

THE STATE OF PHYTOCENOSSES IN NATURE 2000 AREA – THE VALLEY OF MIDDLE WARTA RIVER AND ITS LANDSCAPE ATTRACTIVENESS IN THE CONTEXT OF CLOSE NEIGHBOURHOOD OF KOŹMIN EXPOSURE

Summary

The aim of the research was to assess natural and landscape values of plant communities located in the area of an inter-embankment zone of Warta River nearby Koło which, inter alia, decided of the landscape attractiveness of Nature 2000 area – the valley of middle Warta River. Natural values were assessed on the basis of selected plant communities and their phytosociological structure, the richness of species and the frequency of their appearance, the structure of life forms, a geographical and historical spectrum, Shannon-Wiener's index of floristic diversity and the presence of endangered species. The assessment of the communities was conducted with a phytoindicative method; landscape attractiveness was valorised with Mahon's and Miller's method and presented on a map prepared with Autocad 2012 in the scale of 1:25 000. Landscape attractiveness of Nature 2000 area – the valley of middle Warta River in the inter-embankment zone between Koło and Kozubów is shaped by the diversity of geomorphology and local habitats, both of which facilitate the appearance of numerous communities, as well as by plant cover, which is considerably natural, the appearance of endangered species, the domination of native species. Therefore, it holds significant and even unique natural values. Majority of the area is rich in significant and very significant natural values.

Key words: plant community, natural values, environmental conditions, landscape attractiveness

STAN ZACHOWANIA FITOCENOZ OBSZARU NATURA 2000 - DOLINA ŚRODKOWEJ WARTY I JEGO ATRAKCYJNOŚĆ KRAJOBRAZOWA W KONTEKŚCIE BLISKIEGO SĄSIEDZTWA ODKRYWKI „KOŹMIN”

Streszczenie

Celem prowadzonych badań była ocena aktualnych walorów przyrodniczych i krajobrazowych zbiorowisk roślinnych zlokalizowanych na obszarze międzywala rzeki Warty w rejonie Koła, a stanowiące m.in. o atrakcyjności krajobrazu obszaru Natura 2000 - Dolina Środkowej Warty. Walory przyrodnicze określono na podstawie wyróżnionych zbiorowisk roślinnych oceniając ich: strukturę fitosocjologiczną, bogactwo gatunkowe, częstość występowania gatunków, strukturę form życiowych, spektrum geograficzno-historyczne, wskaźnika różnorodności florystycznej Shannona-Wienera i występowania gatunków zagrożonych. W ocenie siedlisk wykorzystano metodę fitoindykacyjną. Natomiast atrakcyjność krajobrazu zwaloryzowano metodą Mahona i Millera i przedstawiono na mapie sporządzonej w programie Autocad 2012 w skali 1:25 000. Na atrakcyjność krajobrazową obszaru Natura 2000 Dolina Środkowej Warty na międzywale (w pobliżu miejscowości Koło-Kozubów) wpływa zróżnicowanie geomorfologiczne i siedlisk obszaru. Sprzyja to występowaniu licznych zbiorowisk, a szata roślinna badanego obszaru charakteryzuje się naturalnością, obecnością gatunków chronionych, dominacją gatunków rodzimych o unikalnych walorach przyrodniczych.

Słowa kluczowe: zbiorowiska roślinne, walory przyrodnicze, warunki siedliskowe, atrakcyjność krajobrazowa

1. Introduction

The attractiveness of the area is much shaped by the landscape, however, an important role must be also attributed to natural elements. Therefore, nowadays more and more attention is paid to such an area management which guarantees protection of natural and landscape values of the area, and their state is the object of interest of numerous researchers [1]. The choice of criteria to assess its attractiveness depends on the character of an investigated area. The most important criteria for the assessment of landscape attractiveness include the assessment of flora, its structure, the level of anthropogenic deformation and spatial variability, which to a large extent depends on the geomorphology of the area [2, 3]. However, what is more and more often emphasized, that is the need for consideration of the diversity of abiotic conditions, and first of all, geomorphological conditions and the connection between soil and flora [4, 5, 6].

The area of Warta valley is characterized by natural and arable values which are unique in Wielkopolska. As a result of progressing anthropopression, as well as in a lot of other similar objects, the area is experienced by unfavourable changes which may lead to irreversible changes especially in habitats and, what follows, in plant communities, fauna and subsequently – in the whole landscape. Such deformations may occur especially in the areas located within the sphere of influence of lignite open-cast pits. Therefore, the conduction of ongoing monitoring of flora allows for the determination of its current state, which is an important message about landscape attractiveness and shows the need for an action which would impede unfavourable changes. Special changes which take place in protected areas such as Nature 2000; the examination of flora in the context of maintaining landscape attractiveness is necessary.

The monitored research conducted from 2007 between Koło and Kozubów, within Nature 2000 – the valley of

middle Warta River is a good example. Apart from the presence of popular threats for flora such as shortage of precipitation, these terrains are endangered by the appearance of a depression cone. It is connected with the neighbourhood of lignite exposure. The aim of the research is to assess current natural and landscape values of plant communities located in the inter-embankment zone of Warta nearby Koło, which influence, inter alia, landscape attractiveness of Nature 2000 area – the valley of middle Warta River.

2. Materials and methods

The analysis was conducted on 160 phytosociological relevés made with Braun-Blanquet's method in the years 2007-2014 in four spots of Nature 2000 area – the valley of middle Warta River: Janów, Dobrów, Dąbrowa, Rgilewka's estuary. Natural values were determined on the basis of selected plant communities with the assessment of:

- phytosociological structure,
- richness of species,
- frequency of the occurrence of species,
- structure of life forms,
- geographical and historical spectrum – classification according to Jackowiak [7],
- Shannon-Wiener's index of floral diversity and comparison of the obtained values to a ten-level scale by Jurko [8],
- appearance of endangered species according to Polish Red Book of Plants [9] and Red List of Plants and Fungi in Poland [10],
- values of an index of natural values [11].

The assessment of communities was conducted with the phytoindicative method and with Ellenberg's indexes [12].

On the other hand, landscape attractiveness, was valorised with Mahon's and Millers's method [13] and presented on a map prepared in Autocad 2012 in the scale of 1: 25 000. In order to complete it, the terrain was divided into 73 squares of 400 m side. Flora of each square was assessed on a point grading scale with regard to terrain cover, presence of endangered species, presence of old and magnificent trees, distance to waterlogged areas and Warta River, psychoregulating and healing properties, continuity of ecosystem's persistence and the appearance of anthropogenic elements (Tab. 1).

Having summed up the points for the landscape assessment, each square was given in a colour designed in accordance with the following scale:

- yellow – 18-21 pp. – little landscape values
- orange – 22-25 pp. – medium landscape values
- red – 26-32 pp. – significant landscape values
- brown – 33-40 pp. – very significant landscape values.

3. Results and discussion

What is undoubtedly a value of terrains located nearby Warta River, that is an inter-embankment which is periodically flooded in the area of Nature 2000. It allows for the development of waterlogged grasslands and pastures at the bottom of the valley. In geomorphologically diverse places, there is a mosaic of old river beds covered by reed communities, humid and flood forests, elm and ash as well as willow and poplar riparian forests and alders. Moreover, in local depressions, communities of *Phragmitetea* class such as *Glycerietum maximae*, *Acoretum calami*, *Phragmitetum australis*, *Magnocaricion* are observed. Places which are located higher and subject to drying are inter alia covered

mostly with communities from *Molinio-Arrhenatheretea* class of *Arrhenatheretalia*. Research and analysis in the area allowed for the selection of 17 plant communities classified in 5 phytosociological classes: *Lemnetea minoris*, *Potametea*, *Phragmitetea*, *Molinio-Arrhenatheretea* and *Salicetea purpurae*. Diversification of flora between research points shows connection with the area's geomorphology and habitat conditions, especially in the scope of moisture and content of nitrogen in soils (Table 2, Fig. 1).

Table 1. Method of landscape valorisation of the researcher area
Tab. 1. Metoda waloryzacji krajobrazowej badanego terenu

Criterion	Points
A. Land cover:	
waterlogged areas, former riverbeds etc.	6
forests (large share of trees)	5
single trees	4
grasslands or lawn grasses with trees or bushes	3
grasslands or lawn grasses without trees and bushes	2
mowed grass or pastures	1
B. Presence of endangered species	
3	5
2	4
1	3
C. Presence of old, magnificent trees	
5 and more	5
4	4
3	3
2	2
1	1
D. Distance to waterlogged areas	
< 10 m	5
0 m	4
30 m and more	3
E. Distance to Warta River	
< 100 m	5
200 m	4
300 m and more	3
F. Healing and psychoregulating properties	
very high	5
high	4
low	3
G. Continuity of ecosystem's persistence	
the same land cover on the map from 1881	5
the same land cover on the map from 1932	4
the same land cover on the map from 1971	3
H. Appearance of anthropogenic elements	
No	3
Yes	1

Source: own work / Źródło: opracowanie własne

In Janowo, where moisture of habitats and content of nitrogen in soils is much diversified, as many as 12 syntaxons were found, both from *Phragmitetea* class and *Molinio-Arrhenatheretea* class with the majority of communities of *Arrhenatheretalia*. Habitats more homogenous in terms of moisture and trophism show little variety of flora, and therefore – few syntaxons, examples of which are the areas of Dąbrowa or Rgilewka's estuary. Such terrains seem to be less attractive in terms of landscape, yet phytocenoses which are present there possess high natural values.

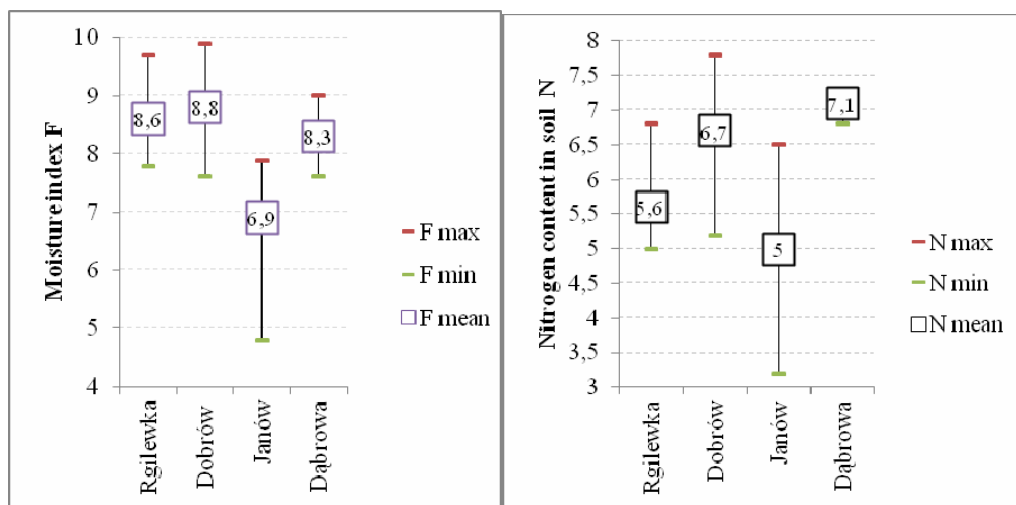
Vegetation communities of *Phalaridetum arundinaceae* were most often observed on research positions, moreover: *Poa pratensis-Festuca rubra* community and *Holcus lanatus* and *Alopecuretum pratensis* communities.

Table 2. Richness of species, structure of life form, geo-historical spectrum and natural valuation of plant communities in the valley of Warta River between Kolo and Kozubów (in years 2007-2014)

Tab. 2. Bogactwo gatunkowe, formy życiowe, spectrum geograficzno-historyczne oraz walory przyrodnicze zbiorowisk roślinnych w dolinie Warty na odcinku Kolo-Kozubów (w latach 2007-2014)

Treatment	Phytosociological unit																
	<i>Spirodelium polyhrizae</i>	<i>Polygonetum natansis</i>	<i>Phragmitetum australis</i>	<i>Carecetum ripariae</i>	<i>Carecetum acutiformis</i>	<i>Carecetum gracilis</i>	<i>Phalaridetum arundinaceae</i>	<i>Glycerietum maximae</i>	Com. <i>Deschampsia caespitosa</i>	<i>Potentillo-Festucetum arundinaceae</i>	<i>Lollio-Cynosuretum</i>	<i>Ranunculo-Alopecuretum geniculati</i>	Com. <i>Poa pratensis-Festuca rubra</i>	Com with. <i>Holcus lanatus</i>	<i>Alopecuretum pratensis</i>	<i>Salicetum triandrio-viminalis</i>	<i>Salicetum albo-fragilis</i>
Number of plant species	13	14	4	6	33	49	87	45	31	18	55	36	58	75	77	6	34
Structure of life form (%)																	
Hemikryptophytes	22,2	55,6	42,9	50,0	51,3	63,6	60,8	58,9	68,3	52,6	61,8	61,9	61,7	71,1	56,7	14,3	42,9
Terophytes	5,6	0	0	50,0	5,1	1,8	9,3	10,7	5,7	31,6	18,2	9,5	19,1	14,5	14,4	0	7,1
Geophytes	22,2	11,1	28,6	0	20,5	20,0	18,6	16,1	17,1	10,5	10,9	21,4	10,6	10,8	18,9	14,3	21,4
Hydrophytes	38,9	33,3	28,6	0	20,5	9,1	8,2	12,5	2,9	0	3,6	2,4	2,1	1,2	5,6	28,6	7,1
Other	11,1	0	0	0	2,6	5,5	3,1	1,8	5,7	5,3	5,5	4,8	6,4	2,4	4,4	42,9	21,4
Structure of phytosociological unit (%)																	
<i>Phragmitetea</i>	53,8	57,1	75,0	66,7	35,3	20,0	19,1	24,4	9,7	0	5,5	8,3	4,8	4,0	9,2	50,0	18,9
<i>Molinio-Arrhenatheretea</i>	7,7	28,6	0	16,7	35,3	60,0	47,2	44,4	64,5	61,1	56,4	58,3	41,1	53,3	50,0	16,7	27,0
<i>Bidentetea</i>	7,7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,4
<i>Potametea</i>	15,4	7,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Lemnetea</i>	7,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Artemisietea</i>	0	0	0	0	14,7	4,0	5,6	4,4	0	0	7,3	11,1	11,3	12,0	9,2	0	16,2
<i>Stellarietea</i>	0	0	0	0	0	0	6,7	6,7	0	22,2	10,9	8,3	11,3	8,0	5,3	0	0
<i>Salicetea</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33,3	24,3
Other	7,7	7,1	25,0	16,7	14,7	16,0	21,3	20,0	25,8	16,7	20,0	13,9	31,5	22,7	26,3	0	5,4
Geographical and historical spectrum (%)																	
Spontaneophytes	53,8	57,1	50,0	50,0	25,8	21,0	28,9	12,9	0	10,9	11,1	12,1	6,8	22,4	50,0	26,5	26,5
Apophytes	46,2	42,9	50,0	50,0	71,0	74,5	64,4	83,9	88,9	72,7	86,1	77,9	81,1	71,1	50,0	73,5	73,5
Archeophytes	0	0	0	0	3,2	0	3,7	4,4	0	5,6	9,1	2,8	6,4	6,8	3,9	0	0
Kenophytes	0	0	0	0	0	0	1,2	2,2	3,2	5,6	7,3	0	2,9	5,4	2,6	0	0
Ephemerophytes	0	0	0	0	0	0	1,2	0	0	0	0	0	0,7	0	0	0	0
Shannon-Wiener index (H')	1,08	1,12	0,60	0,78	1,52	1,62	1,79	1,64	1,46	1,28	1,65	1,51	1,85	1,74	1,72	0,78	1,54
Natural valorization index [11]	4,23	4,14	3,75	4,67	2,94	2,82	2,54	2,64	2,19	1,84	1,84	2,28	1,86	1,99	2,10	2,83	2,82

Source: own work / Źródło: opracowanie własne



Source: own work / Źródło: opracowanie własne

Fig. 1. Diverse habitat conditions in research points in years 2007-2014

Rys. 1. Różnicowanie warunków siedliskowych punktów badawczych w latach 2007-2014

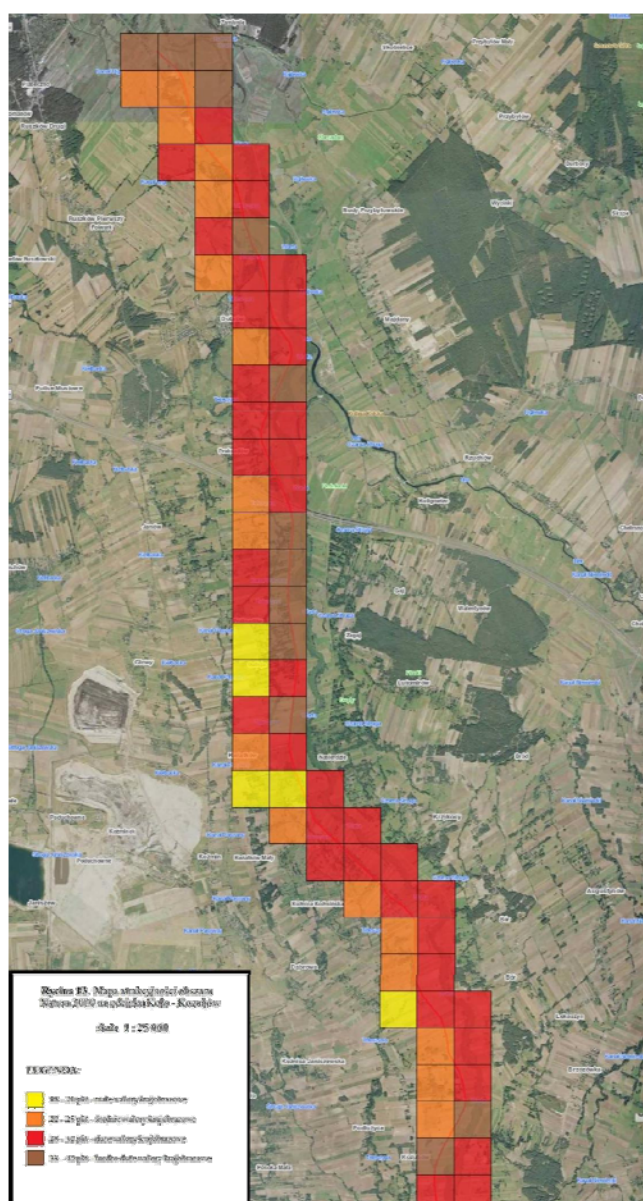
Landscape attractiveness of an area is influenced by floral diversity. In the communities of Nature 2000 area the presence of 187 species of vascular plants were found. Most often observed among of them (and therefore present with the 5th or the 4th permanence index) were *Poa pratensis*, *Alopecurus pratensis*, furthermore *Plantago lanceolata*, *Holcus lanatus*, *Trifolium repens*, *Phalaris arundinaceae* and *Carex gracilis*. Most of the species were observed sporadically. i.e. they reached the 1st permanence index. Such little share of so called characteristic accurate species for the syntaxons connected with flood areas of river valleys shows high level of their deformation. However, other measures for the state of phytocenoses of the area prove

their significant natural values. Their naturalness is conditioned, inter alia, by a significant share of hydrophytes and geophytes as well as by domination of native species and presence of partly protected taxa i.e. *Lathyrus palustris* and *Helichrysum arenarium*.

Floral diversity of the selected phytocenoses marked with Shannon-Wiener's indice is low or very low. The most diversified community among others was *Poa pratensis-Festuca rubra*, and the lowest index value was marked for *Phragmitetum australis*. For most of the communities, however, natural values were assessed as moderate, medium, large, very large and even unique. Especially large natural values were observed in communities whose species

composition included high share of species characteristic to *Phragmitetea* class and non-synantropic native taxa. Two of the most precious natural habitats are reed *Caricetum ripariae* in old river beds, water *Polygonetum natanntis* and *Spirodeletum polyhrizae*. Values of *Carex riparia* Curtis reed were marked as unique which is an evidence of its high naturalness and resistance to anthropopression. The appearance of these communities in research points significantly conditions their landscape attractiveness.

The obtained data, which thoroughly characterizes a current state of flora and was presented on a map, show that the majority of this area possesses large landscape values. Smaller values were observed only in the areas located nearby human settlements (Fig. 2). Such large landscape values are also certainly conditioned by numerous old trees and brushwood from *Salicetea purpurea* or *Alnetea glutinosae* classes, which cover inter-embankments and banks of old river beds, and waterlogged terrains with water and marsh flora from *Potametea*, *Lemnetea* and *Phragmitetea* classes.



Source: own work / Źródło: opracowanie własne

Fig. 2. Map of attractiveness of Nature 2000 area in the valley of Warta River between Koło and Kozubów
Rys. 2. Mapa atrakcyjności obszaru Natura 2000 w dolinie Warty na odcinku Koło-Kozubów

Goossen and Landers [14] emphasize that natural traits are ones of the most important elements which decide about landscape attractiveness. It should be remembered that despite a relatively small area, Nature 2000 regions accumulate a significant variety of habitats and therefore – possess large natural values. According to Cwener and Wojciechowski [15], they somehow complete landscape values and boost attractiveness, especially for so called natural tourism.

Apart from natural values, there are aesthetic ones, human perception and visual impressions of a viewer that decide about landscape attractiveness [16]. When assessing a current plant cover state and landscape attractiveness of an area, it is important to remark that it shows great variety and harmony at the same time. One must emphasize its visual attractiveness, shaped by a vast panorama with old water beds or small groups of trees and bushes. Despite the fact that these areas are located nearby a manmade landscape – *Koźmin* lignite exposure – one cannot observe its negative influence on natural values or landscape attractiveness of the adjacent area. It is also proved by large naturalness of syntaxons developed in highly moisture and humid habitats. However, having taken into consideration the fact that lignite exploitation usually results in changes in water conditions and hydrographic landscape, in a longer time period it may endanger the most valuable phytocenoses and therefore, constant monitoring should be certainly kept. It must be emphasized, however, that the construction of a water tank on the land side of the levee is planned. The tank will be located 120 m from the exposure and its main role will be to alleviate its influence on environment, including Special Protection Area in the valley of middle Warta River PL300002. The reservoir will be also a favourable landscape element and will widen a green corridor, especially for avifauna whose existence is currently limited only to an inter-embankment.

4. Conclusions

1. Landscape attractiveness of Nature 2000 area – the valley of middle Warta River along an inter-embankment (Koło – Kozubów) is conditioned by:
 - geomorphological diversity of habitats which enhances the existence of numerous communities,
 - plant cover of the investigated area which is highly natural, with numerous endangered species, domination of endangered species and therefore – large and even unique natural values.
2. On the basis of a map of area's attractiveness, a majority of large and very large landscape values was found. Attractiveness is boosted by such natural elements as old magnificent trees, old water beds and waterlogged areas with water and marsh flora.
3. Taking into consideration the neighbourhood of a lignite exposure and threats that follow its nearness, constant monitoring of the area should be conducted. Such actions will provide information about possible threats and changes in the flora of the valley of middle Warta River.

5. References

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