

## THE MONITORING OF VEGETATION AND HABITATS OF WATER-PEATLAND ECOSYSTEMS OF „KROWIE BAGNO” (ŁĘCZNA-WŁODAWA LAKELAND)

Bogdan Lorens, Piotr Sugier

Zakład Ekologii

Uniwersytet Marii Curie-Skłodowskiej, ul. Akademicka 19, 20-033 Lublin

e-mail: blorens@biotop.umcs.lublin.pl, psugier@biotop.umcs.lublin.pl

**Summary.** „Krowie Bagno”, a broad complex of peatland vegetation (over 3500 ha area), was one of the most valuable areas of the Lublin region from the natural point of view. Its vegetation was destroyed after drainages carried out at the turn of the 1970's and 1980's. The last refuge of 23 protected, endangered and rare plant species of wetlands is located in the vicinity of Lubowierz and Lubowierzek Lakes. The presence of 8 plant communities of aquatic vegetation, 7 of rushes, 9 of peatland and meadow and 3 of forest ones were noted there. In the perspective of restoration of small areas in „Krowie Bagno”, the monitoring of chosen peatland and meadow ecosystems was started.

**Key words:** monitoring, peatland and meadow ecosystems, „Krowie Bagno”

### INTRODUCTION

The most serious threat to wet regions is the change of their hydrological regime due to drainage. Until the middle of the 18th century water management in Poland was mainly regulated by natural factors. First drainages were made in the 17th as well as in the 18th centuries and were of local character; however, later they began to affect the function of wetland ecosystems. The intensification of drainage took place in the latter part at the turn of the 20th century. Strongly wet areas were changed into meadows and pastures. The habitat conditions of boggy regions were radically altered by drainage in the 20th century [Dugan 1993]. It caused the beginning and acceleration of some dynamic processes in wetland ecosystems. Some of them are very unfavourable taking into account the conservation of biodiversity [Wheeler 1995, Poschold *et al.* 1998]. Active protection of this type of biocenoses requires a detailed recognition of their habitat conditions, vegetation as well as flora and fauna at preliminary stages. The proper assessment of the results of protection is also possible only on the basis of the data obtained from the monitoring of chosen elements of natural habitats which should accompany such undertakings. Hydrological conditions, dynamics of biocenoses as well as a change of the quantity of local populations of the plant and animal species are the most important elements of continuous control in the wetland areas.

The complex of wetland vegetation, located in the vicinity of Lubowierz and Lubowierzek Lakes, is one of few enclaves of „Krowie Bagno”, where the last refuge of protected, endangered and rare plant species still exist. The presence of 8 plant communities of aquatic vegetation, 7 of rushes, 9 of peatbog and meadow and 3 of forest ones were noted there, during the field research [Lorens and Sugier, unpublished data]. In consequence, the monitoring of chosen peatland and meadow ecosystems was started.

## STUDY AREA

„Krowie Bagno” – a broad complex of meadow and peatland vegetation (over 3500 ha area) – was one of the most valuable areas of the Lublin region from the natural point of view [Bernat 1955]. It is situated in the eastern part of Lublin province, on the area of the communes: Urszulin, Hańsk and Stary Brus, being part of Polesie Lubelskie. „Krowie Bagno” lies in the catchment area of the Włodawka river, a left-hand tributary of the Bug. The presence of wide patches of peatland communities with a domination of *Carex elata*, *Cladium mariscus* and *Schoenus ferrugineus* were a characteristic feature of the vegetation of this area. Floristically extremely valuable phytocenoses of *Molinietum caeruleae* meadows and *Betulo-Salicetum repentis* shrubs also had a high share in the vegetation. The presence of about 500 plant species gathered in 28 associations was also noted there [Jargiello 1976, Fijałkowski *et al.* 2000].

Drainage activities on the „Krowie Bagno” were carried out from the beginning of the 19th century; however, the turn of the 1970's and the 1980's was the time of their highest intensity. The total area 2800 ha of unused peatlands was drained then [Demiński 1986, Łoś 1987, Łoś and Panasiuk 2002]. The consequences of a drastic intrusion into hydrological conditions as well as farming were huge transformations of the natural vegetation of „Krowie Bagno”. The drainage together with agricultural usage caused intensification of muck accumulation and a fall in groundwater table about 50 cm on average in comparison with the year 1966 [Łoś 1998]. The crisis of agricultural management contributed to further degradation of vegetation on a considerable area of a meadows, as a result of the cessation of mowing and pasturage.

The prospects of restoration of small fragments of „Krowie Bagno” have appeared recently. It is connected with the necessity of beginning the permanent control of chosen elements of environment.

## MATERIAL AND METHODS

Field studies were carried out in August 2003. Six research transects, 5 meters wide and from 35 to 290 m long, were placed. The plots sized 5 × 5 m were pointed in each community located in the transects. Plant communities were examined using the commonly applied method of Braun-Blanquet. Detailed quantitative inventory of all plant species within the plots was carried out. The syntaxonomic system and syntaxonomic affiliations of species were adopted after Matuszkiewicz [2001]. The data will be used to assess the dynamics of the processes taking place in the structure and floristic composition of monitored phytocenoses. In each of 19 permanent study plots the boreholes were made, the arrangement of soil horizons was characterized and the groundwater table determined. Additionally, the samples of soil from the depth of 10-20 cm were taken and their reaction was measured.

## RESULTS

The arrangement of phytocenoses in individual research transect was as following:

- transect 1-290 m long, included plant communities: *Molinietum caeruleae* variant with *Carex davalliana*, *Caricetum buxbaumii*, *Molinietum caeruleae* after the last year fire, *Molinietum caeruleae* not touched by fire, forest community with *Betula pubescens*;
- transect 2-71 m long, went through the communities: *Thelypteridi-Phragmitetum*, *Salicetum pentandro-cinereae*, *Sphagno-Caricetum rostratae*, *Molinietum caeruleae* with admixture of *Betula pubescens*;
- transect 3-112 m long, within it there were the following plant communities: *Caricetum acutiformis*, *Sphagno-Caricetum rostratae*, *Betulo-Salicetum repentis*;
- transect 4-50 m long, included communities: *Salicetum pentandro-cinereae*, *Sphagno-Caricetum rostratae*;
- transect 5-35 m long, went through the communities: *Salicetum pentandro-cinereae*, *Caricetum lasiocarpae*, *Caricetum appropinquatae*, *Molinietum caeruleae*;
- transect 6-104 m long, situated within *Betulo-Salicetum repentis* and *Molinietum caeruleae*.

Short phytosociological and ecological characteristics of plant communities occurring within the permanent monitoring plots in the transects are presented below.

*Thelypteridi-Phragmitetum*

Phytocenose of that association occurred as a floating layer of plants on the water surface with predominant *Phragmites australis* and *Thelypteris palustris*. In the places of broken cover on the water surface the following aquatic species appeared with low quantity: *Potamogeton natans*, *Myriophyllum verticillatum*, *Hydrocharis morsus-ranae*, *Nymphaea candida*, *Nuphar lutea* and *Stratiotes aloides*. From among the rush species, apart from reed, *Typha latifolia*, *Schoenoplectus lacustris*, *Carex elata*, *C. pseudocyperus*, *Lysimachia thyrsiflora*, *Stellaria uliginosa* and *Galium palustre* were present. Transitional bog species were represented by *Comarum palustre*, *Carex lasiocarpa*, *Viola palustris* and *Agrostis canina*. Most frequently occurring species in the well developed bryophytes layer were *Calliergonella cuspidata* and *Sphagnum girgensohnii*.

*Caricetum acutiformis*

The patch of this association arose on the floating skin of rhizomes and roots. It was created mainly by *Carex acutiformis* with a fairly essential share of *Thelypteris palustris*. Moreover, the class *Phragmitetea* was represented by 6 species, among them only *Typha latifolia*'s cover exceeded 5%. A minor admixture of meadow species (*Lysimachia vulgaris*, *Lythrum salicaria* and *Cirsium palustre*), from the *Molinion* alliance, was present.

*Caricetum appropinquatae*

The association was represented by floristically rich phytocenoses with a specific hummock-hollow structure. *Carex appropinquata* – a characteristic and at the same time dominating species of that association – built the hummocks up to 40 cm high. Such a structure caused differentiation of the soil moisture and affected the floristic composition. Beside rush and peatland vegetation the species of meadow and shrubs communities occurred. In wet hollows as well as on dry hummocks there were favourable conditions

for bryophytes and their cover reached there up to 90%. Most frequently noted species were *Sphagnum palustre* and *S. cuspidatum*.

The above described association of *Caricetum appropinquatae* took up moist peat soil, with slight acidity (pH 5,8). Groundwater table was 30 cm below the surface.

#### *Caricetum buxbaumii*

The phytocenoses of *Caricetum buxbaumii* association had a vertical structure consisting of two layers – one very poor in bryophytes and the other rich in herbs (cover up to 100%). *Carex buxbaumii* prevailed in it with considerable admixture of *Carex davalliana*, *Succisa pratensis* and *Potentilla erecta*. In some fragments, especially on wetter ground, the share of species characteristic of *Scheuchzerio-Caricetea nigrae* class arose (*Carex oederi*, *C. flava*, *C. nigra*, *Eriophorum angustifolium*, *Menyanthes trifoliata*). In some places the clumps of *Molinia caerulea* appeared. Sparse bryophytes represented *Sphagnum capillifolium*.

These patches appeared on peat soil, the reaction of which was close to neutral (pH 6,3) and groundwater table was to be found on depth ca 80 cm.

#### *Caricetum lasiocarpae*

As regards floristic composition, phytocenoses of that association are characterized by unquestionable domination of *Carex lasiocarpa*, reaching the cover up to 40%. Meadow species made up an unimportant admixture of herb layer. Prevalent were the taxons of *Scheuchzerio-Caricetea nigrae* class (*Carex nigra*, *C. limosa*, *C. dioica*, *Comarum palustre*), but the cover of none of them exceeded 5%. The share of *Phragmites australis* grew only in some places. *Alnetea glutinosae* class was represented mainly by *Betula humilis*, rarely by *Salix cinerea* (both of them in shrub layer). Bryophytes were well developed (cover 100%) and their basic components were *Sphagnum cuspidatum* and *S. palustre*.

*Caricetum lasiocarpae* developed on peat soil, whose reaction was pH 5.4 and groundwater table laid 20 cm beneath surface.

#### *Sphagno-Caricetum rostratae*

The phytocenoses of that community had three layers. The cover of shrubs of one reached 20%. Its basic component was *Betula pubescens*, *Betula humilis* and *Salix cinerea* rarely occurred. In the herb layer *Oxycoccus palustris* and *Carex rostrata* prevailed quantitatively. Besides the second of the mentioned species, *Scheuchzerio-Caricetea nigrae* class was also represented by *Carex lasiocarpa*, *C. nigra*, *C. chordorrhiza*, *C. limosa*, *Eriophorum angustifolium* and *Comarum palustre*. A well developed bryophytes layer consisted of *Sphagnum cuspidatum*, *S. rubellum*, *S. palustre*, *S. magellanicum*.

Peat soils of *Sphagno-Caricetum rostratae* were characterized by high acidity (pH 4.2) and groundwater table was near the surface (20-30 cm).

#### *Molinietum caeruleae*

The patches of *Molinietum caeruleae* differentiated into some variants, because of the presence and floristic composition of shrubs. From among them a typical variant, devoid of bushes was selected. *Molinia caerulea* was the species which gave a specific physiognomy to the association because of its high abundance. Its cover varied from 70 to 90%. *Molinia caerulea* was accompanied by characteristic species from the *Molinio-Arrhenatheretea* and *Scheuchzerio-Caricetea nigrae* classes. The admixture of peatland

species (*Carex nigra*, *C. davalliana*, *C. oederi*, *Eriophorum angustifolium*) and rush ones (*Phragmites australis*) developed on most wet peat soils. Moderately moist peat soils were occupied by patches with a higher share of the characteristic species of *Molinio-Arrhenatheretea* class, especially *Succisa pratensis*. Phytocenoses of *Molinietum caeruleae* occurred on deep peat soils (thickness of peat layer exceeded 200 cm). Their reaction was similar to neutral (pH from 6.1 to 6.3). Groundwater table in the summer oscillated between 60 and 200 cm.

#### *Salicetum pentandro-cinereae*

The shrub layer (cover 60-80%) consisted mainly of *Salix cinerea*. In some places there was a visible admixture of *Frangula alnus*. The herb layer was well developed. *Thelypteris palustris* predominated there. In some patches high quantity was shown by *Phragmites australis* as well as *Oxycoccus palustris*. Bryophytes covered from 70 to 100% of the ground. There were first of all *Sphagnum palustre*, *S. squarrosum*, *S. girgensohnii*.

Willow shrubs grew on peat soils whose reaction oscillated in the examined patches from 4.7 to 6.5 pH. The ground was usually flooded from the spring to the beginning of July, afterwards groundwater table was 5-10 below surface.

#### *Betulo-Salicetum repentis*

The association was represented by phytocenoses of low shrubs having a three layer spatial structure. *Salix rosmarinifolia* was dominant in the highest one. In the some places *Betula humilis* and *Frangula alnus* occurred in admixture. The species representing *Alnetea glutinosae*, *Sheuchzerio-Caricetea nigrae*, *Phragmitetea*, *Oxycocco-Sphagnetes* and *Molinio-Arrhenatheretea* classes were the most important components of the herb layer, whose cover reached 70%. Among them, *Molinia caerulea*, *Phragmites australis*, *Oxycoccus palustris* and *Comarum palustre* had the highest quantity. The layer of bryophytes consisted of *Sphagnum cuspidatum* and *S. palustre*.

*Betulo-Salicetum repentis* developed on moist peat soils with a reaction of 5.9 pH, and groundwater table below 40 cm.

#### Forest community *Betula pubescens*

A dense layer of the trees was built of *Betula pubescens* with admixture of *Alnus glutinosa* and *Populus tremula*. Small birches and *Frangula alnus* created the shrub layer. *Molinia caerulea* – as remains of previous stages of succession – predominated in herb vegetation. In the places without that grass *Rubus idaeus*, *Urtica dioica* and *Thelypteris palustris* appeared. Mosses were absent. The ground, where above described community existed, was partially mucked peat with reaction 5.7 pH.

## DISCUSSION

Large patches of *Molinietum caeruleae* occurred in „Krowie Bagno” are one of the most valuable and simultaneously most endangered mesotrophic plant communities. It takes up slightly acid to neutral soils with a low nutrient availability [Westhoff and Den Held 1969, Jansen and Maas 1993]. The last remaining *Molinietum caeruleae* stands are severely endangered by acidification and eutrophication as a result of lowering of the

groundwater table, increasing acid and nitrogen deposition from the atmosphere and indirectly impact of excessive fertilization [Westhoff and Den Hield 1969, Rodwell 1991, De Graaf *et al.* 1994, Michalska-Hejduk 2001]. As a result of acidification and eutrophication, the low-productive *Molinietum caeruleae* is replaced by a vegetation of usually high-productive species, such as *Calamagrostis canescens* and *Filipendula ulmaria*. Additionally, as the result of agricultural crisis and the collapse of the state-owned farms, there followed an essential extension of land use connected mainly with a serious decrease of the frequency of mowing. In the undergrowth, there was a gradual decrease of the share of grasses to the advantage of dicotyledons, particularly of *Urtica dioica* and *Cardaminopsis arenosa*. There are also other valuable and threatened plant communities, especially with transitional peatbog vegetation in the „Krowie Bagno”, such as *Sphagno-Caricetum rostratae*, *Caricetum lasiocarpae* and connected with calcareous soils *Caricetum davallianae*.

For the reason given above, the monitoring and in the future restoration of the diversity of flora and vegetation of some parts of „Krowie Bagno” complex should become one of the most important objectives.

### CONCLUSIONS

In the perspective of restoration of small areas in „Krowie Bagno”, the monitoring of chosen peatland and meadow ecosystems was started. Six study transects, 5 meters wide and from 35 to 290 m long, were placed. Detailed quantitative inventory of all plant species within the 19 permanent plots of the transects was carried out. Within the study plots 10 plant communities occurred. Some of them are severely endangered in Poland by acidification and eutrophication as a result of lowering of the groundwater table. The presented results of the study can be treated as a registration of the actual state of the vegetation and chosen environmental conditions, and will be collected in the future. The data obtained from monitoring may be very useful for the assessment of the results of protection and planning of the restoration management.

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MONITORING ROŚLINNOŚCI I SIEDLIŚK EKOSYSTEMÓW  
WODNO-TORFOWISKOWYCH „KROWIEGO BAGNA”  
(POJEZIERZE ŁĘCZYŃSKO-WŁODAWSKIE)

**Streszczenie.** Jednym z najcenniejszych pod względem przyrodniczym obszarów Lubelszczyzny jest rozległy kompleks roślinności łąkowej i torfowiskowej „Krowie Bagno”. Intensywne melioracje odwadniające przeprowadzone na przełomie lat 70. i 80. ubiegłego wieku doprowadziły do degradacji i zaniku wielu rzadkich i cennych zbiorowisk roślinności torfowiskowej i łąkowej wraz z ich unikatową florą. Jedną z niewielu enklaw, w obrębie których zachowały się ostatnie na tym obszarze refugia gatunków ginących, rzadkich i chronionych (łącznie 23 taksony) jest kompleks roślinności wodno-torfowiskowej w sąsiedztwie jezior Lubowierz i Lubowierzek. Przeprowadzone tu badania wykazały występowanie 8 zbiorowisk roślinności wodnej, 7 szuwarowej, 9 torfowiskowej i łąkowej oraz 3 zaroślowej i leśnej. Ze względu na perspektywy renaturyzacji fragmentów „Krowiego Bagna”, rozpoczęto monitoring wybranych ekosystemów torfowiskowych i łąkowych.

**Słowa kluczowe:** monitoring przyrodniczy, ekosystemy torfowiskowe i łąkowe, „Krowie Bagno”