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THE INFLUENCE OF HUMAN IMPACT ON THE DIVERSITY OF PLANT SPECIES ON THE EXAMPLE OF THE LANDSCAPE CONSERVATION PROTECTED AREA

Banaszek J., Szymczyk A. **Wpływ antropopresji na zróżnicowanie gatunków roślinnych na przykładzie obszaru chronionego krajobrazu**. Przedstawiono problem zróżnicowania gatunkowego na obszarze o różnej intensywności antropogenicznej w czasie i przestrzeni. Główne źródła antropopresji pochodzą z obszarów przyległych do analizowanego. Zmiany antropogeniczne obejmują tu głównie stosunki wodne, wydeptywanie i utwardzenie gleby oraz zanieczyszczenie środowiska. W takich warunkach formowały się różne typy siedlisk, które zostały skolonizowanie przez różne ekologicznie i geograficznie grupy roślin o zróżnicowanych wymaganiach siedliskowych. Na obszarze tym stwierdzono występowanie 149 gatunków roślin naczyniowych. Badana flora składa się z gatunków leśnych, muraw kserotermicznych, apofitów, antropofitów oraz z gatunków o szerokiej amplitudzie ekologicznej. Większość gatunków jest związana ze zbiorowiskami muraw kserotermicznych. Wyniki badań wskazują, iż w niektórych przypadkach wpływ antropopresji doprowadził do wzbogacenia gatunkowego na terenach o wyższej intensywności ludzkich działań.

Банашек Я., Шимчик А. **Влияние антропогенной деятельности на дифференциацию растительных видов на примере территории охраняемого ландшафта**. Представлена проблема видового разнообразия на территории, отличающейся разной нитенсивностью антропогенного прессинга в пространстве и во времени. Основной источник данного прессинга связан с территорией, прилегающей к анализируемой. Антропогенные изменения проявляются здесь, в основном, в водных отношениях, в виде вытаптывания и уплотнения почвы, а также в загрязнении среды. В данных условиях формировались разные типы биотопов, в дальнейшем освоенных экологически и географически разными группами растений с дифференцированными биотопными требованиями. На данной территории выявлено наличие 149 видов сосудистых растений. Исследуемая флора состоит из видов: лесных, травянистых ксеротермических, апофитов, антропофитов, а также видов с широкой экологической амплитудой. Большинство видов связаны с ксеротермическими травянистыми сообществами. Выявлено, что в некоторых случаях антропогенный прессинг привел к видовому обогащению, прежде всего участков с признаками более интенсивной деятельности человека.

Key words: cultural landscape, synanthropic flora, xerophilous vegetation, anthropogenic factors, environmental protection

Słowa kluczowe: krajobraz kulturowy, flora synantropijna, roślinność kserofilna, czynniki antropogeniczne, ochrona środowiska

Ключевые слова: культурный ландшафт, синантропная флора, ксерофитная растительность, антропогенные факторы, охрана среды

Abstract

The paper presents the problem of plant species diversity in the area under different human impact in time and spaces. The main sources of negatives impacts come from surroundings are of investigated land. To anthropogenic factors here include to mainly: the transformation of ground surfaces, water relationships and compact of topsoil. In this way formed different types of habitat where were colonized by variety groups of plants like socio-geographic and ecological requirements. In this area was noticed the occurrence of 149 flowering plant species. The investigated flora composed with following groups like forest species, xerothermic grasses, apophytes, antropophytes and also the species with wide ecological tolerances. The majority of species are connected with xerophilous vegetation community. The result of investigated vegetation shows that in some case the anthropogenic disturbing led to the species diversity in zones with high negative of human impacts.

INTRODUCTION

Mount St. Dorothy is at 382 metres above sea level, one of the highest hills of the Silesian Upland and constitutes a hum of the mid-Triassic-era treshold.

It's an example of the dependence between an area's terrain and its geological structure. The asymmetry between its slopes mirrors the lithological diversity of the rocks on the surface of these slopes. This diversity, and the mountain's situation in the overall landscape, contributes to its physical beauty and the significant diversity of its flora. Moreover, this is an area increasingly affected by human activity, which is reflected by the composition and the functioning of the flora found therein. Furthermore, this area has had great cultural significance throughout centuries, being the site of the remnants of an ancient town of the Lausitzer Culture, a medieval fort, an old church, and a chapel built on a water source. Therefore, this area is still subject to considerable anthropopression. Studies of this hill have, to date, concentrated usually on the landscape and its development, with the results being presented by DULIAS (2012), while research into this area's ecosystems was conducted earlier, in the late 20th century (SENDEK, 1976; SENDEK, WIKA, 1992), showing the uniqueness of this area. Unfortunately, these qualities of Mount St. Dorothy have, by now, been significantly changed. The purpose of this study is to show the effects of anthropopression on the biodiversity and the functioning of the flora in this area.

STUDY AREA

The area under study, Mount St. Dorothy and the surrounding protected area, is situated in the northwest of Będzin (Fig. 1). Będzin's geographical coordinates are: 19°03'30"E–19°11'16"E (and 50°22'13"N –50°18'05"N. The average annual temperature in this area in the years 1994–2003 was 8.9ºC. The warmest month is July, with an average temperature of 19.3ºC, and the coldest are December and January (-1.2ºC on average in both months).

Fig. 1. Location of investigated area
Rys. 1. Lokalizacja obszaru badań

The geological surface is composed of products of the Upper Carboniferous era. The hill, except its southern part, is almost completely surrounded by the outcrops of porebie-type (namur) rock layers, specifically, grey slates and sandstones with contents of carbon and siderite. The peak of Mount St. Dorothy is made up of carbonate rocks from the Triassic era, with a maximal thickness of up to 80 m, which lie on the layers of Carboniferous era products The remnants of the Triassic era are specifically developed in bedrocks as sands and as red and patchy argils. Above lie limestones and dolomites, and above them – thick-bedded dolomitic limestones, cavernous limestones and marls. The highest parts of Mount St. Dorothy are composed of Gogolin layers: flaglike (banded), undulating, conglomerate-type of limestones (DULIAS, 2012).

MATERIALS AND METHODS

In our research, we used the method of in-site observation between the years 2009 and 2013. During the vegetative seasons from 2010 to 2013, floristic indexes of vascular plant species were made. The Latin names of the species and their status in Polish flora were determined in accordance with MIREK et al. (2002) and particular attention was paid to the presence of synanthropic species of foreign (anthropophytes) and domestic (apophytes) origin. On the basis of ecological indices (ZARZYCKI et al., 2002), species diversity was evaluated in terms of ecological parameters.

RESULTS AND DISCUSSION

For several centuries, this area has been increasingly threatened by human interference, first in the form of cutting the original beech forests; then the exploitation of stone resources for the construction industry's needs; and today, increased tourist activity, the practice of extreme sports such as motor- and bicycle riding, and other damaging effects of human activity which are also harmful to this area's ecosystem.

The hill's slopes bear visible signs of economic activity (mainly mining) in the form of collapse lakes, as well as traces of farming, in the form of characteristical farm berms around the hill. The most intensive mining activity around Mount St. Dorothy was conducted by the Grodziec (originally Grodziec II) Mine, established in the years 1899–1901. All older mines were, from then on, in its area of operations. For many years, the fluid back-fill method was used, but in the final years of mining, operations we-

re conducted by artificially collapsing the ground (CIEPIELA, 2003). The areas around Mount St. Dorothy still bear numerous traces of mining activity which constitute habitats for many plant vegetation communities (photo 1) and thus increase the biodiversity of this area.

Photo 1. The forest and non-forest community in ecotone zone (phot. by J. Banaszek)
Fot. 1. Zbiorowisko leśne i nieleśne w strefie ekotonowej (fot. J. Banaszek)

Flora composition

149 vascular plant species have been determined to inhabit the area concerned.The biological spectrum of the flora is composed of hemicryptophytes (Fig. 2).

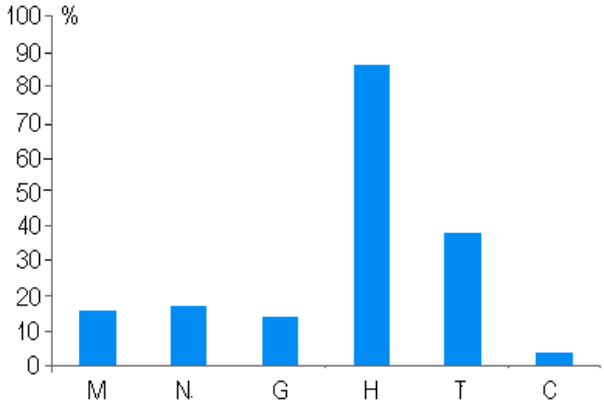

Fig. 2. The percentage of lifes form in investigated flora: M – megaphanerophytes, N – nanophanerophytes, G – geophytes, H – hemicryptophytes, T – therophytes and C – herbaceous chamaephytes
Rys. 2. Udział form życiowych badanej flory: M – megafanerofity, N – nanofanerofity, G – geofity, H – hemikryptofity, T – terofity, C – chamefity zielne

These are species with differing ecological requirements, mainly those typical of xerothermic turfs (*Agrimonia eupatoria, Brachypodium pinnatum, Carlina acaulis, Centaurea scabiosa, Crataegus monogyna, Euphorbia cyparissias, Festuca rubra, Fragaria virdis, Ononis spinosa, Prunnus spinosa, Salvia pratensis,* and others). Of all species found in this area, 105 (i.e. 70%) are synanthropic plants of domestic or alien origin (i.e. apophytes and anthropophytes). The former include species such as: *Achillea millefolium, Aegopodium podagraria, Arctium minus, A. lappa, Artemisia campestris, A. vulgaris, Calamagrostis epigejos, Campanula rapunculoides, C. patula, Chaerophyllum aromaticum, Chelidonium majus, Convolvulus arvensis, Galium aperine, Lamium maculatum, Lathyrus pratensis, Lolium perenne, Medicago lupulina, Melilotus alba, Plantago lanceolata, P. major, Poa annua, P. pratensis, P. trivialis, Ranunculus acris, Rosa canina, Rumex crispus , R. obtusifolius* y, *Senecio jacobea, Senecio viscosus, Silene nutans, Sonchus arvensis, Stellaria graminea, S. media, Tanacetum vulgare, Tragopogon dubiu, Trifolium repens, Tussilago farfara, Verbascum thapsus, Vicia cracca*, and others.

The anthropophytes found most frequently in this area are: *Acer nugundo, Capsella bursa-pastoris, Centaurea cyanus, Consolida regalis, Conyza canadensis, Erigeron annuus, Euphorbia esula, Fumaria officinalis, Helianthus tuberosus, Impatiens parviflora, Juglans regia, Lamium album, Lathyrus tuberosus, Myosotis arvensis, Papaver rhoeas, Pyrus communis, Robinia pseudacacia, Rosa canina, Senecio vernalis, S. vulgaris, Sinapis arvensis, Sisymbrium loeselii, S. officinale, Solidago canadensis, Viola arvensis,* and others.

The first group of flora – apophytes – present in this area consists of as many as 67 species, whereas the second – anthropophytes – consists of 38 invasive species which are gradually supplanting native flora. This indicates, inter alia, a disturbance of ecological processes in this area caused indirectly by human activity. The composition of the flora in this area is similar to that of other parts of the Silesian Upland, especially those also affected by surface mining (RAHMONOV, OLEŚ, 2010; RAHMONOV, SZYMCZYK, 2010; RAHMONOV, PARUSEL, 2011). In term of light and thermal requirements the plant species (photo 2 and 3) are not significant diversity. They are spesies mainle prefering the open habitats. These habitats also rich in organic and mineral both form natural and anthropogenic origin. Some ecological requrements of species is shown in table 1.

Vegetation community

Mount St. Dorothy is covered with a forest that is only slightly drilled. This is a mixed forest, and its various parts are dominated by different tree species that are both native and geographically alien to Polish flora. It is not always possible to determine their geobotanical distigution (SIMANUSKIENE, RAHMONOV, 2005).

Table 1. Some ecological features of flora

Table 1. Some ecological features of flora
Tabela 1. Wybrane cechy ekologiczne flory

Values	Contribution of species (%)	Number of species
Light value		
1 – deep shade	0,0	0
2 – moderate shade	1,3	2
3 – half-shade	16,7	25
4 – moderate light	69,7	105
5 – full light	11,4	17
Organic matter content value		
1 – soil poor in humus	6,71	10
2 – mineral-humic soil	75,84	113
3 – soil rich in organic matter	11,41	17
No indicator	6,4	9
Trophy value		
1 – soil (water) extremely poor	0,0	0
2 – soil (water) poor	2,7	4
3 – soil (water) moderately poor	27,5	41
4 – soil (water) rich	53,7	80
5 – soil (water) very rich	11,4	17
Soil moisture value		
1 – very dry	0,0	0
2 – dry	7,4	11
3 – fresh	84,6	126
4 – moist	3,3	5
5 – wet	0,0	0
6 – aquatic	0,0	0

Photo. 2. Nitrophilous community (a) and *Euonymus europaea* (b)(phot. by J. Banaszek)
Fot. 2. Zbiorowisko nitrofilne (a) i *Euonymus europaea* (b) (fot. J. Banaszek)

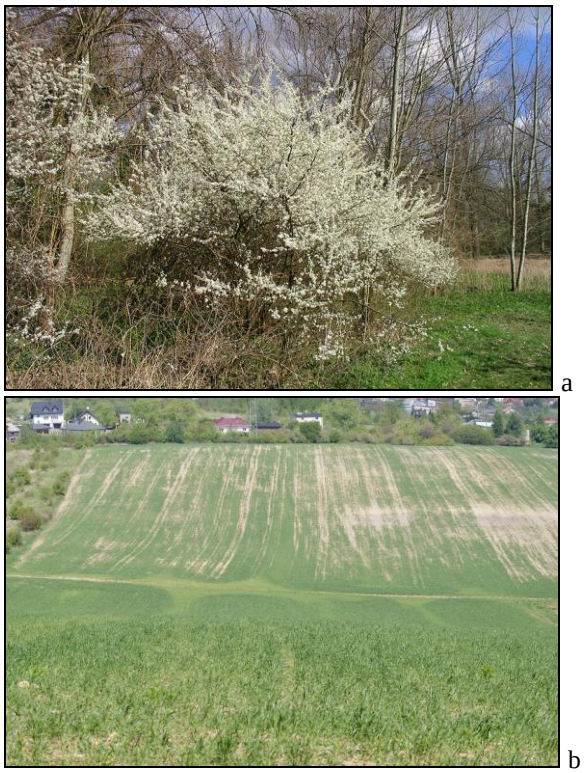

Photo 3. Community of the *Pruno-Crataegetum* (a) and arable area in ecoton zone (b) (phot. by J. Banaszek)
Fot. 3. Zbiorowisko *Pruno-Crataegum* (a) i grunty orne w strefie ekotonowej (b) (fot. J. Banaszek)

The following tree species have been determined to occur in the area concerned: *Acer pseudoplatanus, A. platanoides, A. campestre, A. negundo, Betula pendula, Carpinus betulus, Fagus sylvatica, Fraxinus excelsior, F. pensylvanica, Quercus robur, Q. rubra, Robinia pseudacacia, Tilia cordata, Ulmus laevis,* and *Populus × canadensis*. In the understory, especially on the edge of the forest, *Corylus avellana, Crataegus monogyna, Euonymus europaea*, and *Viburnum opulus* have been found to occur. These species some places form vegetation communities of as thicket or midfield community (photo 3).

Below the forest belt lie farmlands divided by berms with thicket flora of great biocenotic significance, as well as turf that covers these balks and berms. Farm berms prevent soil erosion quite effectively. A vegetation community of the *Pruno-Crataegetum*, which constantly extends its reach due to ecological succession processes, is well developed, especially on slopes receiving much sunlight. These processes also have considerable significance for preventing soil erosion and stabilizing berms.

In the 1990s, the upmost parts of the area also featured xerothermic turfs, namely, vegetation communities of *Adonido-Brachypodetium* (SENDEK, WIKA, 1992). By the present time, as a result of increased trampling by humans, that vegetation community has vanished.

In 1993, a resolution of the Będzin City Council designated Mount St. Dorothy and its immediate surroundings as a protected area, the reason being the necessity to preserve its landscape and its environment of great ecological, archeological, landscape, and aesthetic value and to use it for recreational and tourist purposes. Similar protected areas are not uncommon in the south of Poland (MAJGIER, BADERA, RAHMONOV, 2010).

Human impact

In the area concerned, longtime human activity has contributed to the emergence of new anthropogenic forms. These are post-mining concaves, newly-formed artificial embankments and tresholds inside the forest, and heavily-trampled areas. There are also other traces of human impact, such as the devastation of religious buildings and infrastructure elements in this area, as well as increasingly intensive trashing of the area, including unauthorized garbage landfills. This kind of activity contributes to the formation of new habitats and thus the introduction of new plant species with diverse ecological requirements. The diversity of terrain forms created as a result of human activity, and their role in the area's landscape and biodiversity, have been presented in several different studies (CZYLOK, RAHMONOV, SZYMCZYK, 2008; RAHMONOV, 2007; RAHMONOV, SNYTKO, SZCZYPEK, 2009, 2010; MAJGIER, BADERA, RAHMONOV, 2010).

CONCLUSIONS

Numerous traces of human impact can be found in this area, some dating back as early as the ancient and medieval eras. The slopes of the hill bear traces of human economic activity: mining (in the form of uneven ground and collapse lakes) and farming (in the form of characteristical farm berms). With 105 species in all, synanthropic flora constitutes 70% of the studied area's flora, which numbers 149 species. The biodiversity of this area is affected by the fact that it neighbors lands currently used for farming.

The occurrence of alien tree species (*Fraxinus pensylvanica, Q. rubra, Robinia pseudacacia, Populus × canadensis*) is the result of their artificial planting and their invasive character.

The anthropogenic terrain forms which have emerged in this area over time contribute, on one hand, to the emergence of new habitats for plants and thus to increased biodiversity, but can, on the other hand, disrupt ecological balance in the functioning of the forest ecosystem in this area. The differentiation of flora in the initial stage of the succession is conditioned, in such extreme habitats, by the occurrence of free ecological niches and the lack of interspecies competition.

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