

PRĄDNIK  
PRACE I MATERIAŁY MUZEUM IM. PROF. WŁADYSŁAWA SZAFERA

Prądnik. Prace Muz. Szafera	11–12	7–24	1998
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**GEOLOGICZNY ZAPIS OSADNICTWA PREHISTORYCZNEGO W  
JASKINIACH W OKOLICACH OJCOWA**

**Geological record of prehistoric human settlement in caves of the Ojców area**

**ABSTRACT.** Black coloured laminae were found inside Holocene speleothems from caves situated in the Ojców area. The character of black coloured laminae shows that their origin is related to prehistoric human activity.

**KEYWORDS:** Holocene speleothems, human settlement, radiocarbon dating, caves of Ojców area.

**SUMMARY**

Black coloured laminae were detected inside speleothems from five caves (Wierzchowska Górna, Dziewicza, Nietoperzowa, Łokietka, Ciemna) situated in the Ojców area. The colour of discussed laminae is caused by occurrence of charcoal particles and organic compounds. These particles originated inside the caves during wood combustion caused by prehistoric human activity. The ultrastructures of charcoal particles prove that most of them originated in temperatures from 400 up to 600 °C. It suggests that charcoal is connected with domestic fires rather than torches. Depositional processes and postdepositional corrosion prevent the connection of a single black coloured laminae with a particular episode of human settlement but the laminae are a proof of human activity in caves. These observations in comparison with radiocarbon dating indicate that investigated caves were settled in the Neolithic, the Bronze Age and later periods.

Prądnik. Prace Muz. Szafera	11–12	25–40	1998
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**ANTROPOGENICZNE ZAGROŻENIA I PRZEMIANY STOSUNKÓW  
KRENOLOGICZNYCH OJCOWSKIEGO PARKU NARODOWEGO  
I STREFY OTULINOWEJ**

**Anthropogenic hazards and changes in the crenological regimes  
of the Ojców National Park and its buffer zone**

**ABSTRACT.** Detailed crenological studies carried out between 1986 and 1989 in the Ojców National Park and its buffer zone related mostly to physical/chemical and bacteriological properties and anthropogenic threats and changes in fissure-karstic waters and alluvial cover.

This general assessment of physical-chemical and biological parameters confirms the good quality of spring water (Ist and IInd class) to date in all non-urban areas and the deterioration of outflows (IIIrd and IVth class) in the settlement zones of the Ojców National Park and adjacent areas.

**KEYWORDS:** springs, chemistry of water, threats to water resources, Ojców National Park, Poland.

SUMMARY

The detailed crenological studies carried out between 1986 and 1989 in the Ojców National Park and its buffer zone related mostly to physical/chemical and bacteriological properties and anthropogenic threats and changes in fissure-karstic waters and alluvial cover.

The time profile analysed, covered a period of atmospheric drought spell, and showed an increase in annual mean air temperatures (6.6 to 7.2°C) and some monthly parameters, and a decrease in monthly precipitation (623 mm) and seasonal sums, which had an irregularity coefficient (acc. to classification by Kaczorowska) at the border range between dry and average. The springs studied (9 sites) of the fissure-karstic type, (descensional and ascensional) with characteristic Vauclosian springs of higher yields, flow mainly from rock rubble and alluvia of rock-cover type) in the morphological situations on slopes, below slopes, on terrace or near course. They are situated in the

hipsometric zone between 415 and 310 m a.s.l. and represent three classes of yield; 0.1–1.0, 5.0–10.0 dm<sup>3</sup>s<sup>-1</sup> with little annual variability. Low yields, contingent on low atmospheric precipitation, are characteristic for autumn (Oct.–Dec.) and winter (Jan.–April) with a minimum falling in March, whereas high yields result from melting snow and intensive spring rains (May) and summer rains (July–August) with a peak in September (Table 1, Fig. 1). The response of spring water to precipitation is delayed by 8 to 15 days and the minimum and maximum values are shifted by 1 to 2 months. The springs studied represent the Vth–VIth classes of yield (acc. to Meinzer classification) and the coefficient of multiannual variability 1.2–8.8 (acc. to Maillet classification) characterised by constant (a) and low-variability outflows (b).

Thermal properties of the springs ranges from 8.1 to 8.6°C and represents (acc. to Prikhlonski-Šcukhariev's classification) the range of cold waters (Figs 2, 3). Low temperatures occur in the cold part of the year (Oct.–April) with the minimum occurring in January to February while the high temperatures in the summer season (May–Sept.) with the maximum in September. Amplitudes reach from 3.7 to 9.0°C with the reaction of springs to temperature changes and shifts of extreme values amounting to 1 to 2 months. Waters are generally tasteless and odourless (Z<sub>0</sub>R), or a very slight (Z<sub>1</sub>R), slight (Z<sub>2</sub>R) or evident (Z<sub>3</sub>R) smell of vegetation, occurring mainly in autumn.

The total mineralization of springs of the Jurassic and Quaternary stages ranges from 366.6 to 447.1 mg dm<sup>-3</sup> and represents the group of fresh waters with periodic variability from very fresh to partly fresh (Table 2, Fig. 4). Little variability was found with respect to slight alkaline reaction (7.1–7.3 pH) with the seasonal variability from slightly acid to slightly alkaline, and with respect to total hardness (12.5–15.4°n) with a range which includes waters from soft to hard waters.

The predominating concentrations among cations, in accordance with the mineral/ petrographic composition of substrate, are those of Ca<sup>2+</sup> with small amounts of Mg<sup>2+</sup>, Na<sup>+</sup> and K<sup>+</sup> ions, whereas among anions, ion HCO<sub>3</sub><sup>-</sup> predominates with SO<sub>4</sub><sup>2-</sup> and Cl<sup>-</sup> occurring in lower concentrations. The Jurassic and quaternary stages represent (under Prikhlonski-Šcukhariev's classification) one chemical type of two-ion waters (9th interval of classification): HCO<sub>3</sub>-Ca. Spring waters also contain small quantities of Fe<sup>2+</sup> and Fe<sup>3+</sup>, and larger quantities of nutrients: N (NH<sub>4</sub><sup>+</sup>), N (NO<sub>3</sub><sup>-</sup>) and P (PO<sub>4</sub><sup>-</sup>) (Table 3).

Concentrations of total mineralisation, hardness, reaction and main micro-components constitute the parameters of the over hydrochemical background (except for the anomalous contents of several outflows) which are exceeded seasonally with respect to Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup> as well as N (NH<sub>4</sub><sup>+</sup>), N (NO<sub>3</sub><sup>-</sup>), P (PO<sub>4</sub><sup>-</sup>) and bacteriological contaminants (faecal-type coliform count). Adverse ion proportions exceeding commonly accepted threshold values are shown by the following hydrochemical indices: rCa<sup>++</sup> rMg<sup>+</sup> and rNa<sup>+</sup> + rK<sup>+</sup> : rCl<sup>-</sup>, whereas the proper system is rNa<sup>+</sup> : rK<sup>+</sup> and rSO<sub>4</sub><sup>-</sup>·100 : rCl<sup>-</sup> with parameters typical for the active zone of exchange of underground water with infiltration waters from atmospheric precipitation (Table 4).

To date, the main micro-components of the Jurassic and Quaternary waters have not shown a lack of compliance with national sanitary standards except for the permanent or temporary excessive concentrations of some nutrients and coliform count. A comprehensive assessment of the quality of springs conducted by two methods (Burchard-Dubaniewicz and Macioszczykowa) indicate the highest parameters (of Ist and IIrd class) of several springs studied, situated in the Ojców National Park and including pure waters and those slightly contaminated (Table 5). Evident and heavy contamination (IIIrd and IVth class) was found in some outflows situated below some Ojców households, cultivated fields, meadows and pastures (Table 5, Nos. 3, 9) and dense built-up areas (Table 5, No. 1).

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Prądnik. Prace Muz. Szafera	11–12	41–47	1998
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**SEZONOWE ZMIANY ZAWARTOŚCI AZOTANÓW W WODACH  
RZEKI PRĄDNIK W OJCOWSKIM PARKU NARODOWYM**

**Seasonal changes of the content of nitrate in water of Prądnik river in Ojców  
National Park**

**ABSTRACT.** The paper describes the results of the studies of contents of seasonal changing of concentration of nitrate nitrogen  $N-NO_3^-$  in Prądnik river flowing through Ojców National Park. An attempt was taken up to define such results factors as precipitation and plant vegetation on the level of content of this compound in water of Ojców National Park.

**KEYWORDS:** Prądnik river, water pollution, nutrient, nitrate, water environment, precipitation.

SUMMARY

The study presents the results of the test for the concentration of nitrate nitrogen contained in water of Prądnik river. Studies showed that water flowing through Ojców National Park has not been contaminated by nitrate yet. It was stated that contents of nitrate nitrogen in Prądnik river fluctuate considerably during the year. That is the result of the plant biological activity as well as the result of precipitation.

Statistical analysis of the data proves that the precipitation has considerable influence on the process of washing the nitrate out of the soil, what leads to its concentration increase in water of Prądnik river.

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Prądnik. Prace Muz. Szafera	11–12	49–113	1998
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ZBIOROWISKA ŁĄKOWE WYŻYNY CZĘSTOCHOWSKIEJ

**The meadow communities of the Częstochowa Upland**

**ABSTRACT.** The Częstochowa Upland has very diversified meadow vegetation which covers especially large acreages in the area of following microregions: the Wolbrom Gate, the Pradła Depression and the Janów Plain. 32 associations and 7 communities have been distinguished and described there. They belong to 4 classes: *Phragmitetea* (18 syntaxa), *Scheuchzerio-Caricetea fuscae* (6), *Molinio-Arrhenatheretea* (13) and *Nardo-Callunetea* (2).

These communities are connected with soils which represent 3 divisions: semi-hydrogenic soils, hydrogenic soils, alluvial and deluvial soils. Some of them, especially peatbogs, rushes and moist meadows are endangered because of drainage and other anthropogenic disturbances of water conditions.

**KEYWORDS:** meadow vegetation, rushes, peatbogs, moist meadows, fresh meadows, mat-grass meadows, phytosociology, syntaxonomy, Częstochowa Upland, Southern Poland.

SUMMARY

Introduction

The Częstochowa Upland is the central part of the Cracov-Wieluń Upland. This region used to be considered as „a land of rocky hills and sandy deserts” (Michalik 1974) where the habitats conducive to higo- and mesophilous meadow vegetation are very rare. However, this is not quite true because rushes, peatbogs and moist and fresh meadows are very important components of the vegetation in 3 of the 5 the Częstochowa Upland microregions (fig. 1), i.e. the Wolbrom Gate, the Pradła Depression and the Janów Plain. These communities cover large acreages and are refuges for many rare and interesting plant species. They occur in the water-course valleys and are differentiated according to the soil and water conditions as well as human activity.

The aim of this paper is to distinguish and describe associations and communities of rush, peatbog and meadow vegetation occurring in the Częstochowa Upland. Furthermore, phytosociological and ecological characteristics, as complete as possible, are included together with comparison to similar communities which have been described from other, especially southern, regions of Poland.

#### I. Short characteristics of the investigated area

Investigations were carried out in the area of the Częstochowa Upland which reaches from the Wolbrom Gate in the south to the Warta river gorge near Częstochowa in the north. This region has a very diversified topography of the land surface. Rocky monadnocks built by upper Jurassic limestones are the most characteristic elements of the landscape and are responsible for its individual character. Considerable areas of the table-like top are covered by pleistocene sands. Loesses occur only in the south-eastern part of the Upland, as well as near Lelów.

The biggest conglomerations of rocky and other karstic forms are located in the territory of the Ryczów — and the Mirów-Olsztyn Rocky Microregion. These areas have mostly no permanent surface water courses. Much better hydrological conditions exist in 3 other microregions: the Wolbrom Gate, the Pradła Depression and the Janów Plain.

A big variety of habitats caused by diversified sculpture and the occurrence side by side of different geological formations is the characteristic feature of the Częstochowa Upland environment. It finds an expression in mosaic variability of soil cover and in big microclimatic contrasts. All of that have an effect on variety of vegetation.

#### II. Methods

The field investigations were carried out in the years 1977-1982. By means of the Braun-Blanquet's method 452 phytosociological relevés have been made and 263 among them have been set into 24 phytosociological tables. They gave a base for characteristics of distinguished syntaxa. Single relevés which represent very rare communities are quoted in the text. Moreover synthetic tables (3) have been made for particular groups of communities.

The systematics of communities and their nomenclature is employed after Matuszkiewicz (1981). Only the names of those not included in that elaboration, are taken from original dissertations. The nomenclature of vascular plant species is employed after Jasiewicz (1984), mosses — after Ochyra and Szmajda (1978), lichens — after Nowak and Tobolewski (1975).

In typical patches of the investigated communities 41 soil pits were dug. In taken soil samples following determinations were made: mechanical composition by the Casagrande's method modified by Prószyński (mineral samples), pH in H<sub>2</sub>O and in 1N KCl potentiometrically, CaCO<sub>3</sub> by Scheibler's method. Moreover in samples taken from the upper horizons of profiles the contents of: available forms of K<sub>2</sub>O and P<sub>2</sub>O<sub>5</sub> by Egner's method in the modification of Rhiem, organic C by Türlin's method (with calculation of organic matter) and total N by Kjeldahl's method were determined. The proportion C/N was also calculated for these samples.

#### III. A review of the meadow communities of the Częstochowa Upland

##### A. Systematics of associations and communities

##### B. Characteristics of distinguished communities

### 1. Rush communities of the class *Phragmitetea*

These communities don't cover large areas in the Cześćochowa Upland. They usually form enclaves among other types of meadow vegetation.

#### 1.1. Typical rushes of the alliance *Phragmition* (tab. 1)

They are rare. Only 4 from 7 identified associations could be considered as quite frequent.

***Phragmitetum communis***. Though *Phragmites australis* appeared quite frequently, well developed phytocoenoses of this association did not cover big areas. They occurred on eutrophic mud-gley soils.

***Equisetetum limosi***. Its patches were found only at 3 points of the Cześćochowa Upland, the biggest one near Kroczyce. Two variants are clearly conspicuous: with *Lemna minor* and with *Peucedanum palustre*. The soil pit dug at the patch of the first variant showed an initial gyttja soil.

***Eleocharitetum palustre***. Its small phytocoenoses were found only in 3 localities. They developed in shallow, slowly flowing, clear water on sandy ground.

***Glycerietum maximae***. Rushes of this type were found in 4 places. They were connected both with standing water reservoirs and with small water courses. Two variants have been distinguished: with *Glyceria fluitans* (inundated phytocoenoses) and with *Caltha palustris* (slightly flooded patches, situated between hay meadows). The soil profile from the second variant showed eutrophic mud-gley soil.

Patches of other rushes: *Typhetum angustifoliae*, *Acoretum calami* and *Typhetum latifoliae* were found in single stands. *Typhetum latifoliae*, because of its small area and partly developed patches, has not even been described in phytosociological relevé.

#### 1.2. Sedge rushes of the alliance *Magnocaricion*

These are the most frequent occurring communities from the class *Phragmitetea*. From among 9 distinguished associations of the alliance *Magnocaricion*, phytocoenoses 5 of them are relatively common.

***Phalaridetum arundinaceae*** (tab. 2). Well developed phytocoenoses of this association do not occur frequently nowadays but the characteristic species — *Phalaris arundinacea*, often occurs along banks of regulated water courses. There have been distinguished 2 variants: with *Glyceria maxima*, and a typical one. First of them prefers more moistened habitats on mud-gley soils. The patches of the second one have many *Molinio-Arrhenatheretea* species. It is differentiated into 3 further sub-variants.

***Caricetum gracilis*** (tab. 3). Its phytocoenoses are relatively frequent especially in river valleys. Sometimes they cover fairly large areas adjoining *Molinio-Arrhenatheretea* meadows. The mud-gley soils have developed on sandy ground. In patches of *Caricetum gracilis* from the investigated area, species from the *Phragmitetea* class are scarce but meadow species have large participation in them. Therefore they have been included into subassociation *C.g. filipendulosum ulmariae*, described by Denisiuk (1967 b, 1980). Moreover, 2 variants have been distinguished: with *Potentilla anserina* and with *Climacium dendroides*. The first patches cover rather small areas. The phytocoenoses of the second one are greater. They represent this form of *Caricetum gracilis* which is the most typical in the Upland.

***Caricetum rostratae*** (tab. 4). This is one of the most common sedge rushes associations in the investigated area. *Carex rostrata*, a characteristic species, is very common too and occurs in almost all rush and peat-bog communities.

However in *Caricetum rostratae* it attains the biggest constancy and cover. Phytocoenoses of *Caricetum rostratae* occur on gley soils (mucky-gley and mud-peaty-gley soils) which have developed on sandy ground. The association is divided into 2 variants. Phytocoenoses with *Rumex hydrolapathum* are flooded for the greater part of the year. The variant with *Cardamine pratensis* is represented by patches rich in meadow species, which have a well developed moss layer.

***Caricetum acutiformis*** (tab. 5). Its patches are of medium occurrence in the investigated area. They are connected with shallow flooded habitats or with the habitats which are only wet for the greater part of the year. Soil profile dug in this community presents peat-mud soil. Two variants have been distinguished: a typical variant and one with *Lychnis flos-cuculi*. Typical patches which are poor floristically, represent an earlier phase of development. They are more frequent. Patches of the second variant are more abundant in species. *Carex acutiformis* has lower cover here and moss layer is very well developed. *Caricetum acutiformis* hasn't been described from neighbouring areas of the Cześćochowa Upland till now.

***Caricetum paniculatae*** (tab. 6). Although *Carex paniculata* is a fairly common species in the investigated area, its rushes were found only at some sites. Two subassociations have been distinguished: *C.p. scrophularietosum umbrosae* and *C.p. menyanthetosum*. Phytocoenoses of the first exist on habitats with flowing, cold and calcareous waters of Jurassic springs and streams. Soils have the character of initial gytta soil here and they contain a large amount of  $\text{CaCO}_3$ . Two variants have been distinguished in it: typical and dried. Phytocoenoses of *C.p. menyanthetosum* are more rare. They develop in wet places, on the eutrophic low peat soils, which doesn't contain a considerable amount of  $\text{CaCO}_3$ . Within this subassociation 2 variants are separated: with *Carex diandra* (in the proximity of peat-bogs communities) and with *Alnus glutinosa* (near alder thicket).

***Caricetum appropinquatae*** (tab. 7). The phytocoenoses of this association are rare in the Cześćochowa Upland. However they are differentiated into 2 variants: with *Lemna minor* (initial stages) and with *Filipendula ulmaria* (patches with considerable number of meadow species, on eutrophic peat-muck soil). Phytocoenoses of other associations of the alliance *Magnocaricion* (*Caricetum vesicariae*, *Cicuto-Caricetum pseudocyperii* and *Caricetum elatae*) were very rare and occurred only in a single localities.

### 1.3. Stream rushes of the alliance *Sparganio-Glycerion*

This syntaxon is represented by 1 association and 1 community.

***Glycerietum plicatae*** (tab. 8). Its phytocoenoses overgrow on the banks of Jurassic streams, their shallow overflow-areas and shallow ditches with enough fast flowing water. Two variants have been distinguished: with *Glyceria fluitans* and with *Berula erecta*. The patches of the first one are very rare. More frequent are the phytocoenoses of the second variant. The form of the association with a large participation of *Berula erecta* is also typical for cold springs and streams in the Cracov Upland (Michalik 1980).

**Community of *Mentha longifolia***. Its well developed patches were found only in one place: in the spring stretch of the Centuria valley. It is possible that it is a variant of *Glycerietum plicatae*.

### 2. Peatbog communities of the class *Scheuchzerio-Caricetea fuscae*

These communities occupy a small area in the Cześćochowa Upland. However, they are very interesting from the nature point of view because they are biotopes for many rare, disappearing and probably soon to be extinct plant species.



Peatbogs were probably a little more extended in the past but today they are diminishing in acreage very quickly as a result of drainage and other anthropogenic disturbances of the water conditions. This is why incomplete and degenerated forms of different syntaxons are often found.

As a result of the investigations, 6 peatbog communities have been identified. Two of these, are very rare.

#### 2.1. Transitional peatbogs of the order *Scheuchzerietalia palustris*

Typically developed communities of the *Scheuchzerietalia* order haven't been found on the Cześćochowa Upland. Also, the species characteristic for this syntaxon are very rare. In spite of that 2 of the identified peatbog communities can be put into this order.

**Mossy peatbog with *Sphagnum palustre*** (tab. 10). Patches of this community have been found in 2 localities in the area of the Wolbrom Gate. They are connected with shallow acid soil of transitional peatbogs, lying on sand.

Species from the class *Oxycocco-Sphagnetea* had large covering here but the plants from the *Scheuchzerio-Caricetea* class were more numerous. Participation of the species from the *Scheuchzerietalia* order was slight but considering the characteristic species combination, the community has been included in this syntaxon. The discussed morass shows a certain similarity to *Eriophoro-Sphagnetum recurvi betuletosum* (Jasnowski et al.).

***Caricetum lasiocarpae***. Only one dried up patch of this association was found. Except for the dominant *Carex lasiocarpa* the species from *Caricetalia davallianae* order had considerable participation.

#### 2.2. Mesotrophic low peat bogs from the order *Caricetalia fuscae*

***Caricetum diandrae*** (tab. 11). The patches of this association are rather frequent but they are not large. They develop in strongly flooded places on the slightly acid soils of low peatbogs.

In phytocoenoses of *Caricetum diandrae* from the Cześćochowa Upland grow *Calliergonella cuspidata* and *Calliergon giganteum* — the moss species which differentiate more fertile form of this association. Some spring mosses are frequent here too.

***Carici-Agrostietum caninae*** (tab. 12). Its phytocoenoses are rare and rather small but they are visibly differentiated. That gave the reason for distinguishing 2 subassociations.

*C.-A.c. caricetosum rostratae* represents the boggy form of the association with very well developed moss layer. Its patches are connected with strongly acid mucky-gley soils.

*C.-A.c. typicum* represents the meadow form of described association. Its patches grow on strongly acid gley soils. They adjoin hay meadow communities.

#### 2.3. Eutrophic low peatbogs from the order *Caricetalia davallianae*

***Valeriano-Caricetum flavae*** (tab. 13). The patches of this association were found only in the area of the Wolbrom Gate. They grow on the acid or slightly acid eutrophic/mesotrophic peat-muck soils. Because of depression sink caused by mining around Olkusz, many dried up and degenerated patches of this association were especially frequent.

*Valeriano-Caricetum flavae* is an association of frequent occurrence in the forest mountain zone of the Western Carpathians. It has been seldomly described out of mountains until now.

***Caricetum davallianae*** (tab. 13). Only one large, well developed patch of this

association was found. It overgrew slightly acid eutrophic muck-gley soil.

### 3. The meadow communities of the class *Molinio-Arrhenatheretea*

They occupy great areas in the valleys of Jurassic rivers and major streams. As a result of investigations 13 associations and communities have been identified. Syntaxa of the *Molinietalia* order are predominant among them.

#### 3.1. Moist meadows of the order *Molinietalia*

The biggest part in the vegetation of the Cześćochowa Upland play 4 syntaxa of the alliance *Calthion* and 3 communities for which it wasn't possible to determinate the attachment to units lower than order.

##### 3.1.1. Fragments of the moist tall-herb communities of the alliance *Filipendulo-Petasion*.

These communities are rare and fragmentarily developed. In spite of that, 2 syntaxa have been identified. They are: *Filipendulo-Geranium* (in 2 localities), and the community with *Petasites hybridus* (in 1 locality).

##### 3.1.2. Moor grass meadows of the alliance *Molinion* (tab. 15)

The Cześćochowa Upland meadows of the alliance *Molinion* are very rare, too. Patches of 2 associations have been found.

***Junco-Molinietum***. Its phytocoenoses have been found in 2 localities. They are connected with an acid mesotrophic peaty-gley soils.

***Molinietum medioeuropaeum***. A well developed but small patch of this association was found only in 1 locality in the north part of the investigated area. It overgrew slightly alkaline deluvial humic pararendzina. Considering the participation of the species of the *Caricion davallianae* alliance it represents subassociation *M.m. caricetosum davallianae* (Grynja 1968).

##### 3.1.3. The eutrophic moist meadows of the alliance *Calthion*

This syntaxon is represented by 3 associations and 1 community.

**Mossy meadow with *Equisetum palustre*** (tab. 16). Its phytocoenoses occur rather frequently. They are connected with trickling spring waters. The outcrop made in a patch of this community shows the eutrophic peat-muck soil, containing considerable amount of  $\text{CaCO}_3$ . This is the meadow with a not too high greenness growth in which *Equisetum palustre* achieves appreciable covering. A moss layer is very well developed here. *Climacium dendroides* and *Calliergonella cuspidata* are predominant in it and some rare spring mosses occur too. The discussed community is differentiated into 2 variants: typical (patches scanty floristically in which *Equisetum palustre* dominates) and with *Cardamine pratensis* (phytocoenoses in which meadow plants have substantial participation). In the investigated area the mossy meadow with *Equisetum palustre* represents the moistest syntaxon of the alliance *Calthion*. It shows similarity to low peatbogs.

***Scirpetum silvatici*** (tab. 17). Phytocoenoses of this community are not very common in the investigated area. They were usually found among other meadow communities and they occupied the wettest places. The soil outcrop made in this community represents muck-gley soil.

***Cirsietum rivularis*** (tab. 18). In the Cześćochowa Upland patches of this association are very common in the area of most of the stream and river valleys. This is especially so in the Jurassic part of the Pilica valley and its tributary Żebrówka and in the surroundings of Lelów and Wolbrom. Phytocoenoses of the thistle meadow are most often

connected with alluvial and deluvial soils (gleyed humic alluvial soils — 3 outcrops, deluvial humic rendzina — 1 outcrop, proper deluvial soil on peat — 1 outcrop). In one case mucky black earth was ascertained.

In the investigated area *Cirsietum rivularis* is differentiated into 3 variants: with *Lotus uliginosus*, typical and with *Heracleum sphondylium* (with 2 subvariants: with *Carex acuta* and with *Sanguisorba officinalis*). The moistest phytocoenoses of the thistle meadow have been included into the first variant, a slightly less moist into the second, and patches somewhat resembling fresh meadows into the third. The last ones are the most frequent in the Czeŝtochowa Upland and occupy the greatest area. *Polygonum bistorta* and *Crepis mollis* are, besides *Cirsium rivulare*, the locally characteristic species for the discussed association. The phytocoenoses with dominance of *Polygonum bistorta* have also been included into *Cirsietum rivularis*, as well as patches with considerable participation of *Cirsium rivulare*.

***Alopecuretum pratensis*** (tab. 19). Phytocoenoses of *Alopecuretum* are not too frequent in the Czeŝtochowa Upland. They are connected with fertile and wet alluvial and deluvial soils (humic alluvial soil and deluvial soil with deep humus accumulation horizon) which are formed from silts and silty clays.

According to moisture gradient the association is differentiated into 3 variants: with *Carex acuta*, typical and with *Heracleum sphondylium*. The characteristic species for this association are: *Alopecurus pratensis* (has its growth optimum here) and *Trifolium hybridum* (locally).

The syntaxonomic position of *Alopecuretum* within the class *Molinio-Arrhenatheretea* is controversial. In this elaboration it is included into the alliance *Calthion*.

#### 3.1.4. Other meadow communities of the order *Molinetalia*

**Community of *Deschampsia caespitosa*** (tab. 20). Meadows with dominance of *Deschampsia caespitosa* are rather frequent in the investigated area. Just as in the other regions, they are connected with peat-muck soils. The community is differentiated into 3 variants: moist, dried up and with *Polygonum bistorta* (with 2 subvariants).

There are no good reasons for including the described community into the association *Stellario-Deschampsietum* (Grynia 1961, 1971).

**Community of *Holcus lanatus*** (tab. 21). Phytocoenoses of this meadow occupy the biggest area in the north-east part of the Czeŝtochowa Upland (the Janów Plain). They are connected with muck-gley soils which has developed on sandy substratum. The community is differentiated into 2 variants: with *Equisetum palustre* (moister) and with *Achillea millefolium* (drier). *Briza media* and *Pimpinella saxifraga* are locally its tolerably good differentiating species.

**Community *Ranunculus acris-Poa pratensis*** (tab. 22). It is not very frequent. Its phytocoenoses are connected with mucky-gley soils which are formed on loose sand. They are well moistened owing to nearness of water-courses. The community shows the features intermediate between moist and fresh meadows.

#### 3.2. Fresh meadows of the order *Arrhenatheretalia*.

In the area of the Czeŝtochowa Upland there are not many habitats conducive to the development of meadow communities of the *Arrhenatheretalia* order. A considerable part of the fresh meadows has originated as a result of the drainage of wet rivers valleys. They are mainly used as hay meadows.

***Arrhenatheretum medioeuropaeum*** (tab. 23). Patches of this association occupy

a considerable area in some river valleys. They are usually connected with alluvial and deluvial soils formed by silts and silty clays (deluvial humic pararendzina, humic alluvial soil).

The association is differentiated into 2 subassociations: *A.m. typicum* and *A.m. luzuletosum*. Phytocoenoses with many species characteristic for the association and alliance have been included to *A.m. typicum*. This unit has been divided into 2 variants: with *Medicago lupulina* (warmer and drier habitats) and with *Alopecurus pratensis* (moister habitats). The second one is slightly similar to *A.m. alopecuretosum* and it is the most typical form of the discussed association in the investigated area. *A.m. luzuletosum* is represented by patches where the characteristic species of the association and the alliance are scarce. *Luzula campestris* and *Trifolium repens* are the differentiating species for it.

***Lolio-Cynosuretum*** (tab. 24). Its patches are rare because in the area of the Cześćochowa Upland xerothermic grasslands are usually used as pastures. According to differences in soil moisture, 2 variants have been distinguished, i.e.: with *Ranunculus acris* and with *Thymus pulegioides*.

#### 4. The communities of the class *Nardo-Callunetea*

These communities don't have great participation in the vegetation of the Cześćochowa Upland and their large patches are rare. Two associations have been distinguished here.

***Nardo-Juncetum*** (tab. 26). Well developed patches of this association have been found only in two localities. However they occupied fairly large area there. They are connected with shallow acid peat-muck soils lying on loose sands.

*Nardo-Juncetum* from the Cześćochowa Upland is differentiated into 2 subassociations: *N.-J. juncetosum effusi* (more fertile form) and *N.-J. festucetosum ovinae* (on more scanty habitats). On the basis of moisture differences each subassociation is divided into 2 variants.

***Calluno-Nardetum*** (tab. 27). This community is more frequent only in the middle and north part of the investigated area. Its phytocoenoses are connected with podzolized brown soils. *Calluno-Nardetum* from the Cześćochowa Upland is differentiated into 2 variants: with *Euphrasia stricta* (patches situated on slopes of the Jurassic hills which have some ties to xerothermic grasslands) and with *Polytrichum piliferum* (patches which are somewhat similar to psammophilous grasslands).

#### Recapitulation

1. As a result of investigations of the widely understood meadow vegetation of the Cześćochowa Upland 39 units (32 associations and 7 communities) have been distinguished and described. They belong to 4 vegetation classes: *Phragmitetea* (18 syntaxa), *Scheuchzerio-Caricetea fuscae* (6), *Molinio-Arrhenatheretea* (13) and *Nardo-Callunetea* (2). They are very often differentiated into lower units. The great differentiation of this vegetation is caused by natural variability of habitats and human activity.

2. The meadow communities play the most important part in the vegetation of the Wolbrom Gate, the Pradła Depression and the Janów Plain.

3. Many distinguished communities are very rare or rare in the investigated area. There are only a few syntaxa which patches could be recognized as common or frequent.

4. Drainages and anthropogenic disturbances of water conditions (depression sinks) are the greatest danger for communities of swamp, peatbogs and moist meadows.

5. The soil investigations showed that in the Cześćochowa Upland meadow communities are connected with soils developed under the fundamental influence of water. According to the newest „Systematics of Polish Soils” (1989) they belong to 3 divisions: semi-hydrogenic soils, hydrogenic soils, alluvial and deluvial soils.

Prądnik. Prace Muz. Szafera	11–12	115–139	1998
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## FLORA ORAZ NATURALNE I PÓLNATURALNE ZBIOROWISKA ROŚLINNE OSTAŃCA JURAJSKIEGO W NIEGOWONICACH

### Flora as well as natural and seminatural plant communities of the Jurassic monadnock at Niegowonice

**ABSTRACT.** The paper presents the results of the investigations which have been carried out on the flora and vegetation of natural and seminatural plant communities of the Jurassic monadnock near Niegowonice. This height is situated on the border between the Silesian Upland and the Cracow-Wieluń Upland. 378 vascular plant species (23 protected among them) and 11 plant communities (5 forest, 1 shrub and 5 grassland communities) have been found there. The results of the investigations have showed that the mentioned area geobotanically belongs to the Cracow-Wieluń Upland Region.

**KEY WORDS:** flora, vegetation, forests, shrubs, grasslands, Silesian Upland, Cracow-Wieluń Upland.

### SUMMARY

The Jurassic monadnock near Niegowonice is situated on the western end of the Smoleń-Niegowonice Range. The range spreads out transversely the central part of the Częstochowa Upland.

At the present moment geographers consider this area as the part of the Silesian Upland, which shows only the former, dense reach of the Jurassic table.

The richness of the flora and vegetation of the Niegowonice monadnock is the result of a big variety of the habitat conditions.

Flora of the natural and seminatural plant communities of the investigated area numbers 378 vascular plant species. The xerothermic and thermophilous species have the biggest participation (30%). The mountain element is represented by 7 taxa. The groups of protected plants numbers 23 species and 42 plants rare in the macroregion have been noticed here. They belong into different habitat groups.

In the area of the Niegowonice monadnock following 11 plant communities have been distinguished: 5 forest associations (*Tilio-Carpinetum*, *Dentario enneaphyllidis-Fagetum*, *Carici-Fagetum*, *Luzulo pilosae-Fagetum*, *Quercus roboris-Pinetum*), 1 shrub association (*Pruno-Crataegetum*) and 5 grassland communities (*Libanoti-Potentilletum tabernaemontani*, grassland with *Phleum phleoides*, *Adonido-Brachypodietum*, grassland with *Poa pratensis* var. *angustifolia* and *Coronilla varia*, *Festuco psammophilae-Koelerietum glaucae*).

The results of the investigations allowed precisely to state the geobotanical attachment of the mentioned area. In the light of them it is the integral part of the Cracow-Wieluń Upland Region (Szafer 1972).

PRĄDNIK  
PRACE I MATERIAŁY MUZEUM IM. PROF. WŁADYSŁAWA SZAFERA

Prądnik. Prace Muz. Szafera	11–12	141–146	1998
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**NOWE STANOWISKA ROŚLIN NACZYNIOWYCH GÓRNEGO  
ODCINKA DOLINY POTOKU CHECHŁO**

**New localities of the vascular plants of the upper part  
of the Chechło stream valley**

**ABSTRACT.** This floristic note outlines a list of 75 vascular species new to the flora of the upper part of the Chechło stream valley. For 15 more, new stations have been described. The most interesting species include *Phyteuma orbiculare*, *Dactylorhiza fuchsii* and *Chimaphila umbellata*.

**KEYWORDS:** vascular plants, Chechło stream valley.

SUMMARY

This paper reports results of the master thesis „Flora and vegetation of the upper part of the Chechło stream valley”. The research was done during 1993–1995. There were found 75 species new of the local flora and 15 species on new localities. Those are common species as well as the rare ones, like: *Streptopus amplexifolius*, *Dactylorhiza fuchsii*, *Phyteuma orbiculare*.

PRĄDNIK  
PRACE I MATERIAŁY MUZEUM IM. PROF. WŁADYSŁAWA SZAFERA

Prądnik. Prace Muz. Szafera	11–12	147–165	1998
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**NATURALNE I PÓLNATURALNE ZESPOŁY ROŚLINNE DOLINY  
POTOKU CHECHŁO (WYŻYNA KRAKOWSKO-WIELUŃSKA)**

**Natural and seminatural plant communities in the Chechło stream valley  
(Kraków-Wieluń Uppland)**

**ABSTRACT.** The paper presents results of studies on natural and semi-natural vegetation of the upper part of the Chechło stream valley. It was found that despite changes in the structure and floristic composition of communities brought about by human activities, the area has many valuable natural objects which deserve protection.

**KEYWORDS:** Kraków-Wieluń Uppland, Chechło stream valley, forest communities, grassland communities.

SUMMARY

The aim of this study was to determine the diversity in natural and semi-natural plant communities of the upper part of the Chechło stream valley. In the course of studies carried out in 1993–1995, 18 syntaxa were distinguished: 14 of them ranking as associations, 1 sub-association, and 3 communities of uncertain syntaxonomic position. These represent forest (9), meadow (4), peatbog (3) and rush (3) communities.

Prądnik. Prace Muz. Szafera	11–12	167–182	1998
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## ZBIOROWISKA ROŚLINNE REZERWATU KRAJOBRAZOWEGO DOLINA RACŁAWKI

### Plant Communities of the Raclawka Valley landscape reserve

**ABSTRACT.** In the reserve, six forest communities were found (*Quercus roboris-Pinetum*, *Alno-Padion*, *Tilio-Carpinetum*, *Dentario glandulosae-Fagetum*, *Luzulo pilosae-Fagetum*, and three non-forest communities (*Peucedano cervariae-Coryletum*, *Geranio-Petasitetum*, *Arrhenatheretum medioeuropaeum*). This paper presents the phytosociological and ecological characteristics of these communities.

**KEYWORDS:** forest communities, ecological characteristics of communities, nature reserve, Kraków Upland.

### SUMMARY

The Raclawka Valley landscape reserve (Fig. 1) is located on the Kraków Upland about 30 kilometres south of Kraków. It includes a rocky valley built of limestone and adjacent hilltops covered by a thick layer of clay formations.

In all, six forest communities were distinguished in the reserve: *Quercus roboris-Pinetum*, a riverine forest of the *Alno-Padion* alliance, *Tilio-Carpinetum*, *Dentario glandulosae-Fagetum typicum*, *Dg-F asperuletosum*, *Luzulo pilosae-Fagetum*, and three non-forest communities: *Peucedano cervariae-Coryletum*, *Geranio-Petasitetum* and *Arrhenatheretum medioeuropaeum*.

The area has retained the natural spatial diversity associated with different substrates and climatic conditions. *Dentario glandulosae-Fagetum* relict mountain beech forest occurs on the shaded slopes of valleys with a cold microclimate. Well-insolated habitats are occupied by *Carici-Fagetum* thermophilous beech forest, typical of a dry and warm local climate. Hilltops covered by thick acid brown soils are overgrown by the acidophilous associations *Quercus roboris-Pinetum* and *Luzulo pilosae-Fagetum*. The valley bottom, with very damp, fertile soils of alluvial type, is overgrown by riverine forests of the *Alno-Padion* alliance. (Figs 2, 3).

Analysis of the shares of various species showing different habitat requirements in particular forest communities (Figs. 4-8) permits evaluation of their ecological characteristics. The breakdown of the quantitative proportions of various life forms of plants in forest communities is also presented (Fig. 9).



Prądnik. Prace Muz. Szafera	11–12	183–198	1998
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**SZATA ROŚLINNA REZERWATU LEŚNEGO „DOLINA  
ELIASZÓWKI” I PROGRAM JEJ OCHRONY**

**Vegetation of the Dolina Eliazówki forest reserve and the programme for its  
protection**

**ABSTRACT.** The study outlines characteristics and evaluation of the vegetation of the reserve in which abundant relict stations of mountain species and association were found. On the basis of a phytosociological map and evaluation of vegetation cover, a programme for protection management in the reserve was developed.

**KEYWORDS:** vegetation map, forest communities, mountainous plant species, protection management, nature reserve, Cracow Upland, Southern Poland.

**SUMMARY**

The Dolina Eliazówki nature reserve, situated in the western part of the Kraków upland, includes a Jurassic value of typical shape. Almost all the area of the reserve is occupied by forests, among which some relict stations of mountain flora and other rare plant species have survived (Figs 1, 2, 3).

Seven associations were found within the area of the reserve (Fig. 4), including two typical mountain associations (*Dentario glandulosae-Fagetum* and *Dentario enneaphyllidis-Fagetum*). Mesophilous communities of deciduous forests occupying the slopes and valley floor predominate, whereas mixed forests and acidophilous beech forests occur on hilltops.

As a result of the protection measures carried out in recent years as well as spontaneous succession processes, the compatibility between forest stands and the habitats improved compared with the situation prevailing in the 1968-1975 period. In the last three decades, the share of pine and spruce has decreased in favour of deciduous tree species.

On the basis of cartographic work and evaluation of vegetation cover, a detailed plan of active protection management was developed for the reserve, aiming at the preservation of relict stations of mountain elements, the high species diversity of forest communities and a natural diversification of vegetation within the valley.

PRĄDNIK  
PRACE I MATERIAŁY MUZEUM IM. PROF. WŁADYSŁAWA SZAFERA

Prądnik. Prace Muz. Szafera	11–12	199–206	1998
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**DYNAMIKA PRZYROSTOWA BUKA, JODŁY I SOSNY W  
WYBRANYCH DRZEWOSTANACH OJCOWSKIEGO PARKU  
NARODOWEGO JAKO WSKAŹNIK ICH ŻYWOTNOŚCI**

**Growth dynamics in the beech, fir and the pine in selected forest stands of the  
Ojców National Park as indicator of their viability**

**ABSTRACT.** The study contains an analysis of the results of measurements of dbh (diameter at breast height) of beech, fir and pine trees in seven selected forest stands of the Ojców National Park. This analysis permits drawing indirect conclusions about diversified viability of stands of these species under recently changing conditions of industrial pollution impact on forest trees.

**KEYWORDS:** beech, fir, pine growth dynamics, viability of forest stands.

SUMMARY

As a result of analysis of dbh increment measurements of beech, fir and pine trees in seven forest stands of the Ojców National Park and the analysis of the dynamics of this increment the following conclusions were drawn:

- The development of beech stands goes undisturbed.
- There is an improvement in condition of fir trees which manifests itself in greater increments. The scope of this improvement cannot be regarded as satisfactory, especially since it has been caused partly by elimination of weaker trees.
- The increment in pine trees is poor, and there are no prospects of improvement in near future.

The large differences in increments in beech and the remaining tree species which are more sensitive, results perhaps from different degree of harmful impact of air pollutants.

Prądnik. Prace Muz. Szafera	11–12	207–218	1998
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**WYBRANE ZAGADNIENIA BIOLOGII POPULACJI ZAWILCA  
WIELKOKWIATOWEGO (*ANEMONE SYLVESTRIS* L.)**

**Some Problems of the Population Biology of the Snowdrop Windflower (*Anemone sylvestris* L.)**

**ABSTRACT.** In the Biała Góra reserve, the population dynamics of *Anemone sylvestris* were studied *in situ* in xerothermic grassland with the *Thalicthro-Salvietum* association. The conditions for the occurrence and development of this species in this area are optimal; however, in the future, a succession leading to bush associations might prove to be a potential threat. *Ex situ* experiments imply that the germination capacity of *A. sylvestris* declines with time. This species requires longer observation to determine methods of its propagation and *ex situ* cultivation.

**KEYWORDS:** xerothermic grassland, *Thalicthro-Salvietum* association, Biała Góra reserve, *Anemone sylvestris*, succession.

SUMMARY

1) In 1989–1991, studies on selected problems of the population biology of the snowdrop windflower *Anemone sylvestris* L. were carried out under natural (*in situ*) and laboratory conditions, and attempts were made to cultivate this species in garden conditions (*ex situ*).

2) The studies of the *Anemone sylvestris* population in the Biała Góra reserve indicate its stability; this is evidence that conditions for the occurrence and development of the snowdrop windflower in the reserve are optimal, and that this station of the species is not, at present, threatened in any way. A potential threat in the future might come from succession leading to shrub communities.

3) Laboratory tests regarding the germination capacity of this species indicate that seeds preserved under lower temperatures have better germination capacity and better viability of seedlings.

4) There is a possibility of cultivating *A. sylvestris* under garden conditions, but obtaining plants from seeds is difficult because of its relatively low germination capacity in *ex situ* conditions.

Prądnik. Prace Muz. Szafera	11–12	216–222	1998
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**NOWE DLA POLSKI GATUNKI GRZEBACZY  
(HYMENOPTERA: ACULEATA: SPHECIDAE)  
ORAZ NOWE STANOWISKA GATUNKÓW RZADKICH**

**Some digger wasps new to Polish fauna with notes on two other species  
(Hymenoptera: Aculeata: Sphecidae)**

**ABSTRACT.** Five species of digger wasps (*Hymenoptera: Sphecidae*), namely *Crossocerus heydeni* (Kohl), *Ectemnius confinis* (Walker), *Mimesa vindobonensis* Mäidl, *Solierella compedita* (Piccioli) and *Polemistus abnormis* (Kohl) are recorded in Polish fauna for the first time. New distribution data from *Pemphredon flavistigma* Thompson and *Trypoxylon kolazyi* Kohl are presented.

**KEYWORDS:** Poland, *Hymenoptera*, *Sphecidae*, first records, faunistics.

SUMMARY

The family *Sphecidae* has been studied in Poland for about 200 years now, but our knowledge of both species composition and their distribution is still incomplete. The authors have found five species new to Polish fauna during the last few years.

*Crossocerus heydeni* (Kohl, 1880) is a representative of boreo-montane faunistic element; the first Polish record of the species comes from northern Poland (environs of Sopot, UTM: CF43). *Ectemnius confinis* (Walker, 1871) was found in central Poland (Łódź, CC83); this species represents submediterranean faunistic element. *Mimesa vindobonensis* Mäidl, 1914 was captured in southern Poland on the Błędowska Desert near Olkusz (CA97); the known distribution of the species includes Austria, European part of Russia and the Far East. *Polemistus abnormis* (Kohl, 1888) was collected independently in different parts of Poland (DC46, DC59, CA46, CB86). This species is distributed in Central Europe, the Far East and Japan. One specimen of *Solierella compedita* (Piccioli, 1869) was collected in central Poland in 1994 (DC46).

*Pemphredon flavistigma* (Thompson, 1874), was recorded recently in central Poland (EB03). The only previously known locality of this species was Białowieża Forest (Eastern Poland). Another species, *Trypoxylon kolazyi* Kohl, 1893 was found in southern Poland (DA83).

Prądnik. Prace Muz. Szafera	11–12	223–250	1998
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**WPŁYW SUKCESJI ZBIOROWISK NIELEŚNYCH NA OWADY  
PSZCZOŁOWATE *APOIDEA* REZERWATU LEŚNO-STEPOWEGO  
SKOŁCZANKA**

**Effect of succession of non-forest communities on *Apoidea* in the Skołczanka  
forest-steppe reserve**

**ABSTRACT.** The effect of the succession of a sandy and limestone series of the communities on composition and density of *Apoidea* was studied over six years. In total, 95 species were found, i.e. 20,9% of the total number of the species of *Apoidea* occurring in Poland. Groupings of *Apoidea* in the sandy series were more abundant than those in the limestone series. The most diverse and richest in *Apoidea* species were grasslands and overgrown grasslands. Among 13 zoogeographical elements, the West-Palaearctic, Euro-Siberian, Palaearctic and European predominated. *Bombus jonellus* (K.) in Skołczanka is a glacial relic, threatened with extinction. It is one of the new stations of *Andrena fulva* (Müll.) in Poland. The status of the reserve should be changed and periodic management measures should be carried out in the communities which are particularly threatened by succession.

**KEYWORDS:** *Apoidea*, characteristics of groupings of species, zoogeography, succession of communities of sandy and limestone series, threat, protection of *Apoidea*, nature reserve, Kraków-Częstochowa Jura.

SUMMARY

In the 1989-1994 period, the effect of the succession of non-forest communities on *Apoidea* of the Skołczanka reserve was studied. On the basis of the vegetation map of the reserve, and differences in the geology of the substrate, two succession series of plant communities were distinguished - sandy and limestone (Fig.1). The spatial changes in the plant communities of the reserve over the period of 25 years are illustrated in Figs. 2 and 3. The striking feature in the figures is a rapid decrease in the areas of open communities (dunes, grasslands on sand and grasslands on limestone) and an increase in the area occupied by secondary pine forests.

The effect of succession on the changes in the floristic composition of a xerothermic grassland over 5 years was shown in Table 1. It was found that the numbers of many xerothermic species dropped to a level that threatened their extinction in the reserve.

Studies on *Apidea* in the communities of both series were only carried out in 1989-1991 and 1992-1993 seven times, whereas in 1994 thirteen times, in order to learn about the full species composition of this group of insects. Each time, both qualitative and quantitative estimates of *Apidea* groupings were made by counting along transects in all communities of the both series. In total, 95 species of *Apidea* of 6 families were found (Table 2), i.e. 20,9% of the total number of such species occurring in Poland. The total numbers of *Apidea* species in individual communities of both series ranged from 4 (climax stages) to 42 (non-forest communities), while the number of individuals ranged 25 to 227. The composition and the number of species changed throughout the vegetation season (Table 3). In this connection, two maxima in the number of species were found (Fig. 4): the spring maximum in May (64 species) and the summer maximum in July (55 species) separated by a transitional spring/summer period in June (44 species). In the fauna of *Apidea* in Skolczanka reserve, 20 species of parasite bees were found, i.e. over 21% of all *Apidea* known to occur in the reserve (cf. Table 2). Among the 95 species of *Apidea*, 33 species are common for both series, 40 species occurred only in the sandy series and 22 - in the limestone series. Open communities in both series (dune, grassland) had much a larger number of species compared with semi-open (artificial pine forest) and closed (climax) stages (cf. Table 2).

The qualitative/quantitative assessment of *Apidea* groupings in the two series of communities permitted the determination of the number of species (S) and density of individuals (N/hectare) on the dates of field censuses (Table 4). The number of *Apidea* species in the communities of the sandy series ranged from 1 to 15, and in the limestone series from 1 to 10; density in the former series fluctuated from 50 to 2100 individuals/hectare and from 50 to 1450 individuals/hectare respectively in the latter. Based on the number of species (S) and density (N/hectare), species diversity (H') and the structure of species domination (J') were calculated for groupings of *Apidea* in the two series. The basic structural parameters of the *Apidea* groupings in 4 time intervals is outlined in Table 5. It was found that the *Apidea* groupings in the sandy series were richer than those in the limestone series. In both series, grasslands and overgrown grasslands were the most diverse and richest in *Apidea*.

The ever shrinking area of dunes and grasslands on sand (cf. Figs. 2 and 3) and of xerothermic grasslands on limestone (fig. 5) significantly affected the groupings of *Apidea* have probably withdrawn from the reserve (cf. Tabl. 3). However, in the last year of the study, there were 14 new species were found, mostly nesting above the ground. The species of *Andrenidae* and *Halictidae* (nesting in the ground) appeared the most susceptible to succession in both series of communities. Significantly less sensitive were species of *Megachilidae*, *Anthophoridae* and *Apidae*. Such species as, for example, *Colletes cunicularius*, *Sphecodes albilabris*, *Andrena fulva*, *Heliophila bimaculata*, *Ceratina cyanea* and eight species of *Apidea* family were resistant to succession (cf. Tabl 3).

In the *Apoidea* fauna of the Skolczanka reserve, four zoogeographical elements predominated (Table 6): the West-Palearctic (21.0%), Euro-Siberian (17.9%), Palearctic (16.8%) and the European (12.6%). The share of the Southern element (*sensu lato*) was markedly smaller (7.4%). *Bombus jonellus* represents, in the Skolczanka reserve, a glacial relic now threatened with extinction. *Andrena fulva*, however, was now found in a new location on the right bank of the Vistula River.

*Apoidea* of the Skolczanka reserve visited 61 species of flowering plants belonging to 21 families (Annex 1) including a number of valuable xerothermophilous, cultivated and medicinal plant species. The main role in pollinating of these species was played by bumble bees which visited between 3 and 25 plant species, whereas the share of solitary bees in pollinating flowering plants was markedly smaller (cf. Table 3).

In the face of the threat to *Apoidea* posed by the succession of plant communities, it is necessary to introduce measures to enable conservation of the optimum groupings of these insects. For this purpose, the status of the reserve should be urgently changed from strict reserve to partial reserve. This would enable the carrying out of periodic practices (cutting grasses, trees and bushes) ensuring the protection of *Apoidea* in the non-forest communities of both series which are particularly threatened by succession.

Prądnik. Prace Muz. Szafera	11–12	251–260	1998
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**MATERIAŁY DO POZNANIA NASTECZNIKOWATYCH POLSKI  
(HYMENOPTERA: ACULEATA: POMPILIDAE)**

**Contributions to the knowledge of Polish spider wasps  
(Hymenoptera: Aculeata: Pompilidae)**

**ABSTRACT.** Distribution data from 19 species of spider wasps (*Hymenoptera, Pompilidae*) in Poland are presented. *Anoplius aeruginosus* (Tournier, 1890) is recorded in Poland for the first time. For each species is given a short description of its known distribution in Poland.

**KEYWORDS:** Poland, *Hymenoptera, Pompilidae*, new records, faunistics.

SUMMARY

The state of knowledge of Polish spider wasps (*Hymenoptera: Pompilidae*) is rather poor as far as species composition and their distribution is concerned. Most of the existing data comes from the 19th and the first half of the 20th century. The old data are at least partially unreliable because of quite common misidentifications, and they need thorough revision.

The main task of this paper is presenting new distribution data from 19 species of *Pompilidae* in Poland. The specimens come from the collection of the second author and were collected during 1975–1998. The species are presented in alphabetical order; the division of Poland into zoogeographical regions follows the one applied in Catalogues of Polish fauna (Katalogi fauny Polski) and the localities are arranged alphabetically within the regions. For each species the following information is given: localities with the UTM co-ordinates, dates of collection, number and sex of collected specimens and names of the collectors. The abbreviations used in the text stand for: JKK — Jan K. Kowalczyk, the second author; KPN — Kampinos National Park; PK — landscape park; SPN — Swietokrzyski National Park.

Among the spider wasps concerned in the present paper *Anoplius aeruginosus* (Tournier, 1890) is recorded in Poland for the first time. The species is treated by some authors as a subspecies of *A. infuscatus* Vander Linden, but there are some morphological features that differentiate them: hairs on genae and propleura are black for *A. aeruginosus* and whitish for *A. infuscatus*; the frons of the first species is covered by 40–50 setae, for *A. infuscatus* by only 20–25 setae; both propodeum and the first metasomal segment are hairy for *A. aeruginosus* and have at most a few short and light hairs for *A. infuscatus*. *Ceropales albicincta* (Rossi, 1790), *Episyron gallicum* (Tournier, 1889) and *Homonotus sanguinolentus* (Fabricius, 1793) have been known in Poland from few localities so far.



Prądnik. Prace Muz. Szafera	11–12	261–269	1998
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**OSY SPOŁECZNE (*HYMENOPTERA: ACULEATA: VESPINAE*)  
POŁUDNIOWO-WSCHODNIEJ POLSKI.  
CZĘŚĆ I. WYKAZ GATUNKÓW<sup>1</sup>**

***Vespinae (Hymenoptera: Aculeata) of south-eastern Poland.  
Part I. List of species***

**ABSTRACT.** The paper brings data on the occurrence of paper wasps in south-eastern Poland. So far 13 species are known from the area compared with 14 species occurring in Poland. *Polistes nimpha* is the only species not recorded from Carpathians.

**KEYWORDS:** *Vespinae*, Poland, distribution, Ojców National Park.

**SUMMARY**

The paper brings data on the occurrence of paper wasps in south-eastern Poland based on specimens preserved in following collections: Institute of Systematics and Evolution of Animals PAS in Kraków (Poland), R. Eck — Staatliches Museum für Naturkunde in Dresden (Germany) and private collection of B. Wiśniowski. So far 13 species are known from the area compared with 14 species occurring in Poland. *Polistes nimpha* is the only species not recorded from Carpathians.

Prądnik. Prace Muz. Szafera	11–12	271–278	1998
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**OSY SPOŁECZNE (*HYMENOPTERA: ACULEATA: VESPINAE*)  
POŁUDNIOWO-WSCHODNIEJ POLSKI.  
CZĘŚĆ II. ROZSIEDLENIE WYSOKOŚCIOWE**

***Vespinae (Hymenoptera: Aculeata) of south-eastern Poland.  
Part II. Vertical distribution***

**ABSTRACT.** The authors discuss vertical distribution of social wasps (*Hymenoptera: Aculeata: Vespinae*) in Polish Carpathians. The relationship between climate and the occurrence of certain vespine wasps is pointed out.

**KEYWORDS:** *Vespinae*, Poland, vertical distribution

**SUMMARY**

Thirteen species of *Vespinae* were recorded in south-eastern Poland, and in Polish Carpathians 12 species. Vertical distribution of *Vespinae* in Carpathian Mts agrees with geobotanical division of south-eastern Poland (Fig. 1). *V. crabro* and *P. biglumis* probably do not reach higher than Pogórze, *D. omissa*, *V. austriaca* and *D. media* were not recorded higher than in mixed forest zone, *D. adulterina*, *D. omissa*, *V. vulgaris* not higher than in spruce forest zone, *D. saxonica*, *V. rufa*, *D. norwegica* (?) and *D. sylvestris* (?) not higher than in subalpine zone. *V. vulgaris* dominates in the Pogórze, *D. saxonica* and *D. norwegica* dominate in the mixed forest zone; *D. norwegica* and *V. vulgaris* dominate in the spruce forest zone, while *D. norwegica* in subalpine zone. In alpine zone mainly *D. norwegica* was recorded.

Prądnik. Prace Muz. Szafera	11–12	279–292	1998
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# Babiogórski Park Narodowy, 34–223 Zawoja

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### Ojcowski Park Narodowy, 32–830 Ojców

**SKŁAD GATUNKOWY I LICZEBNOŚĆ TRZMIELI I TRZMIELCÓW  
(*BOMBINAE*, *APOIDEA*, *HYMENOPTERA*) NA ŁĄKACH  
W WYBRANYCH PARKACH NARODOWYCH ORAZ KWIECISTOŚĆ  
ŁĄK W TYCH PARKACH W 1998 ROKU**

**Species composition and numbers of the *Bombus* Latr. and *Psithyrus* Lep.  
on selected meadows in particular National Parks in Poland and the floral  
abundance of these meadows in 1998**

**ABSTRACT.** The species composition and numbers of the *Bombus* Latr. and *Psithyrus* Lep. was examined in 1998 on selected meadows of the Świętokrzyski, Ojców, Magura, Pieniny, Gorce, Babia Góra and Tatra National Parks. The floral abundance of the meadows and the numbers of *Bombus* Latr. and *Psithyrus* Lep. on them were also determined and compared.

**KEYWORDS:** *Bombus*, *Psithyrus*, floral abundance, national parks, Poland.

**SUMMARY**

On the selected meadows of the Świętokrzyski, Ojców, Magura, Pieniny, Gorce and Tatra National Parks, the species composition and numbers of the *Bombus* Latr. and *Psithyrus* Lep. was studied in 1998. At the same time, the floral abundance of the meadows and the numbers of *Bombus* Latr. there were determined. In all the above mentioned National Parks, 12 species of *Bombus* and 6 species of *Psithyrus* were recorded (proportionally 19 and 7 of them being present on the Polish side of the Parks).

*Bombus soroensis soroensis* (a black haired form with white hair at the end of the abdomen) constituted only up to 1% of all *Bombus* sp. until 1992 in the Carpathian national parks. In 1998 its share increased up to 30%.

The average number of *Bombus* and *Psithyrus* on surfaces where floral abundance was determined was, in most cases, 16 to 19 specimens per 100 m<sup>2</sup>, with the floral abundance factor between 0,1 and 0,4% and 4 individuals with the floral abundance 0,02–0,04%. Only in Pieniny 14 individuals with the floral abundance ca. 2%.(the floral abundance represents the quantity of flowers per ground area unit, as well as the total percentage of the flowering area on a ground area unit).

Prądnik. Prace Muz. Szafera	11–12	293–323	1998
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**SUPLEMENT DO ZNAJOMOŚCI CHRZĄSZCZY (*COLEOPTERA*)  
OJCOWSKIEGO PARKU NARODOWEGO I JEGO OTULINY  
(W 145 ROCZNICĘ ROZPOCZĘCIA INWENTARYZACJI  
FAUNISTYCZNEJ W OJCOWIE)**

**Contribution to the knowledge of the beetle fauna (*Coleoptera*)  
of the Ojców National Park and its buffer zone  
(in 145th anniversary of a start of the faunistic inventory at Ojców)**

**ABSTRACT.** New data on 550 species (belonging to 70 families) of the Ojców beetle fauna are presented. In this number 206 species are recorded for the first time.

**KEY WORDS:** Ojców National Park, *Coleoptera*, faunistic inventory.

SUMMARY

Present paper is the first supplement of the main elaboration on *Coleoptera* of the Ojców National Park and its environments (Pawłowski & al. 1994). A monography cited above records 1509 species of beetles collected in the period 1854–1990. In this paper we can inform about next 206 species found in few collections deposited mainly in the Upper Silesian Museum, Bytom (W. Mączyński's collection), in Museum and Institute of Zoology PAS, Warsaw (E. & G. Mazurs' collection and others), in Institute of Systematics and Evolution of Animals PAS, Kraków (A. Waga collection), in the Museum of the Ojców National Park and in few other small collections, as well as in the Biological Station PAS at Ojców (some old, early not elaborated materials). Few further informations based on Stefek's (1939) paper, as well as on unpublished student elaborations made in the Forestry Department of Cracow Academy of Agriculture (Chudzikiewicz 1977, Górka 1993, Łuszczak 1975, Ząbecki 1982, Zyzak 1984).

After all above mentioned complementary informations, a check-list of the beetle fauna of the Ojców region records presently 1712 species. Five families (*Micropeplidae*, *Clambidae*, *Sphindidae*, *Alexiidae*, *Cimberidae*) are recorded for the first time. Three species (*Staphylinus dimidiaticornis*, *Notoxus brachycerus* and *Hylesinus orni*) are deleted from the list as erroneously determined. We can inform also about new data of 345 early recorded species. More interesting presently recorded taxons are: *Carabus irregularis* (*Carabidae*); *Hydraena pygmaea*, *H. excisa*, *H. hungarica* and *Limnebius crinifer* (*Hydraenidae*); *Anemadus strigosus* (*Catopidae*); *Hapalarea pygmaea*, *Zeteotomus brevicornis*, *Mycetoporus piceolus*, *Schistoglossa curtipennis*, *Amischa soror*, *Liogluta oblongiuscula* and *Atheta subrugosa* (*Staphylinidae*); *Cantharis decipiens* and *Rhagonycha interpositus* (*Cantharidae*); *Ptinus villiger* (*Ptinidae*); *Meligethes czwalinai*, *M. lepidii* and *Pocadius adustus* (*Nitidulidae*); *Cryptophagus labilis* and *C. deubeli* (*Cryptophagidae*); *Orthoperus mundus* (*Corylophidae*); *Sphaerosoma globosum* (*Alexiidae*); *Aphthona herbigrada* (*Chrysomelidae*).

Prądnik. Prace Muz. Szafera	11–12	325–333	1998
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## SSAKI (MAMMALIA) OJCOWSKIEGO PARKU NARODOWEGO\*

### Mammals of Ojców National Park

**ABSTRACT.** The authors present a preliminary list of mammal species occurring in the area of Ojców National Park. No species of small mammals and chase game in this area belong neither to the primary nor secondary faunistic values, eight species were ranked as the tertiary faunistic value. The numbers and population density of the most common species are given and factors threatening mammals of the ONP as well as means of their preservation are discussed in the paper. There is also a list of mammals presently occurring in the area, which fossil remainings were found in pleistocene deposits of ONP and its surroundings.

The list is incomplete and fragmentary because of lack of data.

**KEYWORDS:** chase game, small mammals, Ojców National Park, evaluation, nature conservation, fossil mammals.

### SUMMARY

The aim of this paper was to gather data on small mammals and chase game of the Ojców National Park (OPN). The obtained information — unfortunately incomplete and fragmentary — was based on the scanty literature and included fossil remainings of mammals as well as animals spotted around the territory of the OPN.

The paleontological materials found in caves and rock shelters, dated on Quaternary, are presented in Table 1. Elk (*Alces alces*), red deer (*Cervus elaphus*), wolf (*Canis lupus*), wild cat (*Felis silvestris*), brown bear (*Ursus arctos*) and garden dormouse (*Eliomys quercius*) are species that extincted on the present area of the OPN.

Bank vole (*Clethrionomys glareolus*) and yellow-necked mouse (*Apodemus flavicollis*) constituted 98% of all rodents inhabiting beech forest. During three years both populations completed a cycle from high density (27 per ha) to a low one (8 per ha). Mole (*Talpa europea*) and common shrew (*Sorex araneus*) were the most common insectivores. The most numerous game were brown hare (*Lepus capensis*) and fallow deer (*Dama dama*) — Table 2.

The presence of red deer (*Cervus elaphus*) was not confirmed.

Due to small area of the Ojców National Park its mammals don't stand out against the fauna of surrounding areas, i.e. Krakowsko-Wieluńska Jura. There were no species belonging neither to the primary nor secondary faunistic values, eight species were ranked as the tertiary faunistic value: European water shrew (*Neomys fodiens*), lesser white-toothed shrew (*Crocidura suaveolens*), northern birch mouse (*Sicista betulina*), fat dormouse (*Glis glis*), forest dormouse (*Dryomys nitedula*), common dormouse (*Muscardinus avellanarius*), European beaver (*Castor fiber*) and stoat (*Mustella erminea*).

Factors threatening mammals of the OPN and means of their preservation are discussed in the paper. Most of all, there is the need to conduct systematic observations and annual inventory-takings of the OPN game to determine tendencies of changes in the population numbers for particular species. It helps to conclude precise protective actions for preserving small mammals and chase game of the OPN.

Prądnik. Prace Muz. Szafera	11–12	335–345	1998
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**ROLA STAWÓW HODOWLANÝCH W PRZEMIANACH KRAJOBRAZU  
KULTUROWEGO DOLINY WIERCICY**

**Importance of breeding ponds in transformation  
of Wiercica Valley cultural landscape**

**ABSTRACT.** This article is a part of an elaborate which concerns changes in cultural landscape under an influence of water economy in the chosen area of the catchment of upper Wiercica river. In 1881 the biggest and the most modern fish breeding of Europe was started there. The consequences of scenic establishment of breeding ponds in upper Wiercica, near Złoty Potok, are presented.

**KEYWORDS:** breeding ponds, changes in cultural landscape, Wiercica Valley, history.

SUMMARY

Wiercica is a typical river for karstic regions. It takes beginning in many springs, grouped in two large complexes, known as Zygmunt's Springs and Elżbieta's Springs.

Advantages of clean Wiercica, flowing diversified from the point of view of scenery valley, were known since long time ago. The idea of setting fish-farms in upper part of Wiercica descend from Krasieński's family. Undertaking a building of palace-park complex in Złoty Potok ( Gold Stream), Krasieński's family established first ponds which functions at the beginning were only decorative. However, abundance of Wiercica's springs and its natural specific fishes affluence inclined Krasieński's inheritor, GA. E. Raczyński, to undertaking of implements of Wiercica waters. Execution of project and supervision over the building were given to outstanding specialist — M. Girdwoyń. At the first stage the project assumed building up of 22 ponds with 4 metres depth and total surface over 13 hectares, and also hatchery and a building for pond-supervisor, so called fisherman's hut „rybaczówka”. Execution of the undertaking was the biggest and the most modern in Europe in that time. Fishbreeding estate had started activity in 1881, when let out pedigree part of salmon fishes. Progressively, trout farm had increased, and in 1908 the number of ponds had grown up to 46 and built up new farm building in Zakopane style, so called mountaineer's hut „góralówka”.

Establishment of ponds in Wiercica imparted dynamism of change of cultural scenery in these part of valley. Significance of nearby Janów and Złoty Potok had grown up, which on the turn of the 19th century lived its the biggest bloom. From this period originate architectonic centre with strong connection to regional tradition.

PRĄDNIK  
PRACE I MATERIAŁY MUZEUM IM. PROF. WŁADYSŁAWA SZAFERA

Prądnik. Prace Muz. Szafera	11–12	347–354	1998
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**ANALIZA ZAWARTOŚCI WYBRANYCH PIERWIASTKÓW  
W OPADZIE ORGANICZNYM I ŚCIOLE BUKOWEJ  
NA POWIERZCHNI DOŚWIADCZALNEJ „CHEŁMOWA GÓRA”  
W OJCOWSKIM PARKU NARODOWYM**

**Analysis of the content of selected elements in litterfall and organic matter on  
experimental plot of beech stand „Chełmowa Góra” in Ojców National Park**

**ABSTRACT.** Content of selected elements in organic matter from litter trap and upper layer of soil were taken and analyzed in 1994 from experimental area „Chełmowa Góra” of beech stand in Ojców National Park.

**KEY WORDS:** litterfall, organic matter, heavy metals, mineral nutrition, *Fagus sylvatica* L.

SUMMARY

The aim of the present experiment was to determine the content of selected elements in litterfall on experimental area „Chełmowa Góra” of beech stand in Ojców National Park. The organic matter from litter trap and upper layer of soil were taken and analyzed in 1994. On the base of the present results we can draw following conclusions: organic matter from litterfall can not provide mineral nutrition of the tree; differences can be found in contents of minerals in litterfall and in organic layer of soil as a accumulation of heavy metals as well as S, and Na were found in organic layer of soil and leaching of K, Ca and Mg; increasing of content of S, Pb and Cr in leaves; continuation of permanent observations and addition of numbers of litter trap is needed.

Prądnik. Prace Muz. Szafera	11–12	355–367	1998
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**RUCH TURYSTYCZNY W OJCOWSKIM PARKU NARODOWYM  
W LATACH 1993–1994**

**Tourist flows in the Ojców National Park during 1993–1994**

**ABSTRACT.** The area covered by Ojców National Park hosts a variety of social and economic functions. One of these is tourism. Tourist movement today presents a real danger to the region's natural environment. There is a real need to research this danger — hence this paper. This article traces the characteristics of tourist movement in ONP, highlighting its dimensions, structures and temporal and spatial arrangement.

**KEYWORDS:** tourist flows, structure of tourist movement, seasonality of tourist flows, Ojców National Park.

SUMMARY

Tourist flows to Ojców National Park (ONP) during 1993–94 totalled some 230–240,000 people. However over the last 10 years (1985–94) numbers have been declining. This may be related to a decline in the frequency of tourists visiting monuments (Fig.1). The area attracting the greatest concentration of tourists is the Castle Park in Ojców, which is visited by practically all visitors to ONP. The most intensively-traversed track runs from Castle Park to Lokietka Caves — the Lokietka Way. The most-visited parts of the Park include the area around Lokietka Caves (61 per cent of all visitors), the castle at Pieskowa Skala and Maczuga Herculesa (50 and 41 per cent respectively), the Dark Caves region (21 per cent) and Brama Krakowska (20 per cent).

Short-stay tourism dominates in Ojców National Park, with most tourists staying just 1–8 hours. Only a few per cent stay longer than three days, but this proportion increases during the summer holidays (to 31 per cent of visitors).



Tourists staying longer than a day (1993—22 per cent; 1994 — 11 per cent) over-nighted mainly in private accommodation (35 per cent) and in camping grounds (27 per cent). Visits most frequently take place on Tuesdays, Wednesdays and work-free days. Holiday-time tourism amounts to some 110–120,000 people over the course of a year.

As regards organized tours, the most important are organized outings. These involve around 140–160,000 tourists annually, but over the last ten years this figure has declined. These outings are particularly popular with young people, who account for 90 per cent of those taking part. May, June and October are the most popular months.

Re recuperative visits and guided tours are the main types of visits. The latter category of visits are generally organized in groups, while rest is the motivation especially for short-staying individual tourists. The main reasons stated for visiting the Park include: to see the caves (47 per cent), to see the castles (34 per cent), a desire to get out of town (32 per cent) and an interest in nature (27 per cent).

Most visitors are young. Those under 26 accounted for 62 per cent of visitors in 1993 and as much as 75 per cent a year later. Most visitors have completed at least secondary-level education

Urban-dwellers form the vast majority (92 per cent) of visitors.

The share of foreign tourists in the total is minimal. Foreigners account for a paltry 2 per cent of all visitors to ONP. Most foreign visitors are Europeans, especially Germans and French. They generally visit the Park during their stay in Cracow. Domestic tourists are sourced mostly in Upper Silesia and the Cracow region (54–58 per cent).

From an environmental viewpoint, the high proportion of visitors arriving by car (38 per cent) is of concern.

Tourist flows into ONP have a seasonal character. The tourist season from May–October sees 91 per cent of tourist movement. Such a strong concentration of arrivals in this period (and especially in May, June and October) greatly affects the ability of the area to absorb the numbers coming in and the possibilities of satisfying demand for some tourist services.

PRĄDNIK  
PRACE I MATERIAŁY MUZEUM IM. PROF. WŁADYSŁAWA SZAFERA

Prądnik. Prace Muz. Szafera	11–12	369–396	1998
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**OJCOWSKI PARK NARODOWY A KSZTAŁTOWANIE SIĘ POSTAW  
I ŚWIADOMOŚCI EKOLOGICZNEJ JEGO MIESZKAŃCÓW**

**Ojców National Park — forming the attitudes and ecological awareness  
of its inhabitants**

**ABSTRACT.** This paper is based on a poll carried out among respondents inhabiting Ojców National Park and its buffer zone. An aim of the study was to show how the inhabitants of ONP perceive the park and how it influences their ecological awareness. Results indicate the reactions of inhabitants on restrictions and injunctions obligatory in a national park, an estimate of managerial actions by inhabitants of the park, and suggest some solutions facilitating their cooperation with the managerial staff of the park.

**KEYWORDS:** poll, Ojców National Park, buffer zone, inhabitants, ecological awareness, estimate of managerial actions.

SUMMARY

All available inhabitants of the park ( $N = 88$ ) and as many in its buffer zone were polled. Distinct differences were found in education level and occupations of respondents (tabl. 1).

Ecological awareness of ONP inhabitants was estimated through their knowledge on the state of environment — in global aspect (Poland), and local (residency site). Respondents estimate the state of environment in Poland quite accurately — the majority of respondents regards it as considerably polluted (tabl. 2, fig. 1).

The state of environment in residency site is generally estimated by respondents as quite good, but relatively more often they indicate higher pollution of waters and forests (tabl. 3, fig. 1).

The level of ecological knowledge and awareness grows together with education level; higher ecological knowledge was among inhabitants of the park than the buffer zone.

Most often (36.9%) the ONP was associated by respondents quite positively — mostly with natural and cultural values. However there is also a relatively numerous group (18.8%) associating the park with uncared for badly managed area (tabl. 4).

Local inhabitants most often hold, that the establishment of the national park was accompanied with indignation and antipathy (30%). Much more often an antipathy as the reaction for the establishment of the national park was stressed by inhabitants of the park (46.6%) than the buffer zone (15.9%) (tabl. 5, fig. 3). The negative reactions, according to inhabitants, were mostly caused by restrictions introduced in commercial activity, constructions, communication, as well as due to perceiving the park staff as being privileged, not subject to such restrictions.

The respondents declare their understanding for some restrictions obligatory within the park area (an access by car — tabl. 6), the definite majority (90.9%) claims that they do not violate regulations of environment protection, and thinks that their non-observance should be punished (tabl. 7), however generally they observe and tolerate these rules only when they do not interfere with their personal interest.

Activities of park managerial staff, connected with nature conservancy, were accepted by only 19.9% of respondents. Inefficiency of park management is claimed by 46%, and undecided is 33%. The development of facilities connected with protection of environment and cleanness of the area (e.g. cleaning up the forest) were mentioned as the most important fields, where the management should improve its effectiveness.

Regarding the living standards in ONP dominating are low marks — 40.6% of all appreciations of various aspects of living in ONP are negative (tabl. 8). Most critically are perceived possibilities of employment and the development of cultural life in the place of residence. There is a distinct disproportion in these estimates between the inhabitants of the park and the buffer zone. The former much more often perceive their living standards as bad (fig. 4).

Over a half of respondents (51.5%), as the main advantage of living in the park consider values of landscape, and the most often stated difficulties are restrictions in communication and development resulting from stricter rules of environment protection in the park.

Activities considered as the most effective for the better environment protection in the park are educational enterprises (education of inhabitants, introduction of ecological knowledge to schools) and economic (profitability of environment protection, expenses on protective facilities — tabl. 9 and 10). Inhabitants see the necessity of actions for the improvement of environment quality carried out by other institutions or social organisations (the Church, ecological movements). At the same time, in majority they do not declare their involvement in such movements — only about one third of respondents claimed such readiness.

Concluding, it is possible to say, that park inhabitants represent in general the higher level of ecological knowledge, also more often they chose the pro-ecological attitude than inhabitants of the buffer zone. On other hand, they are much less satisfied with their living standard, comparing to people living in the buffer zone. In general, the respondents consider the state of environment in the park as bad, and claim the necessity for changes, but often assume that somebody else should deal with that problem.

Comparing Ojców and Bieszczady National Parks, there are visible some differences in perceiving the park as an institution by its inhabitants, as well as in the appraisal of park administration, and the management of natural resources. Inhabitants of ONP perceive those aspects more negatively. These differences may however result from various location, history and the size of both parks.