

IMPORTANCE OF VEGETATION
IN THE ORAWSKO-NOWOTARSKIE PEAT BOGS
TO BIOLOGICAL DIVERSITY IN THE POLISH CARPATHIANS*

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Abstract. The Orawa-Nowy Targ Basin is an area of the most abundant occurrence of bog plants in the Polish Carpathians. Thanks to this region, contemporary flora of the Carpathians is richer in many plant species and animals related to them, often glacial relics. At the moment, the bogs flora is poorer and biological diversity has decreased in consequence of wasteful exploitation of the site. Degradation of the Orawa-Nowy Targ bogs is a serious threat for the biological diversity of the Carpathians.

Key words: peat bogs, biological diversity, glacial relics, endangered species, Orawa-Nowy Targ Basin

INTRODUCTION

The areas of specific geological, topographical, microclimatic, and soil conditions are of major importance to the biodiversity of a given region. Such areas include habitats suitable for rare species, including not only those specific of a single region but also on a much wider scale. Often such areas include isolated stations of species typical of other, often quite distant regions, relics of geological epochs of the past, or even endemic species. Both the flora and vegetation of these areas may not always be very rich in terms of species; to the contrary, they are sometimes rather poor in terms of the number of species inhabiting them. But the overall value consists not in the abundance but rather in the unique features of the vegetation. This is particularly true for wetlands, and among those especially for sites with raised peat bogs. These peat bogs are formed by a relatively small number of plant species, but they are extremely

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specialised species that are practically not found in other habitats. Additionally, the phytocoenoses are mostly composed of rare species.

In the Polish Carpathians, the predominantly peaty Orawsko-Nowotarska basin represents just such an exceptional area. The region provides a refuge for many rare plant and animal species which, owing to the specific environment, have survived there since the glaciation periods.

Neither the flora, actual vegetation, nor the fauna of the Orawsko-Nowotarska basin have been thoroughly studied yet. The current research on the vegetation cover of peat bogs, fens and swamps and their immediate environs has discovered a number of previously unknown rare plants species as well as rarely found specific plant communities. Some of the plant species have not previously been recorded in the Polish Carpathians, while some others are known to-date only from a few isolated stations.

CHARACTERISTICS OF THE AREA

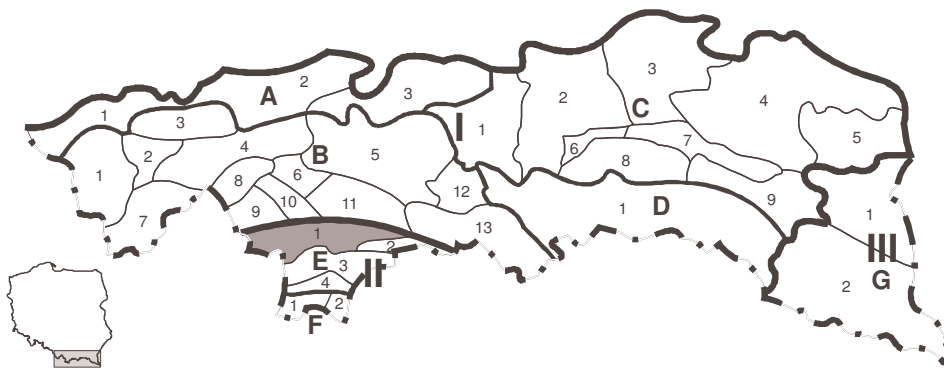


Fig. 1. The Orawa-Nowy Targ Basin on the background of the physiographic division of the Polish Carpathians (ac. to Kondracki [9])

I – Outer Western Carpathians – A – Western Beskid Foothills: 1 – Śląskie Foothills, 2 – Wielickie Foothills, 3 – Wiśnickie Foothills; B – Western Beskids: 1 – Beskid Śląski Mts., 2 – Żywiecka Dell, 3 – Beskid Mały Mts., 4 – Beskid Makowski Mts., 5 – Beskid Wyspowy Mts., 6 – Rabczań-ska Dell, 7 – Beskid Żywiecki Mts., 8 – Babia Góra Range, 9 – Działy Orawskie Mts., 10 – Beskid Orawsko-Podhalański Mts., 11 – Gorce Mts., 12 – Sądecka Dell, 13 – Beskid Sądecki Mts.; C – Central Beskid Foothills: 1 – Rożnowskie Foothills, 2 – Ciężkowickie Foothills, 3 – Strzyżowskie Foothills, 4 – Dynowskie Foothills, 5 – Przemyskie Foothills, 6 – Gorlice Depression, 7 – Jasiel-sko-Krośnieńska Dell, 8 – Jasielskie Foothills, 9 – Bukowskie Foothills; D – Central Beskids: 1 – Beskid Niski Mts.. II – Central Western Carpathians – E – Orawa-Podhale Depression: 1 – Orawsko-Nowotarska Basin, 2 – Pieniny Klippen Belt, 3 – Spisko-Gubałowskie Foothills, 4 – Sub-Tatra Trough; F – Tatra Mts.: 1 – Western Tatra, 2 – Eastern Tatra. III – Outer Eastern Carpathians – G – Wood Beskids: 1 – Sanocko-Turczańskie Mts., 2 – Western Bieszczady Mts.

The Orawsko-Nowotarska basin is situated in the Central Western Carpathians, within the Orawsko-Podhalańskie depression (Fig. 1), separating the Tatra Mountains range from the Western Beskidy Mts. [9]. It is a vast basin that resulted from subsidence and is encircled by mountain ranges.

The Orawsko-Nowotarska basin is elevated from 490 to 650 m a.s.l, whereas the surrounding mountain ranges are higher by even as much as 1000 m. This situation is reflected in the specific climate, with frequent thermal inversions caused by stagnant masses of cold air flowing down from the surrounding mountains, great cloudiness, frequent fogs and persistently long snow cover [18]. The specific climate and impermeable substrate comprising clayey loams covering gravels of fluvio-glacial cones [1,11], left behind by the Tatra glaciers once active there, have all contributed to the high proportion of peat bogs in the basin. There are a dozen or so sites with raised peat bogs of the Baltic type (Fig. 2), fragments of transitional peat bogs and fens, and a number of post-exploitation areas with relatively well-preserved peat bog flora. Adjacent to the peat bogs are vast areas occupied by bog coniferous forests. The Orawsko-Nowotarskie peat bogs and fens are the single largest peat bog complex in the Polish Carpathians. Its total area exceeds 1 100 hectares [3].

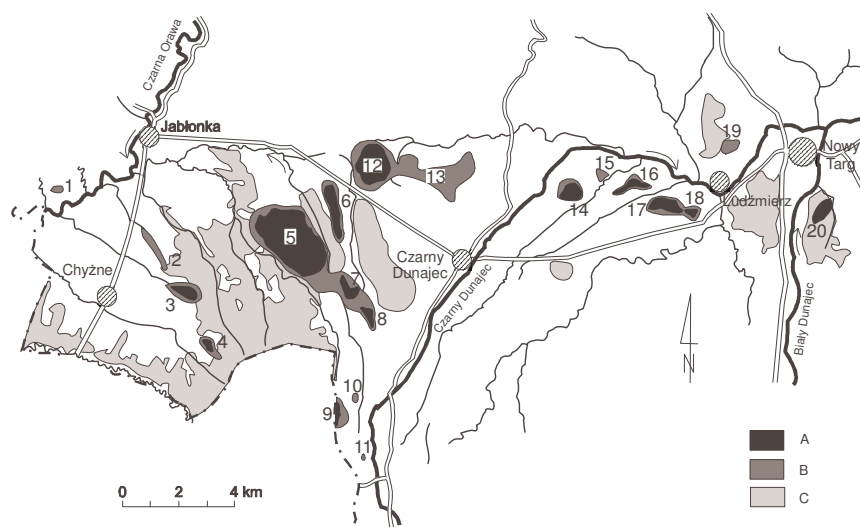


Fig. 2. Distribution of raised bogs and coniferous bog forests in Orawa-Nowy Targ Basin

1 – Janowiackie; 2 – Puścizna Jasiowska; 3 – Łysa Puścizna; 4 – Pustać Chyżne; 5 – Puścizna Wielka; 6 – Puścizna Mała; 7 – Kaczmarka; 8 – Bór za Lasem; 9 – Puścizna Przybojec; 10 – Bacuch; 11 – Kosarzyska; 12 – Baligówka; 13 – Puścizna Rękowiańska; 14 – puścizna koło Wróblówki; 15 – Cyrla; 16 – Puścizna Franków; 17 – Młaka Brzeże; 18 – Przymiarki; 19 – Do Grela; 20 – Bór na Czerwonym

A – raised bogs; B – post-exploitation areas; C – coniferous bog forests.

PECULIAR FEATURES OF THE VEGETATION COVER
OF THE ORAWSKO-NOWOTARSKA BASIN

In the Orawsko-Nowotarska basin, in peat bogs and the immediate environs, some 420 species of vascular plants have been found during the floristic studies completed to date (Koczur, unpublished data). Of this number, only 57 species were found on typically-formed domes of raised peat bogs. Twelve out of these are associated solely with this habitat, whereas the remaining species are plants growing chiefly in edge communities, post-exploitation areas, adjacent coniferous bog forests, as well as forest and meadow species only accidentally brought into the peat bogs.

Occurring exclusively on the undisturbed, best-preserved portions of the domes of raised peat bogs, eight species can be found: *Carex limosa*, *C. pauciflora*, *Empetrum nigrum*, *Oxycoccus microcarpus*, *Pinus mugo*, *P. x rhaetica*, *Rubus chamaemorus* and *Scheuchzeria palustris*. Only slightly more extended are stations of: *Andromeda polifolia*, *Drosera anglica*, *D. rotundifolia* and *Rhynchospora alba*, which appear also on degraded parts of peat bog domes and in regenerating post-exploitation areas immediately adjacent to domes.

Still reaching further outside the peat bog domes are such species as *Eriophorum vaginatum*, *Ledum palustre*, *Oxycoccus palustris* and *Vaccinium uliginosum*, which occur frequently in the surrounding coniferous bog forests, and *Eriophorum angustifolium* which grows in oligotrophic fens.

Still rather more diversified is the group of plant species occurring on the edge peat bog communities and in some post-exploitation areas. Some of them occur also on domes, although they are less numerous and more scattered. In edge communities, there are species typical of intermediate peat bogs and acidic fens, such as: *Agrostis canina*, *Carex canescens*, *C. echinata*, *C. lasiocarpa*, *C. nigra*, *Comarum palustre*, *Eriophorum gracile*, *Juncus filiformis*, *Menyanthes trifoliata*, *Ranunculus flammula*, *Stellaria palustris*, *Veronica scutellata*, *Viola palustris*, reed community species: *Alisma plantago-aquatica*, *Carex disticha*, *C. gracilis*, *C. hudsonii*, *C. rostrata*, *C. vesicaria*, *Eleocharis palustris*, *Phragmites australis*, *Sparganium emersum*, *S. erectum*, *Typha latifolia*, and even some plant species typical of short-growing mires and eutrophic mountain fens, such as: *Carex dioica*, *C. flava*, *C. lepidocarpa*, *C. pulicaris*, *Eleocharis pauciflora*, *Epipactis palustris*, *Eriophorum latifolium*, *Parnassia palustris*, *Pinguicula vulgaris*, *Valeriana simplicifolia*.

In small natural ponds and in numerous peat pits there are communities of aquatic plants where *Nymphaea alba*, *Potamogeton alpinus*, *P. natans*, *P. pusillus*, *Sparganium minimum*, *Utricularia minor* and *U. vulgaris* can be found among other species.

Among the plant species occurring on the Orawsko-Nowotarskie peat bogs and fens, plants occur which are rarely encountered not only in the Polish Carpathians but also in Poland as a whole. This group includes glacial relics, e.g. *Carex*

pauciflora, *Empetrum nigrum*, *Eriophorum gracile*, *Oxycoccus microcarpus*, *Potamogeton alpinus* and *Rubus chamaemorus*. In the peat bogs of the Orawsko-Nowotarska basin, 13 vascular plant species which are listed in the Polish Red Book [4] as either rare or endangered, as well as in the Red List of vascular plants considered endangered in Poland [21]. These are: *Carex davalliana*, *C. limosa*, *C. pauciflora*, *C. pulicaris*, *Dactylorhiza maculata*, *Drosera anglica*, *D. rotundifolia*, *Dryopteris cristata*, *Epipactis palustris*, *Eriophorum gracile*, *Oxycoccus microcarpus*, *Pinus x rhaetica* and *Rubus chamaemorus*.

There are significantly more species which are endangered in terms of the Polish Carpathians. Occurring there are some species for which no records are known from other parts of the Polish Carpathians: *Rhynchospora alba* (Fig. 3), *Sparganium minimum* and *Rubus chamaemorus* (the only station throughout the Carpathians) [6] as well as *Eriophorum gracile*, whose station in the Orawsko-Nowotarska basin is the last one in the Polish portion of the Carpathians (Fig. 4).



Fig. 3. Distribution of *Rhynchospora alba* in the Polish Carpathians. 1 – stations existing at present, 2 – historical locality

Many of the plant species occurring in the basin have only a few stations in other parts of the Polish Carpathians. Most of these are regarded as lowland species, for example such species such as *Andromeda polifolia*, *Calla palustris*, *Carex lasiocarpa*, *Carex limosa*, *Carex pulicaris*, *Ceratophyllum demersum*, *Comarum palustre*, *Drosera anglica*, *Dryopteris cristata*, *Empetrum nigrum*, *Juncus alpino-articulatus*, *Ledum palustre*, *Nymphaea alba*, *Oxycoccus palustris*, *Potamogeton alpinus*, *Scheuchzeria palustris*, *Utricularia minor* or *U. vulgaris*. Some of these species, such as *Nymphaea alba* and *Potamogeton alpinus*, have in the Orawsko-Nowotarska basin their most highly elevated stations in Poland. Most of the aforementioned species are rare or endangered throughout the Carpathians [20].



Fig. 4. Distribution of *Eriophorum gracile* in the Polish Carpathians. 1 – stations existing at present, 2 – uncertain historical stations

The flora of bryophytes is equally interesting. The flora of bryopsides is particularly rich and exceptional in the Carpathians, as it contains particularly large number of peat mosses. It includes both species which are typical of Central-European quagmires (*Sphagnum magellanicum*, *S. rubellum*), or that dominate in the Sub-Arctic-Boreal zone (*S. fuscum*) as well as some characteristic of Sub-Atlantic quagmires (*S. compactum*, *S. molle*, *S. papillosum*) [12]. Five out of the species listed (*Sphagnum fuscum*, *S. imbricatum*, *S. molle*, *S. papillosum*, *S. tenellum*) are placed on the Red List of mosses most endangered in Poland [15]. Most of them occur very rarely, or have not been found at all in other parts of the Polish Carpathians.

A similar situation occurs with respect to liverworts – almost all species, characteristic of the communities in the *Oxycocco-Sphagnetea* class (*Calypogeia azurea*, *C. sphagnicola*, *Cephalozia connivens*, *C. macrostachya*, *Gymnocolea inflata*, *Kurzia pauciflora*, *Mylia anomala*) [12], occurring in Poland are found in the area, along with four endangered species placed on the Red list of liverwort species [19] – *Cladopodiella fluitans*, *Geocalyx graveolens*, *Moerckia hibernica*, *Pallavicinia lyellii* [14]. The station of *Pallavicinia lyellii* in the Orawsko-Nowotarska basin is its only station in the Carpathians [13]. One species, *Barbilophozia kunzeana*, deemed to be a glacial relic, was also found – [14].

The plants characteristic of raised peat bogs in the Polish Carpathians are among those which occur in the Orawsko-Nowotarska basin in the greatest numbers, and which have their centre of distribution here. It is further confirmed by their distribution in the Western Carpathians where most frequent records and most comprehensive lists of peat bog plant species are reported from the areas bordering the basin (Działy Orawskie and other parts of the Beskid Żywiecki Mts, Tatra Mts, and Gorce Mts.) – cf. distribution of *Carex pauciflora* – Figure 5.



Fig. 5. Distribution of *Carex pauciflora* in the Polish Carpathians. 1 – stations existing at present, 2 – historical locality

All these plants form specific communities which are very rarely found in the Carpathians. Also many associations rare in Poland appear, that are typical rather of lowland areas, such as: *Sphagnetum fuscii*, *Sphagnetum magellanici boreale*, *Ledo-Sphagnetum magellanici*, *Eriophoro vaginati-Sphagnetum recurvi*, *Caricetum limosae*, *Rhynchosporietum albae*, *Caricetum nigrae*, *Carici-Agrostietum*, *Caricetum rostratae* or *Sparganietum minimi*, which often occur in the form of regional varieties. However, there are also some plant communities that occur which are characteristic of these areas, such as: *Pino x rhaeticae-Sphagnetum*, or *Calamagrostio villosae-Pinetum*.

PECULIARITIES OF FAUNA

The specific vegetation of peat bogs is also associated with certain animal life. Particularly rich and distinctly specific is the fauna of invertebrates. Many insects feeding on peat bog plants, such as hare's tails, sedges, bog bilberry and ledum are observed. Among them are several species of butterflies, such as moorland clouded yellow *Colias palaeno* and *Chlorocysta infuscata*, and boreal species: *Crambus alienellus* and *Lygris testata* var. *insulicola* (not observed recently) which had their stations in the Orawsko-Nowotarska basin as unique, relic stations [2,17].

Equally rich and specific is the ichthyofauna of the basin, further augmented by species characteristic only of streams flowing through peat bogs, such as Vladykov's lamprey *Lampetra vladykovi* [2].

The Orawsko-Nowotarskie peat bogs provide a refuge to many vertebrate species. Although the animal wildlife does not include any species related exclusively to peat bogs, many species find favourable conditions for development there. There are numerous populations of reptiles, namely the scaly lizard *Lacerta vivipara* and the adder *Vipera berus*. Among birds, black grouse *Lyrurus tetrix*

can often be seen tooting in nearby meadows, and feeding on the peat bog domes. The most commonly found mammals are roe deer *Capreolus capreolus*, wild boars *Sus scrofa*, red deer *Cervus elaphus*, and red foxes *Vulpes vulpes*.

The relatively wild areas of the basin are located on the migration routes of many animals and provide an ecological corridor linking the Tatra Mts. with the Babia Góra massif. Among other species, migrating brown bears have been observed.

THE STATE OF PRESERVATION OF THE PEAT BOGS

The peat bogs in the Orawsko-Nowotarska basin have undergone a process of rapid degradation. The extraction of peat continues both on an industrial scale as well as by local residents. The post-exploitation areas have been partly converted into floristically poor green crops, and in some parts are subject to spontaneous succession into forest communities. In some sites, the post-exploitation sites have been re-vegetated by peat-forming plants, although the species composition of such secondary communities is much poorer. The patches are formed by the most expansive and most common peat bog plants, among which such species as *Eriophorum vaginatum* and *Sphagnum recurvum* predominate. The most susceptible and valuable species, such as *Carex limosa*, *Carex pauciflora*, *Empetrum nigrum*, *Oxycoccus microcarpus* or *Scheuchzeria palustris* are no longer found even in the oldest post-exploitation sites that are now well-regenerated and suitably wet.

Draining the peat bog edges and digging at the domes' bases causes serious disturbance to the hydrological processes in peat bogs, and ultimately leads to the disappearance of many plants. The first to vanish are the species of the moistest places, typical of the hollows, such as *Carex limosa* or *Scheuchzeria palustris* [7]. The hummock species provide the bulk of the vegetation covering the domes of peat bogs, and they also occur within coniferous bog forests and on some post-exploitation sites. Despite this wider distribution, these plants are more endangered now, because they withdraw from the previously occupied areas in line with the disappearance and degradation of the peat bogs [8].

Because of the rather poor level of knowledge about the previous vegetation cover in the area, it is difficult to evaluate now the particular species and exactly how many have become extinct in the Orawsko-Nowotarska basin in the last century. It is likely that the following species disappeared: marsh club moss *Lycopodiella inundata* which was recorded till the 1920s [10] (Fig. 6), and dwarf birch *Betula nana*, reported to occur there in the 19th century but not found thereafter [10]. A species which is currently in danger of becoming extinct is graceful cotton grass *Eriophorum gracile* which was once relatively common [16]; in recent years it has been reported on only a single site.

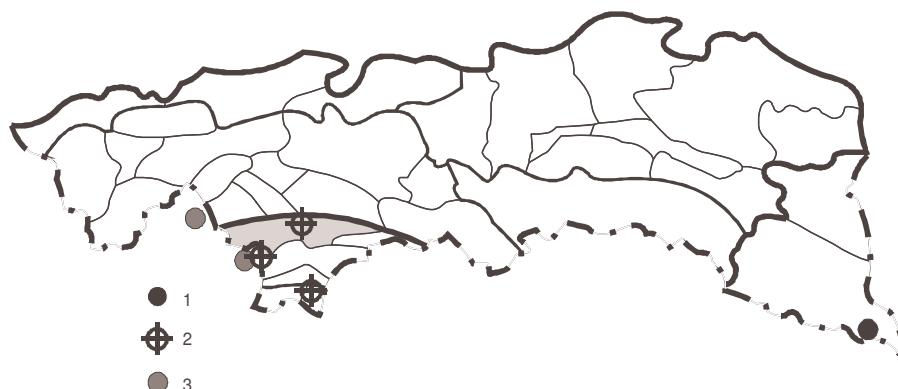


Fig. 6. Distribution of *Lycopodiella inundata* in the Polish Carpathians. 1 – stations existing at present, 2 – historical locality, 3 – stations outside of the Polish state border

As a result of wasteful exploitation, the area of peat bogs throughout the Polish part of the Orawsko-Nowotarska basin has decreased by 34% in the last hundred years [11]. To-date, in the Orawsko-Nowotarska basin, several peat bogs have been fully exploited or drained and converted into green crop areas, now grossly neglected; the remaining peat bogs have excessively dried-up and are reduced in size [5]. These are overgrown with impoverished and greatly disturbed hummock communities with major proportions of *Eriophorum vaginatum*, *Calluna vulgaris* and *Ledum palustre*. Also rapidly increasing is the proportion of Scots pine *Pinus sylvestris*. Only within the three largest peat bogs (Puścizna Wielka, Baligówka and Młaka Brzeże), in their central parts, have some well-watered and almost undisturbed patches of natural peat bog-forming communities survived, such as *Caricetum limosae* hollow community, and two hummock communities: *Sphagnetum fusci* and *Sphagnetum magellanicum boreale*.

In line with the degradation of peat bogs, and the disappearance of the plant communities characteristic of these areas, and the continually shrinking distribution ranges of many species, some animal species feeding or living in the peat bog vegetation have also disappeared.

CONCLUSIONS

1. Owing to the specific vegetation in the Orawsko-Nowotarska basin, the flora of the Carpathians is richer in many species of peat bog, wetland and aquatic plants regarded as typical of the lowlands, which are practically not found elsewhere in the interior parts of the mountains. Most of these species are rare plant species subject to legal protection, while many of them are glacial relics.

2. The Orawsko-Nowotarska basin is a place containing the most numerous occurrences of raised peat bog species within the whole of the Polish Carpathians. Some of them have probably spread from here into the neighbouring mountain ranges.

3. The specific flora is accompanied by specific fauna. The invertebrate fauna is particularly rich, having many species characteristic of boreal areas.

4. As a result of past wasteful management, which has continued in part in recent times in the Orawsko-Nowotarskie peat bogs, significant impoverishment of the flora along with a major reduction in the biological diversity of the basin, and ultimately of the whole Carpathians, has occurred.

5. If the exploitation of peat continues, the last or almost last remaining Carpathian stations of other rare plant species will disappear, including some relic species which have survived there since the glacial periods.

6. The extinction of many animal species associated with peat bog vegetation is another consequence of dramatic changes in the latter.

7. The degradation of the Orawsko-Nowotarskie peat bogs represents a major threat to the overall biological diversity of the Polish Carpathians.

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ZNACZENIE ROŚLINNOŚCI TORFOWISK ORAWSKO-NOWOTARSKICH DLA RÓŻNORODNOŚCI BIOLOGICZNEJ KARPAT POLSKICH

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Streszczenie. Kotlina Orawsko-Nowotarska to miejsce najliczniejszego występowania roślin torfowiskowych na terenie Karpat Polskich. Dzięki niej współczesna flora Karpat jest bogatsza o liczne gatunki roślin i związanych z nimi zwierząt. Wiele z nich to relikty glacialne. W wyniku rabunkowej gospodarki na torfowiskach doprowadzono do znacznego zubożenia flory i zmniejszenia różnorodności biologicznej Kotliny. Degradacja torfowisk orawsko-nowotarskich stanowi duże zagrożenie dla bioróżnorodności Karpat.

Słowa kluczowe: torfowiska wysokie, bioróżnorodność, relikty glacialne, gatunki zagrożone, Kotlina Orawsko-Nowotarska