

Original Research

Protecting Nature in National Parks: The Spatial and Financial Contexts

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Abstract

The article discusses the nature protection function as implemented in national parks that have adopted the space context of the territorially linked municipalities, including the funding sources of the activities carried out in parks. The research was initiated by identifying anthropogenic hazards occurring in the area of national parks. In the next part of the study, the priority task of national parks, i.e., nature protection, was presented in a way that goes beyond the administrative borders of the protected area. The transformations of the nature protection function, covering 117 municipalities territorially linked with 23 national parks in Poland in the period 2001-2016, are presented. For this purpose, a statistical analysis was conducted using linear ordering methods, and the synthetic development method was applied. In the third stage of the study the funding sources of national parks were analysed, which allowed identifying the involvement of individual institutions in funding national parks and, indirectly, the scale of the activities carried out by national parks. Due to limited data availability, the third stage was implemented for the years 2015-2016. The article draws attention to the need of taking a comprehensive approach toward space covered by the area form of nature protection.

Keywords: nature protection, national parks, local development

Introduction

The area of national parks covers less than 1% of Poland. The smallest, Ojców National Park, has 2,000 ha while the largest, Biebrza National Park, encompasses 59,000 ha. Hence one can argue the sense of researching such a small area. Doubts are dispelled when the perspective of an ecosystem's value is adopted along with more than 13 million people visiting national parks annually. The perception of national parks by the international community is also important. In 1962 in

Seattle, a meeting of professionals interested in spatial forms of nature conservation was referred to as the First World Conference on National Parks. A decade later, the Second World Conference of National Parks, "National Parks: A Heritage for a Better World," was held in the area of Yellowstone National Park. In the subsequent ten years, during the Third World Congress on Protected Areas, the following slogan was popularized: "National Parks and protected areas in support of Social and Economic Development" [1-2]. It can therefore be adopted that since 1982, the international community has been emphasizing the relationship between nature conservation and the processes included in both social and economic spheres. The persisting problem is how to implement a modern approach to the functioning of

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protected areas. The research shows that the integration of nature conservation priorities and socio-economic development of the area is difficult and frequently results in failure [3-10].

Nature protection remains the priority task of national parks – their functioning is determined by the Act of 16 April 2004 on Nature Conservation [11]. The legislature also imposed an obligation on national parks to provide access to their area and to conduct environmental education activities. This means the need to reconcile the apparently mutually exclusive functions in the space of national parks. Tourism and education are not only connected with the presence of a human being in the protected areas, but also with the need to provide adequate security [12]. Thus they naturally result in exerting direct anthropogenic pressure on the environment. This phenomenon was broadly described in the subject literature and is worth highlighting the global occurrence of this problem, which is important not only from the perspective of nature, but also ethics. [13-20]. The level of anthropopressure is quantifiable, which facilitates both the process of environmental management in a given area [21, 22] and planning work [23]. In the context of tasks to be carried out by national parks, the possibilities of reducing anthropopressure can be divided into two groups: the first refers to behaviour modification through education while the second is related to tourist infrastructure limiting negative impacts of the protected areas penetration. Both groups require adequate funding. Similarly, financial resources are required for protection-oriented activities, covering the ecosystems of national parks. In connection with the aforementioned facts, nature protection in national parks presents not just a spatial, but also an economic dimension [24-26].

The question arises about the type of anthropogenic threat present in national parks. It is also interesting what level of nature conservation functions occurs in the municipalities territorially linked with national parks. As a result, it seems important to answer the question about the funding sources of national parks. In view of the above, the hypothesis stating that national parks differ in terms of the experienced anthropopressure and financial needs will be verified.

Taking into account the method of collecting statistical data, the spatial scope of conducted research covers the area of 117 municipalities territorially linked to national parks. The time range covers the years 2001-2016.

The article attempts to present nature protection activities in national parks through the prism of funding sources and the space of territorially linked municipalities.

Methodology

The implementation of the research objective required a library query, the application of statistical

tools, and the synthesis of results, along with the presentation of conclusions and recommendations. The statistical data from the local data bank of the Central Statistical Office (CSO) and the source data from 23 national parks were used. This allowed for specifying anthropogenic hazards, calculating synthetic measures of nature protection functions, and indicating the funding sources of national parks.

Due to the same first letters of national parks' names, for the purpose of creating acronyms only the phrase "national park" has been abbreviated to NP.

The statistical analysis carried out using linear ordering methods – synthetic development measures (SDM) – requires a detailed description. It allowed the constructing ranking of the municipalities in terms of the development level of the analyzed function.

SDM construction and application are described by [27-36]. Synthetic development measures are primarily recommended as a tool used in comparing local and regional systems, e.g., in terms of economic, social, and environmental development as indicated, among others, by Bal-Domańska [37], Rak, and Pstrocka-Rak [38]. Therefore, they can be applied in analyzing the nature protection function.

The study assumes that the municipalities linked with national parks form one set was made up of 117 objects.

Based on SDM value the position of each municipality was determined in terms of the development level of the nature protection function. The following research procedure was adopted:

- 1) Defining variables (indicators) for SDM.
- 2) Carrying out unitarization with zero minimum procedure.
- 3) SDM construction with a weight system in accordance with the method of (standardized) sums with a common development pattern for the years 2001 and 2016.
- 4) Defining the ranking position of municipalities in each of the analyzed years.
- 5) Comparing changes of the situation in a municipality over time based on SDM.
- 6) Classification of municipalities according to SDM value using arithmetic mean and standard deviation.

The research procedure began with defining indicators characterizing the thematic area. For the purposes of SDM, determining the following indicators were defined:

- 1) Share of national park area within the area of a municipality (NP share).
- 2) Share of landscape parks area within the area of a municipality (LP share).
- 3) Share of protected landscape areas within the area of a municipality (Protl share).

All indicators were considered to be stimulants without a veto threshold, i.e., the municipalities with a high share of protected area were ranked the highest. Due to the differences in restrictions referring to the areas covered by a specific type of nature protection

form provided by the Act of 16 April 2004 on Nature Conservation, the following weights were arbitrarily assigned to the indicators: NP share – weight 0.65, PL share – weight 0.25, and Protl– weight 0.10. Thus it was assumed that the highest ranked situation occurs in national parks.

The aforementioned indicators were calculated based on the data collected from the Central Statistical Office (Local Data Bank).

The unitarization of values of the characteristics adopted for the research was carried out according to the following formula:

$$Z_{jit} = \frac{X_{jit} - \min X_{jit}}{\max X_{jit} - \min X_{jit}}$$

Notes:

x – value of the characteristic

j – variable j, where j = (1, ..., p)

i – object (municipality), where i = (1, ..., N),

N for $SDM = 117$

t – time (year), where t = (2001; 2016)

It allowed obtaining values within the range [0.1]. For SDM all variables adopted for the study were stimulants and thus the need for unifying them (preference function) did not occur. SDM was calculated using the standardized sum method. SDM value for the analyzed municipalities were calculated using the formula:

$$SDM_{it} = \frac{1}{p} \sum_{j=1}^p Z_{ijt} \quad (i = 1, \dots, N) \quad (t = 2001; 2016)$$

Notes:

SDM – value of non-model synthetic development measure in an object (municipality)

p – number of characteristics

In order to supplement the classification of municipalities in accordance with SDM values we used two parameters: arithmetic mean and standard deviation of the values of the aforementioned synthetic measures achieved by the municipalities in individual years. The following class ranges (groups) were identified:

1. Class A (the highest activity level)

$$SDM > \overline{SDM} + s_{SDM}$$

2. Class B (medium higher activity level)

$$\overline{SDM} + s_{SDM} > SDM \geq \overline{SDM}$$

3. Class C (medium lower activity level)

$$\overline{SDM} > SDM \geq \overline{SDM} - s_{SDM}$$

4. Class D (lower activity level)

$$SDM \leq \overline{SDM} - s_{SDM}$$

Notes:

\overline{SDM} – synthetic development measure value

\overline{SDM} – arithmetic mean of the synthetic development measure value for municipalities,

s_{SDM} – standard deviation of the synthetic development measure value for municipalities.

The procedure for calculating correlation between financial needs, the park area, and the number of tourists also needs to be explained in detail.

Correlation was calculated using Spearman's rank correlation coefficient using the following formula [39]:

$$r_s = 1 - \frac{6 \sum_{i=1}^N d_i^2}{N(N^2-1)}$$

Notes:

dit – determines differences between ranks (positions)

N – number of objects (23 national parks)

We decided that the highest rank refers to the highest funding level, the greatest area in km², and the largest number of tourists. The publication Environment Protection by CSO was the source of data on the number of tourists and park areas.

The following scale was used to assess the strength of dependencies between variables [30]: |0.00 – 0.3| is weak dependence; |0.31 – 0.6| is moderate dependence; and |0.61 – 1.0| is strong dependence.

Results and Discussion

Anthropogenic Threats in National Parks

The diversity of ecosystems in national parks results in various anthropogenic threats observed within the described protected areas. The most frequent burden caused by the visitors results from their non-compliance with the rules of nature protection: littering the area; damaging plant, mushroom, and animal habitats; illegal collection of specimens; scaring away and disturbing animals; penetrating areas not provided for access; and damaging tourist infrastructure. These burdens were identified by Babia Góra NP, Białowieża NP, Bieszczady NP, Stołowe Mountains NP, Karkonosze NP, Roztocze NP, Słowiński NP, Świętokrzyski NP, Tatra NP, and Wolin NP. It should be emphasized that trespassing tourist trails results in the erosion of surface soil layer structure. This phenomenon is particularly dangerous in steep terrain and has been observed in Bieszczady NP, Stołowe Mountains NP, Karkonosze NP, Świętokrzyski NP, and Tatra NP. The problem of trampling in the vicinity of tourist trails is also emphasized by Roztocze NP, whereas anthropogenic soil erosion of dunes occurs in Słowiński NP and Kampinos NP. The national parks, most popular among visitors, experience the problem of providing adequate sanitary security-pollution with faecal matter resulting both from inefficient

infrastructure and the behaviour of individual people on tourist trails.

Leaving the remains of food in the protected area has not only an aesthetic dimension, but also leads to the synanthropization of animals. Bieszczady NP and Tatra NP indicate unfavourable changes in the natural behaviour of, e.g., bears. In addition, the presence of a human being may cause alien species being dragged in (this problem was identified, among others, in Białowieża NP). It is worth noting that just a few years ago nettle communities on the slopes of Śnieżka along Droga Jubileuszowa [Jubilee Road] (Karkonosze NP) were in high abundance.

Tourist attractiveness of protected areas, combined with communication access, results in exceeding the permissible area capacity and unauthorized entry of motor vehicles (motorcycles, quads). This phenomenon refers to Stołowe Mountains NP, Gorce NP, Karkonosze NP, and Magura NP (especially in the area of lynx and wolf refuges). Moreover, Pieniny NP has recorded the use of drones, and Tatra NP of paragliders. Traffic routes are the reason for the increased mortality of amphibians and disturbances in the movement of animals, as observed in Bieszczady NP, Magura NP, and Roztocze NP.

Fire hazard was listed by Babia Góra NP, Drawno NP, Kampinos NP, Pieniny NP, Roztocze NP, Świętokrzyski NP, Wigry NP, and Wolin NP.

In national parks with private land within their area, the pressure to develop private areas is observed, along with running business activities or no acceptance of private owners for conducting protective procedures (e.g., Stołowe Mountains NP, Magura NP, Narew NP, Pieniny NP).

Natural resources covered by national parks are not indifferent to the activities carried out outside the protected area. Biebrza NP points out that hydro-technical and drainage works, as well as the construction of a retention reservoir in Bobra Wielka village, remain a significant anthropogenic threat. Ojcowski NP is endangered by the consequences of construction works in its buffer zone. Pieniny NP indicates the pollution of Dunajec River waters from the basin above Dunajec gorge and also air pollution by gases and dust emitted to the atmosphere by the objects located outside the park. Magura NP draws attention to the shrinking hunting area of predatory birds in its buffer zone, which is a consequence of the increasing dispersion of building arrangements. Roztocze NP has recorded the effects of changes in water relations ratio in the area of Międzyrzeki. In Warta Mouth NP the breeding of water birds is destroyed by American minks (*Neovison vison*) from breeding farms. Wolin NP has recorded a decline in the number of buildings and construction serving as shelters for bat colonies and bird breeding sites.

There is also a criminal dimension of anthropopressure through the theft of wood and other forest benefits as well as poaching as observed, among

others, in Gorce NP, Magura NP, and Wolin NP (illegal fishing).

Karkonosze NP is an area struggling with the effects of transformations in both species and spatial structure of the stand. The currently observed reduced resistance of forest ecosystems to biotic and abiotic factors results from human activities carried out decades ago.

It is worth emphasizing that a significant part of the above anthropogenic threats can be eliminated through education, affecting the attitudes of people staying in the area of parks and in their surroundings – therefore not only the attitudes of tourists, but also the residents of the territorially linked municipalities are important. The negative effects of tourist traffic may also be limited by providing adequate infrastructure. In terms of the local community, it should be remembered that “none of the protected area management systems will help if there are external sources of degradation and if local communities prefer development activities not conducive to achieving nature protection objectives” [40].

Nature Protection Function in Municipalities Linked with National Parks

In terms of nature, the administrative division is irrelevant as value streams are exchanged irrespective of borders. Therefore, it is difficult to consider nature protection carried out in national parks only in the context of the protected area. For this reason the research was extended by the area of municipalities territorially linked with national parks – there are 117 of them. It should be emphasized that the youngest Polish national park was established in 2001 (Warta Mouth NP) – a fact that influenced the choice of the first period of research. The second period, i.e., 2016, is a derivative of the availability of statistical data (Table 1). In both analyzed years, based on the ranking prepared following the value of the discussed synthetic measure, the municipalities territorially linked with the following national parks: Biebrza (Goniądz Municipality), Bieszczady (Lutowiska Municipality), Kampinos (Izabelin Municipality, Leoncin Municipality), Magura (Krempna Municipality), Roztocze (Zwierzyniec Municipality), and Tatra (Zakopane Municipality, Kościelisko Municipality) were ranked among the top 10. In 2001, the following municipalities were also included among the 10 leaders: Międzyzdroje (Wolin NP) and Karpacz (Karkonosze NP); however, later they lost their leading position. In 2016 the group of 10 leaders was extended by two municipalities: Leszno (Kampinos NP) and Smóldzin (Słowiński NP).

A comparison of 2001 and 2016 rankings indicates that the vast majority of municipalities were slightly changing their ranking position; only 10% of the analyzed units changed their position by a two-digit value. The aforementioned drops in the ranking were recorded by the municipalities linked with Karkonosze

Table 1. SDM of the nature protection function for the municipalities territorially linked with national parks (2001 and 2016).

| National Park | Name of the municipality | 2001 | | 2016 | |
|----------------|--------------------------|--------|----------|--------|----------|
| | | SDM | P | SDM | P |
| Babia Góra | Jabłonka (2) | 0.0299 | 87 | 0.0335 | 84 |
| | Lipnica Wielka (2) | 0.0355 | 81 | 0.0602 | 46 |
| | Zawoja (2) | 0.0500 | 59 | 0.0501 | 58 |
| Białowieża | Białowieża (2) | 0.0964 | 25 | 0.0985 | 25 |
| | Narewka (2) | 0.0618 | 45 | 0.0617 | 44 |
| Biebrza | Bargłów Kościelny (2) | 0.0162 | 104 | 0.0162 | 104 |
| | Dąbrowa Białostocka (3) | 0.0170 | 103 | 0.0176 | 101 |
| | Goniądz (3) | 0.1490 | 9 | 0.1470 | 9 |
| | Grajewo (2) | 0.0076 | 111 | 0.0080 | 110 |
| | Jaświły (2) | 0.0172 | 102 | 0.0171 | 102 |
| | Jedwabne (3) | 0.0072 | 112 | 0.0052 | 112 |
| | Lipsk (3) | 0.0430 | 71 | 0.0408 | 71 |
| | Nowy Dwór (2) | 0.0027 | 116 | 0.0036 | 114 |
| | Radziłów (2) | 0.0464 | 65 | 0.0528 | 54 |
| | Rajgród (3) | 0.0383 | 76 | 0.0355 | 78 |
| | Suchowola (3) | 0.0290 | 89 | 0.0309 | 87 |
| | Sztabin (2) | 0.0619 | 43 | 0.0576 | 49 |
| | Trzcianne (2) | 0.1273 | 17 | 0.1257 | 16 |
| | Wizna (2) | 0.0058 | 114 | 0.0032 | 115 |
| Bieszczady | Cisna (2) | 0.1339 | 15 | 0.1353 | 12 |
| | Czarna (2) | 0.0526 | 53 | 0.0539 | 52 |
| | Lutowiska (2) | 0.1691 | 2 | 0.1715 | 3 |
| | Ustrzyki Dolne (3) | 0.0715 | 33 | 0.0817 | 28 |
| Tuchola Forest | Brusy (3) | 0.0588 | 49 | 0.0589 | 48 |
| | Chojnice (2) | 0.0609 | 46 | 0.0598 | 47 |
| Drawno | Bierzwnik (2) | 0.0216 | 101 | 0.0221 | 100 |
| | Człopa (3) | 0.0409 | 74 | 0.0409 | 70 |
| | Dobiegiew (3) | 0.0581 | 51 | 0.0676 | 37 |
| | Drawno (3) | 0.0321 | 85 | 0.0342 | 81 |
| | Krzyż Wielkopolski (3) | 0.0260 | 95 | 0.0260 | 96 |
| | Tuczno (3) | 0.0240 | 99 | 0.0240 | 97 |
| Gorce | Kamienica (2) | 0.0608 | 47 | 0.0636 | 43 |
| | Mszana Dolna (2) | 0.0444 | 70 | 0.0400 | 72 |
| | Niedzwiedź (2) | 0.1084 | 19 | 0.1150 | 19 |
| | Nowy Targ (2) | 0.0303 | 86 | 0.0397 | 73 |
| | Ochoznica Dolna (2) | 0.0506 | 57 | 0.0546 | 51 |

Table 1. Continued.

| National Park | Name of the municipality | 2001 | | 2016 | |
|-------------------|----------------------------|--------|----------|--------|-----------|
| | | SDM | P | SDM | P |
| Stołowe Mountains | Kudowa-Zdrój (1) | 0.0801 | 29 | 0.0807 | 29 |
| | Lewin Kłodzki (2) | 0.0291 | 88 | 0.0302 | 88 |
| | Radków (3) | 0.0521 | 54 | 0.0521 | 55 |
| | Szczytna (3) | 0.0448 | 69 | 0.0453 | 64 |
| Kampinos | Brochów (2) | 0.1355 | 14 | 0.1321 | 14 |
| | Czosnów (2) | 0.1381 | 13 | 0.1380 | 11 |
| | Izabelin (2) | 0.2169 | 1 | 0.2166 | 1 |
| | Kampinos (2) | 0.1058 | 21 | 0.1054 | 23 |
| | Leoncin (2) | 0.1563 | 6 | 0.1571 | 6 |
| | Leszno (2) | 0.1453 | 11 | 0.1452 | 10 |
| | Łomianki (3) | 0.0567 | 52 | 0.0555 | 50 |
| | Stare Babice (2) | 0.0471 | 63 | 0.0472 | 62 |
| Karkonosze | Jelenia Góra (1) | 0.0503 | 58 | 0.0440 | 67 |
| | Karpacz (1) | 0.1492 | 8 | 0.1337 | 13 |
| | Kowary (1) | 0.0618 | 44 | 0.0395 | 74 |
| | Piechowice (1) | 0.0590 | 48 | 0.0296 | 89 |
| | Podgórzyn (2) | 0.0410 | 73 | 0.0167 | 103 |
| | Szklarska Poręba (1) | 0.0634 | 41 | 0.0346 | 80 |
| Magura | Dębowiec (2) | 0.0518 | 55 | 0.0509 | 57 |
| | Dukla (3) | 0.0726 | 32 | 0.0670 | 38 |
| | Krempna (2) | 0.1687 | 3 | 0.1732 | 2 |
| | Lipinki (2) | 0.0383 | 75 | 0.0382 | 76 |
| | Nowy Żmigród (2) | 0.0363 | 78 | 0.0392 | 75 |
| | Osiek Jasielski (2) | 0.0458 | 66 | 0.0463 | 63 |
| | Sękowa (2) | 0.0360 | 79 | 0.0434 | 68 |
| Narew | Choroszcz (3) | 0.0287 | 90 | 0.0286 | 90 |
| | Kobylin-Borzymy (2) | 0.0068 | 113 | 0.0068 | 111 |
| | Łapy (3) | 0.0485 | 61 | 0.0484 | 61 |
| | Sokoły (2) | 0.0118 | 106 | 0.0118 | 108 |
| | Suraż (3) | 0.0271 | 92 | 0.0271 | 93 |
| | Turośl Kościelna (2) | 0.0284 | 91 | 0.0285 | 91 |
| | Tykocin (3) | 0.0144 | 105 | 0.0143 | 105 |
| Ojców | Jerzmanowice-Przebinia (2) | 0.0686 | 36 | 0.0700 | 34 |
| | Skąpa (3) | 0.0797 | 30 | 0.0696 | 36 |
| | Sułoszowa (2) | 0.0240 | 98 | 0.0240 | 98 |
| | Wielka Wieś (2) | 0.0642 | 39 | 0.0663 | 40 |

Table 1. Continued.

| National Park | Name of the municipality | 2001 | | 2016 | |
|---------------|-----------------------------|--------|-----------|--------|----------|
| | | SDM | P | SDM | P |
| Pieniny | Czorsztyn (2) | 0.0672 | 38 | 0.0739 | 30 |
| | Krościenko nad Dunajcem (2) | 0.0844 | 28 | 0.0830 | 27 |
| | Łapsze Niżne (2) | 0.0325 | 83 | 0.0338 | 82 |
| | Szczawnica (3) | 0.0894 | 26 | 0.0729 | 32 |
| Polesie | Hańsk (2) | 0.0346 | 82 | 0.0353 | 79 |
| | Ludwin (2) | 0.0426 | 72 | 0.0420 | 69 |
| | Sosnowica (2) | 0.0634 | 40 | 0.0638 | 42 |
| | Stary Brus (2) | 0.0266 | 94 | 0.0270 | 94 |
| | Urszulin (2) | 0.0995 | 24 | 0.0991 | 24 |
| | Wierzbica (2) | 0.0232 | 100 | 0.0233 | 99 |
| Roztocze | Adamów (2) | 0.0097 | 108 | 0.0097 | 109 |
| | Józefów (3) | 0.0376 | 77 | 0.0370 | 77 |
| | Zamość (2) | 0.0001 | 117 | 0.0001 | 117 |
| | Zwierzyniec (3) | 0.1465 | 10 | 0.1496 | 8 |
| Słowiński | Główczyce (2) | 0.0094 | 110 | 0.0134 | 106 |
| | Łeba (1) | 0.0634 | 42 | 0.0615 | 45 |
| | Smołdzino (2) | 0.1426 | 12 | 0.1631 | 5 |
| | Ustka (2) | 0.0110 | 107 | 0.0123 | 107 |
| | Wicko (2) | 0.0270 | 93 | 0.0279 | 92 |
| Świętokrzyski | Bieliny (2) | 0.0466 | 64 | 0.0669 | 39 |
| | Bodzentyn (3) | 0.0997 | 23 | 0.1086 | 20 |
| | Górno (2) | 0.0246 | 97 | 0.0336 | 83 |
| | Łączna (2) | 0.0757 | 31 | 0.0732 | 31 |
| | Maslów (2) | 0.0358 | 80 | 0.0334 | 85 |
| | Nowa Słupia (2) | 0.0694 | 35 | 0.0699 | 35 |
| Tatra | Bukowina Tatrzańska (2) | 0.1057 | 22 | 0.1061 | 22 |
| | Kościelisko (2) | 0.1639 | 5 | 0.1637 | 4 |
| | Poronin (2) | 0.1277 | 16 | 0.1277 | 15 |
| | Zakopane (1) | 0.1649 | 4 | 0.1518 | 7 |
| Warta Mouth | Górzycza (2) | 0.0511 | 56 | 0.0516 | 56 |
| | Kostrzyn nad Odrą (1) | 0.0253 | 96 | 0.0270 | 95 |
| | Słońsk (2) | 0.1173 | 18 | 0.1177 | 18 |
| | Witnica (3) | 0.0582 | 50 | 0.0532 | 53 |

Table 1. Continued.

| National Park | Name of the municipality | 2001 | | 2016 | |
|---------------|--------------------------|--------|----------|--------|-----|
| | | SDM | P | SDM | P |
| Wielkopolska | Dopiewo (2) | 0.0046 | 115 | 0.0046 | 113 |
| | Komorniki (2) | 0.0704 | 34 | 0.0702 | 33 |
| | Mosina (3) | 0.0685 | 37 | 0.0657 | 41 |
| | Puszczykowo (1) | 0.1065 | 20 | 0.1082 | 21 |
| | Stęszew (3) | 0.0489 | 60 | 0.0490 | 59 |
| Wigry | Giby (2) | 0.0456 | 67 | 0.0446 | 65 |
| | Krasnopol (2) | 0.0454 | 68 | 0.0444 | 66 |
| | Nowinka (2) | 0.0477 | 62 | 0.0486 | 60 |
| | Suwałki (2) | 0.0844 | 27 | 0.0897 | 26 |
| Wolin | Międzyzdroje (3) | 0.1545 | 7 | 0.1187 | 17 |
| | Świnoujście (1) | 0.0323 | 84 | 0.0320 | 86 |
| | Wolin (3) | 0.0097 | 109 | 0.0025 | 116 |

Notes:

Urban municipality, (2) rural municipality, (3) urban-rural municipality

SDM – synthetic development measure value

P – the ranking position based on SDM

Positions from 1 to 10 are marked in bold and refer to the highest development level of the analyzed phenomenon among the municipalities covered by the research

Source: author's compilation based on Central Statistical Office data

NP, i.e., Piechowice, Szklarska Poręba, Kowary, Podgórzyn (resulting from a reduction in the protected landscape areas) and Międzyzdroje Municipality (Wolin NP), where the national park area was reduced. A higher ranking position, by a two-digit value, was recorded by the following municipalities: Radziłów (Biebrza NP), Sękowa (Magura NP), Nowy Targ (Gorce NP), Dobięgniew (Drawno NP), Górnio and Bieliny (Świętokrzyski NP), and Lipnica Wielka (Babia Góra NP). It is worth emphasizing that the main reason for such a situation was the increase in protected landscape areas, i.e., changes in the least stringent form of nature protection.

The synthetic development measure shows a significant differentiation in the level of nature protection functions in the analyzed municipalities. The leader's position, i.e., Izabelin Municipality (Kampinos NP), was undisputed; SDM value for Lutowska Municipality ranked as the second was by 20% lower, whereas Zamość Municipality ranked as the last (Roztocze NP) and did not even achieve 1% of Izabelin's SDM. It should be emphasized that the diversity was visible not only in the set of all analyzed units, but also in 23 subsets of municipalities linked with a particular national park. The analysis of indicators, as the components of the described measure, allows observing that in the case of 12 municipalities more than half of municipal territory remained within the borders of a national park. This phenomenon occurred in the municipalities linked

with eight national parks, including the most popular among tourists: Karkonosze NP (Karpacz) and Tatra NP (Kościelisko, Zakopane Municipalities).

The classification of municipalities by SDM_{prot} value, performed using the arithmetic mean and standard deviation, shows that the vast majority of municipalities were characterized by a medium lower level of nature protection function, i.e., class C (Table 2). The specification confirms stabilization in the level of nature protection function. It should be assessed positively as nature conservation requires long-term activities and therefore dynamic changes (especially a decrease) in terms of protected areas are not desirable.

Table 2. Classification of municipalities using SDM_{prot} value, 2001-2016.

| Specification | 2001 | 2008 | 2016 |
|---------------------------------------|------|------|------|
| Class A: the highest activity level | 19 | 20 | 21 |
| Class B: medium higher activity level | 23 | 25 | 23 |
| Class C: medium lower activity level | 61 | 59 | 60 |
| Class D: lower activity level | 14 | 13 | 13 |

Source: author's compilation

Table 3. Funding sources of national parks in thousand PLN for the 2015 and 2016.

| National Park | Total | | Including: | | | | | | | |
|-------------------|--------|--------|--------------|-------|------------|--------|--------|--------|----------|------|
| | | | Subsidiaries | | Activities | | Funds | | UE funds | |
| | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 | 2015 | 2016 |
| Babiogóra | 9 964 | 9 208 | 2 331 | 2 425 | 5 735 | 5 135 | 1 857 | 1 648 | 41 | 0 |
| Białowieża | 13 295 | 20 784 | 5 148 | 5 322 | 3 123 | 3 779 | 4 473 | 11 139 | 551 | 544 |
| Biebrza | 20 735 | 20 435 | 4 836 | 5 214 | 4 868 | 4 535 | 5 190 | 4 648 | 4 167 | 4309 |
| Bieszczady | 15 168 | 12 631 | 4 668 | 4 995 | 3 490 | 4 297 | 6 863 | 3 123 | 147 | 215 |
| Tuchola Forest | 4 516 | 3 675 | 2 301 | 2 524 | 451 | 464 | 1 764 | 687 | 0 | 0 |
| Drawno | 7 907 | 8 905 | 2 946 | 3 046 | 3 611 | 3 329 | 1 351 | 2 530 | 0 | 0 |
| Gorce | 9 292 | 9 320 | 3 489 | 3 459 | 2 291 | 1 732 | 1 896 | 3 599 | 1 068 | 124 |
| Stołowe Mountains | 9 154 | 13 415 | 2 761 | 2 852 | 4 745 | 4 940 | 1 346 | 5 623 | 302 | 0 |
| Kampinos | 36 042 | 27 654 | 8 120 | 8 465 | 5 960 | 6 030 | 11 183 | 12 554 | 10 647 | 533 |
| Karkonosze | 14 975 | 17 960 | 3 674 | 3 712 | 5 776 | 6 241 | 1 079 | 5 841 | 4 446 | 2165 |
| Magura | 10 637 | 8 543 | 4 023 | 4 320 | 2 963 | 3 064 | 2 320 | 965 | 1 331 | 189 |
| Narew | 4 481 | 3 903 | 1 879 | 1 973 | 1 332 | 1 853 | 724 | 5 | 546 | 72 |
| Ojców | 5 282 | 4 671 | 2 194 | 2 432 | 1 644 | 1 822 | 1 444 | 417 | 0 | 0 |
| Pieniny | 6 317 | 6 762 | 2 341 | 2 441 | 2 659 | 2 977 | 960 | 1 141 | 357 | 203 |
| Polesie | 7 043 | 6 543 | 2 805 | 2 905 | 2 095 | 2 452 | 2 138 | 1 176 | 0 | 0 |
| Roztocze | 12 566 | 13 049 | 3 882 | 3 938 | 5 843 | 6 311 | 2 841 | 2 800 | 0 | 0 |
| Słowiński | 17 331 | 16 077 | 3 585 | 3 659 | 6 043 | 6 122 | 6 411 | 5 631 | 1 144 | 297 |
| Świętokrzyski | 6 909 | 5 572 | 3 621 | 3 993 | 1 507 | 1 558 | 1 780 | 21 | 0 | 0 |
| Tatra | 32 526 | 39 183 | 5 241 | 5 418 | 23 802 | 25 999 | 1 680 | 6 226 | 1 803 | 1540 |
| Warta Mouth | 5 339 | 5 477 | 1 869 | 1 860 | 2 383 | 3 565 | 92 | 0 | 996 | 52 |
| Wielkopolska | 9 320 | 8 352 | 3 271 | 3 371 | 4 230 | 3 820 | 1 819 | 1 161 | 0 | 0 |
| Wigry | 10 857 | 11 309 | 4 459 | 4 723 | 2 930 | 3 527 | 2 272 | 2 506 | 1 177 | 541 |
| Wolin | 7 617 | 7 503 | 3 205 | 3 479 | 2 995 | 3 271 | 1 174 | 753 | 243 | 0 |

Notes:

Subsidiaries – grants from the state budget for current activities and for cofunding the EU projects

Activities – revenues from own activities including: leases, rentals, admission fees, educational, scientific activities, publishers

Funds – Forest Fund, National Fund for Environmental Protection and Water Management, Regional Fund for Environmental Protection and Water Management

EU funds – European Union funds

Source: author's compilation based on the national parks' data

Funding Sources of National Parks

The legislature has specified the sources of revenues for national parks (Art. 8h of the Nature Conservation Act). It is worth indicating that the change, introduced in 2012, in the organizational and legal form of a national park, from a budgetary unit into a state legal entity, allowed allocating funds from business operations for the implementation of its own tasks. This fact should be emphasized because, since then, national parks – despite their role performed in nature protection – do not have the guarantee of full financial security from the state budget, and thus are forced to take advantage of diverse funding sources (Table 3). The analysis of data on national park funding highlights a significant diversification regarding the financial needs of individual units. The following national parks dominated in terms

of the total funding value: Kampinos, Tatra, Biebrza, and Białowieża. The maximum share in the funds allocated to all parks was reached by Kampinos NP (13%) in 2015. The lowest values were recorded for Tuchola Forest NP and Narew NP. The scale of differences was significant, as these parks received as much as eight times less funding comparing to the leader.

Spearman's rank correlation indicates a moderate positive relationship in the case of total funding and a national park area (the value of correlation coefficient was 0.32 in 2015 and 0.45 in 2016). The relationships between the analyzed value and the number of visitors are also positive, although much stronger: in 2015 the value of correlation coefficient was 0.61 (strong dependence), whereas in 2016 it dropped to the level of 0.56 (moderate dependence).

It is very important to observe that budgetary subsidies constituted the predominant source of financing for only five national parks (Tuchola Forest NP, Magura NP, Narew NP, Ojców NP, Świętokrzyski NP). The lowest share of subsidies in total funding was recorded in Tatra NP (16% in 2015 and 14% in 2016), i.e., in the unit being only second to Kampinos NP in terms of subsidy amounts. This means that national parks are forced to look for other sources than the budgetary subsidies and thus participate in economic life competing for financial resources.

The highest total revenues from their own activity, in both studied years, were achieved by Tatra NP (24 million PLN in 2015 and 26 million PLN in 2016). These values accounted for 73% and 66% of funding, respectively, meaning that Tatra NP had the status of the most financially independent unit. Such activities also provided over half of the funding in Babia Góra NP, Stołowe Maintains NP, and Warta Mouth NP. The most frequently reported revenues accounted for 30-50% of the total funding in individual parks. Against this background, Tuchola Forest NP, which earned revenues from its own activity in both analyzed years at the level of PLN 0.5 million (10% and 13% of total funding respectively), presents unsatisfactory results. It should be emphasized that the admission fee to enter the protected area remains an element of revenues from their own activity. However, the relationship between the number of visitors and revenues seems interesting. Nevertheless, it should be remembered that Kampinos NP, Ojców NP, Pieniny NP, Wielkopolska NP, Wolin NP, and Warta Mouth NP do not charge admission fees to enter the protected area. Therefore, calculating the correlation between the above-mentioned characteristics would lead to incorrect conclusions.

The analyzed units also differed significantly in terms of using funds (Forest Fund, National Fund for Environmental Protection and Water Management, and the Regional Fund for Environmental Protection and Water Management). Kampinos NP dominated in both analyzed years. Among the three leaders there were also: Białowieża NP, Bieszczady NP, Słowiński NP, and Tatra NP. Warta Mouth National Park and Narew NP benefited the least from the described source.

The following parks dominated in terms of using foreign funds: Kampinos, Karkonosze, Biebrza, and Tatra. It is worth drawing attention to the ratio of foreign funds against total funding. The highest (30%) share occurred in 2015 in Kampinos NP and Karkonosze NP, the next ranking position was taken by Biebrza NP and Warta Mouth NP (20%). The share of Magura, Narew, Wigry, and Gorce National Parks ranged within [11-13], whereas seven parks recorded a one-digit share. In the next analyzed year the share of foreign funds dropped significantly, and the classification in this respect changed in favour of Biebrza NP (21%), with Karkonosze NP ranked second. Apart from the above-mentioned national parks, no other unit exceeded

the two-digit share threshold. The differences in the amount of funding from foreign sources result from tranches being a derivative of work schedule envisaged in EU projects. Therefore, the decline observed in 2016 should not be assessed negatively. However, it is important to observe that in both analyzed years seven parks did not take advantage of the EU programs at all: Tuchola Forest NP, Drawno NP, Ojców NP, Polesie NP, Roztocze NP, Świętokrzyski NP, and Wielkopolska NP.

The presented information not only reflects the funding sources of national parks, but also indicates the scale of their activities. National parks allocate all of their revenues to implement their own activities, which are carried out in the area of the territorially linked municipalities – they focus on protecting ecosystems, securing tourist infrastructure, and environmental education, and thus affect local development.

Conclusions

The conducted research allowed us to identify anthropogenic threats occurring in national parks – most of which (littering, walking off the trails, etc.) can be eliminated if the behaviour of tourists and members of the local community changes. The hazards related to activities outside the protected area have also been identified (e.g., drainage works). Thus, not only was the first research question answered, but it also was found that environmental education and the analysis of nature conservation in a broader context than just the national park area is very important. The conducted research regarding the level of nature protection functions in the municipalities territorially linked with national parks showed a significant diversification of the discussed function in the group of 117 analyzed municipalities. The research results confirm the stabilisation of the analysed function, which should be assessed positively.

Izabelin Municipality (Kampinos NP) remains the undisputed leader. There are also 12 municipalities in which more than half of their area is covered by protection in the form of a national park. The analysis of national parks' revenue sources indicates diverse financial needs of the 23 studied units. There is a positive correlation between the financial needs and the area and also the number of tourists. Concerns are raised by the absence of secured budgetary funds for the activities carried out by national parks; budgetary subsidies were the major funding source for only five units. Tatra NP should be considered the unit most independent from external funding sources. The above findings confirm the research realisation and give grounds for providing answers to all the research questions. The research results allow confirming the initially accepted hypothesis that national parks differ in terms of the experienced anthropopressure and financial needs.

Conflict of Interest

The authors declare no conflict of interest.

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