



The Biebrza National Park protects the biggest and the best preserved in the European Union complex of peatland located in the marshy, lowland river valley. It covers 59 223 ha, and it is the largest national park in Poland. An unique diversity of plant and animal species and almost natural ecosystems have survived in the Biebrza River valley. 280 species of birds have been recorded; among them 178 breed in the Biebrza wetlands. 48 mammal species, including the largest elk's population (about 600 individuals) in Poland, as well as more than 1000 vascular plant species have been observed in the area. Any other region in Poland has larger population of Lady's Slipper orchid than the



Biebrza wetlands. It is an important breeding, feeding and resting site for many waterfowl and wetland birds. According to Bird Life International, it is the birds' refuge of global significance. The Biebrza National Park was added to the RAMSAR Convention list in 1995, as one of the most important world wetland sites. The Biebrza River valley was also incorporated into the European Ecological Natura 2000 Network, which protects the most valuable nature ecosystems in the European Union. As the result many species of flora and fauna including: birds - Spotted Eagle, Black Grouse, Great Snipe, Aquatic Warbler, mammals - Beaver, Otter, Wolf as well as plants - Fen Orchid, Marsh Saxifrage and Eastern Pasque Flower are particularly protected in the Biebrza River valley.



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Biebrza National Park



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# Project Red Bog

Project **Biodiversity protection of Red Bog (Czerwone Bagno) - relic of raised bogs in Central Europe - PL 0082**  
- is supported by a grant from Iceland, Liechtenstein and Norway through the EEA Financial Mechanism  
and the Norwegian Financial Mechanism. Project co-financed in 15% by Ministry of Science and Higher Education.







The Red Bog reserve was regarded as the second biggest raised bog in Poland and probably the only big peatland of this type preserved in the nearly natural state in the entire country. Due to wide-spread endanger of wetland habitats by eutrophication and drying up, investigation of ecological relationships on the relatively little transformed sites is getting a lot of importance and causes that the Red Bog is area of unique value on the European scale.

Regardless of non-questionable nature value and primary assessment and analysis of the scientific research results conducted in this area prior to the Project, the Red Bog reserve had not been yet scientifically documented and mapped in methodological way. Moreover, we were not able to ascertain, how stabile is this unique system (considerable development of Alder buckthorn (*Frangula alnus*) and pine forest might indicated some significant changes in water recharge mechanism of this area). Therefore, the direct aim of the project was to recognize ecological relationships that decide about biodiversity of this type of peatland and to attempt answering a question is this a raised bog or we shall rather talk about a transitional bogs, and if so, what is its present status and direction of changes. Description of relationships between water and soil (including soil-forming processes) conditions and plant communities and relationships between ungulates herbivorous and large predators has enabled for formulating protection and restoration principles for this type of peatland. At the European scale, elaboration of efficient restoration and protection methods of transitional bogs, priority habitats of EU, is the need of the moment.

Proposed and carried out activities of the project implementation covered three main themes: (1) recognition and documentation of the present state of the system, (2) formulation of protection strategy, (3) study on ecological relations. Those tasks have been implemented by six research



teams which were specialized in the following fields: hydrology and hydrogeology, meteorology, hydrogenic sites and peat soils, botany - forest and non forest plants, mammals and birds. The additional team was responsible for GIS and data bases documentation. The main findings obtained by the research teams are presented on the leaflet.

The Red Bog strict protection zone is one of the oldest and the most famous protected areas in Poland. It is probably named after red colour of water observed between tussocks of sedge and moss. The Red Bog forest reserve was established in 1925 with the area of 2.179 ha. According to Professor Władysław Zafer (1932) "the bog pine forest with transition to the birch forest" covered the area. A protection of the one of the last Elk's (*Alces alces*) refuges in Poland was the reason to create the reserve. It was an area where Elk, in number of several individuals, has survived a severe poaching that took place during the II World War. Thoughtful care allowed successful rebuilding of Polish population of that species.

This reserve, with adjoining Grzędy reserve, were made into one nature reserve with the total area of about 12,000 ha in 1981 and was named the Red Bog (Czerwone Bagno). It became a part of the Biebrza National Park, when the park was establishment in 1993.

The Red Bog strict protection zone covers about 3000 ha according to the data from 2007. Only indispensable scientific researches are carried out here. Neither the economic activities nor the tourist traffic take place in the zone. Nevertheless, the educational trail along the boardwalk leading to the observation platform allows seeing fragments of this precious area.



## MAMMALS

The most abundant species in the ungulate community of Biebrza National Park is roe deer (38%), whereas the remaining species are less numerous and their percentage shares in the community are as follows: moose – 24%, red deer – 20%, and wild boar – 18%.

Moose are mostly solitary (except mother – calf relation), and the mean size of the group is 1.6 individuals. Small groups of moose (2-4 individuals) are more common in open areas than in forests of national park. During summer, autumn and winter, moose usually inhabit forests, both coniferous and deciduous. In spring, however, especially in the calving season, they strongly prefer open marshes. This may be caused by food abundance (faster development of plant cover in open areas) or the avoidance of predation risk from wolves.

Wolves occur throughout the entire BNP and are a part of the larger population inhabiting north-eastern Poland. In Biebrza River Valley, comprising BNP and southern part of Augustów Forest, around 30-35 individuals in 6-8 packs are found. Only three packs live largely in the national park, whereas the territories of other packs mostly stretch outside BNP. Biebrza National Park serves as the ecological corridor providing connectivity between wolf subpopulations occurring north and south of national park.

In Biebrza National Park wolves most often hunt red deer and strongly prefer this species from the available community of prey. Moose and roe deer are killed accordingly to their shares in the community, whereas wild boar is avoided.



## BIRDS

Bird study were conducted in 2007-2010. Field observations were made in breeding season (4 study plots using cartographic method, searching of rare birds on whole area) and in non-breeding season (transect). In Czerwone Bagno area (37 km<sup>2</sup> of boggy forest and adjacent meadows) 137 bird species were recorded (including 93 breeders).

Breeding bird communities characterize by low density (up to 25 pairs/10 ha). In forest habitats dominants are: Chaffinch, Chiffchaff, Willow Warbler and Robin. In bushy areas bird community was very specific: Whitethroat, Red-backed Shrike, Common Snipe, Barred Warbler and Reed Warbler were dominated. Comparison with data from many parts of Poland shows, that bird communities of Czerwone Bagno (especially birds of bushy habitats) are generally not similar to other bird communities, probably due to low fertility of habitats.

Czerwone Bagno is important area for protection of some rare birds. For 3 species (Spotted Eagle, White-backed Woodpecker and Eagle Owl) it holds more than 1% of polish population. In old boggy pine forest Swifts and Stock Doves breeds. Alder forest are home for Middle Spotted Woodpecker, Lesser Spotted Eagle and crane (high density). Meadows near strict protected area are breeding habitat for Aquatic Warbler, Great Snipe and Citrine Wagtail. In surrounding spruce forests Pygmy Owl was recorded.



## VEGETATION

The project allowed for vegetation documentation by more than 300 phytosociological releves and a vegetation map, as well as research on recent vegetation changes and ecological preconditions of current vegetation patterns.

The current shape and dynamics of vegetation in the Red Bog is largely an effect of hydrological alterations in the area c. 150-200 years ago due to digging deep canals in the Middle Basin of the Biebrza Valley. This has caused mineralization processes in peat soils in the outer zone of the mire and probably enhanced accumulation of rain water and subsequent acidification in the central part.

Today, an important factor influencing vegetation dynamics is the grazing activity of a particularly abundant elk population;

The main groups of plant communities occurring today in the Red Bog are: alder woods (*Ribesio nigri-Alnetum* and *Sphagno squarrozi-Alnetum*), birch wood community of *Betula pubescens* – *Pinus sylvestris* – *Telypteris palustris*, bog-related community close to *Ledo-Sphagnetum magellanicum* with an old-growth pine woodland, willow shrub community *Salicetum pentandro-cinereae*, often marked by abundant occurrence of *Betula humilis* and open meadow and herb communities related to the alliance *Molinion caeruleae*.

The pine woodland in the middle part of the peatland has a multi-aged structure (which excluded the hypothesis of afforestation of the area), while the recruitment phase is almost absent, likely due to the elk grazing activity.

The main abiotic factors responsible for current vegetation patterns are pH and moisture, directly related to local productivity.

The analysis of aerial photographs revealed that, in the scale of the whole peatland, open communities give space to shrub and forest communities. The remarkable presence of open vegetation patches (meadows and brushwoods, including very valuable stands of *Betula humilis*) despite the lack of management is linked to the elk grazing, whose abundant population seems crucial to the maintenance of current ecological processes and the local biodiversity.

## HABITATS AND SOILS



A development of the peatland itself and the peat accumulation process in the Red Bog area had started about 13600 years ago due to paludification of the mineral sediments.

The community with *Scorpidium scorpioides* moss was one of the initial peat forming phytocoenosis.

Accumulation of lacustrine deposits (gyttja) had started in many spots about 12800 years ago.

The most lakes had been terrestrialized about 7700 years ago. During next several thousand years prevailing part of today's Red Bog was covered by peat-forming communities with a prevalence of sedge: slender sedge (*Carex lasiocarpa*) and Bowles golden sedge (*C. elata*) as well as significant share of common reed (*Phragmites communis*).

Under conditions of rain water feeding increase, in the central part of the area plant communities with *Sphagnum* species appeared.

Due to accumulation of different types of peat and gyttja, within Red Bog area formed deposits up to 4,6 m depth. Two types of peat prevail: sedge peat (*Magnocaricioni*) and sedge moss peat (*Bryalo-Parvocaricioni*). Sedge peat is mainly represented by *Cariceti*, and at the object's boundaries – by *Carici-Phragmiteti*. Moss peat is mainly exemplified by *Carici-Bryaleti*, and in the floor of the deposit – as *Bryaleti*, which makes up two layers intersected by a layer of sedge peat. In addition, at the edges of the bed, alder peat (*Alnioni*) and reed peat (*Limno-Phragmitioni*) can be found.

The upper layer in the central part of the deposit contains birch peat (*Betulioni*) and *Sphagnioni* peat typical for transitional mires and raised bogs.

In general, the medium decomposed peat prevails in the deposit, but the lower and upper layers are made of slightly decomposed one.

The peat accumulating raised bogs and transitional mire ecosystems with prevailing peat soils strongly waterlogged exist in the central part of the area. Drained fen ecosystems with less paludified peat soils and with peat-moorish slightly degraded soils occur in the outer zones and in the vicinity of mineral islands.

## METEOROLOGY

High water content leads to slow decomposition of organic matter and is a precondition for conservation of organic carbon in peatland. However, decomposition of organic matter in absence of oxygen leads to emissions of methane (CH<sub>4</sub>), which is a green house gas with 25times higher global warming potential than that of CO<sub>2</sub> in a 100 years horizon.

Methane emissions have been measured from four sites in the period July 2007 – October 2009 (winter seasons excluded). The emissions showed high spatial and temporal variability, reflecting the fact that vegetation, peat characteristics, ground water level and soil moisture are main driving forces for methane emission. The mean emissions from the sites varied from 4 to 26 mg CH<sub>4</sub> m<sup>-2</sup> h<sup>-1</sup>. These values correspond to total emissions of about 15 – 114 g CH<sub>4</sub> m<sup>-2</sup> for a 6 months period.

In a very dry period autumn 2008, three of the sites were in fact methane sinks due to methane oxidation in the upper horizon. The sites with the largest emissions in wet periods had the largest sinks in the dry period, which indicates that the methane oxidation potential is high in soils with generally high methane production.

Extremely high emission was observed from one of the sites with totally flooded soil, where the methane production was stimulated and the methane oxidation was depressed.

## HYDROLOGY AND HYDROGEOLOGY



Groundwater becomes a dominant source of wetlands feeding. Groundwater feeding is the most intensive within the northern part of "Czerwone Bagno".

Within the core area of "Czerwone Bagno" the surficial layer of the peatland is fed mostly with the rainfall water, which is the reason of transitional bog and the raised bog occurrence.

Mean measured annual groundwater level is almost equal to the ground level. In the spring inundation occurs mostly within the south-western part of the "Czerwone Bagno", in the area of alder forests. During droughts, the most decent groundwater level drawdown was observed in north-eastern and south-western part of "Czerwone Bagno".

Evapotranspiration becomes an important factor that induces groundwater level, especially in the areas of alder, birch and willow succession to the open areas. Decent drainage impact of canals was observed within the eastern-most parts of "Czerwone Bagno".

Spatial distribution of groundwater level dynamics was confirmed with chemical research as to the type of water, that feeds wetlands.

Evolution of wetland ecosystems to the direction of raised bog in the central part of "Czerwone Bagno" was accelerated in result of construction of Woznawiejski Canal and Augustowski Canal. Groundwater feeding of those wetlands was reduced of around 20%.

# RED BOG

