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## THE BRYOPHYTE COLLECTION IN THE OPOLE SILESIA MUSEUM IN OPOLE

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**ABSTRACT:** This paper contains the localities of 73 bryophyte taxa collected by A. Graw, K. Bialucha and R. Woesler in the 1920, '30s and '40s from Upper Silesia and housed in the herbarium of the Opole Silesia Museum.

**KEY WORDS:** mosses, liverworts, Silesia, Opole Silesia, Upper Silesia, Poland, protected plants, distribution

### Introduction

Housed in the herbarium of the Opole Silesia Museum is an assemblage of bryophytes collected by A. Graw, K. Bialucha and R. Woesler in the 1920, '30s and '40s from Upper Silesia in an area which forms part of the present-day Opole and Silesia Provinces. The collection consists almost entirely of mosses, the only liverwort appearing as an addition beside the *Hypnum jutlandicum* specimen. This collection is a valuable addition to our knowledge of the bryoflora of Upper Silesia. In the interwar period only a few accounts were published from this area (Torka 1931, Rejment-Grochowka 1936, Wilczek 1936). Furthermore, part of the herbarium material, especially Torka's collection, disappeared during the Second World War. The specimens in the Opole Silesia Museum collection are principally mosses of terrestrial habitats, occurring fairly frequently in this area up to the present time. Some rare taxa are worth mentioning such as *Sphagnum affine* which is new to the Kotlina Raciborska Basin and the Równina Opolska Plain floras and *Sphagnum platyphyllum* new to the Silesian

Upland flora. The biggest part of the collection originates from the Silesian Lowland, especially from the Równina Opolska Plain where botanical investigation was carried out by K. Bialucha. Many data (collected primarily by A. Graw) are from the Silesian Upland, while from the Beskid Śląski Range only two bog-moss species are included. Part of the collection (that assembled by K. Bialucha and W. Woesler) consists of specimens glued to sheets of white cardboard, while A. Graw's material is in paper envelopes. The whole collection is stored in cardboard boxes.

## Results

The identifications of all the species found have been checked. The taxa present in the material examined have been listed in an alphabetical order. Liverwort nomenclature follows Grolle and Long (2000) and that for mosses Ochyra *et al.* (2003). For each station the following information is given: author of the collection, collecting date, information written on the specimen labels (habitat, altitude), notes about the presence of sporophytes and the number of the specimen as recorded in the catalogue of the Opole Silesian Museum Herbarium (OPOL). Where a name change has occurred after revision the original name of the specimen is given. For rare or interesting species information about their present distribution, legal status and degree and type of threat in Poland (Żarnowiec *et al.* 2004) is given. Details of collecting sites precede the floristic list. The sites are categorized according to the physico-geographical regions in which they lie (Kondracki 1994). The following information is given for each site: its present-day Polish name (in bold type), its German name (in italic type) and administrative district (in brackets).

Collecting sites:

- Bizja** *Bisia* (Świerklaniec commune; Garb Tarnogórski Mound)
- Brynek** *Brunnek* (Tworóg commune; Równina Opolska Plain)
- Bytom** *Beuthen*, west of the town (Garb Tarnogórski Mound)
- Chmielowice** *Chmiellowitz* (Komprachcice commune; Równina Niemodlińska Plain)
- Dębie** *Dembio* (Chrzastowice commune; Równina Opolska Plain)
- Dębska Kuźnia** *Dembiohammer* (Chrzastowice commune; Równina Opolska Plain)
- Domecko** *Dometzko* (Komprachcice commune; Równina Niemodlińska Plain)
- Fossowskie** (Kolonowskie commune; Równina Opolska Plain)
- Gliwice-Łabędy** *Laband* (Kotlina Raciborska Basin)
- Góra Św. Anny** *Annaberg* (Leśnica commune; Chełm Mound)
- Kały** *Podewils* (Murów commune; Równina Opolska Plain)
- Katowice** *Kattowitz* (Wyżyna Katowicka Upland)
- Kolonia Popielowska** *Klink* (Popielów commune; Pradolina Wrocławska Valley)
- Ochodze** *Ochotz* (Komprachcice commune; Równina Niemodlińska Plain)
- Opole** *Oppeln* (Pradolina Wrocławska Valley)
- Opole-wyspa Bolko** *Bolko Insel* (Pradolina Wrocławska Valley)
- Opole-Wyspa Pasięka** *Wilhelmsthal* (Pradolina Wrocławska Valley)

**Opole-Zakrzów** *Sakrau* (Pradolina Wrocławska Valley)  
**Ostrożnica** *Ostroznica* (Świerklaniec commune; Garb Tarnogórski Mound)  
**Prószków** *Proskau* (Równina Niemodlińska Plain)  
**Przechlebie** *Sandwiesen* (Zbrosławice commune; Wyżyna Katowicka Upland)  
**Rudy** *Rauden* (Kuźnia Raciborska commune; Kotlina Raciborska Basin)  
**Sławięcice** *Slavencicz* (Kotlina Raciborska Basin)  
**Staw Sangów** *Sangow Teich* (Niemodlin commune; Równina Niemodlińska Plain)  
**Suchy Bór** *Derschau* (Chrzastowice commune; Równina Opolska Plain)  
**Szydłów** *Schiedlow* (Tułowice commune; Równina Niemodlińska Plain)  
**Tarnowskie Góry** *Tarnowitz* (Garb Tarnogórski Mound)  
**Turawa** *Turawa* (Równina Opolska Plain)  
**Tworóg** *Tworog* (Równina Opolska Plain)  
**Winów** *Winau* (Prószków commune; Pradolina Wrocławska Valley)  
**Wisła** *Weichsel* (Beskid Śląski Range)  
**Zbicko** *Zbitzko* (Chrzastowice commune; Równina Opolska Plain)

Collectors: B. – K. Białucha; G. – A. Graw; W – R. Woesler.

Key to symbols: ● – strictly protected species; ◆ - partly protected species;

\* - species threatened in Poland.

#### Liverworts Marchantiopsida

*Lophocolea bidentata* (L.) Dumort. – Staw Sangów (leg. B. 25 September 1932; as admixture among *Hypnum jutlandicum*, P/1545).

#### Mosses Bryopsida

◆*Abietinella abietina* (Hedw.) M.Fleisch. – Chmielowice (Wullesruh), near brickyard (leg. B. 1 October 1932, P/1532).

*Atrichum undulatum* (Hedw.) P.Beauv. – Dębska Kuźnia and Suchy Bór, forest, *c. spor.* (leg. B. 6 October 1930, P/1520).

◆*Aulacomnium palustre* (Hedw.) Schwägr. – Opole-Zakrzów, quarry (leg. B. 8 October 1932, as admixture among *Philonotis fontana*, P/1521).

*Brachythecium glareosum* (Bruch ex Spruce) Schimp. – Winów (leg. B. 4 October 1932, P/1536 as *Homalothecium lutescens*).

*B. salebrosum* (Hoffm. ex F.Weber & D.Mohr) Schimp. – Staw Sangów, bank of pond, *c. spor.* (leg. B. 25 September 1932, P/1544).

*Bryum argenteum* Hedw. – Turawa, among stones, *c. spor.*, (leg. B. 3 October 1941, P/1511).

*B. caespiticium* Hedw. – Suchy Bór, in forest with *Ceratodon purpureus*, *c. spor.* (leg. B. 5 May 1932, P/1510).

- B. pseudotriquetrum* (Hedw.) P.Gaertn., B.Mey. & Scherb. – Chmielowice, brickyard, *c. spor.* (leg. B. 1 December 1932, P/1509).
- Calliergon cordifolium* (Hedw.) Kindb. – Suchy Bór (leg. B. 20 October 1932, P/1562).
- ◆ *Calliergonella cuspidata* (Hedw.) Loeske – Chmielowice (Wullesruh), rushes in clay-pit (leg. B. 1 October 1932, P/1559); Kały, *c. spor.* (leg. B. 20 July 1932, P/1560); Opole-Zakrzów, quarry (leg. B. 8 October 1932, P/1558).
- Ceratodon purpureus* (Hedw.) Brid. – Suchy Bór, forest, *c. spor.* (leg. B. 5 May 1932, P/1497).
- ◆ *Climacium dendroides* (Hedw.) F.Weber & D.Mohr – Opole-Bolko Island, park (leg. B. ? July 1930, P/1538); Staw Sangów, bank of pond (leg. B. 25 September 1932, P/1539); Suchy Bór, forest, *c. spor.* (leg. B. ?? 1931, P/1537).
- Dicranella heteromalla* (Hedw.) Schimp. – Kały, forest, *c. spor.* (leg. B. 20 July 1932, P/1495).
- ◆ *Dicranum polysetum* Sw. ex anon. – Zbicko, forest (leg. W. ?? 1929, P/1494).
- ◆ *D. scoparium* Hedw. – Ochodze, forest, *c. spor.* (leg. B. 30 August 1931, P/1493); Suchy Bór (Reichwiesen), *c. spor.* (leg. B. 2 August 1930, P/1492).
- Didymodon fallax* (Hedw.) R.H.Zander. – Opole-Zakrzów, quarry, *c. spor.* (leg. B. 8 October 1932, P/1499).
- Drepanocladus aduncus* (Hedw.) Warnst. – Opole, pond near Langosch brickyard (leg. B. 7 July 1930, as *Hypnum exannulatum*, P/1565).
- D. polycarpus* (Blandow ex Voit) Warnst. – Szydłów, place called Złote Bagna, (leg. B. 29 June 1932, as admixture among *Pohlia nutans*, P/1503).
- ◆ *Eurhynchium angustirete* (Broth.) T.J.Kop. – Dębska Kuźnia, place called Srebrne Źródła, *c. spor.* (leg. B. 4 October 1930, P/1551); Ochodze, forest, (leg. B. 6 October 1931, P/1552). All as *E. striatum*.
- Fissidens adianthoides* Hedw. – Suchy Bór, forest ditches, *c. spor.* (leg. B. 5 May 1932 & 18.04.1933, P/1490 & P/1491).
- Fontinalis antipyretica* Hedw. – Zbicko, forest ditches, *c. spor.* (leg. B. 12 July 1930, P/1524).
- Funaria hygrometrica* Hedw. – Dębska Kuźnia, place called Srebrne Źródła, *c. spor.* (leg. B. 6 October 1930, P/1506).
- Herzogiella seligeri* (Brid.) Z.Iwats. – Zbicko, forest, *c. spor.* (leg. B. 15 July 1931, P/1547).
- ◆ *Hylocomium splendens* (Hedw.) Schimp. – Suchy Bór, forest (leg. B. 24 September 1933, P/1566); Zbicko, forest (leg. W. ?? 1929, P/1567).
- Hypnum cupressiforme* Hedw. – Dębska Kuźnia, place called Srebrne Źródła, *c. spor.* (leg. B. 4 October 1930, P/1553); Ochodze, forest, *c. spor.* (leg. B. 6 October 1931, P/1554 & P/1557).
- H. jutlandicum* Holmen & E.Warncke – Staw Sangów (leg. B. 25 September 1932, P/1556 as *Plagiothecium laetum*).
- Leskea polycarpa* Hedw. – Opole-Bolko Island, *c. spor.* (leg. B. 10 July 1930, P/1535).



- ◆ *Leucobryum glaucum* (Hedw.) Ångstr. – Szydłów, near way to peatbog (leg. B. 21 June 1931, P/1489).
- Mnium hornum* Hedw. – Kały, ditches, *c. spor.* (leg. B. 10 July 1932, P/1517).
- M. stellare* Reichard ex Hedw. – Góra Św. Anny near Żyrowa, deciduous forest, *c. spor.* (leg. B. 7 May 1933, as *Mnium cuspidatum*, P/1515).
- Orthotrichum anomalum* Hedw. – Opole, *c. spor.*, (leg. B. 1 November 1930, P/1504).
- Philonotis fontana* (Hedw.) Brid. – Opole-Zakrzów, quarry (leg. B. 8 October 1932, P/1521).
- Plagiomnium cuspidatum* (Hedw.) T.J.Kop. – Kolonia Popielowska, forest near the Odra river, *c. spor.* (leg. B. 20 May 1936, P/1513); Suchy Bór, ditches along railway, *c. spor.* (leg. B. 30 July 1932, P/1514);
- P. ellipticum* (Brid.) T.J.Kop. – Zbicko, forest near river, *c. spor.* (leg. B. 20 July 1931, as *Mnium affine* P/1516). New to the bryoflora of the Równina Opolska Plain.
- P. undulatum* (Hedw.) T.J.Kop. – Dębska Kuźnia, place called Srebrne Źródła (leg. B. 6 June 1930, P/1512).
- Plagiothecium denticulatum* (Hedw.) Schimp. – Kały, *c. spor.* (leg. B. 20 July 1932, P/1546).
- P. nemorale* (Mitt.) A.Jaeger. – Zbicko, forest, *c. spor.* (leg. B. 15 July 1931, P/1548).
- ◆ *Pleurozium schreberi* (Willd. ex Brid.) Mitt. – Ochodze, pine forest, *c. spor.* (leg. B. 6 October 1931, P/1561).
- Pogonatum urnigerum* (Hedw.) P.Beauv. – Kały, forest, *c. spor.* (leg. B. 24 August 1930, P/1522). New to the bryoflora of the Równina Opolska Plain.
- Pohlia nutans* (Hedw.) Lindb. – Szydłów, place called Złote Bagna, *c. spor.* (leg. B. 30 June 1931 & 29 June 1932, P/1502 & P/1503).
- Polytrichastrum formosum* (Hedw.) G.L.Sm. – Suchy Bór (Reichwiesen?), *c. spor.* (leg. B. ? July 1930, P/1527).
- ◆ *Polytrichum commune* Hedw. – Kały, forest in the direction of Czarnowąsy and Biadacz, *c. spor.* (leg. W. & B. ?? 1929, P/1528).
- P. juniperinum* Hedw. – Suchy Bór, forest, *c. spor.* (leg. B. ?? 1930, P/1529); Zbicko, forest near river (leg. W. ?? 1929, P/1531).
- P. piliferum* Hedw. – Kały, on sandy soil, *c. spor.* (leg. B. ?? 1930, P/1526); Suchy Bór, forest (leg. B. ?? 1931, as *P. juniperinum*, P/1530).
- ◆ *Pseudoscleropodium purum* (Hedw.) M.Fleisch. – Chmielowice (Wullesruh), edge of forest (leg. B. 1 October 1932, P/1541); Ochodze, forest (leg. B. 6 October 1931, P/1540); Staw Sangów (leg. B. 25 September 1932, P/1542).
- Rhizomnium punctatum* (Hedw.) T.J.Kop. – Dębska Kuźnia, place called Srebrne Źródła, *c. spor.* (leg. B. 4 October 1930, P/1518); Suchy Bór, ditches in forest, *c. spor.* (leg. B. 5 May 1932, P/1519).
- Rhodobryum roseum* (Hedw.) Limpr. – Zbicko, forest (leg. B. ?? 1929, P/1508). Very rare in the Równina Opolska Plain, reported only from the vicinity of Fossowskie (Koła 1964).

- Rhynchostegium murale* (Hedw.) Schimp. – Dębska Kuźnia, place called Srebrne Źródła, *c. spor.* (leg. B. 6 October 1930, P/1549); Opole-Pasieka Island *Wilhelmsthal*, limestone railway embankment (leg. B. 6 October 1930, P/1550).
- ◆ *Rhytidiadelphus squarrosus* (Hedw.) Warnst. – Winów, peatbog (leg. B. 4 October 1932, P/1563).
- ◆ *Rh. triquetrus* (Hedw.) Warnst. – Kały, forest, *c. spor.* (leg. B. 20 July 1932, P/1564).
- *Sphagnum affine* Renauld & Cardot – Rudy, boggy meadow on edge of forest (leg. G. 7 August 1939, P/7215); Tworóg, wet meadow (leg. G. 28 June 1932, P/7214). Species new to the bryoflora of the Kotlina Raciborska Basin and the Równina Opolska Plain (Stebel 1997; Stebel, Fojcik 2003).
- *Sphagnum capillifolium* (Ehrh.) Hedw. – Kały, drainage ditches, *c. spor.* (leg. B. 20 July 1932 as *S. teres*, P/1484).
- *S. compactum* Lam. & DC. – Kały, road ditches (leg. B. 20 July 1932, P/1483). Very rare in the Równina Opolska Plain, reported only from Jeleniak-Mikuliny Nature Reserve (Stebel, Fojcik 2003).
- *S. cuspidatum* Ehrh. ex Hoffm. – Kały, *c. spor.* (leg. B. ???.1929 as *S. capillifolium*, P/1486); Szydłów, bog (leg. B. 30 June 1931 as *S. capillifolium*, P/1487).
- *S. denticulatum* Brid. – Bizja, in ditches (leg. G. 10 April 1940 as *S. rufescens*, P/7200); near Brynek (leg. G. 4 June 1933, P/7188).
- ◆ *S. fallax* (H. Klinggr.) H. Klinggr. – Bizja, drainage ditches (leg. G. 31 August 1942, admixture among *S. inundatum*, P/7191); near Brynek (leg. G. 26 August 1932, P/7241 & 9 October 1934, P/7201); Katowice, forest ditches (leg. G. 1 September 1941, P/7242); Łabędy, peat bog west of town (leg. G. 11 October 1932, P/7243).
- *S. fimbriatum* Wilson – Bizja, (leg. G. 10 September 1940, P/7227 & 27 August 1942, P/7228 & 29 August 1942; P/??); Bytom, west of town (leg. G. 15 September 1933, P/?? & 11 October 1934, P/7224); Bytom, in ?Kreisdorf (leg. G. ? June 1936, P/7726); Dębie, place called Srebrne Źródła (leg. B. 7 July 1930, P/1482); Przezchlebie, (leg. G. 1 September 1934, P/7225);
- *S. girgensohnii* Russow – near Tarnowskie Góry (leg. G. 4 September 1941, P/7236); Wiśla, about 700 m above sea level (leg. G. 21 July 1942, P/7240). This species is very rare on the Tarnowskie Góry Moud (Stebel, Fojcik 2003), but common in the Beskid Śląski Range (Plášek, Stebel 2002).
- *S. inundatum* Russow – Bizja, boggy forest ditches (leg. G. 31 August 1942; P/7192 & P/7191); near Brynek, forest peat bog (leg. G. 15 September 1933, P/7187, P/7189 & 16 September 1933, P/7186 & 27 September 1942, P/7193); Bytom, west of town, forest ditches (leg. G. 7 October 1933, P/7195); near Katowice, forest ditches (leg. G. 1 September 1941, P/7197); Łabędy, peat bog west of town (leg. G. 8 October 1932; P/7190); Suchy Bór, ditches in the direction of Opole (leg. B. 10 September 1932, P/1481).
- *S. magellanicum* Brid. – near Brynek (leg. G. 25 August 1932, P/7216), near Brynek, peat bog (leg. G. 27 September 1942, P/7217); near Fosowskie, forest ditches

- (leg. G. 9 October 1933 as *S. cymbifolium* var. *versicolor*, P/7207). Very rare species in the Równina Opolska Plain (Stebel, Fojcik 2003).
- *S. palustre* L. – Bizja (leg. G. 10 September 1940, P/7210 & 27 August 1942, P/7211); near Brynek (leg. G. 27 August 1932, P/7204); Domecko, in the direction of Ochodze village (leg. W. ?? 1929, P/1485); Kały (leg. B. 20 July 1932 as *S. squarrosus*, P/1488); Prószków, boggy meadow (leg. G. 13 September 1933 as *S. subbicolor*, P/7203); Sławęcice (leg. G. 14 August 1935, P/7208); Wisła, wet place, 600 m above sea level (leg. G. 20 July 1942, P/7212).
  - \* *S. papillosum* Lindb. – near Brynek, peat bog in forest (leg. G. 16 August 1934, P/7213 & 27 September 1942, P/7206). Very rare species in the Równina Opolska Plain (Stebel, Fojcik 2003).
  - *S. platyphyllum* (Braithw.) Warnst. – Góra Św. Anny, 300 m a.s.l. (leg. G. 4 August 1932, P/7202). Species new to the Silesian Upland and the whole of Opole Province (Stebel 2004).
  - ◆ *S. squarrosus* Crome – Ostrowica (leg. G. 1 September 1940, P/7219); Rudy, forest, *c. spor.* (leg. G. 16 September 1934, P/7221).
  - *S. subsecundum* Nees – near Brynek, forest bog (leg. G. 8 June 1933, P/7185 & 12 June 1933, P/7185). Very rare species in the Równina Opolska Plain (Stebel, Fojcik 2003).
  - *S. teres* (Schimp.) Ångstr. – near Brynek (leg. G. 15 June 1932, P/7218). Very rare species in the Równina Opolska Plain (Stebel, Fojcik 2003).
- Straminergon stramineum* (Dicks. ex Brid.) Hedenäs – Łabędy, peat bog west of town (leg. G. 8 October 1932, admixture among *Sphagnum inundatum*, P/7190).
- ◆ *Thuidium delicatulum* (Hedw.) Schimp. – Chmielowice (Wullesruh), near brickyard (leg. B. 4 October 1932, P/1533).
  - ◆ *Th. tamariscinum* (Hedw.) Schimp. – Kały (leg. B. 20 July 1932, P/1534).
- Tortula muralis* Hedw. – Opole (leg. B. 16 September 1930, P/1501).
- Warnstorfia exannulata* (Schimp.) Loeske – near Brynek, forest bog (leg. G. 8 June 1933, admixture among *Sphagnum subsecundum*, P/7185).
- W. fluitans* (Hedw.) Loeske – near Katowice, forest ditches (leg. G. 1 September 1941, admixture among *Sphagnum fallax*, P/7242). At present this species is common in the area of Katowice town (Fojcik, Stebel 2001).

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## Streszczenie

### *Kolekcja mszaków w Muzeum Śląska Opolskiego w Opolu*

W zbiorach Muzeum Śląska Opolskiego znajduje się kolekcja mszaków zebranych przez A. Grawa, K. Białuchę i R. Woesslera w latach 20., 30. i 40. XX wieku z terenów Górnego Śląska, obejmujących obecnie obszar województw opolskiego i śląskiego. Są to przede wszystkim mchy. Jedyny okaz wątrobowca *Lophocolea bidentata* odnaleziono jako domieszkę w próbie *Hypnum jutlandicum*. Odnalezione zbiory są cennym uzupełnieniem wiedzy o brioflorze Górnego Śląska. Z omawianego terenu w okresie międzywojennym opublikowano niewiele prac briologicznych (Torka 1931, Rejment-Grochowka 1936; Wilczek 1936). Dodatkowo, część materiałów zielnikowych, zwłaszcza zbiory V. Torcki, podczas II wojny światowej zaginęła. Gatunki odnalezione w zbiorach Muzeum Śląska Opolskiego to przede wszystkim mszaki siedlisk naziemnych, dość często występujące na tym terenie do tej pory. Na uwagę zasługuje kilka rzadszych taksonów, np. *Sphagnum affine*, nowy dla flory Kotliny Raciborskiej i Równiny Opolskiej lub *Sphagnum platyphyllum*, nowy dla flory Wyżyny Śląskiej. Najwięcej zbiorów pochodzi z Niziny Śląskiej, zwłaszcza z Równiny Opolskiej, gdzie badania botaniczne prowadził K. Białucha. Liczne dane (zebrane przede wszystkim przez A. Grawa) dotyczą Wyżyny Śląskiej, natomiast na terenie Beskidu Śląskiego odnaleziono tylko 2 gatunki torfowców.

Oznaczenia wszystkich odnalezionych okazów zostały sprawdzone. Tak opracowane materiały zestawiono w postaci listy florystycznej w porządku alfabetycznym. Dla każdego stanowiska podano następujące informacje: autora zbioru, datę zbioru, informacje zapisane na etykietach zielnikowych (siedlisko, wysokość n.p.m.), uwagi o obecności sporogonów oraz numer okazu zielnikowego według katalogu zielnika Muzeum Śląska Opolskiego (OPOL). W przypadku zmiany nazwy po rewizji zamieszczono również oryginalną nazwą pod jaką dany okaz znajduje się w zielniku. Przy rzadszych i interesujących gatunkach podano informacje o ich aktualnym rozmieszczeniu, statusie prawnym, zagrożeniach itp. Stanowiska zbiorów zestawiono przed listą florystyczną. Uporządkowano je według regionów fizyczno-geograficznych. Dla każdego stanowiska podano następujące informacje: obecną nazwę polską, nazwę niemiecką i przynależność administracyjną.



## THE BRYOPHYTE COLLECTION IN THE UPPER SILESIA MUSEUM IN BYTOM (PART I)

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**ABSTRACT:** This paper contains the localities of bryophyte taxa collected by E. Drescher, F. Kern, L. Pfützenreiter and V. Torka mainly from the first half of the twentieth century from Silesia (mostly in the present-day Opole Province) and housed in the herbarium of the Upper Silesian Museum in Bytom.

**KEY WORDS:** mosses, liverworts, Silesia, Lower Silesia, Opole Silesia, Upper Silesia, Poland, protected plants, distribution

### Introduction

Housed in the Upper Silesian Museum in Bytom is a large bryophyte collection originating from the first half of the twentieth century. It contains primarily specimens collected by E. Drescher, F. Kern, L. Pfützenreiter and V. Torka mostly in the present-day Opole Province and by I. Rejment, K. Lubliner and R. Wilczek from what is now Silesia Province. The collections of I. Rejment and R. Wilczek are documented in papers dealing with the hepatics of the Pogórze Cieszyńskie Foothills (Rejment 1936) and the Beskid Śląski Range (Rejment-Grochowska 1950) and the mosses of the forest communities of the Pogórze Cieszyńskie Foothills (Wilczek 1936). The specimens collected by K. Lubliner are of peat bog origin, mainly from the Beskid Śląski Range, and until now their localities have not been published. The collections of F. Kern, E. Drescher and L. Pfützenreiter are almost completely unknown. The bryophytes in the Upper Silesian Museum supplement some small collections of various other authors.

The first part of this paper documents the bryophytes collected by L. Pfützenreiter, E. Drescher, F. Kern and V. Torka. Part of the collection (that of Drescher, Kern and Torka) is glued to sheets of white cardboard, while Pfützenreiter's specimens are contained in paper envelopes. The whole collection is stored in cardboard boxes. In the list of species only localities from present-day Poland are included. However, the collection does contain single specimens of frequent or common species originating from the Czech Republic and Austria.

## Results

The identifications of all the species found have been checked. The taxa contained within the material examined are listed in alphabetical order. Liverwort nomenclature follows Grolle and Long (2000) and that for mosses Ochyra *et al.* (2003). For each station the following information is given: author of the collection, collecting date, information written on the specimen labels (habitat, altitude) and notes about the presence of sporophytes and/or gemmae. For rare or interesting species information about their legal status and degree and type of threat in Poland (Żarnowiec *et al.* 2004) is given. Details of collecting stations precede the floristic list. The sites are arranged alphabetical according to their present-day Polish names, shown in bold type. Immediately following are the corresponding German names in italic type and in brackets the administrative district and/or physico-geographical regions (after Kondracki 1994).

### Collecting sites:

- Bolesławiec Śląski** *Bunzlau* (Pogórze Kaczawskie)  
**Dolina Łomniczki** *Melzergrunde* near Karpacz (Karkonosze)  
**Duszniki Zdrój** *Reinerz* (Pogórze Orlickie)  
**Głucholazy**, *Ziegenhals* (Góry Opawskie)  
**Głucholazy, Góra Parkowa** *Ziegenhals, Holzberg* (Góry Opawskie)  
**Głucholazy, Pośrednia Kopa** *Ziegenhals, Mittelberg* (Góry Opawskie)  
**Głucholazy, Promenada Głucholaska** *Ziegenhals, Ziegenhalsler Promenade* (Góry Opawskie)  
**Golkowice** *Golkowitz* (Godów commune; Ostrawa Basin).  
**Kamieniec Ząbkowicki**, Zamkowa Góra, *Camenz, Schlossberg* (Obniżenie Otmuchowskie)  
**Kunice** *Kuzitz bei Liegnitz*, (Równina Legnicka)  
**Łądek Zdrój**, *Landeck* (Góry Złote)  
**Łądek Zdrój**, *Landeck*, ruins of Karpien castle near Łądek Zdrój *Ruine Karpenstein bei Landeck* (Góry Złote)  
**Ligota Wielka**, *Ellguth Ottmachau* (Obniżenie Otmuchowskie)  
**Ligota Wielka**, *Ellguth Ottmachau*, 'Raudenbusch' – forest NE of Ligota Wielka (Obniżenie Otmuchowskie)



**Ligota Wielka**, *Ellguth Ottmachau*, 'Nakelbusch' (Obniżenie Otmuchowskie)  
**Ligota Wielka**, *Ellguth Ottmachau*, 'Wacheberg' (Obniżenie Otmuchowskie)  
**Łazy** (Zawiercie District; Garb Tarnogórski Mound)  
**Otmuchów**, *Ottmachau* 'Oberwald' (Obniżenie Otmuchowskie)  
**Podgórzyn Giersdorf**, 'Giersdorfer torfstich bei Warmbrunn' (Kotlina Jeleniogórska)  
**Pokój Carlsruhe** (Równina Opolska)  
**Pokrzywna Wildgrund** (Góry Opawskie)  
**Prudnik Neustadt** (Płaskowyż Głubczycki)  
**Przełęcz Jugowska Hausdorfer Kreuz** (Góry Sowie)  
**Racibórz-Markowice Markowitz bei Ratibor** (Kotlina Raciborska)  
**Romanka** (Żywiec district), mountain in the Beskid Wysoki Range  
**Szczeliniec Wielki**, *Heuscheuer* (Góry Stołowe)  
**Śnieżnik Kłodzki**, *Glatzer Schneeberg* (Masyw Śnieżnika)  
**Torfowisko pod Zieleńcem Nature Reserve Seefelder bei Reinerz** (Góry Bystrzyckie)  
**near Wrocław bei Breslau** (Pradolina Wrocławska)

Key to symbols: ● – strictly protected species; ◆ - partly protected species; \* - species threatened in Poland.

#### L. Pfützenreiter's collection

##### Liverworts Marchantiopsida

*Plagiochila porelloides* (Torrey ex Nees) Lindenb. – Pokrzywna, shaded forest ground (August 1941).

##### Mosses Bryopsida

*Amblystegium juratzkanum* Schimp. – Gołkowice, old well (August 1941).

*A. serpens* (Hedw.) Schimp. – Pokrzywna, Villa Krueger, garden wall, *c. spor.* (31 July 1941).

◆*Buckiella undulata* (Hedw.) (= *Plagiothecium undulatum* (Hedw.) ) – Mt Romanka, 1200 m (4 September 1942).

*Campyliadelphus chrysophyllus* (Brid.) Kanda – Łazy, stone wall of cement works, on Jurassic limestone (28 September 1941).

*Ceratodon purpureus* (Hedw.) Brid. – Pokrzywna, *c. spor.* (4 August 1941).

◆*Dicranum scoparium* Hedw. – Pokrzywna, wet place (August 1941).

*Didymodon fallax* (Hedw.) R.H.Zander var. *brevifolius* (Dicks.) Ochyra – Łazy, stone wall of cement works, on Jurassic limestone, *c. spor.* (28 September 1941).

*Hypnum cupressiforme* Hedw. – Pokrzywna, *c. spor.* (August 1941).

*Mnium hornum* Hedw. – Pokrzywna, *c. spor.*, (August 1941).

*Plagiomnium undulatum* (Hedw.) T.J.Kop. – Pokrzywna, wet place (August 1941).

- Plagiothecium laetum* Schimp. – Pokrzywna, shaded forest ground, *c. spor.* (August 1941).
- Platyhypnidium riparioides* (Hedw.) Dixon – Gołkowice, old well (August 1941).
- ◆*Pleurozium schreberi* (Willd. ex Brid.) Mitt. – Pokrzywna, shady wet place in forest (August 1941).
- Pogonatum urnigerum* (Hedw.) P.Beauv. – Pokrzywna, *c. spor.* (August 1941).
- ◆*Polytrichum commune* Hedw. – Pokrzywna, shady wet place in forest, *c. spor.* (August 1941).
- P. juniperinum* Hedw. – Pokrzywna, dry and insolated place in forest, *c. spor.* (August 1941).
- Rhizomnium punctatum* (Hedw.) T.J.Kop. – Pokrzywna, wet coniferous forest, *c. spor.* (August 1941).
- Sphagnum compactum* Lam. & DC. – Pokrzywna (August 1941).
- S. flexuosum* Dozy & Molk. – Pokrzywna, shaded and wet place in forest (August 1941).
- ◆*S. squarrosum* Crome – Mt Romanka, 1200 m (4 September 1942).
- ◆*Thuidium tamariscinum* (Hedw.) Schimp. – Pokrzywna, wet place (August 1941).
- Tortula muralis* Hedw. – Pokrzywna, Strandbad, garden wall (31 July 1941).

#### E. Drescher's collection

##### Liverworts Marchantiopsida

*Ricciocarpos natans* (L.) Corda – Pokój, fish-pond (15 June 1924).

##### Mosses Bryopsida

- ◆*Abietinella abietina* (Hedw.) M.Fleisch. – Ligota Wielka, sandpit (25 July 1920).
- Amblystegium serpens* (Hedw.) Schimp – Ligota Wielka, *c. spor.* (15 June 1929).
- ◆*Aulacomnium palustre* (Hedw.) Schwägr. – Ligota Wielka, meadows (10 July 1923); Ligota Wielka, 'Wacheberg' (13 June 1926); Otmuchów, 'Oberwald', in forest (11 October 1932); Torfowisko pod Zieleńcem Nature Reserve, bog (12 September 1919).
- Brachythecium albicans* (Hedw.) Schimp. – Ligota Wielka, 'Raudenbusch' (27 June 1926).
- Calliergon giganteum* (Schimp.) Kindb. – Otmuchów, 'Oberwald' (19 May 1928)
- ◆*Calliergonella cuspidata* (Hedw.) Loeske – Ligota Wielka, meadows (10 April 1926); Otmuchów, 'Oberwald', bog, *c. spor.* (5 June 1930).
- Ceratodon purpureus* (Hedw.) Brid. – Ligota Wielka (10 June 1926); Racibórz-Markowice, *c. spor.* (?).
- ◆*Climacium dendroides* (Hedw.) F.Weber & D.Mohr – Ligota Wielka, 'Wacheberg' (13 June 1926).

- Dryptodon pulvinatus* (Hedw.) Brid. – Ligota Wielka, stone wall, *c. spor.* (18 June 1926).
- Encalypta streptocarpa* Hedw. – Ligota Wielka, wall, *c. gem.* (15 June 1926).
- Funaria hygrometrica* Hedw. – Ligota Wielka, stone wall, *c. spor.* (10 June 1926).
- Hypnum cupressiforme* Hedw. – Ligota Wielka, meadows (June 1924); old willow (?); wall of house (?).
- Orthotrichum anomalum* Hedw. – Ligota Wielka, stone wall, *c. spor.* (18 June 1926);
- O. pumilum* Sw. *ex anon.* – Ligota Wielka, stone wall, *c. spor.* (11 June 1926).
- Plagiomnium cuspidatum* (Hedw.) T.J.Kop. – Ligota Wielka, wall, *c. spor.* (15 June 1924 lub 26).
- P. elatum* (Bruch & Schimp.) T.J.Kop. – Ligota Wielka, ‘Wacheberg’ (11 June 1926)
- P. undulatum* (Hedw.) T.J.Kop. – Ligota Wielka, on lawn and wall (15 June 1926).
- Polytrichastrum formosum* (Hedw.) G.L.Sm. – bog near Duszniki Zdrój, *c. spor.* (26 May 1919).
- ◆ *Polytrichum strictum* Menzies *ex* Brid. – Torfowisko pod Zieleńcem Nature Reserve, *c. spor.* (12 September 1919).
- Pylaisia polyantha* (Hedw.) Grout – Ligota Wielka, bark of willow, *c. spor.* (April 1924).
- Rosulabryum laevifilum* (Syed) Ochyra – Ligota Wielka ?, *c. gem.* (?).
- \**Scorpidium scorpioides* (Hedw.) Limpr. – Kunice, *c. spor.* (June 1923); near Wrocław, bog (1890).
- *Sphagnum contortum* Schultz – Bolesławiec Śl. (June 1922).
- *S. palustre* L. – Głuchołazy, *c. spor.* (July 1922).
- ◆ *Thuidium delicatulum* (Hedw.) Schimp. – Ligota Wielka, wall (14 July 1926).
- Tortula muralis* Hedw. – Ligota Wielka, on bricks, *c. spor.* (?).

## F. Kern's collection

### Liverworts Marchantiopsida

- Conocephalum conicum* (L.) Dumort. – Głuchołazy, Promenada Głuchołaska (30 March 1916).
- Diplophyllum albicans* (L.) Dumort. – Głuchołazy, Góra Parkowa, wet soil (leg. Kern; 20 March 1916).
- Frullania dilatata* (L.) Dumort. – Ligota Wielka ‘Raudenbusch’, bark of *Quercus* sp. (4 September 1919).
- Lepidozia reptans* (L.) Dumort. – Głuchołazy, Góra Parkowa, wet place (31 March 1916).
- Marchantia polymorpha* L. – Ligota Wielka (10 August 1913); Ligota Wielka, ditches near rail embankment (26 April 1914).
- Mylia taylorii* (Hook.) Gray – Przełęcz Jugowska, on rock (31 July 1919).

- Pellia endiviifolia* (Dicks.) Dumort. – Głuchołazy, Góra Parkowa, boggy place, *c. spor.* (20 March 1916); Głuchołazy, Promenada Głuchołaska, dry soil, *c. spor.* (20 March 1916).
- Riccia fluitans* L. – Ligota Wielka, ditches near rail embankment (26 April 1914).
- R. glauca* L. – Ligota Wielka, towards ... Sarlowice, sandy place (6 October 1919).
- R. sorocarpa* Bisch. – Ligota Wielka, towards Sarlowice, sandy place (6 October 1919).
- Scapania undulata* (L.) Dumort. – Głuchołazy, boulders in fast-running stream (27 March 1916).

## Mosses Bryopsida

- Amblystegium serpens* (Hedw.) Schimp. – Ligota Wielka, garden, *c. spor.* (4 April 1916); near Nysa Kłodzka river (17 April 1914); Otmuchów, 'Oberwald', old willow (17 April 1914) & old oak, *c. spor.* (22 April 1914).
- Atrichum undulatum* (Hedw.) P.Beauv. – Ligota Wielka, 'Raudenbusch', on soil in forest, *c. spor.* (4 March 1914).
- Bartramia halleriana* Hedw. – Głuchołazy, wet stony place (18 March 1916).
- B. pomiformis* Hedw. – Głuchołazy, wet stones, *c. spor.* (18 March 1916).
- Brachytheciastrum velutinum* (Hedw.) Ignatov & Huttunen – Ligota Wielka, 'Raudenbusch', bark of tree, *c. spor.* (03. April 1914 & 27 June 1926); Ligota Wielka, garden, on bricks, *c. spor.* (4 April 1914).
- Brachythecium rivulare* Schimp. – Ligota Wielka 'Raudenbusch', root of old tree in bog, *c. spor.* (23 April 1914).
- B. rutabulum* (Hedw.) Schimp. – Ligota Wielka, 'Raudenbusch', bark of old tree, *c. spor.* (23 June 1914).
- B. salebrosum* (Hoffm. ex F. Weber & D. Mohr) Schimp. – Ligota Wielka, old willow, *c. spor.* (17 April 1914).
- Bryum caespiticium* Hedw. – Pokrzywna, wall, *c. spor.* (6 April 1916).
- Buxbaumia aphylla* Hedw. – Głuchołazy, Góra Parkowa, dry place, *c. spor.* (leg. 23 March 1916).
- Calliergon giganteum* (Schimp.) Kindb. – Ligota Wielka, ditches near rail embankment (26 April 1914).
- Campylidium calcareum* (Crundwell & Nyholm) Ochyra – Łądek Zdrój, ruins of Karpień castle, wall (5 October 1919).
- \**Campylopus flexuosus* (Hedw.) Brid. – Przełęcz Jugowska, on rock (31 July 1919).
- Ceratodon purpureus* (Hedw.) Brid. – Ligota Wielka, bank of ditch, *c. spor.* (21 April 1914); Głuchołazy, Góra Parkowa, dry wayside, *c. spor.* (25 March 1916).
- Dicranella heteromalla* (Hedw.) Schimp. – Głuchołazy, Góra Parkowa, on both dry and wet soil, *c. spor.* (21 March 1916).
- Dicranum fuscescens* Sm. – Mt Śnieżnik Kłodzki, scree, alt. 1400 m (3 June 1914).
- ◆*Dicranum scoparium* Hedw. – Głuchołazy, Góra Parkowa, on soil in forest, *c. spor.* (12 April 1916).

- Drepanocladus aduncus* (Hedw.) Warnst. – Ligota Wielka, near Nysa Kłodzka river, ditch on edge of forest (21 April 1914).
- Dryptodon pulvinatus* (Hedw.) Brid. – Ligota Wielka, wall, *c. spor.*, (17 April 1914).
- ◆ *Eurhynchium angustirete* (Broth.) T.J.Kop. – Łądek Zdrój, ruins of Karpien castle (5 October 1919).
- Fontinalis antipyretica* Hedw. – Głuchołazy, 'Schoenwald', in clear water (16 March 1916); Ligota Wielka, on wood in the Nysa Kłodzka river (5 July 1914).
- Funaria hygrometrica* Hedw. – Ligota Wielka, wall in the garden, *c. spor.* (4 April 1916).
- Hedwigia ciliata* (Hedw.) P.Beauv. – Głuchołazy, Góra Parkowa, on rocks (12 April 1916).
- Herzogiella striatella* (Brid.) Z.Iwats. – Mt Śnieżnik Kłodzki, near the summit, alt. about 1400 m (3 June 1914).
- *Homalia trichomanoides* (Hedw.) Schimp. – Otmuchów, 'Oberwald', bark of oak, (3 April 1914).
- Homalothecium sericeum* (Hedw.) Schimp. – Pokrzywna, on slate, (12 April 1914).
- Homomallium incurvatum* (Schrad. ex Brid.) Loeske – Otmuchów, 'Oberwald', bark of beech, *c. spor.* (2 April 1914).
- \* *Hygroamblystegium fluviatile* (Hedw.) Loeske – Podgórzyn, 'Giersdorfer torfstich', (13 May 1921).
- Hygrohypnum ochraceum* (Turner ex Wilson) Loeske – stony ravine near Dolina Łomniczki (30 September 1919).
- Hypnum cupressiforme* Hedw. – Głuchołazy, Góra Parkowa, old trunk in forest, *c. spor.* (27 March 1916).
- Kindbergia praelonga* (Hedw.) Ochyra – Ligota Wielka, garden (4 April 1916); Głuchołazy, Pośrednia Kopa, (30 March 1916).
- Leptodictyum riparium* (Hedw.) Warnst. – Ligota Wielka, old willow near the Nysa Kłodzka river (9 October 1919); Ligota Wielka, wood on bank of the Nysa Kłodzka river (4 July 1914).
- Leskea polycarpa* Hedw. – Ligota Wielka, *c. spor.* (12 July 1914).
- ◆ *Leucobryum glaucum* (Hedw.) Ångstr. – Głuchołazy, Góra Parkowa (27 March 1916).
- Mnium hornum* Hedw. – Głuchołazy, Góra Parkowa, northern slopes, *c. spor.* (30 March 1916).
- Orthotrichum diaphanum* Schrad. ex Brid. – Ligota Wielka, stony wall, *c. spor.* (17 April 1916).
- Paraleucobryum longifolium* (Hedw.) Loeske – Mt Śnieżnik Kłodzki, scree, alt. 1400 m (3 March 1914).
- Philonotis fontana* (Hedw.) Brid. – Głuchołazy, Pośrednia Kopa, bog (31 March 1916)
- Plagiomnium cuspidatum* (Hedw.) T.J.Kop. – Ligota Wielka, 'Raudenbusch', forest soil, *c. spor.* (4 March 1914) and willow forest, *c. spor.* (23 April 1914).
- P. undulatum* (Hedw.) T.J.Kop. – Głuchołazy, Góra Parkowa, wet soil (20 March 1916); Kamieniec Ząbkowicki, park (19 July 1914).

- Plagiothecium curvifolium* Schlieph. ex Limpr. – Głuchołazy, Pośrednia Kopa, on ground in forest, *c. spor.* (26 March 1916).
- P. denticulatum* (Hedw.) Schimp. – Głuchołazy, Góra Parkowa, wet forest soil, *c. spor.* (20 March 1916); Ligota Wielka, 'Raudenbusch' bark of willow, *c. spor.* (23.04.1914) and bark of oak, *c. spor.* (23 June 1914).
- P. laetum* Schimp. – Głuchołazy, Góra Parkowa, northern slopes (20 March 1916); Ligota Wielka, 'Raudenbusch', *c. gem* (23 June 1914).
- P. succulentum* (Wilson) Lindb. – Głuchołazy, Góra Parkowa, northern slopes (20 March 1916).
- Pogonatum urnigerum* (Hedw.) P.Beauv. – Głuchołazy, Góra Parkowa, dry place, *c. spor.* (23 March 1916).
- Pohlia nutans* (Hedw.) Lindb. – Ligota Wielka, wall (4 April 1916); Głuchołazy, Góra Parkowa, wet soil, *c. spor.* (20 March 1916).
- ◆*Polytrichum commune* Hedw. – Głuchołazy, Góra Parkowa, *c. spor.* (5 March 1916).
- P. juniperinum* Hedw. – Ligota Wielka, 'Lobedauer Strasse', sandy place, *c. spor.* (17 April 1914).
- P. piliferum* Hedw. – Głuchołazy, Góra Parkowa, dry forest, *c. spor.* (23 March 1916).
- ◆*Pseudoscleropodium purum* (Hedw.) M.Fleisch. ex Broth. – Ligota Wielka, 'Nakelbusch', among *Picea abies* (24 April 1914).
- Pseudotaxiphyllum elegans* (Brid.) Z.Iwats. – Ligota Wielka, 'Raudenbusch', *c. gem* (23 June 1914).
- Rhizomnium magnifolium* (Horik.) T.J.Kop. – Szczeliniec Wielki, wet place, (7 August 1919).
- Rh. punctatum* (Hedw.) T.J.Kop. – Głuchołazy, on stones, *c. spor.* (30 March 1916).
- ◆*Rhytidiadelphus triquetrus* (Hedw.) Warnst. – Ligota Wielka, 'Nakelbusch', among *Picea abies* (24 April 1914).
- Rosulabryum laevifilum* (Syed) Ochyra. – Ligota Wielka, wall of house, *c. gem.* (4 April 1916).
- Sphagnum capillifolium* (Ehrh.) Hedw. – Torfowisko pod Zieleńcem Nature Reserve, bog (12 September 1919).
- S. cuspidatum* Ehrh. ex Hoffm. – Torfowisko pod Zieleńcem Nature Reserve, bog (12 September 1919).
- S. girgensohnii* Russow – Głuchołazy, Góra Parkowa, wet soil, (23 June 1916).
- S. palustre* L. – Głuchołazy, wet forest (27 March 1916); Łądek-Zdrój, on the way to 'Kargenstein', (30 November 1917).
- \**Syntrichia papillosa* (Wilson) Jur. – Ligota Wielka, stony wall, *c. gem.* (17 April 1916).
- S. ruralis* (Hedw.) F.Weber & D.Mohr – Ligota Wielka, on bricks (17 April 1916).
- ◆*Thuidium philibertii* Limpr. – Ligota Wielka, 'Nachelberg', among *Picea abies* (24 April 1914).
- ◆*Th. tamariscinum* (Hedw.) Schimp. – Głuchołazy, Góra Parkowa, wet soil (26 March 1916).

*Tortula modica* R.H.Zander – Ligota Wielka, *c. spor.* (October 1919).

*Tortula muralis* Hedw. – Ligota Wielka, bricks of house wall, *c. spor.* (4 April 1916).

#### V. Torka's collection

#### Liverworts Marchantiopsida

*Riccia fluitans* L. s.l. – Prudnik (26 November 1928). Specimens determined as *R. huebeneriana* Lindenb. var. *natans* Torka, but they are sterile.

#### Mosses Bryopsida

◆*Eurhynchium angustirete* (Broth.) T.J.Kop. – Ligota Wielka, 'raudenbusch' (10 June 1927).

*Oxyrrhynchium hians* (Hedw.) Loeske – Ligota Wielka, "Raudenbush", bank of ditch (10 June 1927).

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## Streszczenie

### *Kolekcja mszaków w Muzeum Górnośląskim w Bytomiu. Część I.*

W Muzeum Górnośląskim w Bytomiu przechowywana jest obszerna kolekcja mszaków pochodzących głównie z I połowy XX wieku. Są to przede wszystkim materiały F. Kerna, E. Dreschera i X. Pfützenreitera pochodzące głównie z województwa opolskiego oraz I. Rejment, K. Lubliner i R. Wilczka z województwa śląskiego. Zbiory I. Rejment i R. Wilczka są w większości dokumentacją do opublikowanych flor wątrobowców Pogórza Cieszyńskiego (Rejment 1936) i Beskidu Śląskiego (Rejment-Grochowska 1950) oraz flory mchów zespołów leśnych Pogórza Cieszyńskiego (Wilczek 1936). Materiały zielnikowe zebrane przez K. Lubliner to głównie torfowce, pochodzące przede wszystkim z Beskidu Śląskiego, których stanowiska do tej pory nie zostały opublikowane. Zbiory F. Kerna, E. Dreschera i X. Pfützenreitera są prawie zupełnie nieznanne. Kolekcję mszaków w Muzeum Górnośląskim w Bytomiu uzupełniają niewielkie zbiory różnych autorów.

Prezentowana pierwsza część opracowania obejmuje mszaki zebrane przez L. Pfützenreitera, E. Dreschera, F. Kerna i V. Torkę. W wykazie zamieszczono tylko stanowiska mszaków znajdujące się w granicach Polski. W zbiorach znajdują się także pojedyncze okazy częstych lub pospolitych gatunków pochodzące z Czech (Sudety, Jeseniki) i Austrii (Wysokie Taury).

Opracowane materiały zestawiono w postaci listy florystycznej w porządku alfabetycznym. Dla każdego stanowiska podano następujące informacje: autora zbioru, datę zbioru, informacje zapisane na etykietach zielnikowych (siedlisko, wysokość n.p.m.) oraz uwagi o obecności sporogonów i/lub rozmnożeń. Dla rzadszych i interesujących gatunków podano informacje o ich aktualnym statusie prawnym i zagrożeniach. Stanowiska zbiorów zestawiono przed listą florystyczną. Uporządkowano je według regionów fizyczno-geograficznych. Dla każdego stanowiska podano następujące informacje: obecną nazwę polską, nazwę niemiecką oraz przynależność administracyjną i/lub geograficzną



**MATERIALS TO THE DISTRIBUTION OF THREATENED  
VASCULAR PLANTS IN THE OPOLE SILESIA**

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**ABSTRACT:** The paper presents the results of phytogeographical researches in Opole Silesia for the period of 1998-2005. Chorological data of the threatened plants of the region were given. Almost eight hundred locations of 220 zoophytes were presented, among other for taxa that were considered to be extinct within the regional borders.

**KEY WORDS:** threatened plants, rare plants, Opole province, flora conservation, chorology

### **Introduction**

Knowledge of the distribution of regional flora species has fundamental importance in plant geography and also in realisation of floristic biodiversity strategy. It is also important to update the knowledge about the regional flora and to present the outcomes of the ongoing researches. This allows considering the newest data about interesting plants during the preparation of the synthetic elaborations like red data books and lists.

In the Opole Silesia the phytogeographical researches have long tradition coming back to XIX century (e.g. Wimmer 1844, Fiek 1881, Schube 1903). After Second World War the intensity of the botanical studies decreases, but also in this period several important publications were issued, e.g. of Michalak (1968, 1970, 1972)

and Szotkowski (1987, 1988). In last few years the considerable increase in floristical field works is observed in Opole Silesia as a supposed result of the establishment of the Biosystematics Department on the Opole University. Among many publications, some play significant role in geobotanical researches summarizing the whole knowledge about regional flora (Dajdok et al. 1998a, Dajdok et al. 1998b, Nowak, Spałek red. 2002, Nowak et al. 2003, Kuźniewski 2004, Nowak, Spałek red. 2004). In those works almost all regional botanical bibliography is given.

Presented work gives the chorological data of the threatened plants of the Opole Silesia. The aim of the study was to supplement the geographical knowledge about red-listed taxa of the region. Altogether 220 species were found on 789 locations.

### Methods

The field works were conducted in 1998-2005 vegetation seasons within the borders of the Opole province. During field works, the habitat and spatial differentiations were considered. The nomenclature of the species follows Mirek et al. (2002). The species were chosen on the basis of the degree of endangerment due to regional red list of vascular plants (Nowak et al. 2003). Species were ordered alphabetically.

For each location the symbol of adequate ATPOL grid square was given and also the population size of the species and habitat type. In some cases, when the location needs to be precisely stated (e.g. in large forest complexes or fields) the geographical coordinates were used using the GPS set working in WGS 84 system.

The data was collected not systematically and only new locations are presented. So, the number of species stands could not represent the actual endangerment or rarity state of the taxon considered.

### Results

The following locations of the chosen threatened species were found or confirmed:

*Achillea ptarmica* L.: to the South from Niemodlin, in woodland wet meadow, several individuals (ATPOL: CF03); pond "Pietruszka" surroundings by Tułowice, several dozens individuals in wet shrubs (ATPOL: CF03); several individuals in Ecological Ground "Suchy Ług" to the SW from Ligota Prószkowska (ATPOL: CF14); to the N from Wronów, ca. 30 individuals on wet meadow (ATPOL: CE83),

*Actaea spicata* L.: several dozens individuals in clay-pit to the S from Wachów (ATPOL: CE88); in great number in broad-leaved forests in Sławniowice (ATPOL: CF30),

*Adonis aestivalis* L.: Opole, several individuals in wheat crops by Luboszycka St. (ATPOL: CE95),

***Agrimonia procera* Wallr.:** several dozens individuals in marl quarry in Opole-Nowa Wieś Królewska (ATPOL: CE95); Ochodze, several individuals alongside field road on forest edge (N 50° 36' 11" E 17° 48' 19"; ATPOL: CF04); between Czarnowąs and Brzezie, several individuals alongside forest road (ATPOL: CE85); surroundings of Turawa, Rzędów and Ligota Turawska, in many places up to 100 individuals alongside forest roads (e.g. N 50° 46' 48" E 18° 09' 23"; N 50° 45' 39" E 18° 06' 44"; ATPOL: CE86, CE87); to the N from Zbicko, ca. 100 individuals on dried up meadow and on road verges (ATPOL: CE96),

***Agrostemma githago* L.:** in great number in rye crops in Marszałki (ATPOL: CE86); Rudniki-Jawor, ca. 200 individuals in rye crops (ATPOL: DE50); Świerkle, several thousands in rye crops (ATPOL: CE85); to the NW from Gogolin, several dozens individuals in rye crops (N 50° 30' 26" E 17° 59' 54"; ATPOL: CF16); Barucice, several individuals in cereals (ATPOL: CE63); between Przygorzele and Bąkowiec, 1 individual in field road verge (ATPOL: CE64); to the NW from Zawadno, several dozens individuals in cereals (ATPOL: CE83); to the N from Wronów, several individuals in cereals (ATPOL: CE83); to the S from Luboszyce, several individuals in cereals (ATPOL: CE95),

***Aira caryophylla* L.:** several dozens individuals in small quarry in Mrokocin (ATPOL: BF18),

***Ajuga genevensis* L.:** in great number on road verges to the E from Gogolin (ATPOL: CF16); to the N from Braciszów, several individuals in swards and dry bushes (ATPOL: CF53); to the NW from Pietrowice Głębczyckie, several dozens individuals in swards (ATPOL: CF53); Malnie, several dozens individuals in road side grasses (ATPOL: CF15); to the NW from Surowina, several dozens individuals in light oak forest (N 50° 47' 25" E 17° 54' 59"; ATPOL: CE85); to the S from Kup, several individuals in forest road verges (N 50° 47' 24" E 17° 54' 09"; ATPOL: CE85),

***Alisma lanceolatum* With.:** in great number in drainage ditches by Kościerzycy (ATPOL: CE72); Faustianka (Rudniki commune), several individuals in drainage ditches (ATPOL: CE59); Opole, at the beginning of Ulga Canal, several dozens individuals by pond (ATPOL: CE95); to the SE from Opole-Malina, several individuals in Czarnka stream (N 50° 37' 00" E 18° 00' 30") (ATPOL: CF05); surroundings of Mańczok, several individuals by potable water reservoir (N 50° 50' 01" E 18° 00' 32"; ATPOL: DE76),

***Allium angulosum* L.:** to the W from Januszkowice, several dozens individuals on flooded meadow (ATPOL: CF36); to the S from Stobrawa, hundreds of individuals on Odra valley meadows (ATPOL: CE73); Stare Kolnie, hundreds of individuals on wet meadows *Alopecuretum pratensis* (ATPOL: CE73); Nowe Kolnie, thousands of individuals on wet meadows *Alopecuretum pratensis* (ATPOL: CE73); to the W from Krzywa Góra, several dozens individuals on wet meadows near ponds (ATPOL: CE75); to the NW from Leśniczówka, several individuals in wet meadow (ATPOL: CE82); to

the NE from Zbicko, ca. 100 individuals on wet meadow (ATPOL: CE96); Popielów-Kabachy, several individuals in road verge (ATPOL: CE74); to the N from Brzeg, commonly on wet meadow (ATPOL: CE72); to the S from Kościerzycy, several individuals in wet meadow in Odra valley (ATPOL: CE72),

*Alyssum alyssoides* (L.) L.: in great number in marl quarry in Szczepanek (ATPOL: CF18); Opole-Groszowice, in great number on Odra river embankments (N 50° 36' 38" E 17° 57' 56"; ATPOL: CF05); in great number in marl quarry in Strzelce Opolskie, Szymiszów, Otmice and Kamień Śl. (ATPOL: CF18, CF17, CF16); several dozens individuals in gravel-pit in Grotowice (ATPOL: CF05),

*Anchusa officinalis* L.: in great number in roadside ditches in Nysa and Głębinów (ATPOL: CF10, CF11); to the S from Dąbrowa, 1 individual in road verge (ATPOL: CE64),

*Anthemis tinctoria* L.: in great number on road escarpment in Krzyżanowice (ATPOL: CF77),

*Anthericum ramosum* L.: between Świerkle and Kup, in several places in light coniferous forests, altogether ca. 100 individuals (ATPOL: CE85),

*Anthriscus nitida* (Wahlenb.) Hazsl.: Biernatówek, in great number in riverside forest to the S from village (ATPOL: CF44),

*Aphanes microcarpa* (Boiss. & Reut.) Rothm.: Młyny (Rudniki commune), not many in rye crops in *Papaveretum argemones* association (ATPOL: DE50); to the E from Bobrowa (Rudniki commune), several individuals in rye crops in *Arnoserido-Scleranthetum* association (ATPOL: DE60),

*Aquilegia vulgaris* L.: several individuals on the broad-leaved forest edge to the E from Sławniowice (ATPOL: CF30),

*Arnoseris minima* (L.) Schweigg. & Körte: Bażany, in very great number in rye field by north part of the nature reserve (ATPOL: CE67); in surroundings of Słowików, Żytniów, Ciecuiów, Jaworzno, Dalachów and Rudniki – in great number and very often on sandy fields in *Arnoserido-Scleranthetum* association (ATPOL: CE59, DE50, DE60); to the NW from Masów, several individuals on sandy road side (N 50° 46' 56" E 17° 58' 28"; ATPOL: CE85); Marcinek by Zagwiździe, not many in swards with *Corynephorus canescens* (N 50° 52' 20" E 18° 01' 03"; ATPOL: CE75); Stare Budkowice, several individuals on sandy fallow land (N 50° 52' 27" E 18° 03' 02"; ATPOL: CE76),

*Aruncus sylvestris* Kostel.: several individuals on Las Rozumicki edge (ATPOL: CF75); several individuals in proposed nature reserve "Sławniowice" (ATPOL: CF30); escarpment and road side by border passage in Głucholazy (ATPOL: CF31),

*Asperula cynanchica* L.: to the N from Gogolin, several dozens individuals in swards (ATPOL: CF16); reclaimed limestone quarry in Otmice (ATPOL: CF17),

***Asplenium septentrionale* (L.) Hoffm.:** small, out of use quarry to the S from Doboszowice (ATPOL: BF18),

***Asplenium trichomanes* L.:** in great number on walls of out of use quarries to the E from Sławniowice (ATPOL: CF30); to the E from Sławice, several individuals on wall by water purification plant (N 50° 42' 37" E 17° 53' 08"; ATPOL: CE95),

***Astragalus arenarius* L.:** several individuals on forest road verge to the NE from Kosowce (ATPOL: CE86),

***Astrantia major* L.:** Skrońsko, several dozens individuals in riverside forest (ATPOL: CE69); several dozens individuals by spring in Czarnocin (ATPOL: CF27),

***Barbarea stricta* Andrz.:** to the E from Sławice, several individuals by water purification plant in Odra valley (N 50° 42' 33" E 17° 53' 07"; ATPOL: CE95); Opole-Groszowice, several dozens individuals by Odra dam (ATPOL: CF05); Opole, several individuals in Młynówka Canal (N 50° 39' 36" E 17° 55' 27"; ATPOL: CE95); Kotórz Wielki, several individuals alongside stream by dam escarpment of Turawa Reservoir (N 50° 44' 00" E 18° 05' 12"; ATPOL: CE96); to the SE from Kuźnica Katowska, ecological ground „Puchacz”, few individuals in wet meadow (ATPOL: CE74),

***Batrachium circinatum* (Sibth) Fr.:** in great number in fish-pond “Loża” by Lipno (ATPOL: CF03); Rogi, several dozens individuals in gravel-pits in Odra valley (ATPOL: CF78); between Obrowiec and Gogolin, several dozens individuals in fish-pond (ATPOL: CF26); Kuźnica Dąbrowska, in great number in fish-ponds (ATPOL: CE64); to the NE from Zawadno, hundreds of individuals in ox-bow lake (ATPOL: CE84); to the W from Kantorowice, several individuals in gravel-pits (ATPOL: CE83),

***Batrachium trichophyllum* (Chaix) Bosch:** in great number in Lutnia stream between Przywory and Groszowice (e.g. N 50 34 41,0 E 18 00 37,4; ATPOL: CF05); to the NE from Zbicko, ca. 100 individuals in small pond (ATPOL: CE96),

***Blechnum spicant* (L.) Roth.:** to the S from Ładza, 3 individuals on drainage ditch escarpment in pine forest (ATPOL: CE75),

***Botrychium matricariifolium* (Retz.) A. Braun ex W. D. J. Koch:** Świerkle, 1 specimen in light pine forest (N 50° 46' 05" E 17° 55' 21"; ATPOL: CE85),

***Bromus erectus* Huds.:** between Chorula and Malnie, several dozens individuals in out of work limestone quarry (ATPOL: CF15); Opole-Wójtowa Wieś, on railway embankments, quite numerous (ATPOL: CE95); Opole-Malina, several dozens individuals on meadow (N 50° 37' 55" E 18° 00' 12"; ATPOL: CF06); between Opole and Boguszyce, quite numerous on water embankments of Odra river and Ulga Canal (ATPOL: CE95),

***Bromus secalinus* L.:** in great number on road verges and balks in Opole-Kolonia Gosławicka (ATPOL: CE95); Faustianka (Rudniki commune), several individuals in wheat crops (ATPOL: CE59); to the S from Wawelno, several individuals

on field road verge (ATPOL: CE94); in great number in rye crops in Chrzastowice (ATPOL: CE96),

***Bulboschoenus maritimus* (L.) Palla:** several dozens individuals on gravel-pit bank in Kantorowice (ATPOL: CE83); to the N from Chróścina, several individuals on the bottom of periodic water reservoir (N 50° 40' 28" E 17° 47' 56") and in great number on wet maize field as a weed (ATPOL: CE94); Opole, city entrance from Chmielowice, several individuals on waste heap (ATPOL: CE95),

***Butomus umbellatus* L.:** to the N from Chróścina, several individuals on the bottom of small, periodic water reservoir (N 50° 40' 28" E 17° 47' 56"); ATPOL: CE94); to the N from Brzeg, several dozens individuals in ox-bow lake (ATPOL: CE72); Radomierowice-Bożejów, several individuals in pond banks (ATPOL: CE66),

***Callitriche hamulata* Kütz. ex W. D. J. Koch:** Opole, several dozens individuals in small ox-bow lake in south part of the city (ATPOL: CE95); Kuźnica Żytniowska, in great number on field furrows (ATPOL: CE69); Zagwizdzie surroundings, in very great number in Budkowiczanka river (ATPOL: CE75); to the W from Pokój, not numerous on the bottom of the dried up pond (ATPOL: CE74),

***Camelina microcarpa* subsp. *sylvestris* (Wallr.) Hiitonen:** to the NE from Chrzowice, several individuals on river embankments (ATPOL: CF05); to the NW from Gogolin, several individuals on road verges and rye crops (N 50° 30' 26" E 17° 59' 54"); ATPOL: CF15),

***Campanula glomerata* L.:** several dozens individuals in swards to the N from Lubiatów (ATPOL: BF19); to the E from Chróstno, several dozens individuals in road side grasses (ATPOL: CF64),

***Cardamine impatiens* L.:** to the E from Niwki, ca. 100 individuals on forest road verge (ATPOL: CE96),

***Carduus personata* (L.) Jacq.:** several individuals on the margin of Nysa dam reservoir by Kwiatków (ATPOL: CF20),

***Carex diandra* Schrank:** to the SW from Januszkowice, several dozens individuals on wet meadows (ATPOL: CF36); to the S from Zdzieszowice, thousands of individuals on wet meadow (ATPOL: CF26); in great number in shale quarry "Dewon" in Jarnołtówek (ATPOL: CF31),

***Carex hartmanii* Cajander:** to the SE from Opole-Malina, in great number on wet meadow (N 50° 36' 55" E 18° 00' 55"); ATPOL: CF06); Opole-Zaodrze, several dozens individuals in dried up meadow by the Ulga Canal embankments (ATPOL: CE95); to the NE from Zbicko, quite numerous alongside the road dry ditch (N 50° 41' 02" E 18° 01' 33"); ATPOL: CE96); Szydłów, quite numerous on wet meadow (N 50° 36' 23" E 17° 43' 49"); ATPOL: CF04),

***Carex montana* L.:** to the S from Kup, several tussocks in pine forests and oak forest with high *Rubus* sp. cover (ATPOL: CE85),

***Carex oederi* Retz:** Opole – limestone quarry “Piaś”, hundreds of individuals in wet grasses (ATPOL: CE95); Opole, limestone quarry “Odra 1”, several dozens individuals on wet grasses (ATPOL: CE95),

***Carex pilulifera* L.:** to the E from Mostki (Rudniki commune), several individuals in beech forest (ATPOL: DE50); in Świerkle and Kup surroundings, often and in great numbers in pine forests (e.g. N 50° 46' 58" E 17° 55' 15"; N 50° 47' 12" E 17° 54' 58"; N 50° 46' 13" E 17° 55' 20"; N 50° 47' 45" E 17° 54' 39"; N 50° 46' 41" E 17° 54' 39"; ATPOL: CE85); Bory Niemodlińskie, in many places, quite numerous in pine forest (e.g. N 50° 32' 03" E 17° 52' 21"; N 50° 34' 05" E 17° 42' 33"; ATPOL: CF04, CF14); Mańczok surroundings, several dozens individuals in pine forest (N 50° 49' 45" E 17° 59' 11"; ATPOL: CE76); to the N from Jelowa, quite numerous in pine forest (N 50° 49' 41" E 18° 03' 19"; ATPOL: CE86); to the E from Zawada, several individuals in pine forest (N 50° 42' 27" E 18° 01' 53"; ATPOL: CE96); Turawa and Rzędów surroundings, quite commonly and numerous in pine forests (e.g. N 50° 44' 50" E 18° 06' 16"; N 50° 45' 05" E 18° 08' 21"; ATPOL: CE86, CE87); to the N from Kaniów, several individuals in beech wood (ATPOL: CE74),

***Carex praecox* Schreb.:** commonly to the N from Zwanowice, pastures in Odra valley (ATPOL: CE73); in great numbers to the NW from Wronów, pastures in Odra valley (ATPOL: CE83); in great numbers on road verges in Przywory (ATPOL: CF05); Opole, ca. 100 individuals on Odra meadows, near bridge on by-pass road (N 50° 41' 44" E 17° 53' 58"; ATPOL: CE95); Opole from Chmielowice side, several dozens individuals on meadow (ATPOL: CE95); Opole, in grasses on road verge in Odra valley near Bolko island, ca. 100 individuals (N 50° 39' 01" E 17° 55' 54"; ATPOL: CE95); railway station in Nowy Świątów, in great numbers on track-way (ATPOL: CF21),

***Carex pseudocyperus* L.:** Rozwadza, several dozens individuals in fish ponds (ATPOL: CF26); pond “Pietruszka” by Tułowice, seldom in pond banks (ATPOL: CF03); to the NE from Zawadno, several dozens individuals on ox-bow lake banks (ATPOL: CE83); Rudniki-Jawor, on the fish pond bottom several dozens individuals (ATPOL: DE50); to the E from Boguszyce, several dozens individuals by ox-bow lake (N 50° 36' 18" E 17° 56' 44"; ATPOL: CF05),

***Carlina acaulis* L.:** several individuals in swards to the N from Lubiatów (ATPOL: BF19),

***Centaurea pseudophrygia* C. A. Mey.:** commonly on the meadows and balks near Belsznica (ATPOL: CF78),

***Centaurium erythraea* Rafn subsp. *erythraea*:** seldom in gravel-pit in Głębocko (ATPOL: CE92); to the SE from Burgrabice, several dozens individuals on forest road (ATPOL: CF30); to the SW from Chróścina, several dozens individuals on wet meadow

(ATPOL: CE94); to the SE from Zawada, several individuals on forest road verge (ATPOL: CE96),

***Centaurium pulchellum* (Sw.) Druce:** to the N from Brzezie, ca. 100 individuals on road side and puddle margins (N 50° 45' 51" E 17° 50' 05"; ATPOL: CE85),

***Centunculus minimus* L.:** to the W from Polska Nowa Wieś, ca. 100 individuals in stubble field (N 50° 38' 35" E 17° 45' 35"; ATPOL: CE94); Rudniki-Jawor, several individuals in stubble field (ATPOL: DE50),

***Cephalanthera damasonium* (Mill.) Druce:** commonly in beech forest and quarry mine-dumps to the S and SW from Górażdże (ATPOL: CF16),

***Cerastium brachypetalum* (Spreng.)A. Kerner. subsp. *tauricum*:** Kotórz Wielki, in very great numbers on dam escarpments of Turawa Reservoir (N 50° 44' 00" E 18° 05' 12"; ATPOL: CE96),

***Ceratophyllum submersum* L.:** Jelonki (Rudniki commune), in very great number in pond (ATPOL: CE69),

***Cerinthe minor* L.:** to the W from Chrzowice, several dozens individuals in waste lands of limestone quarry (ATPOL: CF05); Folwark, several dozens individuals on road escarpment (N 50° 37' 41" E 17° 55' 06"; ATPOL: CF05),

***Chamaecytisus ratisbonensis* (Schaeff.) Rothm.:** to the S from Kotórz Mały, several dozens individuals in pine forest (N 50° 43' 05" E 18° 03' 02"; ATPOL: CE96); between Marszałki and Ligota Turawska, several dozens individuals on pine forest margin (N 50° 46' 15" E 18° 07' 34"; ATPOL: CE87); Świerkle, several dozens individuals in pine forest (ATPOL: CE85),

***Chamaecytisus ruthenicus* (Fish. Ex Woł.) Klásk.:** several dozens individuals in swards in old sand-pit in Kozłówki (ATPOL: CF65); several dozens individuals in swards of "Góra Gipsowa" nature reserve (ATPOL: CF65),

***Chamaecytisus supinus* (L.) Link:** to the S from Kup, ca. 100 individuals on pine forest margin (ATPOL: CE85); Braciszów, waste heap within the basalt quarry area, several individuals (ATPOL: CF53),

***Chondrilla juncea* L.:** to the W from Jaworzno (Rudniki commune), ca. 100 individuals in grasses and on balks (ATPOL: DE50); between Mostki and Polesie (Rudniki commune), several dozens individuals in sandy road verge (ATPOL: DE60); to the W from Ochodze, hundreds of individuals alongside field road (N 50° 37' 18" E 17° 47' 56"; ATPOL: CF04); to the N from Głębinów, hundreds of individuals alongside field road and in sand-pit (ATPOL: CF10),

***Chrysanthemum segetum* L.:** commonly in fresh meadows to the E from Opole-Kolonia Gosławicka (ATPOL: CE95),



***Circaea alpina* L.:** to the SE from Osiecko, several dozens individuals in wooded ravine (ATPOL: CE88),

***Circaea intermedia* Ehrh.:** to the E from Przylesie, several dozens individuals in broad-leaved forest (ATPOL: CE81),

***Cirsium canum* (L.) All.:** Chrzowice, several dozens individuals in waste lands of limestone quarry (ATPOL: CF05); to the S from Nowa Cerekiew, several dozens individuals in out of use quarry (ATPOL: CF65); Chrzaszczyce, several dozens individuals on wet meadow (ATPOL: CF05); Krępna, several dozens individuals on wet meadow (ATPOL: CF26); to the NW from Leśniczówka, several individuals on wet meadow (ATPOL: CE83); Opole, from Chmielowice side, several dozens individuals on wet meadows and alongside field road (N 50° 39' 40" E 17° 52' 47"; ATPOL: CE95); to the W from Nowa Kuźnia, ca. 100 individuals on meadow in few places (e.g. N 50° 35' 38" E 17° 51' 23"; N 50° 35' 17" E 17° 51' 37"; ATPOL: CF04); to the SW from Chróścina, several individuals on wet meadow (ATPOL: CE94),

***Cnidium dubium* (Schkuhr) Thell.:** Nowe Kolnie, hundreds of individuals on wet meadows in Odra valley (ATPOL: CE73); Stare Kolnie, several dozens individuals on wet meadows in Stobrawa valley (ATPOL: CE73); to the NE from Zbicko, several dozens individuals on wet meadow (N 50° 41' 25" E 18° 01' 40"; ATPOL: CE96),

***Colchicum autumnale* L.:** several individuals on wet meadow in Opole-Nowa Wieś Królewska (ATPOL: CE95); to the SW from Januszkowice, several dozens individuals in flooded meadows (ATPOL: CF36); Rozwadza, several dozens individuals on wet meadows (ATPOL: CF26); between Rozwadza and Krępna, several dozens individuals on wet meadows (ATPOL: CF26); to the SW from Rybna, several dozens individuals on wet meadows (ATPOL: CE73); Stradunia, several dozens individuals on wet meadows (ATPOL: CF26); Dziergowice, several dozens individuals on wet meadows (ATPOL: CF47); Babi Las, several dozens individuals on wet meadows (ATPOL: CE84); Chróścice-Ostrówek, several dozens individuals on wet meadows (ATPOL: CE84); to the N from Zawadno, several dozens individuals on wet meadows (ATPOL: CE84); to the E from Winów, ca. 200 individuals on wet meadow in Odra valley (50° 37' 36" E 17° 56' 17"; ATPOL: CF05); between Winów and Boguszyce, commonly on Odra river embankments (e.g. N 50° 37' 13" E 17° 57' 18"; N 50° 36' 52" E 17° 57' 25"; N 50° 36' 47" E 17° 57' 23"; ATPOL: CF05),

***Comarum palustre* L.:** Przywory, thousands of individuals in peat meadows in Odra valley (ATPOL: CF05); Dziergowice, hundreds of individuals in wet margin of *Ribeso nigri* – *Alnetum* (ATPOL: CF47); to the E from Opole-Malina, several dozens individuals in drainage ditch (N 50° 37' 44" E 18° 00' 39"; ATPOL: CF06); to the SE from Grabczok, several dozens individuals on wet meadow (N 50° 49' 37" E 17° 57' 10"; ATPOL: CE75); to the SE from Jelowa, commonly in drainage ditch (N 50° 46' 36" E 18° 04' 33"; ATPOL: CE86); Szydłów, several dozens individuals on wet meadow with expanding *Solidago graminifolia* (N 50° 36' 23" E 17° 43' 49"; ATPOL:

CF04); to the N and NW from Rzędów, in several places, hundreds in wet meadow and drainage ditch (N 50° 45' 09" E 18° 08' 44"; N 50° 46' 15" E 18° 08' 03"; ATPOL: CE97),

***Corydalis solida* (L.) Clairv.**: between Kietrz and Ściborzyce, hundreds individuals in broad-leaved forest (ATPOL: CF75); Sławików, hundreds in tree stands in Odra valley escarpments (ATPOL: CF57),

***Cynoglossum officinale* L.**: several dozens individuals in beech forest to the S from Górażdże (ATPOL: CF16); to the S from Górażdże, several individuals in field road verge (N 50° 30' 53" E 17° 59' 20"; ATPOL: CF16),

***Cyperus fuscus* L.**: commonly in Turawa dam reservoir near Szczedrzyk and Antoninek (ATPOL: CE97); Strzelce Opolskie, in great number on the pond bottom and its banks (ATPOL: CF18); in great number in the bottom of the marl quarry in Szymiszów (ATPOL: CF17); to the N from Kuźnica Dąbrowska, in great number in the bottom of dried up pond (ATPOL: CE64),

***Cystopteris fragilis* (L.) Bernh.**: Krasne Pole, several dozens individuals on church walls (ATPOL: CF53); to the E from Sławice, several individuals on wall of the water purification plant (N 50° 42' 37" E 17° 53' 08"; ATPOL: CE95),

***Dactylorhiza majalis* (Rchb.) P. H. Hunt & Summerh.**: several dozens individuals on wet meadow to the N from Proślice (ATPOL: CE47); several dozens individuals on wet meadow between Jarnołówek and Skowronków (ATPOL: CF41); midfield bog to the NW from Stara Kuźnia (ATPOL: CF04); Stary Ujazd, several dozens individuals on wet meadow (ATPOL: CF28); several individuals on wet meadow between Kolanowice and Luboszyce (ATPOL: CE95); several dozens individuals on wet meadow to the N from Kotórz Mały (ATPOL: CE96); several individuals on wet meadow to the S from Kobylno (ATPOL: CE86); to the W from Walidrogi, several individuals on forest meadow (N 50 36 40 E 18 03 14; ATPOL: CF06),

***Daphne mezereum* L.**: several dozens individuals in broad-leaved forest to the S from Lipniki (ATPOL: BF19); several individuals near clay-pit to the S from Wachów (ATPOL: CE78); commonly in broad-leaved forests to the E from Sławniowice (ATPOL: CF30); to the E from Rędzina, several individuals in *Galio sylvatici* – *Carpinetum* (ATPOL: CE89); to the NE from Zawadno, several individuals in broad-leaved forest (ATPOL: CE84); to the E from Kobylno, several individuals in broad-leaved forest (ATPOL: CE86); to the E from Suchy Bór, several individuals in broad-leaved forest (ATPOL: CE96); to the NW from Dąbrówka Górna, several individuals in broad-leaved forest (N 50° 32' 49" E 17° 54' 21"; ATPOL: CF15); to the SE from Opole-Malina, several individuals in wet forest (N 50° 35' 56" E 18° 01' 47"; ATPOL: CF06); to the N from Rzędów, several individuals in wet forest with birch and alder (N 50° 46' 07" E 18° 08' 41"; ATPOL: CE87),

***Dianthus armeria* L.:** several dozens individuals in grasses to the E from Stary Las (ATPOL: CF21),

***Dianthus carthusianorum* L.:** Chomiąza, several dozens individuals in initial grasses on rock outcrops in east part of the village (ATPOL: CF63); to the N from Pietrowice Głubczyckie, several dozens individuals in swards (ATPOL: CF53),

***Dianthus gratianopolitanus* Vill.:** between Łubniany and Surowina, few square meters in forest road verge in pine forest (ATPOL: CE85),

***Digitalis grandiflora* Mill.:** to the W from Pietrowice Głubczyckie, several dozens individuals in acidic oak forest *Luzulo – Quercetum petraeae* (ATPOL: CF53); to the S from Kup, ca.200 individuals in forest road verges (e.g. N 50° 47' 35" E 17° 54' 40"; ATPOL: CE85),

***Digitalis purpurea* L.:** Stare Olesno, several individuals in forest road verge near fish-ponds (ATPOL: CE68); to the NW from Nędza, several individuals in forest road verge (ATPOL: CF57); between Marszałki and Bierdzany, few individuals in road verges (ATPOL: CE87); Zawada, several individuals on Jemielnica escarpment close to the village (N 50° 42' 43" E 17° 59' 39"; ATPOL: CE96),

***Drosera rotundifolia* L.:** „Kacze Doły” by Osowiec, hundreds of individuals on the margins of sand-pit (ATPOL: CE86); to the W from Boroszów, several dozens individuals on east fish-pond bank (ATPOL: CE68); to the SE from Osiecko, hundreds of individuals in wet ravine (ATPOL: CE88); to the S from Rędzina, commonly in old sand-pit (ATPOL: CE89); to the E from Szydłowiec, several dozens individuals in forest bog (N 50° 35' 22" E 17° 43' 39"; ATPOL: CE93),

***Eleocharis mamillata* (H. Lindb.) H. Lindb. ex Dörfl. s. s.:** to the SW from Ochodze, several individuals in peat forest meadow (ATPOL: CF04),

***Eleocharis ovata* (Roth) Roem & Schult.:** Niemodlin, hundreds of individuals in pond to the W from swimming pool (ATPOL: CF03); Strzelce Opolskie, in great number on the pond bottom and its banks on wet sand (ATPOL: CF18); to the N from Kuźnica Dąbrowska, several dozens individuals in the bottom of the dried up pond (ATPOL: CE65),

***Epilobium adnatum* Griseb.:** Opole-Zaodrze, quite commonly in Ulga Canal terraces (ATPOL: CE95),

***Epipactis helleborine* (L.) Crantz:** several dozens individuals in clay-pit to the S from Wachów (ATPOL: CE78); several dozens individuals in broad-leaved forest to the E from Sławniowice (ATPOL: CF30); to the SW from Rybna, hundreds of individuals in broad-leaved forest (ATPOL: CE83); between Narok and Goleczowice, several dozens individuals in river side forest (ATPOL: CE84); Ostrów Narocki, hundreds of individuals in broad-leaved forest (ATPOL: CE84); Góra św. Anny, several dozens individuals in shrubs near monument (ATPOL: CF27); to the N from Kup,

several individuals in pine forest (ATPOL: CE85); several dozens individuals alongside forest road in broad-leaved forest by Kobylno (ATPOL: CE86); between Marszałki and Bierdzany – commonly on road verges in broad-leaved and coniferous forests (ATPOL: CE87); Świerkle, several dozens individuals in pine forest (ATPOL: CE85); to the NW from Surowina, several dozens individuals in light oak forest (N 50° 47' 25" E 17° 54' 59"); ATPOL: CE85),

***Epipactis purpurata* SM.:** to the N from Kolonia Popielowska, several individuals in broad-leaved forest (ATPOL: CE84),

***Equisetum hyemale* L.:** between Narok and Golczowice, hundreds of individuals in river carr forest (ATPOL: CE84); hundreds of individuals in river carr forest in proposed nature reserve “Marmurowa Dolina” in Sławniowice (ATPOL: CF30); to the E from Dąbrówka Górna, in very great number in river carr forest (at least several thousands of shoots; ATPOL: CF15),

***Equisetum telmateia* Ehrh.:** in great number on railway embankment in Brzezcie (ATPOL: CF67); in great number in cereals and root crops and also on railway embankments in Belsznica and Rogów (ATPOL: CF78); between Hajduki Nyskie and Stary Las, in great number on road verge and in forest margin shrubs (N 50° 24' 36" E 17° 22' 37"); ATPOL: CF21),

***Equisetum variegatum* Schleich.:** Chrzowice, in very great number in shallow puddles in marl quarry (ATPOL: CF05); limestone quarry “Odra 1” in Opole, hundreds in bog-spring grasses (ATPOL: CE95),

***Eriophorum latifolium* Hoppe:** Opole, limestone quarry “Odra 1 and 2”, several dozens individuals in bog-springs (ATPOL: CE95),

***Eriophorum vaginatum* L.:** to the S from Jelowa, commonly in peat-bog (N 50° 46' 17" E 18° 04' 22"); ATPOL: CE86),

***Euphorbia exigua* L.:** Faustianka (Rudniki commune), quite commonly in fields (ATPOL: CE59),

***Filago arvensis* L.:** in great numbers in gravel-pit in Głębocko (ATPOL: CE92); to the NW from Świerkle, several dozens individuals on sandy field margin (ATPOL: CE85); to the S from Kolanowice, in great number on sandy fallow lands (N 50° 44' 00" E 17° 59' 38"); ATPOL: CE95); to the SE from Szydłów, several dozens individuals on sandy fallow land (ATPOL: CF04); to the W from Polska Nowa Wieś, several dozens individuals on field balk (ATPOL: CE94); to the E from Stare Budkowice, in great number in dry waste land (ATPOL: CE76); to the S from Okoły, in great number in dry waste land (ATPOL: CE75); to the S from Kościerzycze, few individuals in dry, sandy waste land (ATPOL: CE72),

***Filago vulgaris* Lam.:** in great number in grasses in Pomianów Dolny (ATPOL: BF18),

***Filago minima* (Sm.) Pers.:** not many individuals in gravel-pit in Głębocko (ATPOL: CE92); hundreds of individuals in idle lands in Miedziana (ATPOL: CF16); to the W from Szczedrzyk, commonly in grasses *Spergulo-Coryneporetum* (ATPOL: CE97); to the S from Oldrzychowice, in initial swards alongside motorway A4 (ATPOL: CE93); to the E from Jaworzno (Rudniki commune), in very great number on sandy fallow land (ATPOL: DE50); Ładza, several individuals in dry grasses of the school play field (ATPOL: CE75); to the S from Okoły, in great number in sandy waste land (ATPOL: CE75); to the E from Kolanowice, in very great number in dry waste land (ATPOL: CE95),

***Filipendula vulgaris* Moench:** Opole-Zaodrze, in great number on Ulga Canal embankment (ATPOL: CE95); to the SW from Chróścina, several individuals on field road verge (ATPOL: CE94); to the E from Boguszyce, hundreds of individuals on meadow near ox-bow lake (N 50° 36' 18" E 17° 56' 44"; ATPOL: CF05); Opole from Chmielowice side, few individuals on road verge (ATPOL: CE95); in great number in old sand-pit in Kozłówki (ATPOL: CF65),

***Fumaria vaillantii* Loisel.:** to the E from Zbicko, in great number on waste dump (N 50° 40' 42" E 18° 02' 15"; ATPOL: CE96),

***Gagea arvensis* (Pers.) Dumort.:** Opole-Groszowice, several dozens individuals on walls near allotment gardens (ATPOL: CF05); between Grudzice and Groszowice, several dozens individuals on road verge grasses (ATPOL: CE95),

***Gagea pratensis* (Pers.) Dumort.:** Sękowice, several dozens individuals on waste lands to the N from the village (ATPOL: CF11); to the E from Dębska Kuźnia few individuals in crops (ATPOL: CE96); Opole-Malina, hundreds of individuals in rye crops (ATPOL: CF05); commonly in road verges in the surroundings of Chmielowice, Żerkowice, Mechnice, Osiny and Komprachcice (e.g. N 50° 39' 00" E 17° 51' 19"; ATPOL: CE94, CE95); to the E from Winów, several dozens individuals in road verge (ATPOL: CF05); Opole-Bolko Island, several individuals on Odra river embankment (ATPOL: CE95),

***Galanthus nivalis* L.:** commonly in broad-leaved forest to the E from Sławniowice (ATPOL: CF30); to the SW from Januszkowice, commonly in small patch of broad-leaved forest in Odra river (ATPOL: CF36); to the SE from Krapkowice, commonly in broad-leaved forest and river side forest (ATPOL: CF15); Krapkowice, several individuals in Odra river shrubs in the north part of the city (ATPOL: CF15); Opole-Grudzice, several individuals in broad-leaved forest (ATPOL: CE95); to the S from Ptakowice, several dozens individuals in river side forest *Ficario-Ulmetum minoris* (ATPOL: CE83),

***Galium boreale* L.:** Łąki Groszowickie, quite commonly in wet meadow (ATPOL: CF06); shrubs in marl quarry to the SW from Otmice (ATPOL: CF16),

***Galium rotundifolium* L.:** several dozens individuals on the top of “Czapka” hill in Jarnołtówek in acidic oak forest (ATPOL: CF31); to the W from Pietrowice Głubczyckie, hundreds of individuals in acidic oak forest *Luzulo – Quercetum petraeae* (ATPOL: CF53); to the N from Chomiąza, several dozens individuals in acidic oak forest *Luzulo – Quercetum petraeae* (ATPOL: CF53); to the N from Świerkle, several dozens individuals in fresh pine forest (ATPOL: CE85); to the NW from Biadacz, hundreds of individuals in wet pine forests and in forest road verges (e.g. N 50° 44' 52" E 17° 57' 12"; ATPOL: CE85),

***Galium saxatile* L.:** Bory Niemodlińskie, in pine forest and in forest road verge, in many places builds dense carpets with ca. 1 m<sup>2</sup> surface (e.g. N 50° 34' 18" E 17° 44' 44"; ATPOL: CF04); commonly beneath the top of “Kopa Biskupia” (ATPOL: CF41); bottom of the shale quarry “Dewon” in Jarnołtówek (ATPOL: CF31),

***Genista germanica* L.:** to the W from Pietrowice Głubczyckie, several dozens individuals in the margin of acidic oak forest *Luzulo – Quercetum petraeae* (ATPOL: CF53); in surroundings of Świerkle and Kup, commonly in many places on forest margins, in road verges, on felling sites and also, less frequently, inside pine forest patches (e.g. N 50° 47' 12" E 17° 54' 58"; N 50° 46' 48" E 17° 55' 26"; N 50° 47' 35" E 17° 54' 40"; N 50° 46' 41" E 17° 54' 39"; ATPOL: CE85); to the E from Surowina, several dozens individuals in forest road verge (N 50° 46' 52" E 17° 56' 02"; ATPOL: CE85); to the S from Polska Nowa Wieś, on railway embankment and road verge, several dozens individuals (N 50° 37' 10" E 17° 46' 25"; ATPOL: CE94); to the S from Przysiecz, several individuals in forest road verge (N 50° 32' 46" E 17° 51' 45"; ATPOL: CF14); Bory Niemodlińskie, in several places in road verges and felling sites, altogether ca. 200 individuals (e.g. N 50° 31' 37" E 17° 51' 31"; ATPOL: CF04, CF14); by Middle Turawa Lake, in great number on pine forest margin (ATPOL: CE96); sand-pit in Dziergowice, several individuals in initial swards (ATPOL: CF48),

***Genista pilosa* L.:** to the NW from Rzędów, several dozens individuals in pine forest margin (N 50° 45' 23" E 18° 07' 28"; ATPOL: CE86); to the N from Jełowa, several dozens individuals in fresh pine forest (ATPOL: CE86),

***Gentiana pneumonanthe* L.:** to the NE from Zbicko, several dozens individuals in wet meadow growing over with shrubs (ATPOL: CE96),

***Geranium phaeum* L.:** in great number on broad-leaved forest margin to the E from Sławniowice (ATPOL: CF30); in great number in road verges to the N from Otmuchów (ATPOL: CF10),

***Geranium sanguineum* L.:** surroundings of Surowina, ca. 100 individuals in few places in road verges and light forest (e.g. N 50° 47' 25" E 17° 54' 59"; N 50° 46' 48" E 17° 55' 26"; ATPOL: CE85); to the S from Kup, several dozens individuals in forest road verge (ATPOL: CE85); Kały, several individuals in forest margin (N 50° 50' 54" E 18° 03' 28"; ATPOL: CE76); to the W from Łubniany, 1 individual in forest road verge (ATPOL: CE86),

***Glyceria declinata* Bréb.:** in great number around shallow puddles in gneiss quarry in Mrokocin (ATPOL: BF18),

***Hepatica nobilis* Schreb.:** to the E from Suchy Bór, several dozens individuals in broad-leaved forest (ATPOL: CE96),

***Hottonia palustris* L.:** hundreds of individuals in out of use pond to the S from Karłowice (ATPOL: CE74); Kuźnica Dąbrowska, several dozens individuals in drainage ditches in fish-pond complex (ATPOL: CE64); Szubiennik, in drainage ditches in fish-pond neighbourhood (ATPOL: CE65); to the N from Zdieszowice, several individuals in alder forest *Ribeso nigri-Alnetum* (ATPOL: CF26); Podborze, several dozens individuals in drainage ditches (ATPOL: CF26); to the NE from Bąków, several dozens individuals in Odra ox-bow lake (ATPOL: CF26); to the E from Stradunia, several dozens individuals in ox-bow lake (ATPOL: CF26); Rogi, several dozens individuals in ox-bow lake (ATPOL: CF36); Dziergowice, several dozens individuals in alder forest *Ribeso nigri – Alnetum* (ATPOL: CF47); to the W from Lędziny, hundreds of individuals in drainage ditch (ATPOL: CE96); to the W and N from Czarnowąsy, several dozens individuals in ox-bow lake and gravel-pit (ATPOL: CE95); Lewin Brzeski, several dozens individuals in ox-bow lakes (ATPOL: CE83); Zawadno, hundreds of individuals in ox-bow lakes (ATPOL: CE84); hundreds of individuals in drainage ditch on wet meadow to the N from Kotórz Mały (ATPOL: CE86); in great number in ditch to the E from Kotórz Wielki (ATPOL: CE96); in great number in Mała Panew ox-bow lake between Marszałki and Turawa (ATPOL: CE86); to the SE and E from Opole-Malina, in great number in many places in drainage ditches and Czarnka and Malina streams (e.g. N 50° 37' 37" E 18° 00' 33"; N 50° 38' 19" E 17° 59' 31"; N 50° 36' 47" E 18° 01' 28"; ATPOL: CF05); to the SE from Grabczok, several dozens individuals in stream (N 50° 49' 37" E 17° 57' 10"; ATPOL: CE75); surroundings of Mańczok, quite commonly in water reservoir (N 50° 50' 01" E 18° 00' 32"; ATPOL: CE76); to the E from Boguszyce, commonly in ox-bow lake (N 50° 36' 18" E 17° 56' 44"; ATPOL: CF05),

***Hordelymus europaeus* (L.) Jess. ex Harz.:** rarely in beech forests in nature reserve "Biesiec" (ATPOL: CF16),

***Hyoscyamus niger* L.:** several individuals in cereal crops in Opole-Zakrzów (ATPOL: CE95); Rusków, several individuals in potato crops (ATPOL: CE83); Kościerzycy, several individuals in waste lands near Odra embankments (ATPOL: CE72); several individuals in Młynówka Canal banks in Opole (ATPOL: CE95),

***Hypericum hirsutum* L.:** to the SE from Krapkowice, several dozens individuals in broad-leaved forest (ATPOL: CF25); to the N from Markowice, not numerously in broad-leaved forest (ATPOL: CF21); to the E from Przylesie, quite commonly in broad-leaved forest (ATPOL: CE81); to the S from Michałów, in great number in broad-leaved forest (ATPOL: CE82); several individuals in broad-leaved forest to the SE from Stobrawa village (ATPOL: CE73),

***Hypericum humifusum* L.:** several individuals on roads in old sand-pit „Kacze Doły” by Osowiec (ATPOL: CE86); to the E from Jaworzno (Rudniki commune), on sandy fallow land, quite commonly (ATPOL: DE50); Bory Niemodlińskie, very often and in great number on forest roads (ATPOL: CF04, CF14),

***Hypochoeris glabra* L.:** Odcinek (Rudniki commune), several individuals in sandy potato crops (ATPOL: CE59),

***Inula salicina* L.:** several dozens individuals in military training area in Winów (ATPOL: CF05); to the N from Kocury, hundreds of individuals on wet meadows (ATPOL: CE88); to the SE from Burgrabice, several dozens individuals in swards (ATPOL: CF30); commonly in east part of the airfield in Kamień Śląski (ATPOL: CF16),

***Isolepis setacea* (L.) R. Br.:** Skrońsko, hundreds of individuals on pastures (ATPOL: CE69); to the NW from Nędza, hundreds of individuals on banks of small stream (ATPOL: CF57); to the W from Słowików Szlachecki (Rudniki commune), in great number on pasture wet meadow by dam reservoir (ATPOL: DE50); Brzezcie, quite commonly by pond (ATPOL: CE85),

***Juncus bulbosus* L.:** Brzezcie, in great number on dried up pond bottom (ATPOL: CE85); to the N from Zawada, in very great number on wet sand in huge earthwork (N 50° 43' 34" E 17° 59' 34"; ATPOL: CE96),

***Juncus ranarius* J.O.E. Perrier & Sonjeon:** Strzelce Opolskie, in great number on dried up pond bottom and puddle margins (ATPOL: CF18),

***Kickxia elatine* (L.) Dumort.:** Faustianka (Rudniki commune), several dozens individuals on wheat and oat crops (ATPOL: CE59); to the SW from Chróścina, several dozens individuals in maize crops (N 50° 39' 19" E 17° 37' 36"; ATPOL: CE94),

***Lathraea squamaria* L.:** to the E from Dębska Kuźnia, hundreds of individuals in broad-leaved forest (ATPOL: CE96); Biernatówek, several dozens individuals in broad-leaved forest to the S from the village (ATPOL: CF44); to the N from Głogówek, several dozens individuals in broad-leaved forest (ATPOL: CF34); to the E from Wronów, several individuals in broad-leaved forest (ATPOL: CE83),

***Ledum palustre* L.:** to the SE from Osiecko, several dozens individuals in ravine shrubs (ATPOL: CE88); several individuals in pine forest margin to the SW from Rzędów (ATPOL: CE87); to the S from Jełowa, several dozens individuals in forest peat-bog (N 50° 46' 17" E 18° 04' 22"; ATPOL: CE86),

***Lembotropis nigricans* (L.) Griseb.:** to the SE from Osiecko, several individuals on ravine escarpments (ATPOL: CE88); to the N from Dobrzeń Wielki, several dozens individuals in pine forest margin (ATPOL: CE85); to the SE from Kaniów, in great number in pine forest margin (ATPOL: CE74); to the N from Jełowa, quite commonly in many places in pine forest (e.g. N 50° 50' 46" E 18° 02' 53"; N 50° 50' 22" E 18° 02'



45''; ATPOL: CE86); to the N from Świerkle, several dozens individuals in pine forest and felling site (ATPOL: CE85),

***Lemna gibba* L.:** to the S from Stobrawa, in great number in ox-bow lake in *Wolffio-Lemnetum gibbae* (ATPOL: CE73),

***Lilium martagon* L.:** to the E from Rędzina, several individuals in broad-leaved forest *Galio sylvatici – Carpinetum* (ATPOL: CE89); to the S from Kup, several individuals in pine forest with considerable cover of *Rubus sp.* (ATPOL: CE85); to the NW from Dąbrówka Górna, several individuals in broad-leaved forest (N 50° 32' 49'' E 17° 54' 21''; ATPOL: CF15),

***Listera ovata* (L.) R. Br.:** several individuals in broad-leaved woods in western part of the Kamień Śląski (ATPOL: CF16); Stary Ujazd, several dozens individuals in broad-leaved woods (ATPOL: CF28); to the SE from Opole-Malina, several individuals in wet forest by Czarnka stream (ATPOL: CF05); several individuals in road verge to the E from Rzędów (ATPOL: CE96),

***Luzula luzuloides* (Lam.) Dandy & Willmott:** between Niwki and Zawada, several dozens individuals in forest road verge (ATPOL: CE86),

***Lycopodiella inundata* (L.) Holub:** several dozens individuals on pond "Łoża" banks in Lipno (ATPOL: CF03); "Kacze Doły" by Osowiec, hundreds individuals on the old sand-pit banks (ATPOL: CE86); to the S from Rędzina, in great number in old sand-pit (ATPOL: CE89),

***Lycopodium annotinum* L.:** to the SE from Osiecko, hundreds individuals in ravine shrubs (ATPOL: CE88); in great number in coniferous forest to the S from Kobylno (ATPOL: CE86); in great number in coniferous forest to the NE from Ozimek (ATPOL: CE97); several dozens individuals to the SW from Ligota Turawska, in pine forest (50° 46' 15'' E 18° 08' 03''; ATPOL: CE87),

***Lycopodium clavatum* L.:** to the S from Rędzina, in great number in wet, sandy sites in old sand-pit (ATPOL: CE89); several dozens individuals in pine forest to the S from Marszałki (ATPOL: CE86); several dozens individuals in pine forest between Marszałki and Bierdzany (ATPOL: CE87),

***Lysimachia thyrsiflora* L.:** midfield bog to the NW from Stara Kuźnia (ATPOL: CF04); drainage ditch alongside Turawa reservoir dam (ATPOL: CE96); surroundings of Mańczok, quite commonly by water reservoir (N 50° 50' 01'' E 18° 00' 32''; ATPOL: CE76); to the NW from Chrzastowice, several individuals in drainage ditch (N 50° 40' 54'' E 18° 03' 53''; ATPOL: CE96),

***Lythrum hyssopifolia* L.:** Faustianka (Rudniki commune), 1 individual in wet field furrow (ATPOL: CE59); to the SW from Chróścina, several dozens individuals in maize crops (N 50° 39' 19'' E 17° 37' 36''; ATPOL: CE94),

***Malva pusilla* Sm.:** to the S from Mechnice, several dozens individuals on field road verge (N 50° 39' 26" E 17° 49' 06"; ATPOL: CE94),

***Matteucia struthiopteris* (L.) Tod.:** Rudniki-Jawor, few individuals in alder forest (ATPOL: DE50); to the SW from Świerkle, several individuals in forest road verge (ATPOL: CE85); few individuals in shrubs to the E from Turawa by water embankment (ATPOL: CE86),

***Melandrium noctiflorum* (L.):** Faustianka (Rudniki commune), quite commonly in wheat and potatoe crops (ATPOL: CE59); to the SW from Chróścina, several dozens individuals in maize crops (N 50° 39' 19" E 17° 37' 36"; ATPOL: CE94),

***Melica uniflora* Retz.:** to the NW from Królowe, not frequently in broad-leaved forest (ATPOL: CF44),

***Melittis melissophyllum* L.:** several dozens individuals in beech forest to the S from Góraźdze (ATPOL: CF16); to the S from Kup, ca. 100 individuals in forest road verges and *Rubus sp.* shrubs (ATPOL: CE85),

***Menyanthes trifoliata* L.:** midfield peat-bog to the NW from Stara Kuźnia (ATPOL: CF04); to the S from Zdieszowice, hundreds of individuals in wet meadow (ATPOL: CF26); Przywory, thousands of individuals in bog meadows in Odra valley (ATPOL: CF05); in great number on peat meadow in Kotórz Mały (ATPOL: CE96); Rudniki-Jawor, several dozens individuals in the alder wood margins and marshy meadow (ATPOL: DE50); to the SE from Grabczok, several dozens individuals in wet meadow (N 50° 49' 37" E 17° 57' 10"; ATPOL: CE75); to the SE from Świerkle, several dozens individuals in wet meadow (ATPOL: CE85),

***Misopates orontium* (L.) Raf.:** several dozens individuals in waste land in Jelowa (ATPOL: CE86); Ładza, few individuals in dry pasture; Łubniany, 1 individual in dry waste land (ATPOL: CE75),

***Moneses uniflora* (L.) A. Gray:** Świerkle, several flowering individuals in fresh pine forest (N 50° 46' 27" E 17° 55' 28"; ATPOL: CE85),

***Monotropa hypopitys* L. s. s.:** to the NW from Kosorowice, several dozens individuals in pine forest (ATPOL: CF06); to the N from Dobrzeń Wielki, several dozens individuals in pine forest (ATPOL: CE85); surroundings of Świerkle and Kup, commonly, but in very small populations, in fresh pine forests (ATPOL: CE85); to the NE from Dębska Kuźnia, few individuals in pine forest (ATPOL: CE96),

***Myosotis discolor* Pers.:** in great number on Nysa dam reservoir embankments (ATPOL: CF11),

***Myosurus minimus* L.:** Faustianka (Rudniki commune), ca. 100 individuals in rye crops (ATPOL: CE59); Lampowizna (Rudniki commune), in very great number in rye crops (ATPOL: CE59); Rudniki-Jawor, several dozens individuals in rye crops (location doesn't exist any more; ATPOL: DE50),

*Najas marina* L.: in great number in gravel-pit by Odra village (ATPOL: CF78),

*Neottia nidus-avis* (L.) Rich.: Opole-Grudzice, several dozens individuals in broad-leaved forest (ATPOL: CE96); in great number in beech forest to the SE from Górazdze (ATPOL: CF16),

*Nuphar lutea* (L.) Sibth. & Sm.: to the E from Sławice, quite commonly in ox-bow lake (N 50° 42' 56" E 17° 52' 33"; ATPOL: CE95); Marcinek by Zagwiździe, quite commonly in pond (N 50° 52' 14 E 18° 00' 37"; ATPOL: CE75); to the W from Zbicko, few individuals in Jemielnica river (N 50° 40' 16" E 18° 02' 53"; ATPOL: CE96); to the E from Boguszyce, several individuals in ox-bow lake (N 50° 36' 18" E 17° 56' 44"; ATPOL: CF05),

*Nymphaea alba* L.: to the SW from Januszkowice, several dozens individuals in small ox-bow lake (ATPOL: CF36); Obrowiec, several dozens individuals in ox-bow lake (ATPOL: CF26); to the N from Kłodnica, several individuals in ox-bow lake (ATPOL: CF36); to the E from Stradunia, several dozens individuals in ox-bow lake (ATPOL: CF26); Mechnica-Brodek, several dozens individuals in ox-bow lake (ATPOL: CF26); to the N from Kościerzycy, several dozens individuals in changed ox-bow lake (ATPOL: CE72); to the NE from Młodnik, several dozens individuals in fish-pond (ATPOL: CE66); Borki, several dozens individuals in shallow ox-bow lake (ATPOL: CE95); Lewin Brzeski, Skorogoszcz and Wronów, several dozens individuals in ox-bow lakes (ATPOL: CE83); to the E from Boguszyce, several dozens individuals in ox-bow lakes (N 50° 36' 18" E 17° 56' 44"; ATPOL: CF05); several individuals in gravel-pits in Opole–Grotowice (ATPOL: CF05),

*Ononis spinosa* L.: between Chrzążczyce and Chrzowice, several dozens individuals in limestone quarry (ATPOL: CF05); to the E from Sarnów, several individuals in swards (ATPOL: CF29); to the N from Toszek, several individuals in swards (ATPOL: CF29); to the SW from Chróścina, several dozens individuals on drainage ditch escarpment (N 50° 39' 19" E 17° 37' 36"; ATPOL: CE94),

*Ornithogalum umbellatum* L.: to the S from Kietrz, several dozens individuals in the old gypsum mine (ATPOL: CF65); to the NW from Kosorowice, several individuals in the forest road verge (ATPOL: CF06); Opole-Kolonia Gosławicka, several individuals in rye crops (ATPOL: CE95); Świerkle, several individuals in forest margin (ATPOL: CE85); to the E from Czarnowasy, commonly in the pine forest margin and in shrubs in Mała Panew river valley (ATPOL: CE95); Marcinek by Zagwiździe, few individuals in road verge (N 50° 52' 08" E 18° 00' 43"; ATPOL: CE75); Stare Budkowice, several individuals in forest margin close to the village; ATPOL: CE76),

*Ornithopus perpusillus* L.: Rudniki, hundreds of individuals in grasses on sandy soil by waste dump (ATPOL: DE50),

***Orobanche lutea* Baumg.:** several dozens individuals in swards in marl quarry in Opole-Nowa Wieś Królewska (ATPOL: CE95),

***Orthilia secunda* (L.) House:** to the NW from Kosorowice, several dozens individuals in pine forest (ATPOL: CF06); Szczedrzyk-Podbory, several dozens individuals in pine forest (ATPOL: CE97); to the N from Świerkle, in several places in pine forest, altogether ca. 100 individuals (ATPOL: CE85),

***Osmunda regalis* L.:** between Radomierowice and Wierzchy, several dozens individuals in forest drainage ditch in pine-birch forest (ATPOL: CE66),

***Oxycoccus palustris* Pers.:** to the SE from Osiecko, hundreds of individuals in wooded ravine (ATPOL: CE88),

***Peplis portula* L.:** commonly in Nysa dam reservoir near Biała Nyska, Kwiatków and Buków (ATPOL: CF20); in great number between Kościerzycy and Nowe Kolnie on the sand-pit banks (ATPOL: CE73); in very great number in Turawa dam reservoir near Szczedrzyk (ATPOL: CE97); commonly in gravel-pit in Głębocko (ATPOL: CE92); Niemodlin, in fish-pond to the W from swimming pool, hundreds of individuals (ATPOL: CF03); Kuźnica Żytniowska (Rudniki commune), in great number on the wet field (ATPOL: CE59); Bory Niemodlińskie, ca. 100 individuals in puddle on forest road near Jaśkowice nature reserve (ATPOL: CF04); to the N from Zawada, in very great number on wet sand by huge earthworks (N 50° 43' 34" E 17° 59' 34"; ATPOL: CE96),

***Petasites albus* (L.) Gaertn.:** to the E from Nowa Cerekiew, several individuals in road ditch (ATPOL: CF65); to the S from Dobrodzień, several individuals in forest road verge (ATPOL: CE99); Las Głubczycki, several dozens individuals in forest road verge in the central part of woods (ATPOL: CF44),

***Petasites hybridus* (L.) Gaertn., B. Mey. & Scherb.:** to the S from Kietrz, thousands of individuals alongside Morawka stream (ATPOL: CF65); Stary Ujazd, hundreds of individuals alongside small stream (ATPOL: CF28); to the E from Sudoł, hundreds of individuals in the Odra valley (ATPOL: CF67); to the W from Brzezcie, several dozens individuals in field road verge (ATPOL: CF67); Rudniki-Jawor, ca. 100 individuals in wet meadow and in drainage ditch (ATPOL: DE50); to the SE from Opole-Malina, alongside Czarnka stream, not many (N 50° 36' 53" E 18° 01' 03"; ATPOL: CF05); in great number in Pomologia park near Prószków (ATPOL: CF05),

***Petrorhagia prolifera* (L.) P. W. Ball & Heywood:** between Chorula and Malnie, several dozens individuals in out of use limestone quarry (ATPOL: CF15),

***Plantago arenaria* Waldst. & Kit.:** in very great number in sand-pit near Kotlarnia and Ortowice (ATPOL: CF48),

***Platanthera bifolia* (L.) Rich.:** several dozens individuals in broad-leaved forest to the S from Lipniki (ATPOL: BF19); several individuals in acidic oak forest to the E

from Sławniowice (ATPOL: CF30); to the N from Braciszów, several dozens individuals in acidic oak forest *Luzulo-Quercetum petraeae* (ATPOL: CF53); to the NW from Królowe, several dozens individuals in swards by fish-pond (ATPOL: CF44); to the W from Pietrowice Głubczyckie, several dozens individuals in acidic oak forest *Luzulo – Quercetum petraeae* (ATPOL: CF53); to the W from Szczedrzyk, several dozens individuals in acidic oak forest (ATPOL: CE96); to the NW from Surowina, several dozens individuals in light oak forest (N 50° 47' 25" E 17° 54' 59"; ATPOL: CE85),

***Polygala amarella* Crantz:** Opole-Malina, several individuals in fresh meadow (N 50° 37' 55" E 18° 00' 12"; ATPOL: CF05); in great number in wet meadow in Opole–Nowa Wieś Królewska (ATPOL: CE95); out of use marl quarry to the SW from Otmice, commonly in the bottom of the excavation (ATPOL: CF16),

***Polypodium vulgare* L.:** several dozens individuals in proposed nature reserve “Marmurowa Dolina” in Sławniowice (ATPOL: CF30); Świerkle, several dozens individuals in pine forest margin (ATPOL: CE85); Bory Niemodlińskie, several individuals on oak trunk (N 50° 31' 35" E 17° 51' 49"; ATPOL: CF04); Głuchołazy, several individuals on rocks near play field (ATPOL: CF31),

***Polystichum aculeatum* L.:** several individuals in out of use quarry to the E from Sławniowice (ATPOL: CF30),

***Potamogeton acutifolius* Link:** to the NW from Skorogoszcz, several dozens individuals in ox-bow lake (ATPOL: CE83); in great number in small pond to the S from Winna Góra (ATPOL: CE75),

***Potamogeton alpinus* Balb.:** to the SE from Opole-Malina, several individuals in Czarnka stream (N 50° 37' 00" E 18° 00' 30"; ATPOL: CF05); in great number in Canals and water reservoirs in sand-pit “Kotłarnia” (ATPOL: CF48); in great number in Odra river ox-bow lake to the SE from Stobrawa (ATPOL: CE73); in great number in fish-ponds to the S from Prószków (ATPOL: CF04),

***Potamogeton berchtoldii* Fieber:** in great number in clay-pit to the SW from Wysoka (ATPOL: CE79); Opole, in great number in small water reservoir in limestone quarry “Odra 1” (ATPOL: CE95); several individuals in Biała Głuchołaska river in Głuchołazy-Zdrój (ATPOL: CF31),

***Potamogeton nodosus* Poir.:** in great number in gravel-pit in Głębocko (ATPOL: CE92); hundreds of individuals in gravel-pit in Kantorowice (ATPOL: CE83); several dozens individuals in clay-pit to the S from Mechnice (ATPOL: CE94); several individuals in gravel-pit in Odra village (ATPOL: CF78),

***Potamogeton obtusifolius* Mert. & W. D. J. Koch:** in great number in fish-pond “Łoża” by Lipno (ATPOL: CF03); to the E from Stradunia, several dozens individuals in Odra ox-bow lake (ATPOL: CF26); Rogi, several dozens individuals in ox-bow lake (ATPOL: CF36); Chrzowice, several individuals in small pool in limestone quarry

(ATPOL: CF05); fish-pond “Ładnik” by Tułowice, in great number in western and northern part of the pond (ATPOL: CF03); fish-pond “Pietruszka” by Tułowice, not many individuals in eastern part of the pond (ATPOL: CF03); to the N from Czarnowąsy, not many individuals in fish-ponds (ATPOL: CE85); Wojnowice, several individuals in fish-pond (ATPOL: CF64); Kantorowice, several individuals in gravel-pit (ATPOL: CE83); in great number in fish-pond in Winów (ATPOL: CF05); several individuals in gravel-pit in Opole – Malina (ATPOL: CF05),

***Potamogeton pectinatus* L.:** in great number in gravel-pit in Kantorowice (ATPOL: CE83); Rogi, in great number in gravel-pit in Odra valley (ATPOL: CF36); Chrzowice, in great number in small pool in limestone quarry (ATPOL: CF05); limestone quarry “Piaś” in Opole, in great number in water reservoir (ATPOL: CE95); Kuźnica Dąbrowska, in great number in fish-ponds (ATPOL: CE65); to the NE from Młodnik, hundreds of individuals in fish-pond (ATPOL: CE66); Nowe Kolnie, several dozens individuals in ox-bow lake (ATPOL: CE73); to the E from Bieńkowice, in great number in Odra river and Psina influence section (ATPOL: CF67); to the W from Brzezie, in great number in fish-ponds (ATPOL: CF67); drainage ditches in the limestone quarry in Górażdże (ATPOL: CF16); Opole, Canal Ulga starting section, in great number in small ponds (ATPOL: CE95),

***Potamogeton perfoliatus* L.:** several dozens individuals in gravel-pit in Kantorowice (ATPOL: CE83),

***Potamogeton pusillus* L.s.s.:** in great number in gravel-pit in Opole-Malina (ATPOL: CF05); in great number in clay-pit to the NW from Wierzbicice (ATPOL: CF21); in great number in shallow pools and drainage ditches in marl quarry in Górażdże (ATPOL: CF16); Opole, Canal Ulgi starting section, in great number in small ponds (ATPOL: CE95),

***Potamogeton trichoides* Cham. & Schltl.:** in great number in clay-pit in Wysoka-Dąbrowa (ATPOL: CE79); few individuals in the clay-pit to the NW from Wierzbicice (ATPOL: CF21); few individuals in fish-pond in Winów (ATPOL: CF05); few individuals in ox-bow lake to the NW from Skorogoszcz (ATPOL: CE83),

***Potentilla norvegica* L.:** several dozens individuals in Nysa dam reservoir near Biała Nyska, Kwiatków and Buków (ATPOL: CF20, CF21); Kotórz Wielki, several individuals on the reservoir embankment, near the main dam (N 50° 44' 00" E 18° 05' 12"; ATPOL: CE96),

***Potentilla recta* L.:** to the E from Folwark, several dozens individuals on the Odra river embankments (N 50° 37' 13" E 17° 56' 53"; ATPOL: CF05),

***Potentilla supina* L.:** hundreds of individuals in Nysa dam reservoir near Biała Nyska (ATPOL: CF21); several dozens individuals in dried up fish-pond in Kościerzycy (ATPOL: CE72); Opole-Zaodrze, several dozens individuals in Canal Ulga meadows (ATPOL: CE95); Opole, in Chmielowice direction, several dozens individuals on rubble

heap (ATPOL: CE95); to the N from Zawada, several individuals in field road verge (N 50° 43' 34" E 17° 59' 34"; ATPOL: CE96); Strzelce Opolskie, several individuals in fish-pond embankments on wet sand (ATPOL: CF18); Kujawy, several individuals near small pond in the centre of the village (ATPOL: CF24),

***Primula elatior* (L.) Hill:** in great number in broad-leaved forest to the E from Sławniowice (ATPOL: CF30); to the S from Kietrz, hundreds of individuals in broad-leaved forest *Tilio-Carpinetum* (ATPOL: CF65); to the E from Sukowice, hundreds of individuals on wet meadow (ATPOL: CF11); to the NW from Królów, few individuals in broad-leaved bushes (ATPOL: CF44); Kietlice, hundreds of individuals, close to the village (ATPOL: CF44); Biernatówek, quite many in broad-leaved forest to the S from the village (ATPOL: CF44); to the N from Głogówek, hundreds of individuals in broad-leaved forests (ATPOL: CF34); to the NE from Nowy Dwór, hundreds of individuals in broad-leaved forests (ATPOL: CF64),

***Primula veris* L.:** to the E from Zimnice Małe, several individuals in swards on the Odra valley escarpments (ATPOL: CF05); to the E from Sarnów, several dozens individuals in swards (ATPOL: CF29); in great number in military training area in Winów (ATPOL: CF05),

***Pyrola chlorantha* Sw.:** Szczedrzyk-Podbory, several dozens individuals in pine forest (ATPOL: CE97); Świerkle, altogether most than 100 individuals in pine forest in many places (e.g. N 50° 46' 22" E 17° 55' 41"; N 50° 46' 13" E 17° 55' 20"; N 50° 46' 29" E 17° 54' 42"; ATPOL: CE85),

***Pyrola minor* L.:** Szczedrzyk-Podbory, several dozens individuals in pine forest (ATPOL: CE97); Świerkle, several individuals in pine forest (N 50° 46' 13" E 17° 55' 20"; ATPOL: CE85); in great number in out of use quarry to the N from Chomiąza (ATPOL: CF63),

***Pyrola rotundifolia* L.:** hundreds of individuals in broad-leaved forest to the E from Sławniowice (ATPOL: CF30); to the NW from Kosorowice, several dozens individuals in pine forest (ATPOL: CF06); to the S from Rędzina, on the pine thicket margin (ATPOL: CE89); to the N from Dobrzeń Wielki, several dozens individuals in pine forest (ATPOL: CE85); Szczedrzyk-Podbory, several dozens individuals in pine forest (ATPOL: CE97); to the N from Świerkle, several individuals in pine forest (ATPOL: CE85),

***Ranunculus cassubicus* L. s. l.:** to the S from Kietrz, several individuals in broad-leaved forest *Tilio-Carpinetum* (ATPOL: CF65); Lubotyń, few individuals in linden tree stand in eastern part of the village (ATPOL: CF65),

***Ranunculus lingua* L.:** in great number in Malina river to the NE from Kolonia Gosławicka (ATPOL: CE95); several dozens individuals in peat-bog in Przywory (ATPOL: CF05),

***Salvia pratensis* L.:** Opole, from Chmielowice side, several dozens individuals on the railway embankment (ATPOL: CE95); Opole-Groszowice, several dozens individuals in the Odra river escarpments (N 50° 38' 32" E 17° 56' 09"; ATPOL: CF05); Sprzęcice, ca. 200 individuals i road verge and sports field margin (N 50° 30' 20" E 18° 06' 59"; ATPOL: CF16); in great number in the limestone quarry in Opole-Nowa Wieś Królewska (ATPOL: CE95); in great number in air field in Kamień Śląski (ATPOL: CF16),

***Salvinia natans* (L.) All.:** to the NE from Zawadno, hundreds of individuals in Odra river ox-bow lake (ATPOL: CE83),

***Schoenoplectus tabernaemontani* (C. C. Gmel.) P Palla:** Chrzowice, hundreds of individuals in shallow pools in marl quarry (ATPOL: CF05); limestone quarry "Piast" in Opole, hundreds of individuals in the water reservoir banks (ATPOL: CE95); limestone quarry "Odra 1" in Opole, in great number alongside small brook (ATPOL: CE95); to the NE from Sławice, ca. 100 individuals close to ox-bow lake (N 50° 44' 20" E 17° 51' 26"; ATPOL: CE95),

***Scirpus radicans* Schkuhr:** in Nysa dam reservoir near Biała Nyska, thousands of individuals (ATPOL: CF21); hundreds of individuals in out of use fish-pond to the S from Karłowice (ATPOL: CE74),

***Scorzonera humilis* L.:** several dozens individuals in the forest road verges to the S from Myślińca (ATPOL: CE98); surroundings of Świerkle and Kup, in many places, usually several individuals in pine forests (e.g. N 50° 46' 30" E 17° 55' 43"; N 50° 46' 13" E 17° 55' 20"; N 50° 47' 24" E 17° 54' 09"; N 50° 46' 41" E 17° 54' 39"; ATPOL: CE85); nature reserve "Bazany", northern part, several individuals in pine forest (ATPOL: CE67); Bory Niemodlińskie, several dozens individuals in forest road "Kropkowiec" verge and in pine forest (N 50° 31' 41" E 17° 51' 21"; ATPOL: CF04); to the E from Surowina, several dozens individuals in forest road verge (N 50° 46' 50" E 17° 58' 09"; ATPOL: CE85); to the N from Jełowa, several individuals in fresh pine forest (N 50° 50' 22" E 18° 02' 45"; ATPOL: CE86); to the NE from Turawa, several dozens individuals in pine forest (N 50° 45' 02" E 18° 06' 45"; ATPOL: CE86); to the W from Lubniany, 1 individual in forest road verge (ATPOL: CE86),

***Scrophularia scopolii* Hoppe:** several individuals in road verges in Opole-Zoological garden (ATPOL: CE95); several individuals in gravel-pit by Odra village (ATPOL: CF78),

***Scrophularia umbrosa* Dumort.:** Wojciechów, few individuals in shadow broad-leaved forest by Stobrawa springs (ATPOL: CE78); Rudniki-Jawor, several individuals alongside small water course (ATPOL: DE50); to the SE from Zawada, several individuals alongside Jemielnica river (N 50° 41' 40" E 18° 01' 33"; ATPOL: CE96),



***Senecio barbareifolius* (Krock.) Wimm. Et Grab.:** Opole, from the Chmielowice side, ca. 100 individuals in wet meadow (ATPOL: CE95); to the N from Zbicko, ca. 100 individuals in wet meadow (ATPOL: CE96),

***Senecio congestus* (R. Br.) DC.:** Stradunia, several individuals in alder forest *Ribeso nigri-Alnetum* (ATPOL: CF26); Dziergowice, several individuals in alder forest *Ribeso nigri-Alnetum* (ATPOL: CF47),

***Senecio fluviatilis* Wallr.:** to the E from Winów, in great number in Odra river bushes (ATPOL: CF05); Opole-Wyspa Bolko, in great number in Canal shrubs (ATPOL: CE95),

***Senecio rivularis* (Waldst. & Kit.) DC.:** hundreds of individuals on Turawa reservoir dam embankments near Antoninek (ATPOL: CE97); Rudniki-Jawor, ca. 100 individuals in alder forest *Carici elongatae-Alnetum* (ATPOL: DE50); to the SE from Opole-Malina, ca. 100 individuals in forest wet meadow and alongside Czarnka stream (N 50° 36' 42" E 18° 02' 48"; ATPOL: CF06); surroundings of Mańczok, in many places in forest road verges, altogether ca. 100 individuals (e.g. N 50° 49' 49" E 17° 57' 45"; N 50° 50' 01" E 18° 00' 32"; ATPOL: CE76); to the NW from Chrzastowice, several individuals in shrubs alongside field road (N 50° 40' 54" E 18° 03' 53"; ATPOL: CE96); between Zawada and Middle Turawa Lake, several dozens individuals in forest road verge (ATPOL: CE96); between Rzędów and Jelowa, in many places, altogether ca. 500 individuals in wet forests and in forest road verges (e.g. N 50° 46' 05" E 18° 08' 38"; N 50° 46' 12" E 18° 09' 45"; ATPOL: CE86),

***Serratula tinctoria* L.:** Nowe Kolnie, hundreds of individuals in wet meadows in Odra valley (ATPOL: CE73); between Kościerzycy and Nowe Kolnie, hundreds of individuals in wet meadow in Odra river (ATPOL: CE72),

***Seseli annuum* L.:** in great number in out of use marl quarry in Ligota Dolna (ATPOL: CF16),

***Silaum silaus* (L.) Schinz & Thell.:** Opole from the Chmielowice side, several dozens individuals on wet meadow and on road verges (ATPOL: CE95); to the SW from Chróścina, several dozens individuals on wet meadows (ATPOL: CE94),

***Sparganium minimum* Wallr.:** in great number in small pond to the S from Winna Góra (ATPOL: CE75),

***Spirodela polyrhiza* (L.) Schleid.:** in great number in clay-pit to the N from Ścinawa Nyska (ATPOL: CF11); in great number in pond in Stary Bugaj (Rudniki commune) (ATPOL: DE60); Opole, in great number in pond near the bridge on the north circle road (N 50° 42' 07" E 17° 53' 38"; ATPOL: CE95); to the E from Sławice, not many individuals, close to the sewage purification plant (N 50° 42' 33" E 17° 53' 07"; ATPOL: CE95); to the E from Boguszyce, not many in water course (N 50° 35' 33" E 17° 56' 58"; ATPOL: CF05); hundreds of individuals in Głuchołazy, in small pond in the bottom of the quarry (ATPOL: CF31),

***Stellaria longifolia* Muhl. ex Willd.:** several dozens individuals on the forest road to the NW from Smolarnia (ATPOL: CF14); to the SW from Nowa Kuźnia-Podlesie, several dozens individuals on the wet forest road (N 50° 35' 33" E 17° 50' 02"; ATPOL: CF04); surroundings of Mańczok, hundreds of individuals in forest road ditch (N 50° 49' 41" E 17° 58' 31") and by water reservoir (N 50° 50' 01" E 18° 00' 32"; ATPOL: CF76); to the S from Jelowa, quite commonly in peat-bog margins (N 50° 46' 17" E 18° 04' 22"; ATPOL: CF86); to the SW from Ligota Turawska, several dozens individuals on the wet meadow margin (50° 46' 15" E 18° 08' 03"; ATPOL: CF87),

***Stratiotes aloides* L.:** Obrowiec, thousands of individuals in ox-bow lake (ATPOL: CF26); to the NE from Bąków, several dozens individuals in Odra river ox-bow lake (ATPOL: CF26); to the E from Stradunia, several dozens individuals in ox-bow lake (ATPOL: CF26); Rogi, several individuals in ox-bow lake (ATPOL: CF36); Borki, thousands of individuals in shallow ox-bow lake (ATPOL: CE85); to the E from Sławice, quite many in two ox-bow lakes (eg. N 50° 42' 56" E 17° 52' 33"; N 50° 44' 20" E 17° 51' 26"; ATPOL: CE95); to the SE from Stobrawa, in great number in ox-bow lake in the broad-leaved forest (ATPOL: CE73),

***Teesdalea nudicaulis* (L.) R. Br.:** in great number in sandy waste lands to the N from Ładza (ATPOL: CE75); to the NW from Żelazna, in great number in rye crops (ATPOL: CE94); to the W from Szczedrzyk, in great number in grasses *Spergulo-Corynephorum* (ATPOL: CE97); Dziergowice, in great number in sandy escarpments of the Odra river (ATPOL: CF47); Rudniki-Jawor, hundreds of individuals in sand-pit in *Spergulo-Corynephorum* association and less frequently on neighbouring fields (ATPOL: DE50); to the NW from Masów, in great number on road verges and fallow lands (N 50° 46' 56" E 17° 58' 28"; ATPOL: CE85); to the W from Mańczok, in great number in forest road verge (N 50° 49' 38" E 17° 57' 53"; ATPOL: CE76); Marcinek by Zagwizdzie, several dozens individuals in grasses (N 50° 52' 20" E 18° 01' 03"; ATPOL: CE75); Stare Budkowice, in great number on sandy fallow lands (N 50° 52' 27" E 18° 03' 02"; ATPOL: CE76); to the N from Jelowa, in great number in forest road verge (N 50° 50' 46" E 18° 02' 53"; ATPOL: CE86),

***Teucrium botrys* L.:** between Chorula and Malnie, several dozens of individuals in out of use limestone quarry (ATPOL: CF15),

***Teucrium scorodonia* L.:** Bory Niemodlińskie, to the SE from Szydłów, several dozens individuals in mid forest meadow (N 50° 35' 18" E 17° 46' 09"; ATPOL: CF04),

***Thalictrum flavum* L.:** in great number in Odra river meadows near Bełsznica (ATPOL: CF78),

***Thalictrum lucidum* L.:** several dozens individuals in the wet meadow margins to the N from Zbicko (ATPOL: CE96); several individuals in clay-pit to the S from Wachów (ATPOL: CE79); to the SW from Rybna, several dozens individuals alongside drainage ditches in *Alopecuretum pratensis* meadows (ATPOL: CE83); Stare Kolnie,

several dozens individuals in the wet meadows (ATPOL: CE73); to the SE from Turza, several dozens individuals in wet meadows (ATPOL: CF57); to the N from Zawadno, several dozens individuals in Odra river wet meadows (ATPOL: CE84); Kantorowice, on waste lands by gravel-pits (ATPOL: CE83); to the N from Żytniów (Rudniki commune), few individuals in drainage ditch (ATPOL: DE50),

***Thelypteris palustris* Schott:** Dziergowice, several dozens individuals in alder forest *Ribeso nigri – Alnetum* (ATPOL: CF47); several individuals in alder forest in Winów (ATPOL: CF05),

***Thlaspi perfoliatum* L.:** hundreds of individuals in rye crops to the W from Siedlec (ATPOL: CF16); to the E from Winów, in very great number on Odra river embankments, in several places (e.g. N 50° 38' 22" E 17° 55' 50"), altogether many thousands individuals (ATPOL: CF05); Opole-Zaodrze, in great number in crops and on Ulga Canal embankments (N 50° 39' 17" E 17° 54' 44"; ATPOL: CE95); to the SE from Opole-Malina, several dozens individuals on railway embankment (ATPOL: CF05); Opole-Groszowice, in great number on river embankment (N 50° 37' 39" E 17° 56' 26"; ATPOL: CF05),

***Trapa natans* L.:** in very great number in fish-ponds to the S from Prószków (ATPOL: CF05),

***Trifolium fragiferum* L.:** Opole, from Chmielowice side, several dozens individuals in field road verge (N 50° 39' 40" E 17° 52' 47"; ATPOL: CE95); Opole-Nowa Wieś Królewska, several dozens individuals in road verges by railway track (ATPOL: CE95),

***Triglochin palustre* L.:** in great number on wet meadows and in drainage ditches in Opole-Nowa Wieś Królewska (ATPOL: CE95),

***Utricularia minor* L.:** in great number in "Łoża" fish-pond by Lipno (ATPOL: CE03); to the S from Rędzina, several dozens individuals in small pond in old sand-pit (ATPOL: CE89),

***Vaccinium uliginosum* L.:** to the S from Jełowa, quite commonly in peat-bog (N 50° 46' 17" E 18° 04' 22"; ATPOL: CE86),

***Valeriana dioica* L.:** several dozens individuals in wet meadow between Jarnołtówek and Skowronków (ATPOL: CF41),

***Valeriana sambucifolia* J.C.Mikan:** several dozens individuals in river carr forest to the E from Sławniowice (ATPOL: CF30); Opole-Malina, several dozens individuals alongside Czarnka stream (e.g. N 50° 36' 50" E 18° 01' 18"; ATPOL: CF05); surroundings of Zagwizdzie, in several places alongside Budkowiczanka river (e.g. N 50° 52' 04" E 17° 59' 06"; N 50° 52' 08" E 18° 00' 43"), altogether several dozens individuals (ATPOL: CE75); Osowiec Śląski, several individuals in Mała Panew

banks (ATPOL: CE86); surroundings of Zawada, in great number in shrubs of Jemielnica river (ATPOL: CE96),

***Veratrum lobelianum* Bernh.:** Podborze, several dozens individuals in broad-leaved forest (ATPOL: CF26); Konradów, several individuals in Alder forest (ATPOL: CF31),

***Veronica dillenii* Crantz:** to the W from Sucha, several dozens individuals in rye crops (ATPOL: CF17); Miedziana, several dozens individuals in rye crops (ATPOL: CF16); Rudniki-Jawor, commonly in sand-pit and surrounding fields (ATPOL: DE50); in great number in fields and road verges in surroundings of Janinów, Odcinek, Słowików, Mostki, Młyny, Kuźnica Żytniowska (Rudniki commune; ATPOL: CE59, CE69, DE50); to the NW from Masów, in great number in sandy road verge and fallow land (N 50° 46' 56" E 17° 58' 28"; ATPOL: CE85); Stare Budkowice, in several places on sand, quite commonly (e.g. N 50° 52' 29" E 18° 01' 46"; N 50° 52' 27" E 18° 03' 02"; ATPOL: CE76),

***Veronica longifolia* L.:** to the SW from Rybna, several dozens individuals in road verges on the wet meadows complex *Alpecuretum pratensis* (ATPOL: CE73); Stare Kolnie, commonly in wet meadows *Alpecuretum pratensis* (ATPOL: CE73); Łęg, in great number in drainage ditches (ATPOL: CF57); Stobrawa, several dozens individuals in Stobrawa river valley (ATPOL: CE73); between Kościerzycy and Nowe Kolnie, several dozens individuals in wet meadows in Odra river (ATPOL: CE72); to the S from Wronów, several individuals in road ditches (ATPOL: CE83); between Stroszowice and Oldrzychowice, several dozens individuals around small ox-bow lake (ATPOL: CE93); to the N from Zbicko, several individuals in dried up meadow (ATPOL: CE96),

***Veronica montana* L.:** nature reserves "Grafik", "Boże Oko" and "Lesisko" (ATPOL: CF26, CF27); several individuals on forest road to the SW from Głuchołazy (ATPOL: CF31),

***Veronica verna* L.:** Kuźnica Żytniowska, in great number on sandy field road (ATPOL: CE69); Rudniki, hundreds of individuals on sandy fallow land (ATPOL: DE50); Stare Budkowice, in great number in several places on sand (e.g. N 50° 52' 29" E 18° 01' 46"; N 50° 52' 27" E 18° 03' 02"; ATPOL: CE76); Świerkle, several dozens individuals on sandy road verge (N 50° 46' 08" E 17° 54' 58"; ATPOL: CE85),

***Vicia lathyroides* L.:** several dozens individuals in road verge grasses to the N from Ładza (ATPOL: CE75); Opole-Półwieś, several dozens individuals in cemetery, in grasses (ATPOL: CE95); to the E from Dąbrówka Górna, ca. 100 individuals on river embankments (ATPOL: CF15); Opole-Groszowice, ca. 100 individuals in grasses (N 50° 36' 38" E 17° 57' 56"; ATPOL: CF05); Opole-Grotowice, in great number in road verge grasses (ATPOL: CF05),

***Vicia tenuifolia* Roth:** Opole-Groszowice, in great number in limestone quarry (ATPOL: CF05); Zimnice Małe, in great number on Odra river escarpments, in grasses

and shrubs (ATPOL: CF05); between Sprzęcice and Kamionek, in several places in forest road verge and forest margin (e.g. N 50° 30' 35" E 18° 05' 48"; N 50° 31' 12" E 18° 03' 53"; ATPOL: CF16),

***Viola hirta* L.:** several dozens individuals in grasses in Dębska Kuźnia (ATPOL: CE96); in great number on military training area in Winów (ATPOL: CF05); to the E from Winów, not many on the Odra river embankments, in several places (e.g. N 50° 38' 22" E 17° 55' 50"; ATPOL: CF05); to the W from Żerkowice, several dozens individuals in shrubs close to a farm (ATPOL: CE94),

***Viola stagnina* Kit. :** several individuals on the fish-pond dyke in Kuźnica Dąbrowska (ATPOL: CE65); to the SE from Kuźnica Katowska, in the ecological ground „Puchacz”, several individuals in wet meadow (ATPOL: CE74),

***Vulpia myuros* (L.) C.C. Gmel.:** Kędzierzyn-Koźle, quite commonly on the railway track within the „Blachownia” chemical factory (ATPOL: CF47); in very great number in “Kotlarnia” sand-pit near Ortowice (ATPOL: CF48),

***Wolffia arrhiza* (L.) Horkel ex Wimm.:** to the S from Stobrawa, in great number in ox-bow lake in *Wolffio-Lemnetum gibbae* (ATPOL: CE73); to the W from Wielopole, in great number in ox-bow lake in broad-leaved forest (ATPOL: CE84),

***Zannichellia palustris* L. subsp. *palustris*:** Opole-Zaodrze, in great number in small ponds in Odra and Ulga Canal valley (ATPOL: CE95); Strzelce Opolskie, in great number in drainage ditch by fish-pond (ATPOL: CF18).

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## **Streszczenie**

### *Materiały do rozmieszczenia zagrożonych roślin naczyniowych na Śląsku Opolskim*

Opolszczyzna od bardzo dawna była obiektem zainteresowania botaników (m. in. Wimmer 1844; Fiek 1881; Schube 1904). Po Drugiej Wojnie Światowej zainteresowanie tym terenem nieco osłabło. Z obszerniejszych opracowań z tego okresu wymienić można m. in. prace Michalaka (1968, 1970, 1972) oraz Szotkowskiego (1987; 1988). W ostatnich latach daje się obserwować ponowny wyraźny wzrost zainteresowania województwem opolskim pod względem botanicznym. Z całego szeregu publikacji na szczególną uwagę zasługują prace, które po raz pierwszy w sposób kompleksowy przedstawiają zagadnienia dotyczące flory tego obszaru (Dajdok i in. 1998a; Dajdok

i in. 1998b; Nowak i Spałek (Red.) 2002; Nowak i in. 2003). W pracach tych zawarta jest także niemal cała wcześniejsza literatura z tego tematu.

Poniższa praca przedstawia wykaz stanowisk ciekawszych oraz chronionych gatunków roślin naczyniowych odnalezionych na Opolszczyźnie podczas różnych wycieczek terenowych w latach 1998 – 2004. W swoim założeniu ma ona stanowić uzupełnienie obecnego stanu wiedzy o rozmieszczeniu rzadkich gatunków w województwie opolskim ze szczególnym uwzględnieniem taksonów z Czerwonej Księgi tego obszaru (Nowak i in. 2003).

Listę florystyczną ułożono w porządku alfabetycznym, a nazwy gatunków przyjęto za Mirkiem i in. (2002). Przy poszczególnych gatunkach podano następujące informacje: lokalizację stanowiska lub stanowisk (w wielu przypadkach podano współrzędne geograficzne odczytane z odbiornika GPS w układzie WGS 84), typ zajmowanego siedliska oraz ogólnie oszacowaną liczebność. Aby nie wprowadzić Czytelnika w błąd należy podkreślić, że publikowane poniżej dane nie były gromadzone w sposób systematyczny, w związku z czym liczba stanowisk gatunku nie musi świadczyć o stopniu jego rzadkości.





**THE INFLUENCE OF WEATHER AND INTERIOR  
MICROCLIMATE ON THE HIBERNATION OF COMMON  
LONG-EARED BATS (*PLECOTUS AURITUS*).**

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**ABSTRACT:** The common long-eared bat (*Plecotus auritus*) was studied during 2 consecutive winters within the Tarnowskie Góry – Bytom mine system. This is the largest system of underground corridors and chambers in Poland (>300 km) and one of the most significant hibernation locations for bats, including *P. auritus*. We recorded bat locations, temperature and humidity in a 700 m portion of this system. Subterranean thermal conditions were modified by exterior climatic conditions. Most temperatures at hibernation locations were between 2.8 and 5.8°C (range = 0.7-7.1°C) and humidities were consistently near saturation (95-100%). Hibernation behaviour depended on weather conditions and the underground climate. Bats entered the hibernacula in the autumn, when the temperature inside approached their thermal preference. Short-term and abrupt decreases and increases in the outside temperature in winter caused a significant increase and decrease, respectively, in the number of hibernating bats. The underground temperatures lagged behind exterior temperatures, resulting in a delay in the exodus of bats in spring.

**KEY WORDS:** bats, cave microclimate, *Chiroptera*, hibernation, long-eared bat, *Plecotus auritus*, Poland, refugioclimate.

In temperate latitudes the life cycle of most bats includes a period of hibernation. In continental Europe most species are inactive from October to April. During this period of unfavorable weather many species seek refuge in locations where they can avoid freezing temperatures (Wołoszyn 2001), including a variety of underground sites (e.g., caves, basements, bomb shelters, closed mines, wells, dark places in buildings, hollows or burrows), where they can stay during unfavourable weather conditions. Other species avoid the unfavorable winter climate by undertaking seasonal migrations (Roer 1995).

Caves and other underground spaces do not freeze, experience limited variation in temperatures, and are often accessible for study (Wołoszyn 1994). Climatic conditions can be easily observed in caves, often revealing surprising spatial and temporal dynamics of populations of hibernating bats (Wołoszyn 1976, Skalski 1995, French 1988).

The timing of hibernation of bats, and changes in their population size during the winter have not been investigated in Poland. Quantitative aspects of hibernation have received study elsewhere (Gaisler and Bauerowa 1977; Daan et al. 1980; Gaisler et al. 1981; Harmata 1981; Iljin 1989; Harmata 2000; Postawa and Zygmunt, 2000) but changes in the abundance of bats during the course of the hibernation period have received less attention. Here we describe the dynamics of changes in the hibernation behaviour, relative to climatic conditions during the winter, of the common long-eared bat (*Plecotus auritus*).

### **Materials and methods**

Hibernation dynamics were studied in a portion of the Tarnowskie Góry – Bytom abandoned mine. This is the largest underground mine system in Poland, > 300 km in length, with numerous passages, chambers and excavations that resulted from over 1,000 years of mining ore (Kłys and Rahmonov 2001). The abandoned mine chambers host one of the largest winter aggregations of bats in Poland (Kłys 1994, 1994a). Recent information (Kłys, unpublished data) suggests that the number of bats that use this mine system is higher than previously described.

The site is on Tarnowskie Góry Ridge in Silesian Upland, on lands administered by the Tarnowskie Góry and the north part of Bytom. It is located between 50°24' North and 18°58' and 18°76' East. A 700-m long portion of the system was selected as the study site and it is located in the southern part of the system. Under the Segiet natural reserve, near the mine entrance, is located in the abandoned “Błachówka” quarry, a legally protected site of special geological interest. The study site is complex with varying internal and external topography and microclimate. In addition to the primary entrance to the study site, other more distant openings also connect directly to the portion of the mine system under study. Most excavations on the site are located approximately 40 m below the entrance level. The difference between the entrance level and the shaft connecting other levels is 5 m and there are numerous side passages, some of which have been closed by being filled with stone.

The study was conducted throughout the hibernation season (from the beginning of October until the end of April) during 2 consecutive years (2000-2001 and 2001-2002). The site was visited 15 and 17 times (once every few weeks) during the first and second seasons, respectively. The corridors and chambers of the study site were mapped and specific locations were selected throughout to collect information on climatic conditions (i.e., temperature and humidity), as well as the occurrence and number of all bat species. At each sample point, temperature and humidity were measured at 10, 100 and 180 cm above the floor of the passage (corresponding to the floor, the centre, and the ceiling of the passage).

An Assman aspiration psychrometer (accuracy = 0.1°C) was used to measure air temperature and relative humidity. Humidity values were taken from psychrometric tables (accuracy = 1%). Temperature data were also collected where roosting bats were observed, using a digital thermometer (resolution = 0.1°C) attached to a 1.5 m aluminium pole. (Temperature was measured as close as possible to the hibernating bat to characterise precisely the refugioclimate. All thermometers were calibrated for the thermal ranges of interest. All bats seen were identified to species and counted. Special care was taken to reduce disturbance to hibernating bats and their immediate surroundings.

## Results

Eight species were identified as hibernating at the study site: the common long-eared bat (*Plecotus auritus*), mouse-eared bat (*Myotis myotis*), Natterer's bat (*M. nattereri*), Brand's bat (*M. brandti*), whiskered bat (*M. mystacinus*), Daubenton's bat (*M. daubentoni*), serotine bat (*Eptesicus serotinus*), and gray long-eared bat (*Plecotus austriacus*). Humidity measurements at all sample sites were consistently high and close to saturation; 90-100%. Variation in relative humidity across sample points was insignificant. The greatest variation was near the mine entrance, further from the entrance the humidity is more stable, ranging from 95-100%.

The mean air temperature in the system was 7.5-8.0°C. Air temperature changed with the distance from the entrance and the cross-section of the passage. Daily and seasonal temperature changes were influenced by external and internal factors (Fig. 1, 2). Changes in the outside air temperatures usually influenced the thermal conditions inside the mine system. However, some short term warming periods during the winter (26 January 2001 – Fig. 1, 1 February 2002 – Fig. 2) did not affect the underground microclimate.

One hundred and seventy six measurements of the climate were recorded near the hibernating locations of the common long-eared bat in the winter of 2001-2002. The minimum and maximum temperatures recorded next to a hibernating bat were 0.7 °C and 7.10C, respectively (Fig. 3). The latter was recorded near bats that were assumed to be in poor health because of the condition of their skin. The mean (SD) temperature of hibernation of this species was 4.3 (1.6) °C, with a coefficient of variation = 36%, suggesting a relatively wide thermal preference for the species during

hibernation. At a relative humidity of 97–98 %, 7.1°C was the upper temperature limit of the hibernation locations of the common long-eared bat at our study site.

Sixty and 100 common long-eared bats were observed during the winters of 2000/2001 and 2001/2002, respectively (Fig. 4, 5). Hibernating bats were first observed on 29 November and 10 November in 2000/2001 and 2001/2002, respectively. In the winter season of 2000/2001 the maximum number of bats was observed at the end of January and the beginning of February (Fig. 4). During the winter season of 2001/2002, however, an increase of the number of bats was observed earlier, in the second half of December and it remained at this maximum through the end of February (Fig. 5). The number of bats dropped abruptly in the beginning of March in both years. At the beginning of the hibernation period a slight warming period occurred (Fig. 5), which resulted in the bats leaving. Shortly thereafter the outside temperature dropped, reducing the internal temperature which was followed by an increase in the number of hibernating bats. Periodic warm spells (i.e., 21 December 2001, 1 February 2002) did not cause observable changes in the number of bats (Fig 4, 5) but the number of bats counted shortly thereafter typically decreased. Similar, but less profound, changes were observed in the winter of 2000/2001 (Fig. 1.), probably due to less fluctuation in external temperature. The temperature that *P. auritus* appeared to prefer did not change substantially during the period. An increase in the external temperature in the spring caused the exodus of bats and when the temperature outside was favourable bats did not return to the hibernacula (Fig. 2).

## Discussion

The initiation of hibernation of *Plecotus auritus* depended on both microclimatic conditions outside and inside the subterranean system. Bats occasionally appeared in the mine much earlier, but did not stay, probably because temperatures were too high. External temperatures influenced the number of hibernating bats, in that the number of bats was lower during the warmer part of winter. During this period the bats usually hibernated in the less insulated locations, as suggested also by Kowalski and Lesiński (1994) and Jarzembowski et al. (2000).

The fact that common long-eared bats appeared in wintering places relatively late and left them early may be explained by their thermal preferences. The temperature range that characterized their hibernation site during midwinter did not occur in early winter or early spring. Prolonged warm periods during the winter caused a decrease in the number of hibernating bats, probably because the internal temperatures exceeded the preferred temperature.

Hibernation was a dynamic process (French 1988, Jurczynszyn 1996), with bats frequently observed flying inside the hibernaculum (e.g., Lesiński 1986). This activity was probably caused by microclimatic changes in the mine. Changes in the species composition of hibernating bats were also observed, which may have been caused by changes in temperature (Kozakiewicz 1996). For example, closing of the cave caused the cave temperature to increase, discouraging hibernation of bats in some locations that

were not cool enough. The common long-eared bat is frequently the most common hibernating species in small cellars (Fuszera et al. 1996, Jarzembowski et al. 2000). Most cellars are poorly insulated and they cool quickly, favouring hibernation. Collectively, these small hibernacula probably shelter over a hundred times more bats than the number recorded in large underground systems (Lesinski and Kowalski 1998). Only small portions of large hibernacula, usually in the vicinity of the entrance, provide proper conditions for hibernation. The importance of large underground systems may, however, be underestimated because rarely can all places of refuge be inspected (Bogdanowicz et al. 1983).

Humidity is an important factor that influences the choice of hibernation location (Thomas 1992). In this study, humidity was close to saturation at all hibernation locations where it was measured. Because the humidity we recorded was relatively constant, additional studies are necessary to determine if hibernation occurs at lower humidity, and the temperatures that may accompany lower humidity values.

Previous reported temperatures at the hibernation locations of common long-eared bats ranged from 0.0–9.0°C (Bogdanowicz et al. 1983, Lesiński 1986, Webb et al. 1996) and humidity ranged from 75 – 95% (Bogdanowicz et al. 1983, Lesiński 1986). More species of bats (including the common long-eared bat) appear to associate with lower or higher temperatures during hibernation (Bogdanowicz 1983). The authors of previous work did not report detailed methods so it was unclear whether temperature and humidities were recorded as close to hibernating bats as was conducted in the present study, making comparisons of refugioclimate difficult.

Due to the spatial and temporal dynamics of bat movements and locations during hibernation it is difficult to rely on data obtained from a single season or a single measurement during each of a series of seasons (Postawa and Zygmunt 2000). We suggest that the measurements of abiotic conditions in association with hibernating bats should be standardized so that data among investigators are comparable.

## Conclusions

As the result of the above described researches one can conclude, that the hibernation behavior of the common long-eared bat, *Plecotus auritus*, was apparently affected by weather changes and the microclimate inside the mine. Most bats select hibernation locations where the temperature is between 2.8 and 5.8°C (range 0.7-7.1°C; relative humidity 95-100%) which may represent their thermal preference or refugioclimate). The investigations show, that abrupt decreases in the outside temperatures in winter caused an increase in number of hibernating common long-eared bats. Warm periods during winter caused a decrease in the number of hibernating bats and warming during spring caused an exodus of bats, especially from the less insulated locations.

It seems to be sure, that temperatures in the hibernacula lagged behind changes in the external temperature, resulting in changes of the number of hibernating bats.

### Summary

Badania prowadzono w sezonach zimowych w latach 2000-02 na terenie Podziemi Tarnogórsko-Bytomskich, które są największym w Polsce systemem liczącym ponad 300 km chodników i komór. System ten stanowi pozostałość po prawie tysiącletniej eksploatacji złóż kruszcowych i innych metali. Do badań wykorzystano fragment wyrobisk o długości 700 m. Jest to jedno z największych zimowisk nietoperzy w Polsce, w tym gacka brunatnego *Plecotus auritus*. Badania pozwoliły zaobserwować korelację liczebności zimujących gacków, ze zmianami mikroklimatu w podziemnym systemie. Termika wnętrza badanego odcinka podziemi modyfikowana jest przez zewnętrzne warunki klimatyczne. Zestawienie wyników pomiarów termiki wnętrza oraz średniej dobowej temperatury okolicy ilustruje Rys. 1-2. Na wykresie zaznaczono również optimum termiczne hibernacji dla opisywanego gatunku. Ze względu na to, że pomiary tła termicznego (mikroklimat podziemi) często istotnie różniły się od temperatury w bezpośrednim sąsiedztwie hibernacji (proponuję wprowadzenie pojęcia refugioklimat), mierzone obydwie temperatury. Stwierdzono, że zimowanie tego gatunku uzależnione jest od warunków pogodowych jak i klimatu podziemi warunkującego zaistnienie termopreferendum. Jesienne zasiedlanie podziemi następuje gdy wewnątrz istnieją temperatury korzystne dla opisywanego gatunku – termopreferendum (2,8-5,8<sup>o</sup>C – skrajne refugioklimatu 0,7-7,1<sup>o</sup>C przy wilgotności 95-100%). Gwałtowne spadki temperatur zewnętrznych w okresie jesiennym i zimowym powodują istotny wzrost liczebności hibernujących w podziemiach gacków brunatnych, natomiast ocieplenia powodują spadek liczebności tego gatunku na zimowisku. Gdy zewnętrzne warunki pogodowe umożliwiają znajdowanie refugioklimatu poza systemem podziemi, następuje migracja na zewnątrz. Warunki termiczne na powierzchni wpływają na termikę podziemi z opóźnieniem (przesuwanie się stref termicznych w systemie podziemnym), co powoduje czasowe przesunięcie wylotu.

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## Streszczenie

### *Wpływ zewnętrznego i wewnętrznego mikroklimatu na hibernację gacka brunatnego (*Plecotus auritus*)*

Badania prowadzono w sezonach zimowych w latach 2000-02 na terenie Podziemi Tarnogórsko-Bytomskich, które są największym w Polsce systemem liczącym ponad 300 km chodników i komór. System ten stanowi pozostałość po prawie tysiącletniej eksploatacji złóż kruszcowych i innych metali. Do badań wykorzystano fragment wyrobisk o długości 700 m. Jest to jedno z największych zimowisk nietoperzy w Polsce, w tym gacka brunatnego *Plecotus auritus*. Badania pozwoliły zaobserwować korelację liczebności zimujących gacków, ze zmianami mikroklimatu w podziemnym systemie. Termika wnętrza badanego odcinka podziemi modyfikowana jest przez zewnętrzne warunki klimatyczne. Zestawienie wyników pomiarów termiki wnętrza oraz średniej dobowej temperatury okolicy ilustruje Rys. 1-2. Na wykresie zaznaczono również optimum termiczne hibernacji dla opisywanego gatunku. Ze względu na to, że pomiary tła termicznego (mikroklimat podziemi) często istotnie różniły się od temperatury w bezpośrednim sąsiedztwie hibernacji (proponuję wprowadzenie pojęcia refugioklimat), mierzono obydwie temperatury. Stwierdzono, że zimowanie tego gatunku uzależnione jest od warunków pogodowych jak i klimatu podziemi warunkującego zaistnienie termopreferendum. Jesienne zasiedlanie podziemi następuje gdy wewnątrz istnieją temperatury korzystne dla opisywanego gatunku - termopreferendum (2,8-5,8<sup>o</sup>C – skrajne refugioklimatu 0,7-7,1<sup>o</sup>C przy wilgotności 95-100%. Gwałtowne spadki temperatur zewnętrznych w okresie jesiennym i zimowym powodują istotny wzrost liczebności hibernujących w podziemiach gacków brunatnych, natomiast ocieplenia powodują spadek liczebności tego gatunku na zimowisku. Gdy zewnętrzne warunki pogodowe umożliwiają znajdowanie refugioklimatu poza systemem podziemi, następuje migracja na zewnątrz. Warunki termiczne na powierzchni wpływają na termikę podziemi z opóźnieniem (przesuwanie się stref termicznych w systemie podziemnym), co powoduje czasowe przesunięcie wylotu.

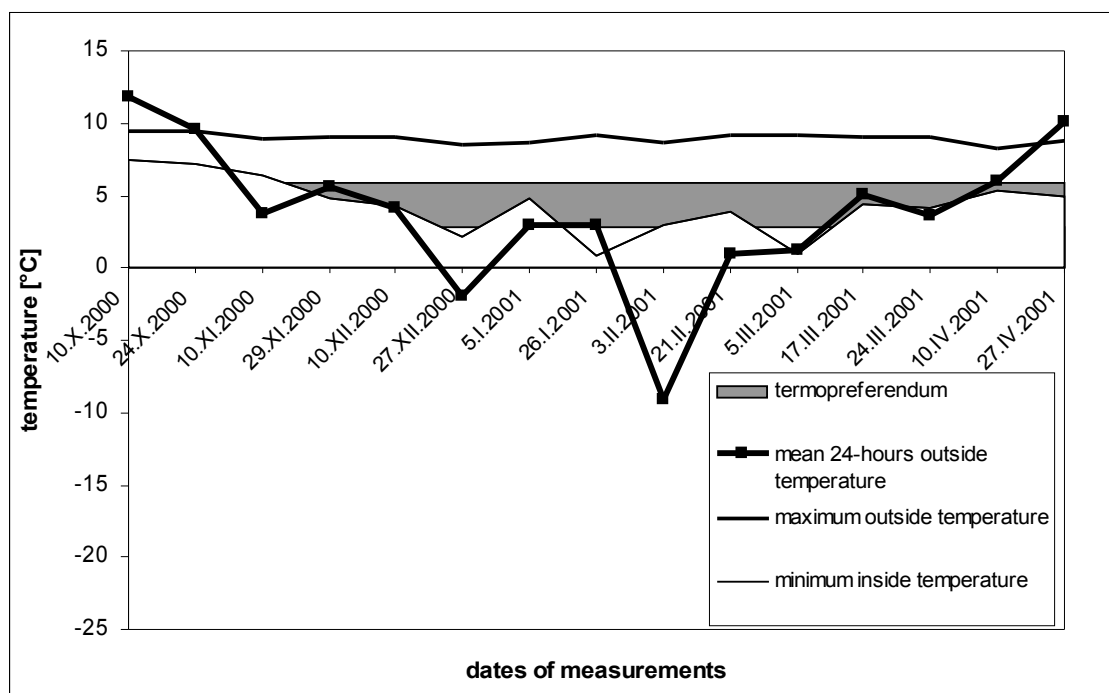


Fig. 1. The course of the inside and outside temperature with the marked thermopreferendum for the common long-eared bat in the investigation period of 2000/01.

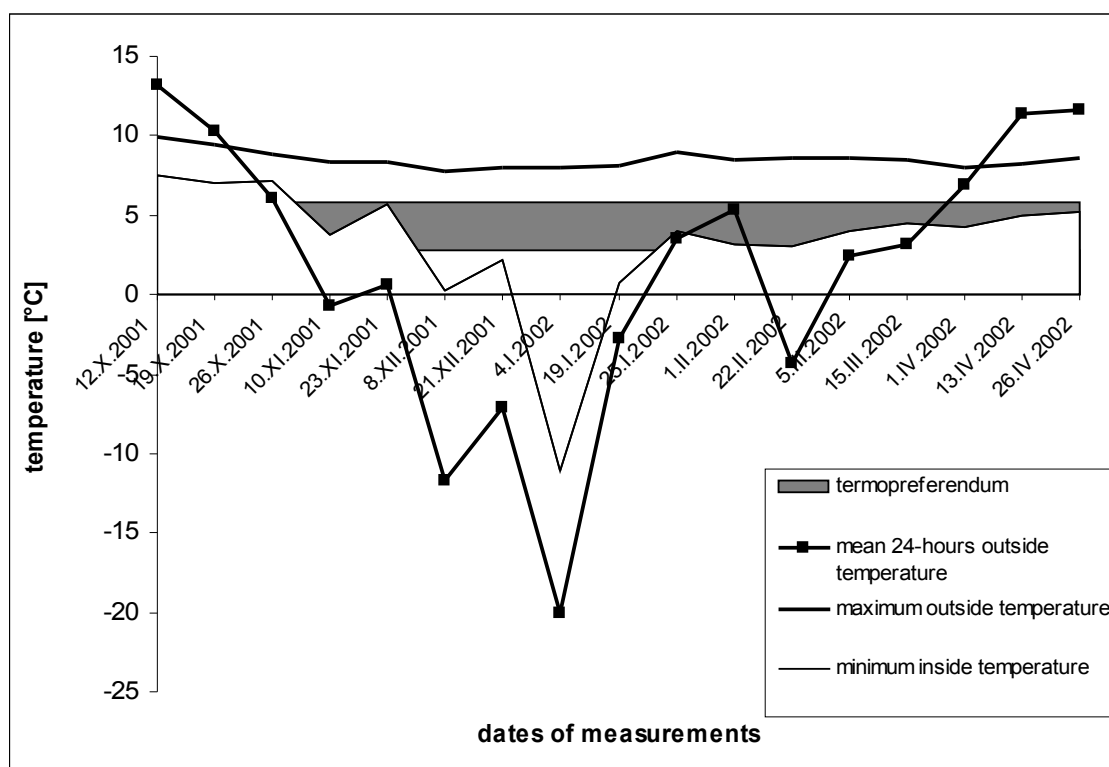


Fig. 2. The course of the inside and outside temperature with the marked thermopreferendum for the common long-eared bat in the investigation period of 2001/02.

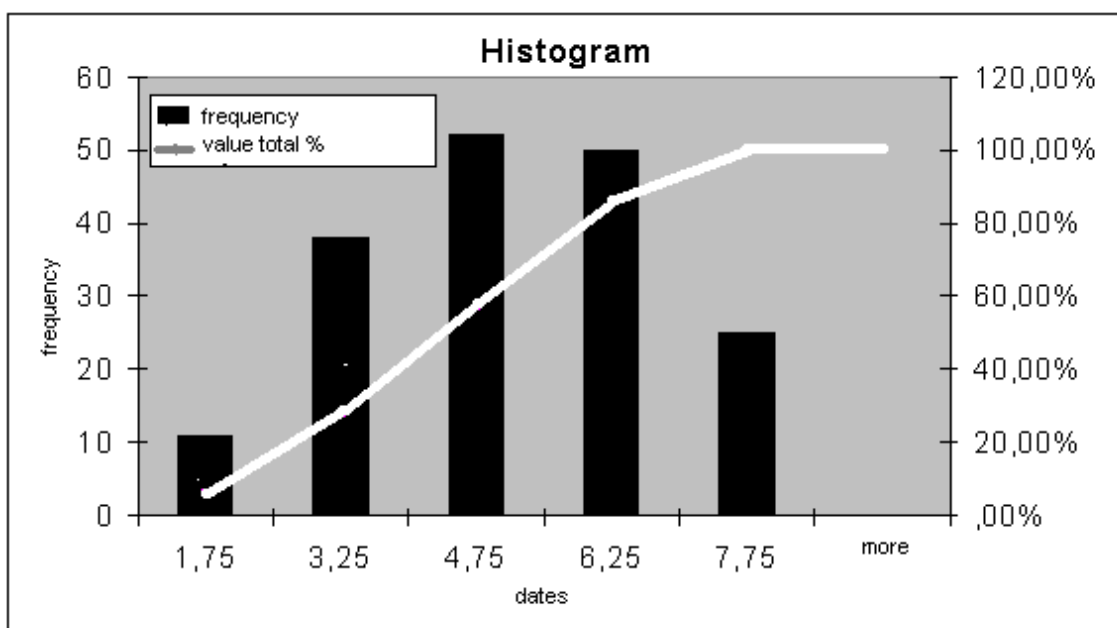


Fig. 3. Frequency of occurrence of the common long-eared bat in particular ranges of temperature.

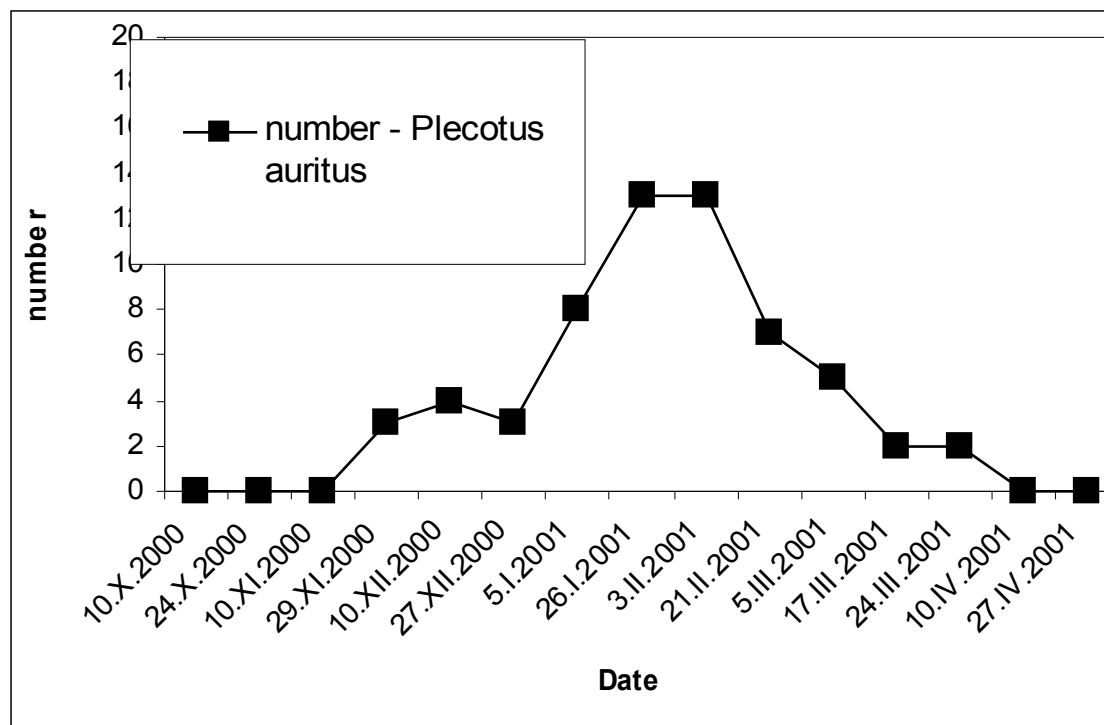


Fig. 4. Dynamics of quantitative changes of the common long-eared bat *Plecotus auritus* in the selected investigation site in the season of 2000/01.

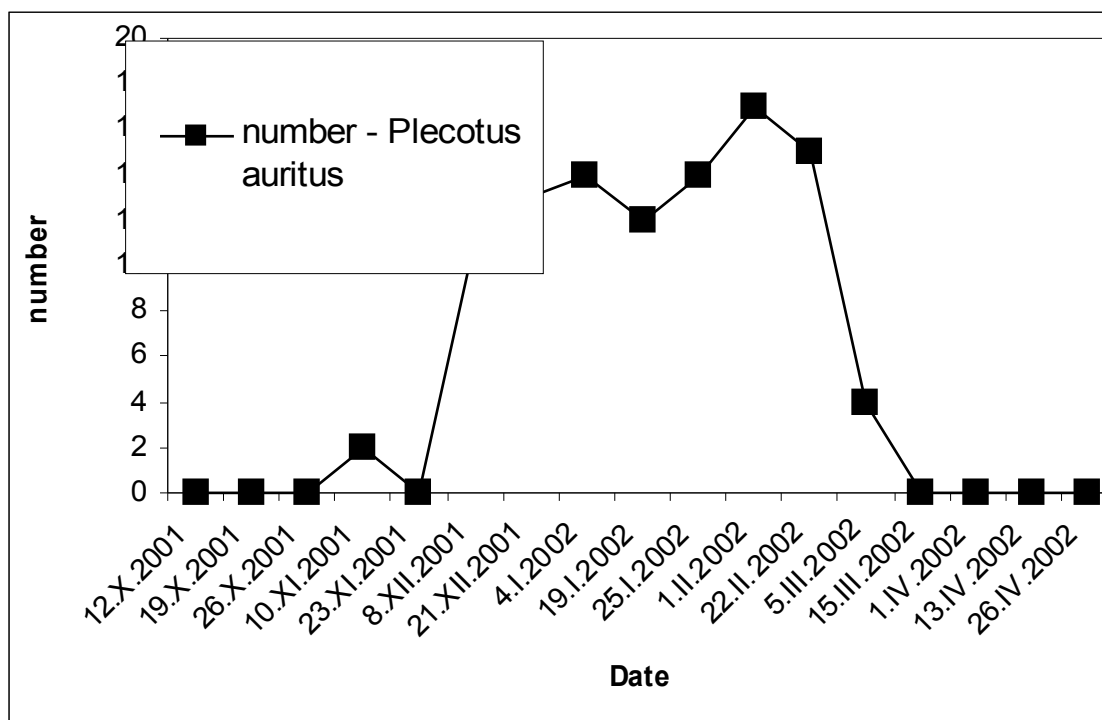


Fig. 5. Dynamics of quantitative changes of the common long-eared bat *Plecotus auritus* in the selected investigation site in the season of 2001/02.

## WINTER LOCALITIES OF BATS IN THE STOBRAWA LANDSCAPE PARK

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**ABSTRACT:** Ten bat hibernacula were examined in the years 1999-2005 ten in the territory of the Stobrawa Landscape Park. Four bats species were recorded during study: *Myotis nattereri*, *Plecotus auritus*, *P. austriacus*, *Barbastella barbastellus*.

**KEY WORDS:** bats, Chiroptera, winter localities, hibernation, Stobrawa Landscape Park

### Introduction

Knowledge about winter bat fauna of lowland areas of Poland, because of inaccessibility of winter shelters, has usually fragmentary nature. Information about bat localities from this area mainly come as result of controls of artificial shelters, such as: home – cellars, dugouts, warehouses and occasionally storm drains, wells, crevices under bridges and attics (ex. Gawlak et al. 2002, Grzywiński and Kmieciak 2003, Hebda 2001, Ignaczak and Radzicki 2002, Kowalski et al. 2001, Ignaczak et al. 2001, Wojciechowski and Neubauer 2002). Observed species diversity, as well as general number, is increasing when there are bigger fortifications, bunkers and underground shelters (Fuszara E. and Fuszara M. 2002, Hebda and Nowak 2002, Kasprzyk et al. 2002, Lesiński 1988, Szkudlarek et al. 2001b, Wojtaszyn et al. 2001, Wojtaszyn et al. 2003), what not always presents the actual state of winter bat fauna in the region. Because of lack of natural underground shelters for bats, and also of closeness of much more attractive places for bat-observers (caves and mines of Sudetes, Szachownica

Reserve, Nysa fortifications), the Stobrawa Landscape Park never has been a popular study area among them. The first observations at this area were made in 1999, during inventorying of planned Stobrawa Landscape park (Makowiecki 1998). Further study was conducted by authors of this paper after Park has been appointed. This paper summarizes all observations that were made during winter season in the years 1999-2005.

### Study area

The Stobrawa Landscape Park has been appointed in 1999 for protection the Silesia Lowland typical landscape. In general, surface area of the Stobrawa Landscape Park amounts around 52 000 ha.

Results of controls of the following bat winter localities are presented in this article:

- Elizium corridor – remains of historic building that are situated on forest, in south direction from Pokój town. The corridor is about 1,75 m tall, 1,20 m wide and long for 26 m. The surface of walls and ceiling is brick. Some piece is made of porous stone blocks (with many cracks). The corridor is open from both sides, it runs on the ground surface but it is buried with soil (landowner). During freezing weather walls are covered with ice.
- Ruin of forester's lodge, in south direction from Jagienna, in unit 125 of Forestry Commission Kup, Pokój region (Pokój district). Ruin of forester's lodge cellar. Surface of walls and ceilings is brick, in some places they are plastered. Many points of entry and poor isolation from outside conditions.
- Cellar in seat of the Stobrawa Landscape Park – cellar of old school in Ładza (Pokój district) Reymonta 3 street. A vast cellar of used building. Bats were recorded mainly in low-rise, brick corridor under stairs. There is relatively fixed temperature, humidity and there is no lighting.
- Castle cellars in Winna Góra – the only remains (lack of building ground level) of castle in Winna Góra (Pokój district). Two small cellars with big points of entry. Big part of walls and ceiling are plastered. At the present they are not used. Very often visited by domestic cats.
- Brickyard in Zieleniec – abandoned buildings of brickyard in Zieleniec (Pokój district). Big terrestrial systems of brickyard with many potential shelters. Surface of buildings is brick.
- Ruin of old 'tea room' situated on island in park in Pokój (distr.). A little cellar which is remain of old 'tea room'. Walls surface is brick. The park is a typical mixed forest, surrounded by vast forest complex.
- The corridor by sewage treatment plant in Pokój – concrete corridor by sewage treatment plant in Pokój. Walls and ceiling surface is concrete, two broad points of entry, frequently shallowly flooded. Partially runs beneath ground level.
- Church in Zagwiździe – attic of used church in Zagwiździe (Murów district).
- Cellar of building in Kały – a small cellar under residential building in Opolska 114 street in Kały (Murów district).

- Cellar under a railway station building in Kały (Murów district). Walls and ceiling mainly plastered but some places also brick.

### Materials and methods

In this article are presented all bat observations made during winter season – from 1st of November to 15th of March (based on Lesiński 1988). Most of them took place in January and in February. The main rule was not to wake up hibernating bats during counting them. Controls included potential bat shelters ex. abandoned cellars, ruin of various type of buildings and other objects indicated by local people as localities of bats. At this area was not conducted methodical seeking out of winter roosts ex. in whole range of chosen villages. Only places accidental and chosen by local people were controlled. During winter 2005 also attics and towers of common churches at area of the Park were checked.

### Results

At area of the Stobrawa Landscape Park 4 bat species were recorded (at 10 localities) (tab.1).

Table 1. Results of bat hibernacula controls at the Stobrawa Landscape Park.

Locality	data	MYN	PAR	PAS	BAR	Chir. ind.	Total
Kały, Opolska 114 str.	27-01-1999		2	1			
Kały, railway station	27-01-1999		6				
Ruin of forester`s lodge by Jagienna	07-11-2002	4	3		1		
	08-11-2002	3	2				
	05-12-2002		1				
	30-01-2003						0
	01-02-2005						0
Elizium corridor, Pokój	07-11-2002	2			1		3
	08-11-2002	5			1		6
	05-12-2002		1				1
	30-01-2003		1			1	2
	28-11-2004		1		2		3
	01-02-2005		1		1		2
Cellar of old school in Ładza	05-11-2002			1			
	30-01-2003		1				
	13-12-2003		1	1			
	28-11-2004		1				
	20-12-2004			1			
	29-12-2004		1	1			
	04-01-2005		1				
	11-01-2005		1				
	01-02-2005				1		
	02-02-2005			1			

Cellar of castle in Winna Góra	18-11-2002				1		1
	05-12-2002				1		1
	30-01-2003						0
	01-02-2005						0
Brickyard in Zieleniec	05-12-2002		1		3		4
	30-01-2003				2		2
	01-02-2005				3		3
Ruin of „tea-room“, park in Pokój	09-12-2002				3		3
	30-01-2003				2		2
	01-02-2005		2				2
Corridor by sewage treatment plant, Pokój	30-01-2003		1				1
	01-02-2005						0
Church in Zagwiździe	18-02-2005			1			1

### **Natterer's bat *Myotis nattereri***

Observed at two localities: in cellars of forester's lodge by Jagienna and in Elizium corridor by Pokój (tab.1). Maximum four individuals were recorded at the first locality and five in Elizium. All four observations of Natterer's bat come from November 2002, after that date this species was absent.

### **Brown long-eared bat *Plecotus auritus***

Observed at eight localities (tab.1). In great numbers registered in cellar under the railway station building in Kały (six individuals). In the rest of localities mostly 1 – 3 individuals were observed.

### **Grey long-eared bat *Plecotus austriacus***

Observed at three localities: in two cellars under buildings (Kały and old school in Ładza) and at the attic of church in Zagwiździe. At every locality only one individual was registered (tab.1).

### **Barbastelle *Barbastella barbastellus***

Observed at five localities: in ruin of forester's lodge by Jagienna, in Elizium corridor by Pokój, in castle ruin in Winna Góra, in brickyard in Zieleniec and in cellar ruin under 'tea room' in Pokój (tab. 1). At this localities singular individuals are observed (maximum three individuals registered in 'tea room' in Pokój and in brickyard in Zieleniec).

## **Discussion**

During winter season four bat species were recorded at area of the Stobrawa Landscape Park: Natterer's bat, Brown long-eared bat, Grey long-eared bat and Barbastelle. Wintering of twelve bat species is registered so far in Opole region. Besides mentioned above also: Greater mouse-eared bat *Myotis myotis*, Whiskered bat *M. mystacinus*, Daubenton's bat *M. daubentonii*, Geoffroy's bat *M. emarginatus*, Bechstein's bat *M. bechsteini*, Serotine *Eptesicus serotinus*, Northern bat *E. nilssonii*, Lesser horseshoe bat *Rhinolophus hipposideros* (Kokurewicz 1987, Kokurewicz and Pomorski 1995, Hebda et al. 2002, Hebda and Nowak 2002, Hebda and Nowak 2003, Szkudlarek and Paszkiewicz 2000, Szkudlarek et al. 2001a, Szkudlarek et al. 2002).



Condition of winter bat fauna in the Park in the context of region fauna ought to be found as poor. But should be remember that at this area was not carried methodical seeking out of bats winter localities ex. searching one by one a home-cellars, dugouts and wells. In some regions they constitute main hibernacula for bats wintering in underground objects (ex. Ignaczak and Radzicki 2002, Bernard et al. 1998, Lesiński and Kowalski 2001). Possibility of locating new species hibernacula is proved by a presence of summer localities of such species as: Brandt's bat *Myotis brandtii*, Daubenton's bat, Serotine, Greater mouse-eared bat (Hebda unpubl.). Till now they were not observed in the Stobrawa Landscape Park winter localities.

On practical accounts, such as: protecting hibernacula of endangered and rare species, worthy of attention are only Barbastelle hibernacula – species placed in II annex of Habitat Directive of EU. Regardless of universality of species recorded till now, described localities are the first winter localities of bats at area of the Stobrawa Landscape Park. Without this knowledge effective biodiversity protection at this area is impossible.

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## **Streszczenie**

### *Zimowe stanowiska nietoperzy w Stobrowskim Parku Krajobrazowym*

Na terenie Stobrowskiego Parku Krajobrazowego w latach 1999-2005 prowadzono okazjonalne badania nietoperzy podczas okresu hibernacji. W tym okresie wykryto 10 zimowisk, w których przebywały cztery gatunki nietoperzy: nocek Natterera *Myotis nattereri*, gacek brunatny *Plecotus auritus*, gacek szary *P. austriacus* i mopek *Barbastella barbastellus*. Schronieniami zimowymi były piwnice, podziemne korytarze, ruiny budowli, cegielnia oraz strych. Nietoperze zasiedlały zimowiska nielicznie, maksymalnie na stanowisku przebywało sześć osobników. Najczęściej stwierdzanym gatunkiem był gacek brunatny.



**HEALTH STATE OF TREE MONUMENTS  
IN THE PROVINCE OF OPOLE  
II. GROUPS OF TREES, TREE ALLEYS**

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**ABSTRACT:** The aim of the article was the analysis of health state regarding monumental groups of trees and monumental tree alleys in the Province of Opole. 72 groups and 19 alleys were analysed.

Health state of tree groups was calculated using health condition of single trees (estimations were based on the five-degree scale worked out by Pacyniak and Smólski), into tree alleys only conservation was analysed. In analysis regarding groups of trees were taking into consideration territorial (district) and species factors.

It demonstrated the following:

- health state of monumental tree groups in the Province of Opole is medium-good;
- the highest proportion of totally healthy tree groups was in the Olesno District - 33,3 %. In the Opole, Krapkowice, Namysłów, Kluczbork, Głubczyce and Prudnik Districts there were no similar groups registered. The group of trees in very bad condition was only in the Opole District;
- the highest percentage of totally healthy trees registered among *Taxus baccata* - 57,1 %, *Tilia cordata* - 53,3 % and *Fagus sylvatica* - 50,0 %. Among ten species there was not a single example in the degree 1 - the highest health condition. Only *Pinus strobus* - 50,0 %, *Quercus robur* - 6,1 % and one tree - *Picea abies* were in very bad health;
- conservation of monumental tree alleys in the Province of Opole is not sufficient.

**KEY WORDS:** tree, group, group of trees, alley, tree alley, nature monument, health state, species, district, the Province of Opole.

## Introduction

Impressive trees have long aroused interest and in several countries they have been under legal protection for many years. In Poland they are protected as items of National Heritage, under the Nature Conservation Bill of 16<sup>th</sup> April 2004, Dz. U. nr 92, poz. 880.

They have always been of great importance to human life. Part of this was of cultural significance, nowadays aesthetic values as well as biocenotic and scientific roles are noticed.

Poland is one of the few European countries where the majority of old trees is preserved (Pacyniak 1992). These are mainly *Quercus robur* (more seldom *Quercus petraea*), *Tilia cordata* (more seldom *Tilia platyphyllos*) and *Fagus sylvatica* (Kuźniewski 1996, Olaczek i in. 1996, Pacyniak 1988, Siewniak 1988). Coniferous trees comprise only 10 % of trees catagorised as Heritage items (Pacyniak 1988).

According to statistics, on 31/12/03, there were 33865 nature monuments in Poland. The most numerous group constituted individual trees - 26505; groups of trees - 4614; erratic boulders - 1137; tree alleys - 808 and lastly rocks, grottos, caves and other miscellaneous sites - 801. In the Province of Opole, 327 individual trees, 85 groups, 20 alleys, 10 erratic boulders, 1 rocks, grottos and miscellaneous sites were registered (GUS 2004).

Single trees, groups of trees and tree alleys are kinds of nature monuments of tall green. They constitute up to 94,3 % all nature monuments in Poland and 97,5 % in the Province of Opole.

Groups of trees can origin in natural or can rise as artificial plants. The natural form of the monumental group of trees can be for example concentration of trees in a forest or the group of trees - as remains of the forest. Mostly, trees are selected suitably and are composed in groups by a human (for example in ex - manor parks, botanical gardens, towns) (Kasprzak 2001).

Tree alleys don't exist in nature - they are made by a human to fulfil his aesthetic, emotional, intellectual, etc. needs (Wasilewska 1993).

Pacyniak and Smólski claim that health condition of old Polish trees is generally catastrophic (Pacyniak 1988, 1992, Pacyniak, Smólski 1973). Harabin (1996) observes that destructive phenomena cause the plant world visible destruction, especially the elimination of old trees. People themselves reduce the resources by the thoughtless felling of trees and their native habitats.

However, there is no authoratative work on the health condition of heritage trees in Poland.

## Methods

The analysis concerned groups of trees and tree alleys in the Province of Opole which were put under protection as nature monuments by the provincial government on 21/01/00. Eight groups had no necessary documentation and eventually 72 groups and 19 alleys were analysed.

The analysis was based on the health condition 5 degree scale shown below.

- 1 - a totally healthy tree with no defects or pests;
- 2 - evidence of partial branch atrophy in upper parts of the tree head and the existence of plant or animal pests (single);
- 3 - 50 % atrophy of the tree head and log or bolt. Attacked by pests to a large extent;
- 4 - 70 % atrophy of the tree head and log or bolt and large xylem loss;
- 5 - evidence of more than 70% of tree head atrophy and log or bolt, with numerous hollows. Also includes dead trees.

Health state of tree groups was calculated using health condition of single trees, into tree alleys only conservation was analysed. In analysis regarding groups of trees were taking into consideration territorial (district) and species factors.

The documentation of Nature Conservation Officer of Opole (collected since the end of the '90's) and the field research were used in this analysis.

## Results

Among the analysed groups of trees there were:

- 5 groups of degree 1 health state
- 32 groups of degree 2 health state
- 20 groups of degree 3 health state
- 14 groups of degree 4 health state
- 1 group of degree 5 health state

The biggest part - 44,4 % (fig. 1) composed groups in good health condition (degree 2). The heritage groups of medium and poor health condition (degrees 3 and 4) comprised 27,8 % and 19,4 % respectively. 7,0 % of all monuments were classified as degree 1 (totally healthy) without any defects or pests and 1,4 % as degree 5 (very poor health condition).

It can be stated that health condition of monumental groups of trees in the Province of Opole is medium-good.

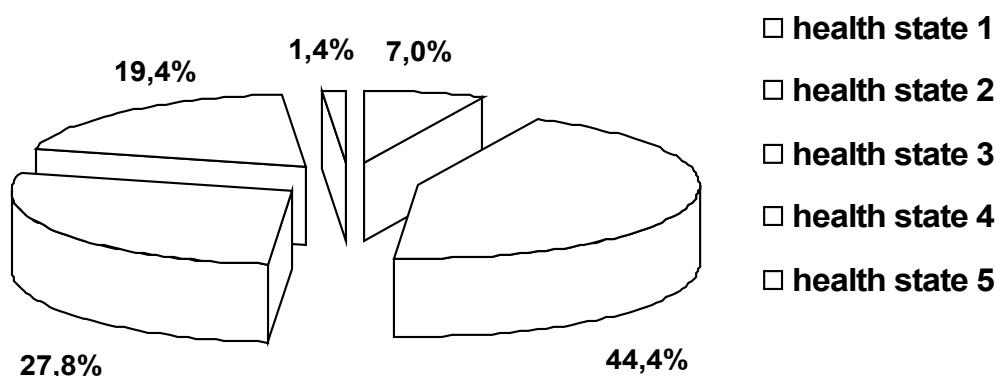


Fig. 1. Health state of monumental groups of trees in the Province of Opole

Tab. 1. Health state of monumental groups of trees in particular districts of Opole

Distric t	Health state (according to Pacyniak and Smólski)				
	1	2	3	4	5
Opolski	-	46,7 %	26,7 %	20,0 %	6,6 %
Strzelecki	8,3 %	50,0 %	16,7 %	25,0 %	-
Krapkowicki	-	50,0 %	20,0 %	30,0 %	-
Nyski	12,5 %	37,5 %	37,5 %	12,5 %	-
Namysłowski	-	50,0 %	50,0 %	-	-
Oleski	33,3 %	33,3 %	-	33,3 %	-
Kluczborski	-	33,3 %	-	66,7 %	-
Brzeski	16,7 %	33,3 %	33,3 %	16,7 %	-
Kędzierzyński	11,1 %	55,6 %	33,3 %	-	-
Głubczycki	1 group of degree 3 health state				
Prudnicki	1 group of degree 3 health state				

According to the data in table 1, the Olesno District represents the highest proportion of totally healthy trees - 33,3 %. In the Opole, Krapkowice, Namysłów, Kluczbork, Głubczyce and Prudnik Districts there were no similar groups registered. The group of trees in very bad condition was only in the Opole District.

18 tree species were distinguished among the analysed groups of trees.

Figure 2 shows that the most frequently represented species was *Quercus robur* - 72,3 %; then *Tilia cordata* - 6,1 %; *Fagus sylvatica* - 3,2 %; *Taxus baccata* - 2,8 %; *Carpinus betulus* - 2,4 %; *Larix decidua* - 2,0 %. Other species: *Acer platanoides*, *Acer pseudo-platanus*, *Ginkgo biloba*, *Fraxinus excelsior*, *Picea abies*, *Pinus strobus*, *Pinus sylvestris*, *Platanus ×hispanica*, *Populus alba*, *Sorbus torminalis*, *Tilia platyphyllos*, *Quercus petraea* comprised 11,2 % of the analysed group of trees (each below 1 %).



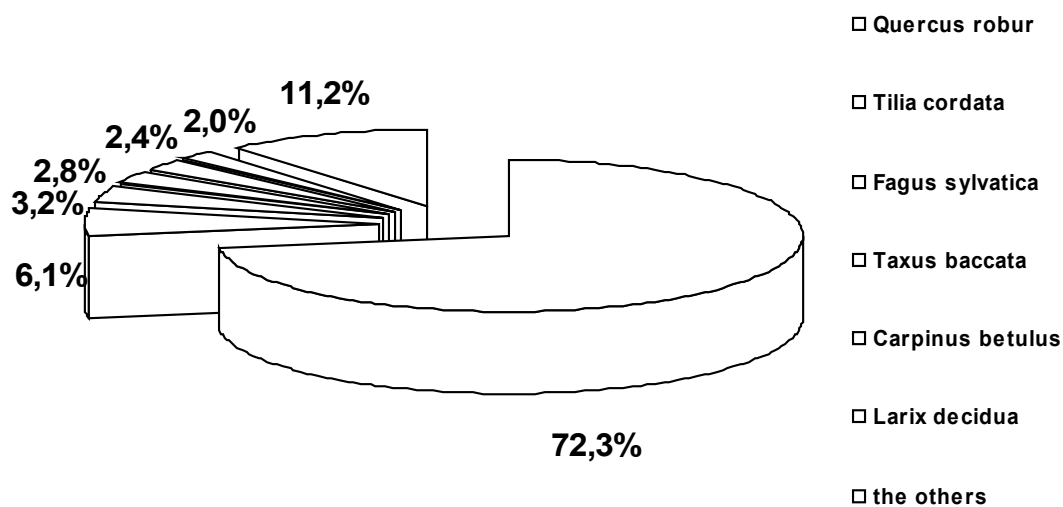


Fig. 2. Species composition of monumental groups of trees in the Province of Opole

Tab. 2. Health state of monumental groups of trees in the Province of Opole according to species

Species	Health state (according to Pacyniak and Smólski)				
	1	2	3	4	5
<i>Quercus robur</i>	2,8 %	26,1 %	44,4 %	20,6 %	6,1 %
<i>Tilia cordata</i>	53,3 %	13,3 %	26,7 %	6,7 %	-
<i>Fagus sylvatica</i>	50,0 %	50,0 %	-	-	-
<i>Taxus baccata</i>	57,1 %	14,3 %	28,6 %	-	-
<i>Carpinus betulus</i>	16,7 %	83,3 %	-	-	-
<i>Larix decidua</i>	40,0 %	60,0 %	-	-	-
<i>Acer platanoides</i>	-	100,0 %	-	-	-
<i>Acer pseudoplatanus</i>	1 tree of degree 2 health state				
<i>Ginkgo biloba</i>	33,3 %	66,7 %	-	-	-
<i>Fraxinus excelsior</i>	-	25,0%	50,0 %	25,0 %	-
<i>Picea abies</i>	1 tree of degree 5 health state				
<i>Pinus strobus</i>	-	-	50,0 %	-	50,0%
<i>Pinus sylvestris</i>	1 tree of degree 2 health state				
<i>Platanus ×hispanica</i>	-	100,0 %	-	-	-
<i>Populus alba</i>	1 tree of degree 4 health state				
<i>Sorbus torminalis</i>	25,0 %	50,0 %	25,0 %	-	-
<i>Tilia platyphyllos</i>	-	100,0 %	-	-	-
<i>Quercus petraea</i>	-	-	100,0 %	-	-

Table 2 represents data referring to health state of monumental groups of trees in

the Province of Opole according to the species.

The biggest share of totally healthy trees was registered among *Taxus baccata* - 57,1 %; *Tilia cordata* - 53,3 % and *Fagus sylvatica* - 50,0 %. Among ten species there was not a single example in the degree 1 - the highest health condition. Only *Pinus strobus* - 50,0 %, *Quercus robur* - 6,1 % and one tree - *Picea abies* were in very bad health.

Table 3 contains the short description of conservation of monumental tree alleys in the Province of Opole. Conclusion is that conservation of monumental tree alleys in the Province of Opole is not sufficient.

Tab. 3. Conservation of monumental tree alleys in the Province of Opole

Regis- tration number	Species and number of trees	Locality and district	The short description of conserva- tion
6	<i>Tilia cordata</i> 334 trees	Klisino, Pomorzowice the Głubczyce District	Many hollow stems.
9	<i>Quercus robur</i> 47 trees	Gierałcice the Kluczbork District	Rare dry boughs and branches.
109	<i>Tilia cordata</i> 249 trees	Gręboszów the Namysłów District	Many hollows. Part of trees (5 %) - dry.
119	<i>Quercus robur</i> 96 trees	Kolonowskie the Strzelce District	In places fructifications of fungi, dry boughs and branches.
473	<i>Quercus robur</i> 12 trees	Kolonowskie the Strzelce District	In places fructifications of fungi, dry boughs and branches.
130	<i>Quercus robur</i> 13 trees	Karłowice the Opole District	In places hollows and fructifications of fungi.
139	<i>Tilia cordata</i> 96 trees	Gręboszów the Namysłów District	The thin out tree alley. Often hollows, fructifications of fungi, dry boughs and branches.
187	<i>Quercus robur</i> 129 trees	Gierałcice the Kluczbork District	The thin out tree alley. Often dry bo- ughs and branches.
235	<i>Quercus robur</i> 4 trees	Karłowice the Opole District	Many hollows and fructifications of fungi. Dry boughs and branches.
245	<i>Taxus baccata</i> 16 trees	Kluczbork the Kluczbork District	All trees in very good condition.
248	<i>Quercus robur</i> 24 szt. <i>Fagus sylvatica</i> 1 tree	Kostów the Kluczbork District	Many hollows. Often dry boughs and branches. Rare fructifications of fungi.
254	<i>Fagus sylvatica</i> 25 trees <i>Quercus robur</i> 8 trees <i>Carpinus betulus</i> 3 trees	Kostów the Kluczbork District	Often fructifications of fungi, dry bo- ughs and branches. Rare hollows.

288	<i>Quercus robur</i> 103 trees	Głogówek the Prudnik District	The thin out tree alley. Often very damaged tree heads. In many places stems without bark. Trees attacked by <i>Cerambyx cerdo</i> .
366	<i>Tilia cordata</i> 360 trees	Lubrza the Prudnik District	The thin out tree alley. Rare dry boughs and branches.
390	<i>Tilia cordata</i> 29 trees	Osiek the Strzelce District	The thin out tree alley. Damaged tree heads.
397	<i>Tilia cordata</i> 31 trees	Kalinowice the Strzelce District	Rare hollows and dry boughs and branches.
399	<i>Betula pendula</i> 85 trees	Otmuchów the Nysa District	The thin out tree alley. Rare fructifications of fungi.
408	<i>Tilia cordata</i> 1403 trees	Tarnkowa, Głubczyce the Głubczyce District	The thin out tree alley. Often dry boughs and branches. Fructifications of fungi and hollow stems.
419	<i>Tilia cordata</i> 132 trees	Gryżów the Nysa District	The thin out tree alley. Often dry boughs and branches.

### Conclusions

1. Health state of monumental tree groups in the Province of Opole is medium-good.
2. The highest proportion of totally healthy tree groups was in the Olesno District - 33,3 %. In the Opole, Krapkowice, Namysłów, Kluczbork, Głubczyce and Prudnik Districts there were no similar groups registered. The group of trees in very bad condition was only in the Opole District.
3. The highest percentage of totally healthy trees registered among *Taxus baccata* - 57,1 %, *Tilia cordata* - 53,3 % and *Fagus sylvatica* - 50,0 %. Among ten species there was not a single example in the degree 1 - the highest health condition. Only *Pinus strobus* - 50,0 %, *Quercus robur* - 6,1 % and one tree - *Picea abies* were in very bad health.
4. Conservation of monumental tree alleys in the Province of Opole is not sufficient.

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## Streszczenie

### *Stan zdrowotny drzew pomnikowych w województwie opolskim II. grupy drzew, aleje*

Artykuł przedstawia analizę stanu zdrowotnego pomnikowych grup drzew oraz układów alejowych w województwie opolskim. Analizą objęto 72 grupy i 19 alei.

Stan zdrowotny grup drzew wyznaczono na podstawie stopni zdrowotności poszczególnych egzemplarzy (określony przy pomocy 5-stopniowej skali opracowanej przez Pacyniaka i Smólskiego) tworzących grupę, natomiast w przypadku układów alejowych ograniczono się jedynie do opisu stanu zachowania. W analizie, w odniesieniu do grup drzew, uwzględniono wpływ czynnika terytorialnego (powiat) oraz gatunkowego.

Wykazano, że:

- zdrowotność pomnikowych grup drzew w województwie opolskim jest średnio dobra;
- największy udział grup drzew zupełnie zdrowych odnotowano w powiecie oleskim - 33,3 % a w sześciu powiatach tj. opolskim, krapkowickim, namysłowskim, kluczborskim, głubczyckim i prudnickim nie występowały w ogóle takie obiekty. Grupę drzew w bardzo złej kondycji zarejestrowano jedynie na terenie powiatu opolskiego;
- największy udział drzew zupełnie zdrowych zarejestrowano wśród *Taxus baccata* (57,1 %), *Tilia cordata* (53,3 %) oraz *Fagus sylvatica* (50,0 %). Wśród dzie-

sięciu gatunków nie odnotowano ani jednego egzemplarza o największej zdrowotności. Bardzo złą kondycją zdrowotną charakteryzowały się tylko pomniki w grupie *Pinus strobus* (50,0 %), *Quercus robur* (6,1 %) a także drzewo z gatunku *Picea abies*;

- stan zachowania pomnikowych układów alejowych w województwie opolskim jest nie najlepszy.



## THE ROLE OF ABIOTIC CRITERIA IN IDENTIFYING AND PROTECTION OF NATURAL HABITATS IN POLAND

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**ABSTRACT:** Protection of 71 types of natural habitats occurring in Poland requires their precise defining. This is of both cognitive (e.g. in qualitative and quantitative analysis of most valuable natural types of ecosystems in Poland) and practical importance (e.g. in designation of habitat sites of the NATURA 2000 Network). By definition, natural habitats are distinguished according to equally treated abiotic and biotic criteria. In practice, abiotic criteria are more ambiguous, which often turns protection of natural habitats to protection of plant communities. In studies the problem of possible protection of geodiversity of Poland by conservation of natural habitats has been generally avoided. Diversity and representativeness of such sites in relation to all occurring in Poland types of natural habitats, forms of surface relief, surface geological formations, water and soil conditions indicates that this is a very important issue, deserving more focussed interest.

**KEY WORDS:** natural habitats, nature conservation, geodiversity.

### Introduction

Natural habitats are the youngest form of the nature protection in Poland. They were introduced in the Polish legislative system and the practice of nature protection due to adopting EU legislation aimed at preservation and restitution of the European natural heritage.

A natural habitat is defined, with small modifications, as a terrestrial or aquatic area, natural, semi-natural or anthropogenic, distinguished according to its geographical,

abiotic and biotic features (Council Directive... 1992, Act... 2004). This definition shows that this form integrates two basic directions of the contemporary nature protection:

- conservation of biodiversity,
- conservation of geodiversity.

Protection of natural habitats has three basic aims:

- preservation or enlargement of their stable area and range of occurrence,
- preservation of specific structure and functioning of natural environment in favour of their persistent preservation,
- preservation of natural species composition, characteristic of each of these sites (Council Directive... 1992).

Efficiency of protection of natural habitats requires precise definition of their different types and preparation of precise criteria of their delimitation. Comparability of delimitation of certain habitats in diverse landscapes by different study groups and in different regions of the country is very important. This is so because natural habitats are a basis for designation of Special Areas of Conservation (SACs) which, besides Special Protection Areas (SPAs) form the European system of the nature protection NATURA 2000. Abiotic criteria are of a great importance in designation of areas which have lost their floristic values for various reasons, but where restitution or expansion of certain habitat types could take place in the future. In spite of more numerous publications referring to the issue of natural habitats in Poland (e.g. Liro, Dyduch-Falniowska 1999, Makomaska-Juchiewicz, Tworek ed., 2003), the problem of criteria of delimitation and protection of sites, in particular – considering abiotic criteria and analysing the practical side, has been neglected until present. In the present paper the following questions considering this issue are addressed:

- what is the role of abiotic criteria in identification of natural habitats in Poland?,
- what is importance of natural habitats for the protection of geodiversity of Poland, including types of natural landscape?

## Methods

To answer the above questions, there were analysed possibilities to identify certain types of natural habitats occurring in Poland in studies and fieldwork, according to their surface features, geological structure, hydrography and soils. Classification of habitats was performed applying the abiotic criteria. In addition, an analysis of representativeness of natural habitats in subsequent types of the natural landscape of Poland described Richling (1992) was performed. In the survey, all Polish natural habitats were considered, including three sites proposed during the negotiations and accepted by EU, belonging to 71 types, including 14 priority ones (Mróz, Perzanowska, 2003). In cases of occurrence of several sub-types within a type, they were analysed separately. In total, a set of 78 habitats was analysed, considering the sub-types. In the analysis of results, besides names, also codes of certain habitats were quoted to facilitate understanding of description. Names and codes were adopted after *Interpretation*



*Manual of European Union Habitats* (1999), which is the basic source of information about protected natural habitats in the whole Europe.

While analysing forms of the surface features accompanying subsequent habitats, they were assigned to one of the following types of surface features: 1) marine coastal zone, 2) lowland rivers, 3) mountain rivers, 4) inland salt-beds, 5) lakes and other natural water bodies, 6) flooded river terraces, 7) swamps and peatbogs, 8) springs, 9) screes, boulder fields and rock debris, 10) rocky slopes, 11) caves, 12) remaining mountain forms in the alpine and sub-alpine zone, 13) remaining mountain forms in the lower and upper mountain forest zone, 14) dunes and wind-blown troughs. The analysis of water and ground water conditions in natural sites was performed within the following groups distinguished according to water conditions: 1) stagnant waters, 2) running waters, 3) peatbogs, swamps and muds, 4) seas, 5) spring, 6) other wetlands, 7) fresh, 8) dry, 9) remaining. In the latter group habitats characterised by a wide gradient of humidity conditions, e.g. 4070 – Bushes with *Pinus mugo* and *Rhododendron hirsutum* (in Poland: Subalpine dwarf mountain pine scrub (*Pinetum mughi*)). During the analysis of soil, habitats were assigned to three ranges: 1) surfaces of initial soils, 2) remaining soils, 3) habitats without any soil surface, e.g. 3110 – Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*), 8110 – Siliceous serce of the montane to snow levels (*Androsacetalia alpinae*) and (*Galeopsetalia ladani*). In the analysis of dominating geological forms the following types were considered: 1) calcareous and calcareous deposits, 2) siliceous deposits, 3) sands, gravels and gravel-banks, 4) clays, silts and dusts, 5) organic and organic-mineral deposits, 6) remaining. The latter type consists of aquatic habitats and those which can occur on several different types of surface geological deposits, e.g. 9110 – *Luzulo-Fagetum* beech forests, 9180 – *Tilio-Acerion* forestes of slopes, screes and ravines.

Classification of sites into subsequent typological units of natural habitats of Poland was done with accuracy as to the type of landscape. Glacial, periglacial and fluvioglacial landscapes were joined in one group because of low representativeness of habitats characteristic of these natural landscape types. If a certain type of habitat occurred in different types of landscape, it was assigned to each of them.

Basic overview studies which were used in classification of habitats into groups according to the analysed criteria, were papers by W. Matuszkiewicz (2001), A. Dyduch-Falniowska et al. (2002) and *Interpretation Manual...* (1999).

## Results

Theoretically, in identification of natural habitats abiotic and biotic criteria are treated equally by definition. Biotic criteria include phytosociological determinants of different taxonomic rank assigned to each type of habitat. Abiotic criteria are defined less precisely and are descriptive, which can cause interpretation problems with certain types of habitats. In the basic source publications on this problem (*Interpretation Manual...* 1999, Dyduch-Falniowska et al., 2002) the accepted abiotic criteria are often very general. Thus, in practice, in identification of natural habitats the role of abiotic

and biotic criteria is different, which complicates the process of their delimitation and impedes comparability of delimitations. Besides habitats which can be easily identified based on geomorphological, geological and hydrographic criteria, e.g. 1130 – Estuaries, 2120 – Shifting dunes along the shoreline (white dunes), 7220 – Petrifying springs with tufa formation and 8210 – Calcareous rocky slopes, a precise identification of a number of natural habitats according to abiotic criteria is practically impossible, e.g. 9170 – *Galio-Carpinetum* oak-hornbeam forests, 6410 – *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils and 9130 – *Asperulo-Fagetum* beech forests.

According to the possibility of applying abiotic criteria to designate natural habitats in Poland, three groups of them can be distinguished:

- natural habitats with no phytosociological determinants,
- natural habitats with phytosociological determinants, which are easy to identify according to abiotic criteria,
- natural habitats which practically cannot be identified according to abiotic criteria.

The first group consists of 8 types of habitats, only two of them being terrestrial: (8310 – Caves not open to the public and 1230 – Vegetated sea cliffs of the Atlantic and Baltic coasts). The remaining ones are associated with aquatic ecosystems and are as follows: 1110 – Sandbanks which are slightly covered by sea water all the time, 1130 – Estuaries, 1150 – Coastal lagoons, 1160 – Large shallow inlets and bays, 1170 – Reefs and 3160 – Natural dystrophic lakes and ponds. The second, most numerous group, includes habitats in which plant communities of a different taxonomic rank are usually strongly associated with certain abiotic conditions. Strong associations within e.g. peatbog habitats were described by Herbichowa (2002), in coastal ones – Herbich (2002). These habitats are most numerous and they are e.g. 3150 – Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation, 3270 – Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation, 8120 – Calcareous and caleshist screes of the montane to alpine levels with *Thlaspietea rotundifolii*, 7110 – Active raised bogs. The third group of habitats comprises floristic complexes which can occur in different abiotic conditions. Most often they are forest or meadow communities, e.g. 9110 – *Luzulo-Fagetum* beech forests, 9170 – *Galio-Carpinetum* oak-hornbeam forests, 6440 – Alluvial meadows of river valleys of the *Cnidion dubii* and 91T0 – Central European lichen Scott pine forests.

The analysis of possibilities to identify natural habitats by recognition of dominating forms of the surface features showed that the majority of habitats was associated with a certain type of relief (in total ca 77% was associated with distinguishable type of relief, characteristic of the habitat). The higher number of habitats were related to swamps and peatbogs – 11, the second in rank were dunes and wind-blown troughs – 8. High were also proportions of habitats associated with the surface features of the marine coastal zone – 6, alpine and subalpine zone in mountains – 5, lakes and other natural water bodies – 5, mountain rivers – 5 and lowland rivers – 5. Only single sites protect such surface features forms as caves or springs. In the latter

case, the Polish proposal to designate Soft water springs with *Cardamino-Montion* as a protected natural habitat in Europe has not been accepted.

Classification of habitats according to their water and ground water conditions indicated that their highest proportion was associated with wetlands – ca 51% of analysed habitats. Fresh habitats constituted ca 13%, while dry ones ca 23%. About 13% of habitats were characterised by a remarkable tolerance to variation of humidity conditions. The analysis indicates that natural habitats in Poland were associated mainly with extreme types of environment considering humidity conditions. This conclusion was confirmed by comparison of the development stage of soil covers characteristic of subsequent habitats. As much as 66% of all habitats is formed on initial soils, only 22% had a well-developed soil layer. Areas of occurrence of ecosystems marginal in Poland with respect to humidity and soil conditions should be particularly focused by theoretical and practical students of nature protection.

Among surface geological forms occurring in natural habitats in Poland, sands, gravels and gravel-banks of various origin predominate – 23%. They are in conditions of Poland most common types of surface geological formations. In particular, they predominate on lowlands and in the belt of uplands, while in mountains they occur to a smaller extent. The second dominants are habitats on organic and organic-mineral deposits – 19%. Areas of swamps, peatbogs and silts, despite remarkably smaller surface than the areas where mineral deposits occur are sites of a distinctive number of Polish habitats covered with protection. Formations of calcareous deposits are characteristic of 12.8% of habitats, siliceous ones of 10.3%. Alluvial deposits, silts and gravel-banks of mountain rivers occur in ca 8% of habitats. In total, only ca 23% of habitats occur on firm deposits and their mantles, 55% on elastic, silt or organic sediments. The remaining 22% of habitats do not show a distinct preference to the geological structure of surface deposits.

It is estimated that a half of types of natural habitats occurring in Poland is associated with a characteristic type of natural landscape. These habitats do not occur at all or occur sporadically outside this certain type of landscape. The remaining habitats can appear in several, structurally different, types of landscape. The analyse of associations of occurrence of specific types of natural habitats with natural landscapes of Poland indicate that they protect selected ecosystems, characteristic of all classes and types of landscape. Subsequent types of landscapes present varied diversity of appearing natural habitats. The highest number of natural habitats can occur in landscapes of denudation depressions and basins in upland and mountain areas – 35 and in middle-mountain erosive landscapes of the lower and upper mountain forest zone – 25 (table 1). Such a strong representation is an effect of occurrence in these landscapes both characteristic habitats, as well as a part of those typical for upland landscape and high mountains. Landscapes of denudation depressions and basins in upland and mountain areas are characterised by the lowest number of habitats, which occur only in this type of landscape.

It is estimated that 24 natural habitats protect selected types of the natural environment of glacial, periglacial and fluvioglacial landscapes, however a remarkable part of habitats occurring there can occur also in other types of landscape, e.g. 9170 – *Galio-Carpinetum* oak-hornbeam forests. Landscapes associated with pleistocene glacial periods are most common in conditions of Poland, and most natural habitats associated with them covers forest areas. Very high number of natural habitats occurs in high mountain landscapes – 20. In these areas there concentrate mostly habitats which do not appear in other types of landscape e.g. 4060 – Alpine and Boral heaths. Due to the fact that high mountain areas cover much smaller area than lowland postglacial landscapes, high representation of mountain natural habitats indicates their particularly high rank in protection of bio- and geodiversity of Poland. Much less natural habitats is associated with landscapes of bottoms of river valleys in lowlands, uplands and mountains – 13. However, considering smaller areas of river valleys in Poland in comparison with e.g. young or old glacial areas, distinct concentrations of natural habitats indicate that these landscapes are very important for preservation of natural heritage of the country and the continent. They include forest habitats, as well and peatbog and aquatic ones. In comparison with bottoms of river valleys, landscapes of the meadow terraces are characterised by low representativeness of protected sites. It is estimated that only 5 of them can occur in this type of landscape. A remarkable depletion of meadow river terraces in protected sites in relation to flooded terraces has been caused to a large extent by changing the first ones in the process of spatial development. Location of meadow terraces outside the range of flood waters, and in the close vicinity to fertile areas abundant in water along rivers caused an intensive development of anthropopressure. Large groups of diverse natural habitats occur in upland carbonate and gypsum landscapes – erosive – 15, and upland silicate and aluminosilicates – erosive – 14. As much as 12 natural habitats occurring in lowland eolic landscapes are associated with dunes. They include different stages of ecological succession that take place on these characteristic forms of surface relief, from initial stages of fixation of windswept sands to dry pine forests.

Table 1. Natural habitats in typological units of the natural landscape of Poland.

<b>Typological units of the natural landscape of Poland</b>	Number of sites
Lowland landscapes	
– glacial (flat and undulating, hummocky, hilly), periglacial (flat and undulating, hummocky, hilly), fluvioglacial (flat and undulating)	24
– eolian (hummocky, hilly)	12
Landscapes of uplands and low mountains	
– loessic eolian (of uplands weakly dissected, uplands strongly dissected)	8
– calcareous and gypsum – erosive (dense massifs with rocks, isolated floors of uplifts, undulating plateaus)	15
– silicate and aluminosilicate – erosive (of mountain foothills, single eminencies)	14
Landscapes of middle and high mountains	
– middle-mountain – erosive (lower forest zone (fir-beech forests)), upper	

forest zone (spruce))	25
– high mountain – erosive and glacial (subalpine (mountain pine), alpine (mountain meadows), subnival (rocks))	20
Landscapes of valleys and lowerings	
– flooded bottoms of valleys – accumulative (of flooded plains in lowland, highland and mountain areas)	13
– meadow terraces – accumulative (terrace plains on lowland, highland and mountain areas)	5
– deltaic – accumulative	2
– swamp plains – accumulative	7
– denudation depressions and basins in upland and mountain	35

Source: author, classification of types of natural habitats according to A. Richling (1992).

## Conclusions

1. Protection of natural habitats in Poland, similarly as in Europe, is concentrated on protection of biodiversity. Abiotic criteria of identification and protection are worse investigated. In consequence, this reduces protection of natural habitats to protection of plant communities of different taxonomic rank, which contradicts the idea of designation of this form of nature protection.
2. Efficient protection of natural habitats requires more precise definition of abiotic natural conditions corresponding with certain plant communities.
3. Considering the type of surface relief, the highest diversity of natural habitats occurs in peatbogs and swamps, marine coastal zone, coastal and inland dunes, rivers and mountains in lower and upper forest, subalpine and alpine zones.
4. About 62% of natural habitats occurring in Poland is located in areas with initial soils, usually of extreme humidity conditions.
5. The highest number of types of natural habitats occur on areas where sands, gravels and gravel-banks of different origin, organic and organic-mineral deposits remain. Ca 23% of all natural habitats is located on carboniferous and siliceous deposits.
6. Key areas for protection of natural habitats in Poland are wetlands, about 50% natural habitats valuable for protection of the European natural heritage occur in these areas.
7. Natural habitats easiest to identify according to abiotic criteria are characterised by high adaptation of vegetation cover to the surface relief, surface geological formations, surface and ground waters.
8. Most difficult to identify according to abiotic criteria are forest communities, which tolerate a great variety of surface relief, geological structure and ground water conditions.
9. Most natural habitats cover types of environments extreme with respect to abiotic conditions.
10. Natural habitats potentially allow for protection of natural conditions representative for types of the natural landscape of Poland.

11. The highest number of types of natural habitats in Poland occur in landscapes of upper mountain forest zone and of denudation depressions and basins. This is caused by overlapping in these areas of habitats that can occur in different types of mountain and upland, and to a smaller extent – lowland landscapes.
12. Crucial types of natural landscapes due to their relatively small area and high diversity are landscapes of flooded bottoms of river valleys and high mountain subalpine and alpine landscapes.
13. According to the possibility of application of abiotic criteria in designation of natural habitats in Poland, three types of them can be distinguished: 1) natural habitats with no phytosociological determinants – comprises 9 sites, 2) natural habitats with phytosociological determinants, which are easy to identify according to abiotic criteria – most sites, 3) natural habitats which practically cannot be identified according to abiotic criteria – over ten, mostly forest sites.

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## Streszczenie

### *Rola kryteriów abiotycznych w identyfikacji i ochronie siedlisk przyrodniczych w Polsce*

Ochrona siedlisk przyrodniczych jest jedną z nowszych koncepcji ochrony przyrody realizowanych w Polsce, mającą swoje powiązania z odpowiedzialnością kraju za ochronę dziedzictwa przyrodniczego Europy. Pod pojęciem siedliska przyrodniczego definiuje się obszar lądowy lub wodny, naturalny, półnaturalny lub antropogeniczny wyodrębniony w oparciu o cechy geograficzne, abiotyczne i biotyczne. Skuteczność ochrony zasobów i walorów przyrodniczych w siedliskach przyrodniczych wymaga każdorazowo dla poszczególnych ich typów bardziej precyzyjnego zdefiniowania. Dla identyfikacji siedlisk kryteria abiotyczne i biotyczne z definicji traktuje się równoważnie. W praktyce w procesie identyfikacji poszczególnych typów siedlisk przyrodniczych rola kryteriów abiotycznych i biotycznych jest zróżnicowana, co komplikuje proces delimitacji ich granic oraz utrudnia porównywalność wydzieleni. Obok siedlisk, które można łatwo zidentyfikować na podstawie kryteriów geomorfologicznych, geologicznych i hydrologicznych, np. 1130 - płytkie ujścia rzek, 2120 - nadmorskie wydmy białe, 7220 - źródła wapienne, precyzyjna identyfikacja szeregu siedlisk przyrodniczych za pomocą kryteriów abiotycznych jest praktycznie niemożliwa np. 9170 - grąd środkowoeuropejski, 6410 - zmiennowilgotne łąki trzęślicowe. Na podstawie analizy abiotycznych uwarunkowań identyfikacji i ochrony siedlisk przyrodniczych stwierdzono między innymi, że ochrona siedlisk przyrodniczych w Polsce podobnie jak w UE koncentruje się na ochronie różnorodności biologicznej. Abiotyczne kryteria identyfikacji siedlisk są słabiej rozpoznane. Efektywna ochrona siedlisk przyrodniczych wymaga bardziej precyzyjnego zdefiniowania warunków środowiska abiotycznych związanych ze zbiorowiskami roślinnymi.