

ECOLOGICALLY VALUABLE AREAS IDENTIFICATION METHOD

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Key words: ecological value, ecologically valuable areas, ecological power, environment status, degree of natural environment elements' preservation, assessment, indicators.

A b s t r a c t

The purpose of this paper is to present a method for identification of ecologically valuable areas and its verification. Identification of ecologically valuable areas can be based on three parameters: ecological power, environment status and degree of natural environment elements' preservation. The paper also presents a case study.

METODA WYZNACZANIA OBSZARÓW EKOLOGICZNIE CENNYCH

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Słowa kluczowe: cennaść ekologiczna, obszary ekologicznie cenne, moc ekologiczna, stan środowiska, stopień zachowania naturalnych elementów środowiska, ocena, wskaźniki.

A b s t r a k t

Celem artykułu jest przedstawienie metody służącej wyodrębnianiu obszarów cennych ekologicznie oraz jej weryfikacja. Wyodrębnienie obszarów ekologicznie cennych można uzależnić od trzech parametrów: mocy ekologicznej, stanu środowiska, stopnia zachowania naturalnych elementów środowiska. W artykule zaprezentowano również studium przypadku.

Introduction

Ecologically valuable areas are forests, waters, areas of rich relief, areas protected by law (national and landscape parks, nature reserves, protected landscape areas) and recreation areas, that is the natural resources representing primary material properties and related methods of use. Their identification can be based on three parameters: ecological power of the form of use, environment status and degree of natural environment elements' preservation. The ecological power of the form of use depends on the type of land use. It should be understood as the area urbanization level (the lower the anthropopressure the higher the ecological power of the area). The environment status is determined by characterizing environment pollutions and degree of degradation of its individual components: air, water, soil, radiation and noise. Finally, the degree of natural environment elements' preservation is measured by the quantity or volume of environment elements protected by law (BAJEROWSKI et al. 1997, pp. 75-89).

There is a strong correlation between the ecological power of the form of use, environment status and degree of natural environment elements' preservation. High levels of pollution and urbanization cause a decrease in the degree of natural environment elements' preservation. In areas protected by law that represent natural elements of the environment bans and orders are implemented that aim at minimizing the level of pollution while economic use of the environment is limited. As a consequence the forms of use characteristic for non-urbanized areas (agriculture, forestry) are mainly applied.

The purpose of the paper is to present a method for assessment of ecological value of areas, which could serve identification of ecologically valuable areas and determining the level of their value. This is an updated and slightly modified (as a consequence of changes in legal regulations) method proposed by BAJEROWSKI et al. (1997) for the purpose of valuation of the environment.

The method for determination of the level of ecological value

Assessment of ecological value can be conducted for real properties, municipalities, counties or other delimited areas. The procedure for identification of ecologically valuable areas can be carried out according to the proposed methodology.

Assessment of ecological power of the form of use

The point score of "ecological power" for the covered area should be computed according to formula 1 (BAJEROWSKI et al. 1997, s. 77).

$$W = \frac{P_1m_1 + P_2m_2 + \dots}{\Sigma P} \quad (1)$$

where:

W – “ecological power” of the form of use,

P – area of the given land use,

m – point score of “ecological power” of a given form of land use.

The area of individual forms of land use in the assessed area should be assumed as the weight (Tab. 1).

Table 1

Determination of “ecological power” of the form of land use

Characteristic: type of land use	Point score of “ecological power” – m [points]
Old forest	10
Young forest	8
Forest on post-agricultural land	7
Tree-coverage	6
Meadows	5
Pastures	4
Orchards	3
Arable land	1
Hardened surface roads	0
Dirt roads	0
Other transportation areas	0
Built-up areas	0
Greenery	5
Natural wastelands	5
Degraded areas	0
Quarry type workings	0
Waters	
– standing	5
– flowing	5
– ditches	3

Source: BAJEROWSKI et al. 1997, p. 89.

Depending on the points scored it is proposed to establish four levels of area “ecological power” (Tab. 2).

Table 2

Assessment of the form of use of the area

Point score	Level of “ecological power”	Assessment of the form of use
7 – 10	I	high
5 – 6	II	medium
3 – 4	III	low
0 – 2	IV	very low

Source: BAJEROWSKI et al. 1997, p. 89.

Assessment of the form of use shows the level of ecological power that represents the anthropogenous transformations and the area urbanization status.

Environment status assessment

Environment status is assessed on the basis of its pollution. Environment pollution is an emission that is harmful for human health or environment condition, causes damages in material property, deteriorates the esthetic values of the environment or collides with other, justified ways of using the

Table 3

Level of environment pollution

Item	Points			
	0	1	2	3
Level of air pollution (heating systems applied in the covered area)	traditional (coal, coke) individual heating	traditional (coal, coke) collective heating	individual heating using ecological fuels (natural gas, straw, willow) and alternative energy sources (solar, geothermal)	collective heating using ecological fuels (natural gas, straw, willow) and alternative energy sources (solar, geothermal)
Level of waters pollutions (ratio of connections to sewers to connections to water supply network)	ratio ranging from 0 to 0.25	ratio ranging from 0.26 to 0.50	ratio ranging from 0.60 to 0.75	ratio ranging from 0.76 to 1
Noise (compliance with standards in measurement points)	presence of arduous objects exceeding day and night limits	presence of arduous objects exceeding night limits	presence of arduous objects exceeding day limits	no objects exceeding limits
Electromagnetic non-ionizing radiation (compliance with standards in measurement points)	limit exceeded by 0.51%-100%	limit exceeded by 0.50%-26%	limit exceeded by 25%-1%	within limits
Waste (ratio of waste disposed at landfills to waste produced during a year)	ratio ranging from 0 to 0.25	ratio ranging from 0.26 to 0.50	ratio ranging from 0.60 to 0.75	ratio ranging from 0.76 to 1
Soils pollution	national roads	voivodship roads	county roads	municipal roads

Source: Own work based on BAJEROWSKI et al. (1997, p. 88).

environment¹. It is proposed to complete the overall environment pollution assessment according to the points scoring system covering six elements specified in table 3 awarding points (from 0 to 3) depending on the level of pollution of individual environment elements.

The air pollution level in case of a municipality or a town or village can be determined on the basis of the heating system (collective or individual) and energy sources used for heating (alternative or traditional) that is on the basis of the so-called low emission. The presence of installations particularly arduous for the environment as concerns emission of pollutions to the atmosphere is not insignificant. In assessing a municipality we should consider the waste management system – recovery and disposal of waste. Presence or absence of a landfill as well as its type (landfill of inert or industrial waste) can be considered. Also the presence of illegal landfills seems to be important. In determining the level of waters pollution within a municipality the area equipment with sewers system and liquid waste treatment plant should be considered. In case of electromagnetic non-ionizing radiation using the number of radiation emitting objects and compliance with the standards in measurement control points is proposed. Similarly, while analyzing noise presence or absence of objects particularly arduous and exceeding day or night noise emission standards can be used. In assessment of soil pollution the presence of roads and traffic density within a given area are currently used. The Overall environment status assessment result is obtained by summing up the individual scores and classifying the pollutions as very low, low, medium and high and very high (Tab.4).

Table 4

Overall assessment of the environment status

Point score (sum of points for individual elements in table 3)	Environment status	
	Pollution level:	Result:
12 – 18	I	very low
9 – 12	II	Low
5 – 9	III	Medium
0 – 5	IV	high and very high

Source: BAJEROWSKI et al. (1997, p. 88).

¹ Act Environment Protection Law of 27 April 2001 (DzU of 2001 No 62, item 627 as amended Art. 3 point 49).

Assessment of the degree of natural environment elements' preservation

Assessment of the degree of natural environment elements' preservation within the area of a town or village or a municipality could be conducted according to the methodology proposed by BAJEROWSKI et al. (1997 p. 89) modified for changes in the Act of 16 April 2004 on nature protection (DzU of 2004 No 92, item 880 as amended, art. 6), which specifies new forms of nature protection resulting from Poland's accession to the European Union (Tab. 5).

Table 5

Degree of natural environment elements' preservation

Elements of environment protected by law within the area of a given municipality	Number [pieces per 1000 ha] or [%] municipality area	Points score
Monuments of nature	– over 5/ 10 000 ha	3
	– 5/ 10 000 ha	2
	– 1-5/ 10 000 ha	1
	– none	0
National parks, nature reserves, landscape parks, Natura 2000 areas	– over 50.1% of municipality area	4
	– 25.1 – 50% of municipality area	3
	– 10.1 – 25% of municipality area	2
	– 1 – 10 % of municipality area	1
	– none	0
Areas of protected landscape, natural-landscape complexes, ecological land use areas, documentation locations, refuges of protected animals	– over 0.21% of municipality area	3
	– 0.11 – 0.2% of municipality area	2
	– up to 0.1% of municipality area	1
	– none	0

Source: Based on BAJEROWSKI et al. (1997, p. 80).

Depending on points scored the degree of natural environment elements' preservation is assessed (Tab. 6) as: high, medium, low or very low (BAJEROWSKI et al. 1997, p. 80).

Table 6

Assessment of the degree of natural environment elements' preservation

Points score	Natural elements of the environment	
	Level of preservation:	Preservation level:
7 – 10	I	High
5 – 6	II	Medium
3 – 4	III	Low
0 – 2	IV	very low

Source: BAJEROWSKI et al. (1997, p. 80).

Overall assessment of ecological value

Three factors: form of use, environment status and degree of natural environment elements' preservation have the same weight. The levels awarded for those factors should be converted to points allocating to them the appropriate points of ecological value: level I – 4 points, level II – 3 points, level III – 2 points and level IV 1 point. Next the points should be summed up. The result obtained allows determining the level of ecological value according to the scale in Table 7.

Table 7

Level of ecological value

Points score	Level of ecological value
3 – 5	areas not ecologically valuable
6 – 7	areas of low ecological value
8 – 9	areas of medium ecological value
10 – 12	areas of high ecological value

Source: BAJEROWSKI et al. (1997, p. 89).

The range of 3 to 5 points indicates areas that are not ecologically valuable. The scores from 6 points up indicate ecologically valuable areas at different value level: low, medium and high ecological value.

In assessment of areas, the population density should additionally be considered as a measure of anthropopressure. The score of the value level should be adjusted by that measure (by deducting the allocated points (BAJEROWSKI et al. 1997, p. 90). This is presented in Table 8.

Table 8

Measure of human changes in the area

Population (persons/km ²)	Points score
0 – 10	0
11 – 20	1
21 – 40	2
41 – 80	3
> 80	4

Source: BAJEROWSKI et al. (1997, p. 90).

The presented method of ecological value assessment for areas (real properties, villages, municipalities) represents just a proposal of a certain outline that could be modified or supplemented with other information.

Case study

Characteristics of the covered area

The study covered the area of planned landscape park and its protection zone. It consists of municipalities situated in three counties: Olsztyn, Nidzica and Szczytno (Fig. 1).

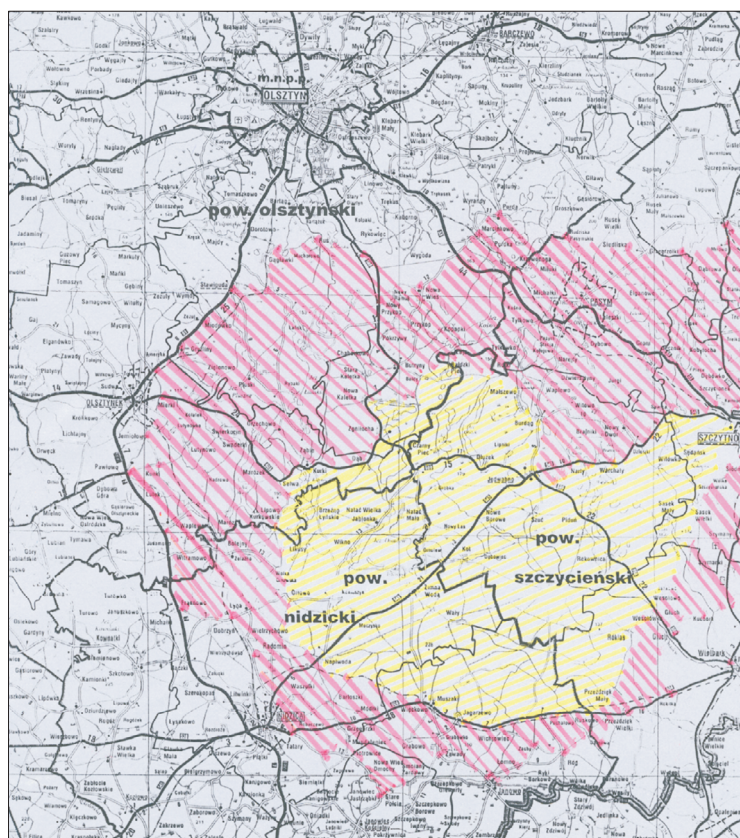


Fig. 1. Location and extent of the projected landscape park and its protection zone
Source: JANKOWSKI (2004, pp. 61-69).

That area belongs to the Green Lungs of Poland. It has many natural values as a consequence of which it is already covered by many forms of nature protection. All three counties belong to Warmia and Mazury voivodship. The specification of municipalities in which the park and its protection zone are planned are presented in Table 9.

Table 9

Municipalities involved in the projected landscape park and its protection zone

Park	Protection zone
Municipalities covered entirely or partly by the projected park	municipalities covered entirely or partly by the projected protection zone
Jedwabno	Dźwierzuty
Nidzica	Pasym
Janowo	Purda
Szczytno	Stawiguda
Wielbark	Town of Szczytno
Olsztyniek	
Purda	

Source: JANKOWSKI (2004, pp. 61-69).

Assessment of ecological power of the form of use

As the area of studies related to the projected park and its protection zone does not match the borders of municipalities, detailed data on land use in the separate parts of municipalities is not available. Knowing that agricultural use in the park and protection zone occupy 27.9% of the area, the scores of ecological power awarded for meadows, pastures, orchards and arable land were averaged. Similar averaging was done in case of waters that represent 6.1% of land in the projected park and protection zone making no division into standing and flowing waters. As around 65% of the projected park area is covered by forests of old standing timber, the maximum score was assumed. This is one of the strongest arguments for those supporting establishment of the landscape park. The area of individual land use types was calculated on the basis of land use structure (Tab. 10).

Table 10

Land use in the area of projected park and its protection zone

Type of land use	Area (ha)	Points score	Product
Total forests	119 200	10	1 192 000
Standing and flowing waters	11 300	5	56 500
Agricultural use (arable and green use)	51 600	3,25	167 700
Built-up areas	2900	0	0
Total	185 000	x	1 416 200

Source: own study based on JANKOWSKI (2004 pp. 61-69).

$$W = \frac{1\ 416\ 200}{185\ 000} = 7.66$$

The projected landscape park and its protection zone was classified as level I of “ecological power” and as a consequence the land use form was graded as good, highest of the possible ones.

Environment status assessment

Environment status assessment was completed by analyzing the level of air pollution, waters pollution, noise, electromagnetic non-ionizing radiation, waste management and soil pollution (Tab. 11).

Table 11

Environment pollution level

Item	Description	Score
Air pollution level	traditional individual heating, sometimes collective heating or individual heating using alternative energy sources	1.5
Waters pollution level	ratio of sewers connections to water system connections – 0.33	1
Noise	absence of objects exceeding allowed limits	3
Electromagnetic non-ionizing radiation	within limits at measurement points	3
Waste	ratio of waste disposed at landfill to waste produced – 0.81	3
Soil pollution	roads of low rank: county and municipal	2
Total		13.5

Source: Own work based on own studies.

The score is 13.5 points and the overall level is level I of environment pollution, which means very low pollution level.

Assessment of the degree of natural environment elements' preservation

The study covered three groups of environment elements protected by law. The score for the degree of natural environment elements' preservation is presented in Table 12.

Table 12

Degree of natural environment elements' preservation

Environment elements protected by law within the municipality	Number or % share in the area of the projected landscape park	Score
Monuments of nature	122 (6.6 / 10 000 ha)	3
Nature reserves, Natura 2000	11 reserves (1.96% of area) Napiwoda-Ramuki Forest (63% of area)	4
Ecological land use, refuges of protected animals	8 ecological land use areas (0.14% of area) and numerous refuges of protected animals	1
Total		8

Source: Own work based on own studies.

It was established that the area of the projected landscape park belongs to level I and as a consequence possesses well-preserved elements of natural environment.

Summary of the ecological value assessment

Assessment of ecological value level was done on the basis of studies on the ecological power of the use form depending on the land use type and measured by the percentage share of individual land use types, environment status and the level of degradation of individual environment components as well as the degree of natural environment elements' preservation measured by the number or area of environment elements protected by law. The levels allocated for those three parameters were converted to points of ecological value. All the three components were rated level I and as a consequence the score was 12 points (Tab. 13)

Table 13

Assessment of ecological value

Item	Score	Level	Grade	Score
Ecological power	7,66	I	high	4
Environment status	13,5	I	very low	4
Degree of natural environment elements' preservation	8	I	high	4
Measure of anthropological changes				2
Total				12-2=10

Source: Own work based on own studies.

The final score was adjusted by the measure of anthropological transformations within the area of the projected park expressed by population density within the range of 21-30 people/km². As a consequence the total score was 10 points and the area should be classified as area of high ecological value.

Conclusion

The ecologically valuable areas identification method can be applied for assessment of villages, municipalities, counties or other limited areas. It facilitates determining the directions of sustainable development at all levels of decision taking and can be a useful tool in physical planning as well as a component in appraisal of real properties valuable for natural reasons. The advantage of the method is that it is universal, although it requires diligent studies of the areas to avoid errors resulting from superficiality.

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