the change of the classification of vegetation communities subject to modelling. An important issue is also the inclusion of shrubs communities in modelling.

The verification of the results of ecological modelling shows that at this stage of work and with the existing materials the usefulness of NTM model for the management of Biebrza National Park is limited.

Preparation of Scenarios whose Implementation Would Be Facilitated by the Ecological Model

Due to the negative verification of modelling the stage of preparing scenarios and the simulation of biodiversity changes was not completed. Only a scheme of the construction of potential scenarios, whose implementation would be potentially facilitated by the ecological modelling, was proposed.

General preconditions per scenario

Target area	Input situation		Socio-Economic goals and assumptions	Modeled measures: Water management changes (effects to be predicted by hydrological modeling)		Modeled measures: Vegetation management changes (effects to be predicted by ecological modeling)	
		BNP Surroundings		Damming	Drainage	Mowing	Grazing
	BNP						
BNP	as present	as present		known	known	not known	not known
1MB (part)	as present	as present	Nature conservation (implementation of agro-environmental schemes)	close Kapicki canal	no	all meadows and part of sedge vegetation (Scheuchzerietea) are mown	changed into mowing
2LB	as present	as present	Nature conservation (implementation of agro-environmental schemes)	close ditches in LB	no	all meadows and part of sedge vegetation (Scheuchzerietea) are mown	changed into mowing
3BNP	as present	intensification of agriculture and/or settlement causing extraction of groundwater	Agriculture	no	"lowering of groundwater level"?	Park owned areas mown and private areas not mown	increase of grazing in private areas
4BNP and smaller areas	deforestation	as present	Nature conservation (no implementation of agro-environmental schemes)	no	no	Park owned areas are deforested and afterwards mown (and partly grazed).	Park owned areas are deforested and afterwards grazed (and partly mown).
5BNP and smaller areas	deforestation	as present	Nature conservation and Agriculture (implementation of agro-environmental schemes)	no	no	Park owned areas and private areas are deforested and afterwards mown.	Park owned areas and private areas are deforested and afterwards grazed.
6BNP	afforestation	as present	Land abandonment (not successful implementation of agro-environmental schemes)	no	no	All private areas are afforestated. No management.	All private areas are afforestated. No management.
7LB	as present	climate change?	Climate change and implementation of agro-environmental schemes	no	decreasing of flooding period	Increase of mowing in private areas	Increase of grazing in private areas
8BNP	as present	as present	not successful agro-environmental schemes implementation and no money to maintain mowing	no	no	no	no
9BNP	as present	as present	not successful agro-environmental schemes implementation	no	No	Park owned areas mown and private areas not mown	no

10BNP	as present	as present	successful agro-environmental schemes implementation; lack of money within BNP budget to maintain open areas	no	No	Park owned areas not mown and private areas mown no

Example of Application of the MSS Helena Bartoszuk, Piotr Marczakiewicz

MSS has proven to be a very effective tool in the preparation of the Aquatic Warbler protection in BNP (Biebrza National Park). From the point of view of environmental protection Aquatic Warbler is one of the most precious bird species inhabiting BNP. The condition of its Polish and world population depends largely on its Biebrza population; therefore Biebrza National Park joined the preparation of the project entitled "Protection of Aquatic Warbler (*Acrocephalus paludicola*) in Poland and in Germany", for which the Polish Society for the Protection of Birds applies for co-financing to the European fund of LIFE-Nature.

The initial material consisted of the following maps included in the MSS: topographic, vegetation of non-forest ecosystems and the ownership of land. Besides, the non-digitalised results of the Aquatic Warbler count conducted in 2003 were taken into consideration. Based on such sources of information the area of 4580 ha was determined, which had the actual or potential breeding habitats (where more than half of the Biebrza population of Aquatic Warbler hatches). Private lands in this area were identified (424 plots of the total area of 812 ha), which were planned for purchase. If not all the abovementioned plots were available for purchase, private land within the habitat of Aquatic Warbler was identified in other parts of the Lower Basin, to be purchased next (1497 plots, the total area of 1539 ha). Based on the abovementioned data from MSS and the on-site verification thereof (measurement with GPS) 39 areas were determined of the total area of 1200 ha which required active protection. Subsequently, the proposal of protective actions for individual areas was presented.

The use of the spatial information system greatly facilitated all the above work. The determination of individual plots, ownership and the precise calculation of area (essential for the calculation of the project implementation costs) were much faster than if conducted in a traditional manner. What was also significant were the MSS tools of visualization of various aspects of the project. The preparation thereof without MSS would require the involvement of a much larger group of employees and much more work.

The application of GIS and databases should facilitate the implementation of the Project, reporting and the control of protection measures.

The data collected in MSS databases was also used in the course of preparing the concept of the protection of the moist litter meadows (*Molinietum caeruleae*) in Biebrza National Park. Information on the area of such meadows and their location was obtained from the database of non-forest ecosystems. Within the borders of BNP the typical moist litter meadows cover the area of 1128 ha: in the Lower Basin – 498 ha, in the Middle Basin – 525 ha and in the Upper Basin – 105 ha. Some further analysis was conducted for the Middle Basin.

Due to the stopped or intensified use of these specific meadows their extent within BNP was clearly reduced (information obtained by comparing the vegetation map by Pałczyński of 1979 and the map by Matuszewicz et al. of 1999). With the map of the utilization of the area obtained from the interpretation of air images of 1962-63 it was determined that all the moist litter meadows had been mown in that area. According to the analysis of the location of the *Molinia* meadows and the range of used meadows in the last years (2001 and 2003) above 40% of these meadows within the Middle Basin were being overgrown by bushes (217 ha). The analysis of the location of the abovementioned meadows and the ownership database resulted in the conclusion that out of 525 ha of meadows within the Middle Basin 203 ha were the state property, of which 96 ha (47%)

were being overgrown by bushes and 322 ha were private meadows, of which 121 ha (38%) were being overgrown by bushes. As the said meadows are within 968 of registered plots, of which 35 are the state property and 322 ha of private meadows are divided into as many as 933 recorded plots, the organization of protection of these meadows is particularly complicated.

The above analysis led to the formulation of an action plan for the protection of moist litter meadows within BNP.

The data from the MSS database was used to produce a cause-result scenario entitled "Possible Implementation of Agri-Environmental Programmes within the Biebrza Valley. What if…", and to prepare the paper entitled "Perspectives of Agri-Environmental Programmes Implementation in Poland Following the Example of the Biebrza Valley" [Bartoszuk at al., 2004] upon the order by WWF Poland and financed by the Ministry of Foreign Affairs of the Kingdom of Norway.

In order to prepare the abovementioned papers the following sources were used: the database of non-forest ecosystems was used to present the scale of threats for such ecosystems due to plant succession (the total threatened area amounts to 15,000 ha) and the scope of recommended protective measures (removal of bushes and forests in the area of 8,000 ha and the mowing and grazing in the area of 32,500 ha). The use of land in the Park within the last years was presented: in 2001 (a wet year) – farmers managed about 5,000 ha and in 2003 (a dry year) –almost 11,000 ha, in addition to the scope of protection projects implemented so far or planned in BNP. In this way the essential requirement for the implementation of agri-environmental programmes in the course of protection of non-forest eco-systems was indicated.

The property database of the Park provided the information that 42% of the area is owned by 17.278 private owners who are potential beneficiaries of the agri-environmental programmes. The analysis of the vegetation map of the Park led to the determination of the area subject to the implementation of specific agri-environmental packages. Due to the vastness and diversity of the valley and in order to facilitate the implementation of the programmes the evaluation of the area was conducted in order to identify the priority sub-areas.

The analysis conducted with MSS data showed the considerable potential for the programmes implementation in BNP: more than 20,000 ha of swamped and wet meadows, a large number of potential beneficiaries and a rather attractive proposal of financial compensations in return for extensive agricultural utilization. Besides, the analysis showed the difficulties and limitations of the implementation of the BNP programmes: the insufficient number of agricultural advisors (8 advisors within the region), dispersed ownership structure (more than 17,000 owners, above 12,000 plots of the area less than 1 ha), many owners of ground residing far from the Biebrza Valley, difficult access to the swamped habitats which significantly reduces the possibility of the use of machines, the low fodder quality of the hay and the reduced demand for bedding, more than 10,000 ha of abandonment fens which are being overgrown and which require the removal of bushes and trees prior to the implementation of the agri-environmental programmes.

Another example of the utilization of MSS by the BNP administration was the determination of strict, active and landscape protection areas for the Draft Management Plan for BNP.. With the tools for spatial analysis available in Arc View and with the data collected in MSS (maps and databases) the borders of the abovementioned areas were stipulated? (identified?, marked out?), their area was calculated and the recorded plots within the specific areas were listed.

MSS was also used within the implementation of 2 projects: “Protection of Non-Forest Ecosystems: Protection of Open Fens in the Lower Basin of BNP” and “Protective Breeding of the Polish Little Horse in the Area of the Middle Basin of BNP”. Within the first project the database of non-forest ecosystems and the ownership database were used in order to establish the borders of the planned protective measures and the owners, who later gave their approval for the implementation of protective measures of plots, were identified. Besides the databases were used to produce the report on the implementation of the project. Within the second project the database of non-forest and forest database as well as the ownership database were used to determine the area (the total of 200 ha) for grazing Polish little horses and, with GPS, to determine the course of the fence.

Dissemination and Communication Martin Wassen
Workshops Jarek Chormanski & Helena Bartoszuk
Webpage Malgorzata Znaniecka
Implementation of the MSS Tadeusz Sidor

Dissemination and Communication - Martin Wassen

The present project envisages a supporting tool for the BNP as well as governmental and non-profit nature organizations in the Biebrza region in their efforts for effective sustainable management of the Biebrza National Park. It also aims at establishing a Polish-Dutch network by means of which existing practical experience and scientific knowledge on wetland conservation from the Polish and Dutch partners especially concerning Biebrza National Park can be exchanged. Last but not least the project aims at improving the communication between the Biebrza National Park, local voivodships (a group of municipalities), local stakeholders (agriculture i.e. farmers in Park and buffer zone, the waterboard, recreation i.e. tourist organisations) and non-governmental organisations focusing on nature and sustainable development (WWF, Workshop of Living Architecture). The implementing organisation is Biebrza National Park. Warsaw Agricultural University and Institute for Land Reclamation and Grassland farming (IMUZ) are in charge of the scientific aspects. They have a strong relation with the BNP since the foundation of the park; carrying out research in the park and advising on nature- and water management.
The knowledge which is combined in the present project serves as the base for a Management Support System (MSS) aiming at several functions: streamlining and formalisation of various knowledge sources; identifying gaps in knowledge; focusing monitoring programmes and adding to transparancy in decision making. The MSS and the network established facilitate communication between various actors in land use planning and nature management.

In this communication process the MSS serves as a demonstration tool offering the opportunity to optimize water and vegetation management and giving more insight in knowledge gaps and lack of specific data. The MSS helps to select scenarios which are economically acceptable for the local stake holders and also add as much as possible to sustainable protection of nature values.

Furthermore, the project aims at exchange of knowledge about and experiences with an integral approach to nature and landscape conservation; integration of knowledge and exchange of practical experiences of nature restoration and management projects. By means of a network the research activities and cooperation between the Warsaw Agricultural University, the University of Utrecht, the research institutes IMUZ and Alterra will be better coordinated and tuned in to the needs of the Biebrza region. Technical meetings served the purpose of better communication among scientists and with professionals in nature management. The network contributes to already existing knowledge and information infrastructures in Poland. Research results of the present project were disseminated and communicated with the main actors in the area in a number of workshops and were published on the web.

In the next three paragraphs we report about the workshops and technical meetings, the webpage and the implementation of the MSS at BNP.

Workshops Jarek Chormanski & Helena Bartoszuk

There were two workshops organized in 2004: first, in Warsaw Agricultural University, in March 2004, and second, the final closing workshop in BNP office in Osowiec (Oktober 2004) The minutes from workshops are presented below.

'Man and Nature at Biebrza' – Technical Meeting
Poland, 28-29.03.2004, Warsaw

Day 1st, Sunday, 28.03.2004, WAU, Warsaw

Attendance:
Utrecht University (UU): Martin Wassen, Wladimir Bleuten, Wilma Vennekens; **Alterra**: Erik Querner, Anne Schmidt, Han van Dobben; **Institute for Land Reclamation and Grassland Farming (IMUZ)**: Waldemar Mioduszewski, Wiesław Dembek, Hubert Piórkowski, Wiktor Kotowski, Alicja Ślesicka, Justyna Bielecka, Agata Klimkowska; **Biebrza National Park (BPN):**Helena Bartoszuk, Tadeusz Sidor, Grzegorz Kwiatkowski, Piotr Marczakiewicz; **Warsaw Agricultural University (WAU)**: Stefan Ignar, Tomasz Okruszko, Dorota Świątek, Ignacy Kardel, Jarosław Chormański, Robert Michałowski, Magdalena Bogobowicz

Minutes of the workshop:

The first day was focused on scenarios, databases for MSS and Hydrological Model.

The following points were discussed during this session:

1. Presentation of proposed scenarios,
2. Presentation of MSS' databases,
3. Presentation of hydrological module and its limitations.

Ad. 1.
Three scenarios were presented by Biebrza National Park.

Scenario 1.:

Application of Agro-Environmental Programme in Biebrza National Park

1. The plant succession, caused mostly by the abandonment of the meadows, is one of the main threats to Biebrza valley nature values – it causes drainage.

2. Area of Biebrza National Park threatened by plant succession:

Shrub encroachment	5 897 ha
Tree encroachment	1 454 ha
Reed encroachment	2 690 ha
Mosaic of open and overgrown areas	5 110 ha
Total	15 151 ha

3. According to the draft Biebrza National Park Management Plan there is area of 30 444 ha which should be mowed. A few projects are undertaken to restrain plant succession in Biebrza National Park. They have covered area of about 2 500 ha until now. Some parts of the land are still used by farmers: about 5000 ha in the wet year (2001) and about 11 000 ha in the dry one (2003).

4. Land use and ownership structure in BNP

Land:	state property in BNP administration		state property in other administration		private		Total	
	[ha]	[%]*	[ha]	[%]*	[ha]	[%]*	[ha]	[%]*
Forests	13623	23,0	141	0,2	1766	3,0	15530	26,2
Arable land	69	0,1	18	0,0	354	0,6	441	0,7
Meadows and pastures	1396	2,4	948	1,6	10983	18,5	13326	22,5
Agricultural land	1465	2,5	966	1,6	11336	19,1	13767	23,2
Waters	449	1,4	105	0,2			955	1,6
Land overgrown by trees and shrubs	134	0,2	21	0,0	340	0,6	495	0,8
Waste land	15 591	26,3	658	1,1	11 099	18,7	27 349	46,2
Others	461	0,8	599	1,0	68	0,1	1128	1,9
Total	32123	54,2	2490	4,2	24610	41,6	59223	100,0

* - percent of BNP area

Farmers will receive subsidies for extensive farming and having waste land.

5. There is 17 278 private landowners in BNP who are potential beneficiaries of Agri-Environmental Programme. Parcels are divided into smaller pieces, which might cause a problem for the beginning of Agro-Environmental Programmes. Actions should be integrated because there are no subsidies for parcels smaller than 1ha.

Biebrza valley is divided into 11 sub-regions (using defined criteria of sensibility and valuability) to make the beginning of Agro-Environmental Programme easier

6. Proposed Agro-Environmental Schemes for application in 2004-2006:

- Sustainable farming S01
- Organic farming S02
- Extensive meadows P01
- Extensive pastures P02
- Erosion and water pollution control K01
- Buffer zones K02
- Protection of genetic resources of traditional animal breeds G01

7. Expected effects of Agro-Environmental Programme application:

- preservation or increase of meadows and pastures biodiversity;

- sustainable use of natural resources;
- reconciliation between farming income and preservation of agricultural land nature values;
- decrease of farmland pollution (water and soil preservation);
- production of healthier food;
- creation of condition to better recreation

8. If Agro-Environmental Programme will not be realized, there are three possibilities:
   - Intensification of agriculture in the surrounding of BNP or even inside the park.
   - No change in existing agricultural land use of Biebrza valley.
   - Abandonment of agricultural land use of Biebrza valley and succession.

Discussion:

The task is still open. There will be 6 future scenarios. The effect of this scenario was considered. Scenarios depend more on changes of management than hydrology. Databases help to formulate the scenarios. Ecological Model and Hydrological Model can't help much with this scenario.

Scenario 2.:

Kapicki Canal

Kapicki Canal was built in the middle of XIX century. It was a tributary of the Biebrza River. It was built for draining areas of Kuwasy Marshland and creating new meadows and pastures. During the last 150 years, faster outflow caused decreasing of ground water level, soil degradation and changes in flora.

The canal overgrows and has no connection with the Biebrza river. In the year 2000 the Biebrza National Park built 3 wooden weirs for increasing grand water table and stopping soil degradation. Action is concentrated on non-forest areas with land using. Only part of meadows is used – it depends on season (if it is dry or wet). For optimal utilization of weirs it is necessary to gain farmers' acceptation. The weirs can be useful also for farmers.

Two different variants were considered:

1. Increase irrigation by closing weirs. It will cause change in plant species and land use. In short perspective we can expect better conditions for valuable animals, better land use conditions and some difficulties in using farm machines and later harvesting. Long time perspectives cause: willow will change into birch, birch into alder, non-forest plants depend on land use (if it'll be used or not), better conditions of valuable species habitats. Crops will increase but there might be problems at canal side (moisture will be too high). Farmers will harvest more hay in dry seasons than before.

2. Without closing weirs – changes in vegetation and change of using meadows. Short time perspective - smaller crops on meadows, in dry summer there might be no crops, conditions for valuable species might occur worse. Long time perspective – birch will decrease, but there will be increase of solix and willow. Non-forest land will be overgrown by trees and shrubs, no conditions for valuable species, lower crops.

Optimal effect for both men and nature is to balance interest of farmers and nature. Without farmers' acceptation further soil degradation and flora changes will take place. Things will improve with subsidies from Agro-Environmental Programme.

With databases it is possible to predict changes and problems in achieving aims (solutions).

Discussion:
Effects were estimated. This scenario is based on December meeting with stakeholders and the data. Hydrological Model underpin where the optimization should be. Discussion focused on how to manage to get the optimal solutions with farm-use.

Scenario 3.:

Tourist infrastructure and other infrastructure - e.g. where and what type of tourist activities could be planned.

In the Biebrza National Park and its protection zone, different investments are being projected and realized, which influence the Park nature in different way. Taking this into account and because of the fact that the Park area (which occupies the territory of 60 thousand ha and its protection zone, which occupies another 60 thousand ha) is very diversified, each investment (investment project) for which investors are applying, have to be treated and considered separately. This is difficult because of the fact that this procedure needs a lot of consultation with all main services of the Park: phytosociology, ornithology, fauna protection specialist, water management specialist etc. This consultation makes the decision making process longer. The role of MSS is to help and accelerate the process of decision making. Moreover, all information and date, collected till this moment in the area of the Park nature, can be watched and analyzed together. This is important because of the fact that it decreases the risk of omission of the very important element during decision making process. Only one employee is engaged in analyzing the process.

The general goal of scenario:

- indication of methods and possibilities of using and managing the territory of the whole Biebrza National Park for tourist purposes,
- helping in making decision concerning investment localization in the Park and its protection zone boundary,

The detailed goals of scenario - tourist infrastructure:

- inventory of tourist infrastructure at the area of the Biebrza National Park and its protection zone,
- identification of development places excessively loaded with traffic and tourists, assessment of proper localization of tourists tracks and structures,
- indication of areas available and non available for tourist traffic,
- indication of areas where tourists purposes can be realized (setting out new tracks, localization of bivouac places, look-on towers etc.).

The detailed scenario - technical infrastructure:

- inventory of technical infrastructure at the area of whole the Biebrza National Park and its protected zone,
- indication of areas which lack necessary technical infrastructure (ways, treatment plants, others),
- identification of places in the Park and its protection zone where excessively investment can have negative influence on nature,
- identification of other hazards,

- specification of orders and conclusions for voivodship and district spatial management plans,

Output materials:

- Map of the Biebrza National Park,
- Administrative division of the Biebrza National Park:
  - according to districts
  - according to protected districts
- The Biebrza National Park in the protected districts net of Natura 2000,
- Map of the protection categories at the area of BNP,
- Mammal valorisation map,
- Birds species protection map (confidential data),
- Plant communities map,
- Landscape valorisation map,
- Map of tourist management inventory,
- Inventory map of technical systems which have disadvantageous influence on the nature of the Biebrza National Park,

Final report:

- The map of possible Park area management. On this map areas showing total prohibition of management are specified.
- The map of possibilities for tourist traffic in the Biebrza National Park.

Discussion:
It shows how database helps in having ideas about scenarios and options for the future (also for people not in the project). Database helps in easy coming to priority areas, protected areas or areas where you can develop (or not) certain things.

Ad. 2
MSS presentation:
Presentation of general aim, physical and logical structure of MSS, review data and GIS catalogue and database. General aim is to collect and sort data and improve access to data.
MSS contains four modules: Hydrological, Ecological, GIS and data catalog and Presentation Module.
GIS and data catalogue contains tools for input and output data. If data location is described in grid then some scenario can be calculated directly in database
Presentation Module should contain the possibility of solving the most important questions.
MSS does not contain automatic connections with models.

Fire and fauna data is collected in grids 50x50.
Following databases were described: fauna, bore-hole, water quality, fire, pollutants, ownership, forests and hydro-meteo. All databases contain three functions: browse, modify and add.
The quality of data should be checked.There is lack of flora and mowing data. The vegetation map was verified and it is not fully correct but for models there is no need of detailed scale.

Discussion:
1st and 3rd scenarios are beyond the possibility of models. Database helps defining the effects of scenarios.

2nd scenario can estimate the effects, if model shows how to regulate the water level around Kapicki Canal.
The scale of scenarios was discussed (regional scale is preferred).

Following types of scenarios were pointed:

- What to do to maximize the water retention in the whole Biebrza Basin.
- Water quantity scenario of Rajgrodzkie Lake and how it can help in retention of water?
- What happen if we do nothing?
- What happen (from hydrological and ecological point of view) if we have a certain or higher amount of money for mowing?
- Potential influence of intensive farming in BNP
- Influence of increased upland fertilizing on water eutrofication
- Who we have to inform/invite to discussion if we want to rise the retention level – database advantage.

Ad. 3.
Presentation of hydrological model:
SIMGRO model can calculate ground water level. This model is a regional model. In this model land use is taken into consideration. It can predict water flow changes and study water level. Results are presented on maps, by statistics etc.
There is no hydrological data in upper basin. Scenarios include: blocking all canals (then the water level will rise – question if mowing is needed on this area) and flood.

Day 2nd, Monday, 29.03.2004, WAU, Warsaw

Attendance:
Utrecht University (UU): Martin Wassen, Wladimir Bleuten, Wilma Vennekens; **Institute for Land Reclamation and Grassland Farming (IMUZ)**: Wiesław Dembek, Hubert Piórkowski, Wiktor Kotowski, Justyna Bielecka, Agata Klimkowska; **Biebrza National Park (BPN):** Helena Bartoszuk, Tadeusz Sidor, Grzegorz Kwiatkowski, Piotr Marczakiewicz; **World Widelife Fund (WWF):** Małgorzta Znaniecka; **Warsaw Agricultural University (WAU**): Tomasz Okruszko, Dorota Świątek, Ignacy Kardel, Magdalena Bogobowicz

Plan of the workshop:

1. Presentation of Ecological module,
2. Results of the MSS
3. Final scenarios discussion
4. Web site appearance and dissemination to stakeholders and others
5. Work plan for remaining time

Ad. 1.
Contribution of Ecological Module to BNP GIS databases is: land use map - results of photo-interpretation of archive photos (11 land use types were defined), verification of the soil map to update soil map and database of BNP and prepare an input for ecological model by former soil map analysis, extensive fieldworks on chosen transects and in random plots (soil type identification, ground water level, organic deposit thickness, pH), vegetation and topographic map analysis and analysis of archive photos; generalisation of vegetation map was made to

prepare input for ecological model and update vegetation map and database of the Biebrza National Park. As a result 9 vegetation types were defined.

Ecological model contains training set with known vegetation and abiotic factors insufficiently available. There are also used Ellenberg values such as: e_F = water availability calibrated to average spring water level, lowest summer water level, flood duration, e_R = acidity – calibrated to pH measured in the field, e_N = nitrogen availability calibrated to mineralisation rate (based on the soil type).
NTM model has serious limitations:
- rough estimation - regional scale is supposed to be operational,
- management is not taken into account directly,
- shrubs and forest vegetation not included in the model,
- inaccurate vegetation map,
- not the very best measures reflecting pH and nutrient availability

In data preparation there are large relevees dataset containing 934 records, small dataset for calibration phase containing 104 records which still should be completed and verified), generalised vector soil map (input; has to be rasterised), generalised vector vegetation map (input; has to be rasterised) and output from hydrological models
In prediction part of module there are now several successful attempts for vegetation type but it still has to be completed considering thorough calibration dataset. The question of scenario for ecological model is: should we try to check the changes in vegetation structure considering two extreme hydrological situations? What would then application of agro-environmental schemes look like?

Discussion:
Ecological Module's team still works on the calibration. Maps have to be transformed into grids (as hydrological model). Ecological model will have a possibility to define for each grid cell the probability of vegetation type but firstly everything must be calibrated. Availability of nutrients is still a problem. Regression has not been calibrated yet and measurement of mineralization rate was considered – it should be classified in about 6 classes. Influence of nutrient availability on vegetation was discussed.
Continuation of calibration has to be done (it will take about 2 weeks), then validation, usefulness of nature technical model has to be checked, and "if → then" mask should be made for grids.

Ad. 2.
BNP has following reservations about:

a) data about vegetation of non-forest areas does not exist
b) connection of soil type map with bore-holes
c) vegetation settlement map
d) no registration of changes in non-forest ecosystems
e) localisation of land use in one parcel

Above mentioned reservations will be discussed between BNP and WAU and priorities will be described.
MSS will be finished till the end of summer (August – September).
Ecological model with NMT, calibration, validation and expert judgement – till half of July
Hydrological Model – end of June

Database – half of July

Ad. 3.
Six types of scenarios were pointed:

a) Agro-Environmental Programmes (the most important for BNP)
b) Tourist infrastructure
c) Kapicki Canal
d) Rajgrodzkie Lake and increasing water retention in Biebrza Valley
e) Maximizing water retention
f) What if the certain amount of money will be provided and what if there is bigger amount of money

Following combinations of scenarios were considered:

"global"			Indicators (maps and characteristic)
	WET	DRY	
Present			Vegetation map
Mowing (a, b, c)			Wetness map
Abandoned			Key species map (e.g. a few animal species)
Intensive land use			Footpath (example)
Present use (moraine and catchment)			

This table should be commented by the Dutch.
Fauna database has to be made by BNP.

Ad. 4.
Web site of the project is ready. It still needs little correction. Links to this web site should be made at other webs of organisations which take part in the project. Information should be shared through web site and director of BNP has to decide which data can be shared. Database can be viewed by web site and some data can be downloaded.
Professional translator is hired to make the web more professional. Information in English need to be less detailed than the Polish version.
Subtitle "news" should contain information about the stage of the project, expectations for the future, etc.
Database and some scenarios could be demonstrated through the web but in *pdf* files. Web site should have photos and counter.

Dissemination to stakeholders and others:
There is a necessity to inform media and scientists of forests, water management, environmental protection etc. to promote the project. The project should be advertised and there must be a possibility of adding comments to the project but with certain deadline.
In October (18^{th} or 25^{th}) there will be a meeting with local stakeholders, directors of other wetland parks (national and landscape), authorities of voivodship office, NGO's, WWF International and somebody. from Holland (BNP, IMUZ and WWF will make the list of

people/organisations invited). This meeting must be well prepared to be interesting for invited people.

Ad. 5.
Work plan for remaining time:

1. maps with indicators – ready till end of September
2. calculated maps – ready till end of September
3. settling all data and models – till end of July
4. organisation of the workshop – in October

Minutes of the workshop
PIN Matra Project „Man and Nature at Biebrza" BPN 17 – 18 Oktober 2004

17th Oktober 2004 – Presentation of the environmental protection an management activities in BNP. Field trip.
The Lower Basin: presentation of the mowing and encroachment activities in "Bagno Lawki" and "Batalionowa Field". The Central Basin: presentation of the encroachment activities – the viewing panoramas on Dunes Area; Red Bog areas – the area which does not need active protection. The results of the management plan, which was realized in BNP was presented by Director of the BNP and BNP's scientific workers. The problem of protection and management balanced in proper way in BNP activities were discussed and commented by stakeholders and other participants of the excursion.

18th Oktober 2004 - Presentation of the project results. Biebrza National Park office. Osowiec.

Indroduction
The official workshop opening was done 18th of Oktober. A workshop was introduced by mgr **A. Sieńko**, a BPN Director. He has spoken about history of the project – the beginning, realization and results from the point of view of BPN.
Prof Martin Wassen (Utrecht University) continued the introductory part of the workshop by presenting aims of the project. The most important aim of this project was creation of the Management Support System linked with spatial database as a tool for sustainable management of BPN. The second was establishing of a network of sciences and others. A function of such a network is extending and integrating of knowledge. The valuable point of the project realization was communication aspect between of the BPN with stakeholders and others. The project mainly focusing on increasing understanding of the different stakeholders point of views for proper environmental management in BPN and their participation in the results of the project. In the end, Prof M. Wassen introduced the project sponsor: Dutch Ministry of Agriculture, Fishering and Food Quality.
Next, **T. Okruszko** (SGGW) introduced project partners. **I. Kardel** (SGGW) presented a database structure and GIS, as well as he introduced to MSS. He presented briefly what was done during a project, by which partner and how it was realized.

MSS presentation session

T. Sidor (BNP) introduced problems related to Forest Management in BPN. Then, he explained database created for forest management, contains of database (attributes stored in),

spatial part of database (he mentioned ***powerfully*** of presentation aspect of GIS) , ability data exchange between databases and links between GIS and database).

Question: about possibility of accessing database by everybody – every forest men could input data directly to the database – Answer: not it is impossible, there is one person – Database manager - who is responsible for that and has rights to change data in database.

G. Kwiatkowski (BNP) – presented the a GIS-based database of land registration. He explained a structure and contents of this database as well as it's functioning in MSS with special attend to: edition, searching and reporting. He showed directions of the future database development. Next, the examples of module application were presented:

1. mowing management – searching for land owners, calculation area of lands, which will be mowed, calculation of the cost of mowing;
2. determination of the conservation and protection maps – done by GIS analysis(buffering and map overlaying;

Discussion: Problems of data quality – measurements by GPS, geodesy surveying and map digitization.
Relations between the land registration map and the landuse map.
How to get actual data from local administration and governments?

P. Marczakiewicz (BNP) - Application of the MSS for project of Aquatic Warbler protection zone. He presented a example of using MSS for preparation a proposal of the new protection project. The presentation was done in following steps:

1. Introduction: protection needs a mowing of the part of sedges where the population of Aquatic Warbler will be increased.
2. GPS measurements – actualization and verification of the vegetation map;
3. Digitalization of the actualisated part of the vegetation map;
4. Map analysis conducted on the vegetation map and landuse map.
5. Analysis how many hectares have to be mowed and searching for owners for communication with them to have their permition.

Discussion: The MSS as a tool for answer managewment question:

- GIS analysis as a tool for resolving of management problems
- Spatial database searching helps in identification attributes of particular areas.

H. Bartoszuk (BNP) and **H. Piórkowski** (IMUZ): Application of the MSS in management of the BNP natural resources
In this presentation authors presented a MSS application for analysis of the possibility `of introduction the management, protection and conservation programs in BNP on privet areas which belongs to BNP. That was explained on the example of the conservation of Molinia meadows in the Central Biebrza Basin. The MSS was used for:

- selection of the Molinia meadows
- analysis of maps derived based on air photos from 60-ties, 90-ties and wet 2001 year and dry 2003 year;
- analysis of owner map;
- searching the database for owners which have a field in area of interest (covered by Molinia meadows)
- communication with farmers – interviewing

Discussion: How many farmers were interviewed in this project? Many of them.

G. Znaniecka (WWF) Dissemination of the results. WEB page.

1. She presented advantages of WWW as a possible information tool.
2. Why WWW:
- Dissemination of the project results;
- GIS propagation for environmental protection studies on other areas;
- MSS promotion in other National Parks;
- Database serving by internet outside of BNP
3. Presentation of actual status of WEB Page and future perspectives

Discussion:
The discussion about problems presented in presentations of database elements was conducted by supervision of **T. Okruszko** (WAU). There are few main problems discussed during this time.
1. Discussed topics: Security of data and database, and problems of the concept of database and the database actualization. The database has a few levels of users: managers of particular databases in MSS (forest, land records, non-forest vegetation, etc.) are only persons which have permission to database actualization by adding new records and attributes only in particular database. For security the end-users can only use data but cannot input new data. The idea of creation a unique electronically forms for storing new data was discussed. This form would helps in easy database actualization.
2. Experience of guests in MSS and databases. So, the MSS-databases not exist in other parks in Poland (with exception of Karkonowski National Park). There is no any such an application in National Park in Poland established for water- wetland protection.
3. Database actualization. It is a financial problem. It is a need to establish a work position: GIS-database manager in National Parks. A lack of such a position in National Parks provides to situation that there is no functioning database in any Park. Even if the database was developed there is nobody who takes care on actualization. The GIS and databases are works only in case that the people who work on are exciting in GIS.
4. A concept of database. The determination of the concept has to be conducted together with future user of database. In case of BNP MSS-database, the resulted view of the MSS structure was discussed with BNP staff, and next changed according to their expectations. The developed MSS is a step to future determination of the methodology of development MSS for National Parks established for water and wetland protection.
5. Budget of the project. The question was how much development of the database for as big national park (as it was in case of Biebrza NP) cost.
6. Data quality and data verification problem. The good database structure minimizes the errors and needs for verification.
7. A GPS technology as a tool for measurement and high quality data input and actualization. Especially, in big wetland parks like Biebrza NP, where it is a problem of localization a GPS receivers are valuable equipment.

Scientific session. Application of the hydrological and ecological MSS modules.

J Bielecka, A. Ślesicka, E.P. Querner,W. Mioduszewki: Groundwater modeling in the Lower Biebrza Basin.

The regional model of groundwater was presented as a tool for the simulation of the impact of the planned types of technical activities for improving of water condition in the

valley and the occurring changes of exploitation due to natural and anthropogenic factors on water relations in the boggy valley of the Biebrza River. The model has been produced in the SIMGRO calculating programme, which is possibly to alculate of various water structures on watercourses or the modifications of vegetation in the valley and the surrounding upland. Examples of simulation scenarios have been produced for the lower basin of the Biebrza River.

T. Okruszko, D. Świątek, J. Chormański: Hydraulic model of the Lower Basin

The numerical model of an unsteady river flow in flood conditions encompassing the area of the Lower Basin realized by combining of the the HECRAS calculating software including main channel and floodplain of the Biebrza River with GIS analysis has been presented. The results obtained are the basic statistical analysis of the flooding depth and the period of flooding performed for the data encompassing 35 years: the medium, minimum and maximum values calculated both for a year and in longer periods.

H. Piórkowski, H. van Dobben, A, Schmidt, A. Klimkowska: Ecological Model – the potential tool for optimalisation of landscape planning

Application of the NMT ecological model for analysis of the was presented. The model does not show any mineral elevations, where meadow complexes occur. Also the range of patches with low sedges is smaller in the model than in the vegetation map. The above discrepancy reveals the necessity of another selection of variables to describe the habitat properties, the extension of the database used for the calibration of the model and the change of the classification of vegetation complexes subject to modelling.

H. Piórkowski, A, Schmidt, H. van Dobben, W. Kotowski The consequences of landuse changes of the Biebrza wetlands

This presentation shows an example of application of the air-photos interpretation for landuse changes and succession assessment. The authors focused mainly on scrubs succession in the area of BNP.

W. Bleuten Influences of outflow reduction on hydrology of the Upper Biebrza Basin

Application of Modflow model for simulation of the groundwater level fluctuations on area of the Upper Biebrza Basin. During a presentation the effects of ditches on hydrological processes were analysed.

Discussion:

It considered on development of the modeling approach, which links groundwater model and hydraulic model, with consequences on ecological aspects.
How we can contact between hydrology and ecology?
How database helps with scenarios – it is very useful in BNP usual work?
Martin Wassen mentioned that an additional result of the project - communications between people from BNP and sciences increased.

Final Tanks and Conclusion by BNP director:

The closing of workshop was done by BNP Director. He thanks to all participant for attention but also thanks to whole partners of the project for their work, and said that the end of the project is the beginning of the MSS work in the Park. He promised to do take care for future continuous development of the MSS and database in BNP.

Lista of Participants
The workshop of the 2004 PIN Matra Project „Man and Nature at Biebrza"
BPN office, Osowiec 17 – 18 Oktober

L.p.	Name	Institution
1.	Martin Wassen	Utrecht University
2.	Wladimir Bleuten	Utrecht University
3.	Maria Muranyi	Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej
4.	Andrzej Demczak	Słowiński National Park
5.	Elżbieta Rutkowska	Słowiński National Park
6.	Magdalena Wojciechowska	National Park Warta River Mouth
7.	Edyta Owadowska	Kampinoski National Park
8.	Jerzy Kostrzewski	Narwiański National Park
9.	Jarosław Szymański	Poleski National Park
10.	Andrzej Szymański	Wigierski National Park
11.	Stanisław Szleter	Urząd Gminy Grajewo
12.	Edyta Dojlida	Północnopodlaskie Towarzystwo Ochrony Ptaków
13.	Justyna Bielecka	Instytut Melioracji i Użytków Zielonych
14.	Alicja Ślesicka	Instytut Melioracji i Użytków Zielonych
15.	Małgorzata Znaniecka	WWF Polska
16.	Agata Klimkowska	Instytut Melioracji i Użytków Zielonych
17.	Hubert Piórkowski	Instytut Melioracji i Użytków Zielonych
18.	Tomasz Okruszko	Warsaw Agricultural University
19.	Jarosław Chormański	Warsaw Agricultural University
20.	Igancy Kardel	Warsaw Agricultural University
21.	Dorota Mirosław-Świątek	Warsaw Agricultural University
22.	Krzysztof Kowalewski	Warsaw Agricultural University
23.	Ryszard Modzelewski	Łomżyński Landscape Protection Park of the Narer River Valley
24.	Renata Krzyściak-Kosińska	Białowieski National Park
25.	Andrzej Karczewski	Białowieski National Park
26.	Adam Sieńko	Biebrzański National Park
27.	Andrzej Grygoruk	Biebrzański National Park
28.	Helena Bartoszuk	Biebrzański National Park
29.	Piotr Marczakiewicz	Biebrzański National Park
30.	Tadeusz Sidor	Biebrzański National Park
31.	Grzegorz Kwiatkowski	Biebrzański National Park
32.	Bogumiła Siłakowska	Biebrzański National Park
33.	Krzysztof Frąckiel	Biebrzański National Park
34.	Paweł Brzezicki	Biebrzański National Park
35.	Robert Acewicz	Biebrzański National Park
36.	Cezary Werpachowski	Biebrzański National Park
37.	Włodzimierz Wróblewski	Biebrzański National Park
38.	Andrzej Kamocki	Technical University Białostocka

WEB Page - Malgorzata Znaniecka

WWF Poland accordingly to the contract signed on 3-10-2002 (PINMATRA/2001/039) has been in charge of the design and information structure for the envisaged Website including updates during the project period; public relations related to the project and making its results on the effect of management practices accessible for the project

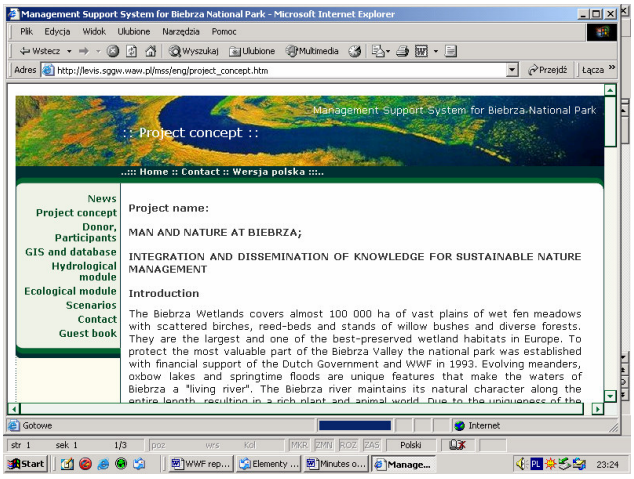
Activities in 2003 in order to planning:

The concept of the web site, as the best way to communicate a project, was developed.
The web site includes:

- the general information on the project,
- news section with actual information if any planned meetings,
- project sponsor and participants section (with links to all involved organisations' web sites)
- presentation of MSS structure
- description of ecological and hydrological modules
- contact details to all project participants (with contact details including e-mail addresses to enable direct contacts with proper experts)

The web site was designed to be bilingual: Polish and English. The design follows WWF's guidelines as it was going to be installed on WWF's server.

The webmaster was hired and the draft (but already operating) version of a project web site was uploaded to http://levis.sggw.waw.pl/mss at first in Polish version, and continuously the English one was added.



The web site started to be a communication platform for all interested. The invitation for planned meetings (eg. the meeting with all stakeholders joined with the scenario meeting on 15th December 2003).

The draft version was consulted with project participants and received comments were taken into account in next updates. The concept of a web was also presented and discussed at the technical meeting on March 2003. It was concluded that: draft version should be on WWF's server but the last version on BNP's server, comment box to exchange information (guest's book) are welcomed.

Activities in 2004 in order to planning:

January-March 2004

The Polish and English versions of the scenarios were published (resulting from meeting 15th December 2003) on the website. The web was linked to the organizations' participating in the project web sites (eg. http://levis.sggw.waw.pl/zhizw_web_top.jpg, http://www.biebrza.org .pl/pol/badania/index.html)

March-December 2004

Updates of website and further developments. The guests book and counter were added.

The workshop with all relevant stakeholders planned for October to present project results was widely communicated. The press release (attached) was prepared and published on the project's web site in news section as well it was distributed to local, regional and country wide media (from WWF's media database). The workshop was also communicated by web site of WWF http://www.wwf.pl/0410141705_newspl.php .

October 2004

During the workshop on 17-18 October 2004 WWF:

- presented to the participants of the field trip to Lower Biebrza Basin the "*Ruff Meadow* project – protection of the biodiversity of open wetlands in Biebrza National Park" using hand mowing as a tool.
- presented during the session in Headquarters of the Biebrza NP the way to dissemination the project results by web page. The advantages of web site as a possible information tool were described, the actual status and future perspectives of project web site development were presented.

During the year 2004 the reports from monitoring the results of field project carried by WWF were delivered to Biebrza NP: report of monitoring of the cattle grazing effect on birds nesting on *Brzostowo* floodplains and final report (1999-2003) on monitoring of hand mowing influence on birds, plant communities and some plants species on *Ruff Meadow*.

The final version of the project web site will be delivered to the Biebrza NP to be put on it's server and for further updates after project end.

Notatka prasowa

2004-10-11

Człowiek i przyroda nad Biebrzą

W dniach 17-18 października 2004 roku w Biebrzańskim Parku Narodowym odbędą się warsztaty podsumowujące polsko-holenderski projekt **„Człowiek i przyroda nad Biebrzą: zintegrowany system wymiany informacji jako podstawowe narzędzie zrównoważonego zarządzania środowiskiem przyrodniczym”**.

Projekt realizowany jest przez Szkołę Główną Gospodarstwa Wiejskiego (SGGW), Instytut Melioracji i Użytków Zielonych (IMUZ), Uniwersytet w Utrechcie (Holandia), Alterra Institute w Wageningen (Holandia) we współpracy z Biebrzańskim Parkiem Narodowym, WWF Polska i Pracownią Architektury Żywej a finansowany przez holenderskie Ministerstwo Rolnictwa, Ochrony Środowiska i Rybactwa z funduszu PIN-MATRA.

Celem trzyletniego projektu było utworzenie MSS (Management Support System) - Systemu Wspierania Zarządzania dla Biebrzańskiego Parku Narodowego oraz stworzenie sieci skupiającej: naukowców, osoby zarządzające zasobami przyrodniczymi i lokalnych użytkowników obszaru BPN dla polepszenia komunikacji i współpracy między nimi w planowaniu ochrony i użytkowania tego unikatowego obszaru.

MSS to komputerowe narzędzie integrujące wiedzę z różnych źródeł, a zawierające tradycyjne i przestrzenne (GIS) bazy danych dla obszaru BPN i jego bezpośredniego sąsiedztwa; moduły: ekologiczny i hydrologiczny oraz scenariusze przyczynowo-skutkowe.

Celem organizowanych warsztatów jest prezentacja i konsultacja rezultatów projektu z przyszłymi i potencjalnymi użytkownikami (dyrektorzy parków narodowych, lokalna i regionalna administracja, lokalne organizacje ekologiczne).

Więcej informacji:
Helena Bartoszuk, Biebrzański Park Narodowy, tel. (86) 2720620, email: hbartosz@biebrza.org.pl

Szczegółowy program warsztatów na stronie http://levis.sggw.waw.pl/mss/index.htm.

Implementation of the MSS Tadeusz Sidor

Forest Database – Tool Supporting the Management of Forest Ecosystem Management Biebrza National Park

According to land registers forest ecosystems cover approximately 16 thousand hectares of the Biebrza National Park, i.e. 27.6% of its total area. This figure includes 14 thousand hectares owned by the Treasury, which are managed by the Park, whereas other property constitutes approximately 2 thousand hectares.

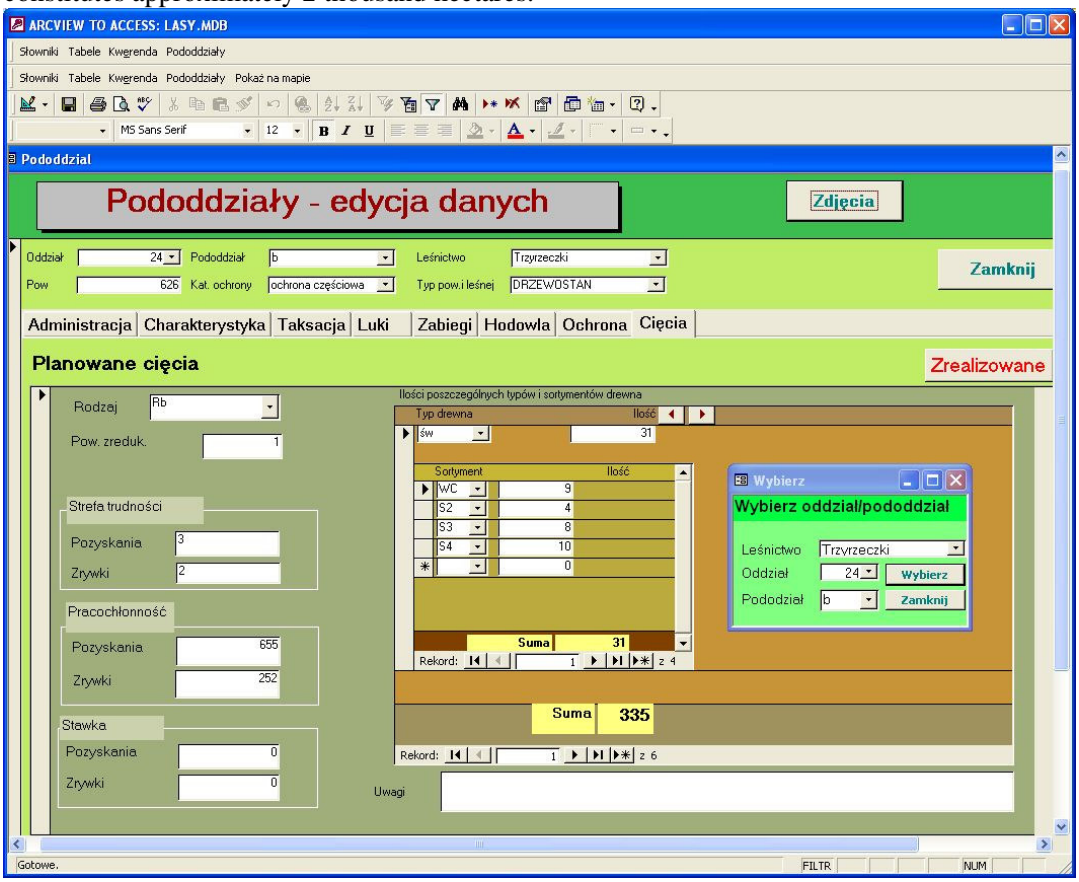


Fig .. The forest database interface

In order to facilitate the management of such an extensive area it has been divided into 511 sectors and 3610 subsectors, i.e. grounds of the area above 20 acres and with the properties of stand which distinguish it from adjacent stands. Additionally, in the area of forest ecosystems there are other important elements, namely: gaps, roads, sector lines, section lines, ditches, monitoring areas, research areas, monument trees, etc. Each subsection possesses numerous distinguishing properties, namely more than a dozen qualities which characterize its habitat (soil, vegetation, etc.), and the taxonomy qualities (description of stand). In the course of preparing the protection plan for the Park for many areas protection activities have been planned with consideration for the specification of various operations, manner, terms, area and several other properties. As a result the Park holds a massive database of the forest collected in the form of a few dozen thousand records.

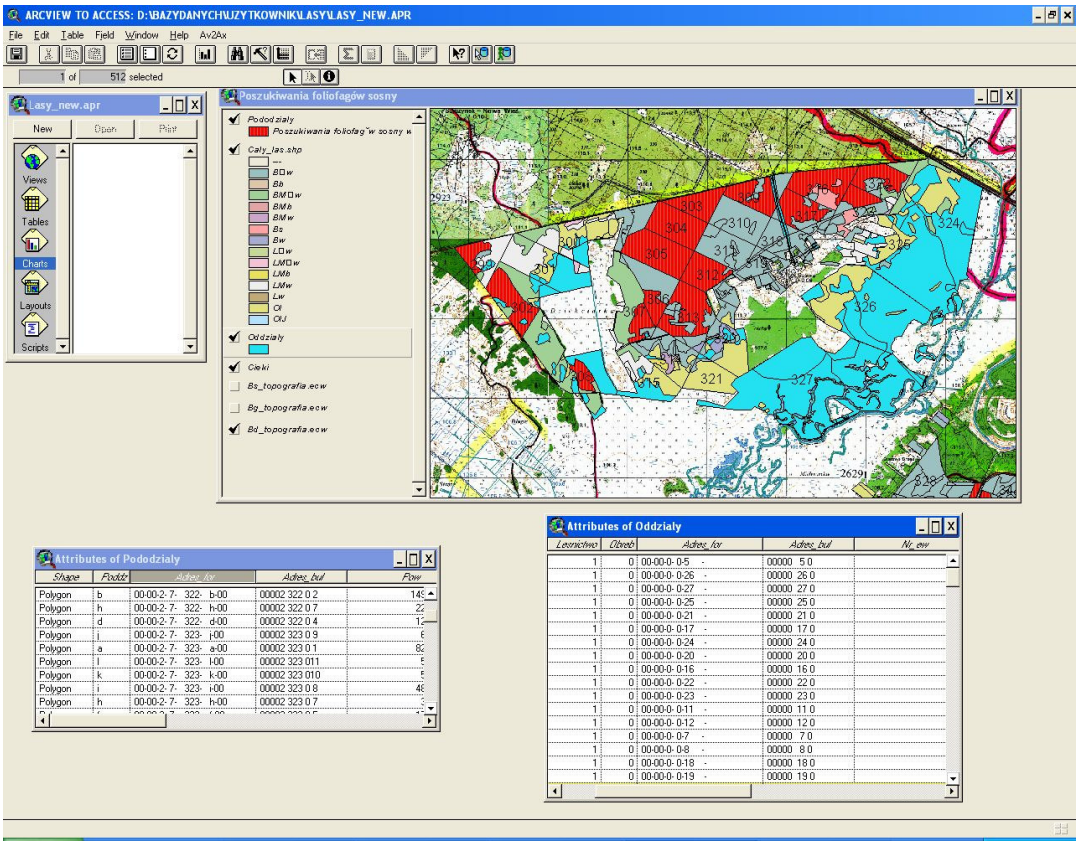


Fig .. The forest database application in MSS

In order to manage such a great database it is necessary to apply the state-of-the-art IT programmes. To this purpose a special database has been designed to fulfil the requirements of the Biebrza National Park. Owing to this software it is possible to search the database quickly in order to find any necessary information. It is also easy to supplement and amend the data contained therein. Another important characteristic of the software is the option of obtaining information in the form of maps.

The protection of forest ecosystems is planned, coordinated and supervised by specialists in the Department of Nature Protection of the Biebrza National Park.

At the planning stage the data collected in 20-year plans (natural and habitat descriptions) is utilised as well as practical information is collected by field services. After the verification and introduction into the forest database of the area, the collected material is analysed in depth. The result of such analysis is the protection action plans for the following year in the field of protection, breeding and cutting. Apart from the address of the protection area such action plans include information on the manner of work, deadlines, volumes (ha, pieces, running metres), labour consumption (rbh), costs (PLN) and the demand for materials (seedlings, chemical agents, etc.). In the case of action involving cutting also the volume of timber (m3) to be received according to the types and species is provided. The collected general information is used to select contractors for services in the protection of ecosystems and procurement. Furthermore, such information includes data on the forecast mass of timber to be collected according to the types, sorts, deadlines and locations. Such information is the necessary basis for the efficient management of timber sale. General reports are the basis for the preparation of the decree by the Minister of Environment concerning tasks within protection, material and financial

plans (income and expenditures) of the whole Park. Approved plans are executed directly by field services. The services produce monthly reports on the progress of work (according to material and financial factors). Owing to the database it is possible to produce monthly and annual general reports including information e.g. on the amount of obtained timber (various aspects) or incurred costs. The forest database is also useful for the monitoring of forest ecosystems. Information is collected monthly concerning the threats from insects for several hundred fromon, classical and other traps and sub-eaves areas. Information on the illnesses of the forest, damage caused by forest animals and abiotic factors are collected.

Such a database of forest ecosystems, including information on both natural and environmental protection, facilitates the comprehensive analysis of data. What is particularly significant in the case of such a large area is the possibility of performing spatial analyses of e.g. the scope of forest illnesses or gradation threats. Such analyses aid the assessment of the effects of performed protection actions and optimisation planning.

Future opportunities Adam Sienko & Martin Wassen

"Man and nature on Biebrza area: integrated system for exchange of information as the basic tool for environmental sustainable management" a report summarising Polish – Dutch Project.

The project works were initiated in 2001 by the Utrecht University. The following organisations declared participation in the project: Alterra (University in Wageningen), SGGW, IMUZ, BPN, PAŻ, WWF-Biebrza.

The main objectives were following:
- to establish tool for support of decision making process concerning management of natural resources protection
- to establish Polish – Dutch network based on BPN enabling exchange of information concerning wetland.

During the project activities, workshops, on spot visits all the participants were aiming at getting to solutions which would satisfy all the potential MSS users. All the partners put all their efforts so that the worked out solutions would cover:

1. databases consisting of data from various source of knowledge to the possible extent
2. monitoring covering most essential issues for BPN

establishment of network which would enable communication between various entities dealing with environmental planning and monitoring.

During the project summarising workshops on 17 – 18 October 2004 the selected elements of the project have been presented and the adopted solutions have been analysed and evaluated. The workshop's participants and project partners agreed that the project and its objectives had been fulfilled. The established databases and GIS made all the participants aware how enormous are data resources. Data systematisation in specific databases already now gives opportunity to consider many elements having impact on correctness and quality of decisions made for environmental protection. The earlier data were dispersed and the opportunity to use them was based entirely on knowledge that hey exist. In result some elements were not taken into consideration in the decision-making process and thus the decisions were not the best possible ones. However the databases need regular updating by BPN staff. The databases and MSS system have to updated due to inflow of new information, results of BPN research and current events. All the system has to be dynamic and it can not possibly be closed, with outdated resources. It raises an obvious question if the present BPN staffing and their qualifications enables pursuing the task. Some changes in organisational structure and job responsibilities are inevitable. Another issue beyond BPN internal impact is level of employment and financing of the system support. Knowing the BPN financing model this issue might be the most important threat for use and updating of the data. New tasks can't be successfully fulfilled without additional staffing and additional financing. The factor which may positively contribute to growth of financial resources is having Biebrza Valley in the Natura 2000 network with new administration tasks for BPN.

Having in mind the aforesaid, the possible raising financial support for additional software for additional workstation has to be considered. It would have to be followed by training for the additional users who would gradually work in the system. Another aspect is possibility to

currently use the already existing resources. The users underline MSS usefulness. The direct contribution of the users during the works to set up databases makes their use easier and helps in the know-how transfer to next users.

Another aspect worth highlighting is participation of many partners in the project. Participation of science institutions, NGOs and BPN personnel is a good example of combining together various fields of interests and activities. MSS is a rare example of good co-operation and good relations between the partners pursuing the project's various tasks. The present co-operation makes a perfect ground for future joint activities because mutual knowledge of issues and partners has removed earlier barriers and divisions.

Yet another essential aspect is present opportunity to use project's experiences and ready MSS by local entities and national parks. The project has proved, that without joint activities of science institutions, national parks, and NGOs the set objectives would have never been reached. Participation of the university safeguarded good scientific level while participation of the national park's personnel provided for working out of practically useful solutions. Participation of NGOs ensured approval for the adopted solutions. The experience should be used by activities of other national parks. The models suggested by universities enables practical use of research results. It is also important that thus the researchers are encouraged to take up works considering real needs of national parks. In this way the research results are used for planning and pursuing parks' tasks connected with nature protection.

Summarising, the project has fulfilled the following objectives:

1. MSS has been established
2. BPN personnel have been trained to manage databases
3. the network for exchange of experience for domestic an foreign partners has been established
4. the gaps in monitoring and databases have been identified
5. MSS has been used for presentation on changes in land use and water management
6. the future research direction has been set out regarding protection tasks.
7. BPN has been equipped with computer hardware and software.

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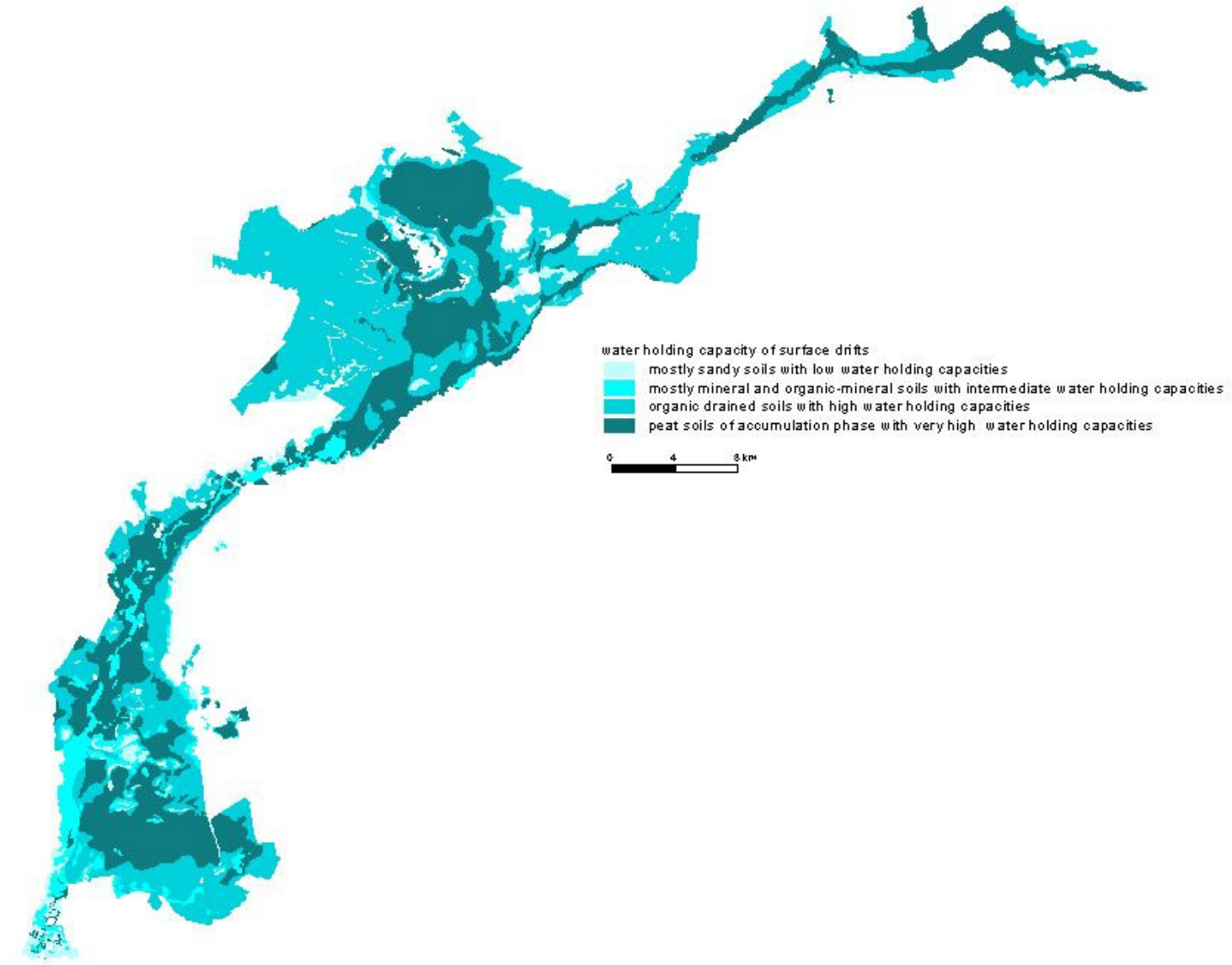
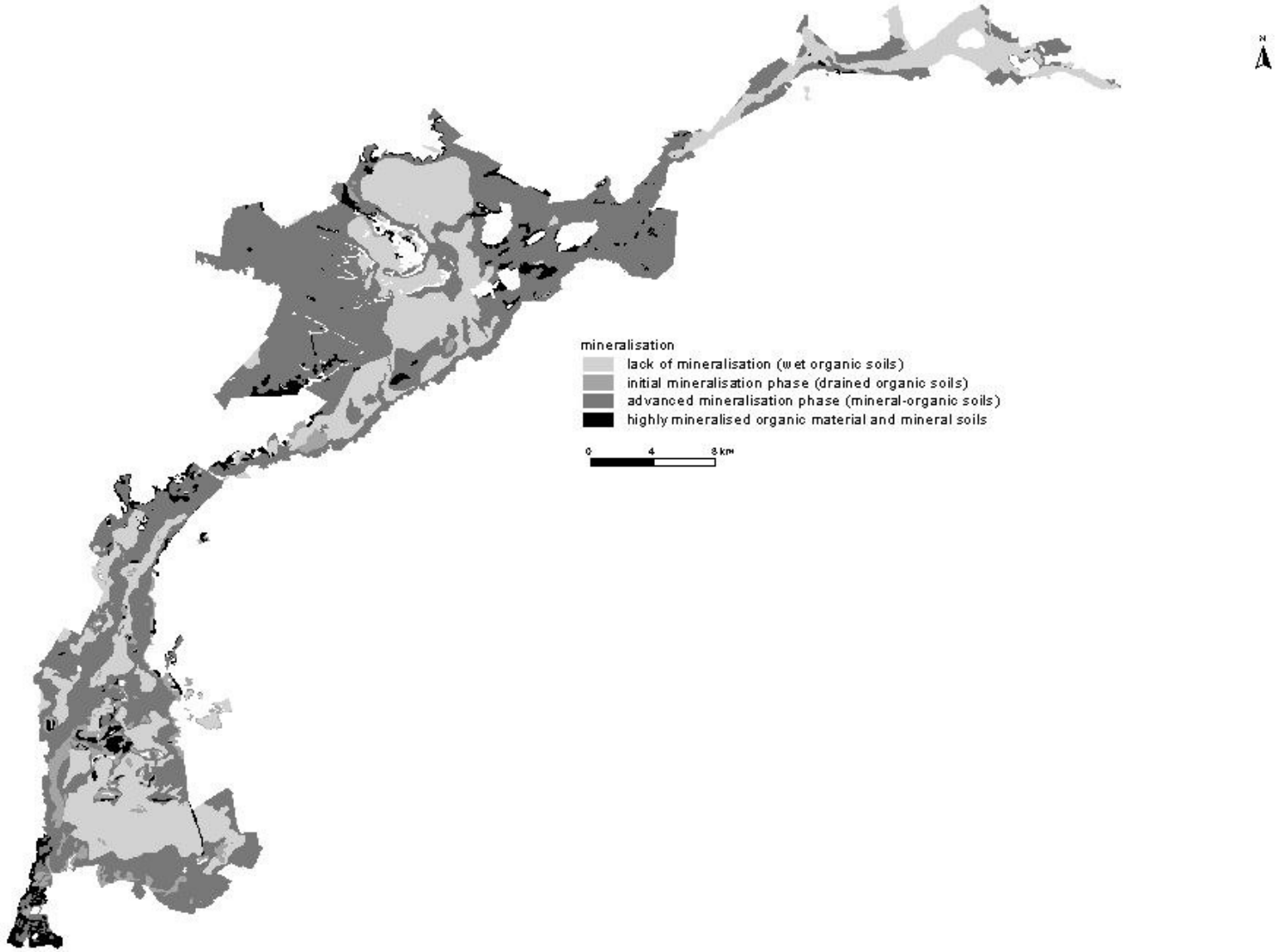
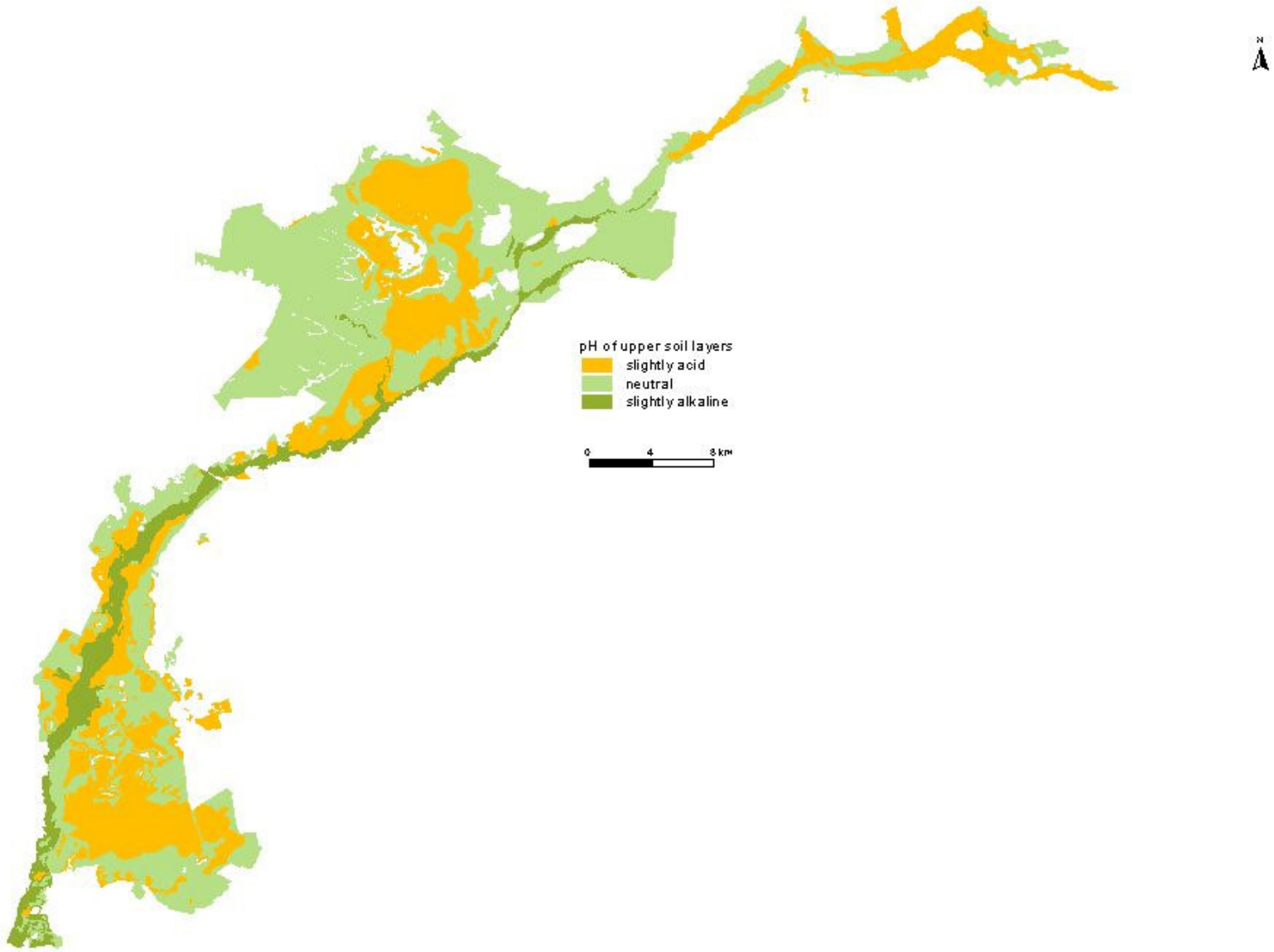
Appendix 1


water holding capacity of surface drifts
mostly sandy soils with low water holding capacities
mostly mineral and organic-mineral soils with intermediate water holding capacities
organic drained soils with high water holding capacities
peat soils of accumulation phase with very high water holding capacities
0
4
8 km

Appendix 2


mineralisation
lack of mineralisation (wet organic soils)
initial mineralisation phase (drained organic soils)
advanced mineralisation phase (mineral-organic soils)
highly mineralised organic material and mineral soils
0
4
8 km
N

Appendix 3


N
pH of upper soil layers
slightly acid
neutral
slightly alkaline
0
4
8 km

Appendix 4

General rules applied during the soil map verification:

I. Soil map present contour lines and database of soil types defined according to Polish soil classification

II. The base source material for the verified soil map is the map of soil cover prepared within the frame of BNP

III. Management Plan, which means that the contour lines of soil types remain unchanged unless:

1. fieldworks and soil sampling do not revealed significant differences with the soil type indicated on the source map
2. Soil type contour lines on the source map follow:
   a.) vegetation contour lines from vegetation map prepared within BNP Management Plan,
   b.) forests and shrubs contour lines from the topographic map,
   c.) forest and shrub ranges from late 90. photo aerials
   d.) contour lines of morphology on the topographic map (particularly on mineral islands and areas neighboring the river bed)
   e.) landforms identified on photo aerials from 90. and 60.
3. there are no reliable source materials available (e.g. photo aerials, soil sampling plots etc.) or an area was not verified during extensive fieldworks

IV. Contour lines of mineral soils related to the not hydrogenous sites remain unchanged unless they cover areas located within the bottom of the ice marginal valley.

V. Mineral soils with thick organic upper layer and high contents of $CaCO_3$, typical for depressions occurring in young glacial landscape are skipped as well as most of the units with typical alluvial soils.

VI. Peat soils of peat-accumulation phase are related to:

1. large homogenous patches of low-sedge communities on peat deposits,
2. patches with low-sedge communities located near the slopes of the ice marginal valley.

VII. Drained peat soils with up to 20 cm moorsh layer are related to:

1. patches with herbal vegetation on peat deposits,
2. forests on sites with peat deposits (particularly related to birch forests in lesser extent to alder carrs),
3. shrubs on peat deposits (particularly related to thick and medium thick shrub cover or mosaic containing patches of shrubs open areas and forests),
4. Molinion meadows on peat deposits,
5. mosaics of meadows and pastures on peat deposits

VIII. Muddy soils are related to:

1. rushes with Glyceria maxima located in the oxbows close to main riverbed.
2. rushes with Phragmites communis located in the oxbows close to main riverbed
3. tall-sedge communities located in large shallow depressions near the riverbed

IX. Muddy-gleyic soils are related to:

1. tall sedges, reed rushes and rushes with Glyceria maxima located on hillocks in the riverside zone
2. meadows in the riverside zone.

X. Peaty-gleyic soils are related to:

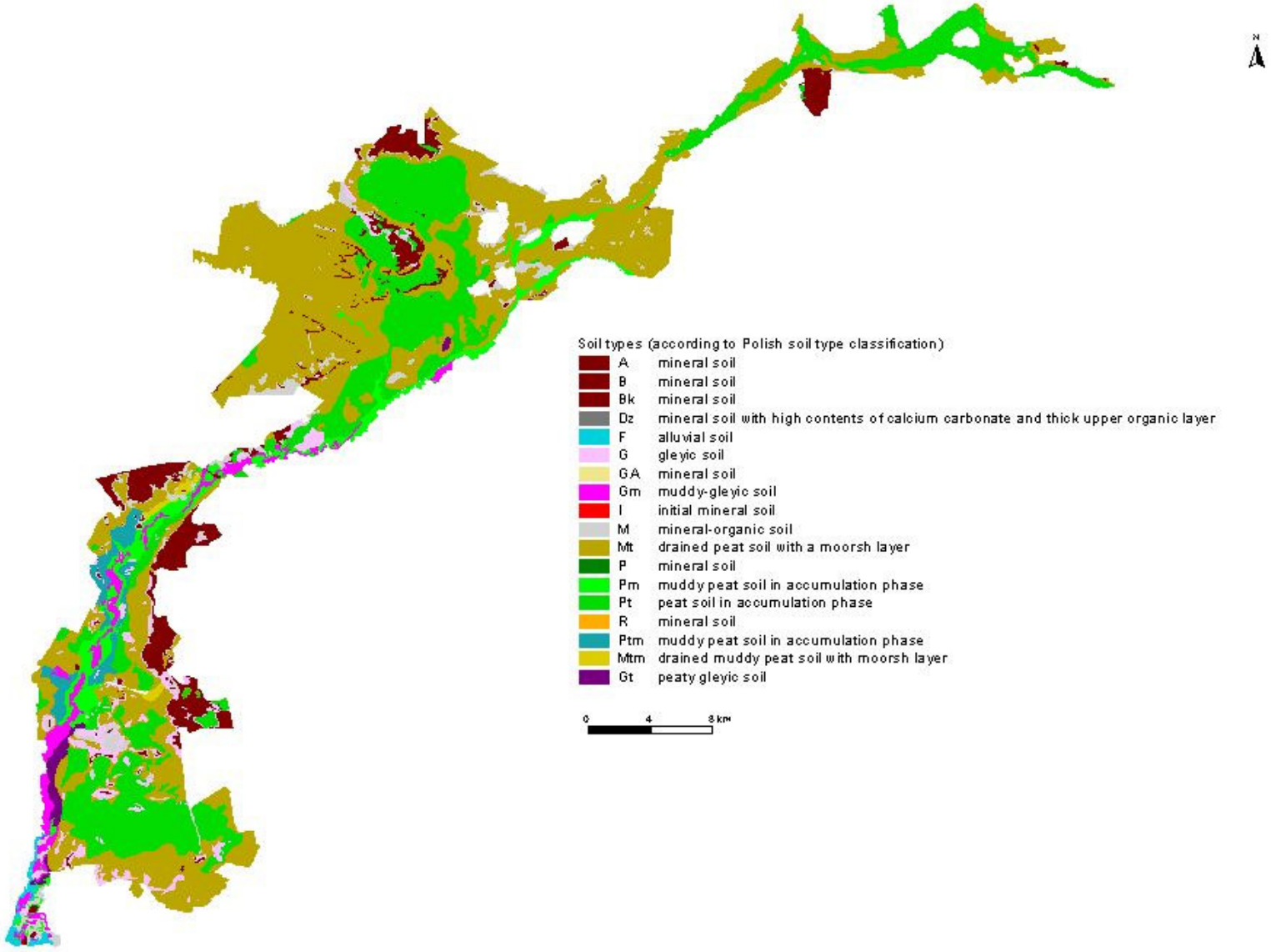
1. tall sedge communities on the floodplain
2. low sedge communities located on the lower parts of river valley slopes

XI. Organic-mineral soils are related to:

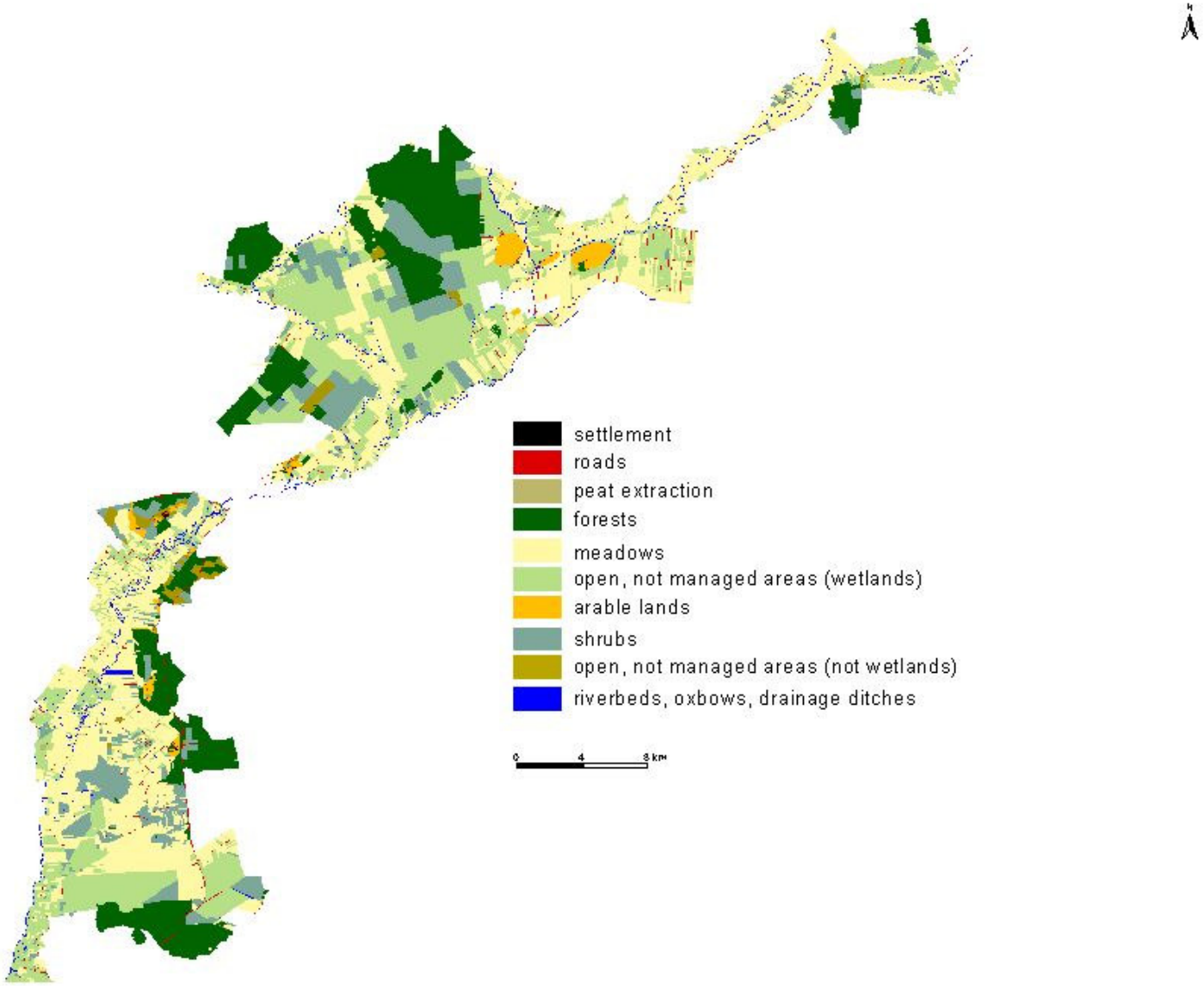
1. Molinion meadows of lower parts of
2. Molinion meadows located on mineral islands or small hillock of riverside zone

XII. A narrow strip of the land of ecotone character with organic-mineral soils is located around large mineral islands or scattered groups of small ones.

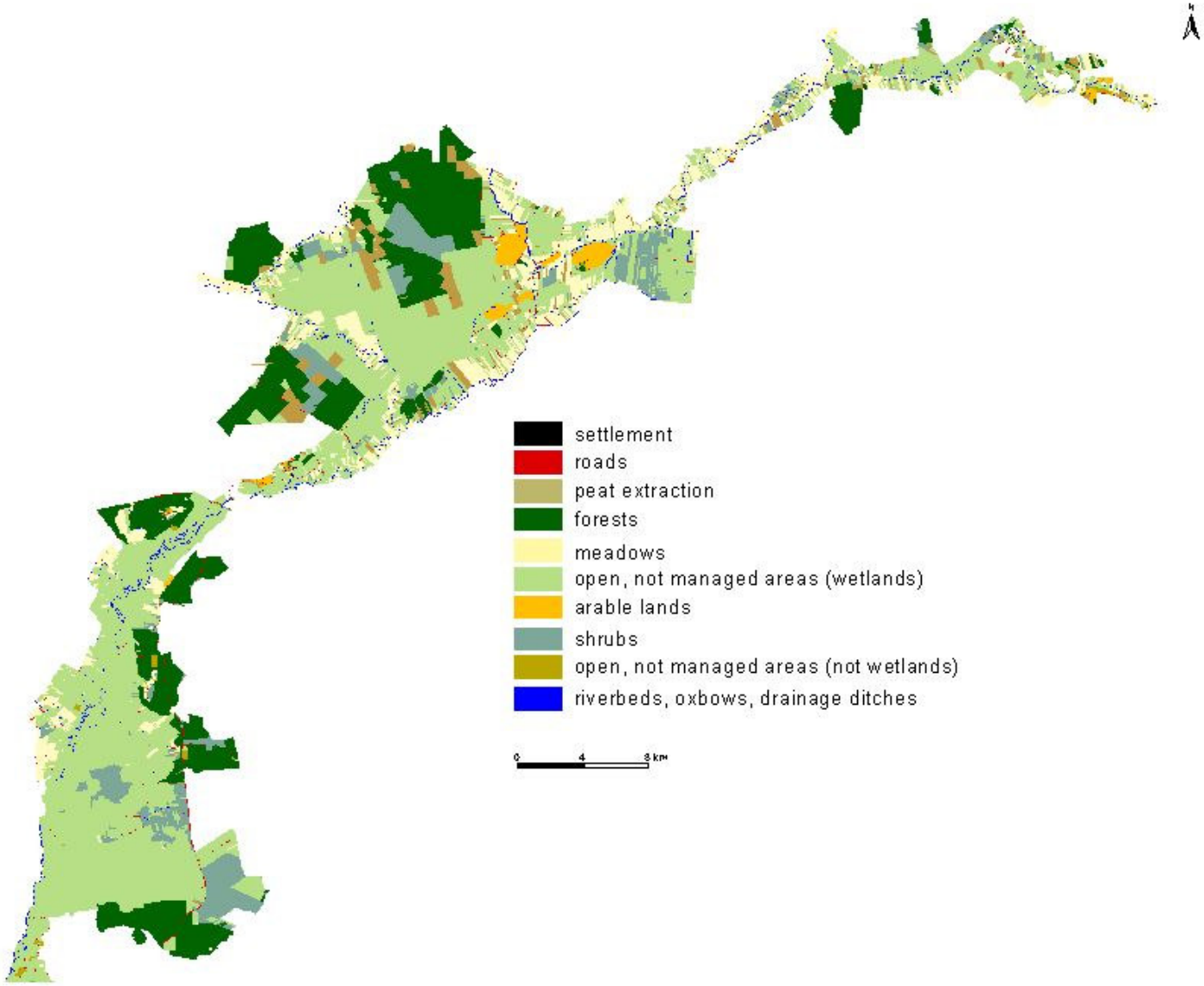
Appendix 5


Soil types (according to Polish soil type classification)
A mineral soil
B mineral soil
Bk mineral soil
Dz mineral soil with high contents of calcium carbonate and thick upper organic layer
F alluvial soil
G gleyic soil
GA mineral soil
Gm muddy-gleyic soil
I initial mineral soil
M mineral-organic soil
Mt drained peat soil with a moorsh layer
P mineral soil
Pm muddy peat soil in accumulation phase
Pt peat soil in accumulation phase
R mineral soil
Ptm muddy peat soil in accumulation phase
Mtm drained muddy peat soil with moorsh layer
Gt peaty gleyic soil
0
4
8 km
N

Appendix 6


settlement
roads
peat extraction
forests
meadows
open, not managed areas (wetlands)
arable lands
shrubs
open, not managed areas (not wetlands)
riverbeds, oxbows, drainage ditches
0
4
8 km

Appendix 7


settlement
roads
peat extraction
forests
meadows
open, not managed areas (wetlands)
arable lands
shrubs
open, not managed areas (not wetlands)
riverbeds, oxbows, drainage ditches
0
4
8 km