

## THE CURRENT DISTRIBUTION IN POLAND OF SOME EUROPEAN NEOPHYTIC BRYOPHYTES WITH SUPPOSED INVASIVE TENDENCIES

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### ABSTRACT

The paper presents a brief review of published so far and recently recorded unpublished bryological data concerning the distribution in Poland of two neophytic (sensu Meusel 1943) mosses: *Campylopus introflexus* (Hedw.) Brid. and *Orthodontium lineare* Schwaegr. to estimate their current influence on native bryoflora. The data clearly indicate the constant spreading of these species towards the east, however, there is no direct evidence that they have been limiting the occurrence of native moss species. They are acidophilous species, so the acidification of the environment probably promotes their expansion. Maps of the most current distribution of *Campylopus introflexus* and *Orthodontium lineare* in Poland (in a system of ATMOS-grid squares) are provided, as well as a description of the first locality in Poland of another European bryo-neophyte species *Leptophascum leptophyllum* Mull. Hal.

**KEY WORDS:** invasive bryophytes, *Campylopus introflexus*, *Orthodontium lineare*, *Leptophascum leptophyllum*, bryophyte distribution in Poland, threats for bryophyte diversity.

### INTRODUCTION

Nowadays biological invasions are considered to be one of the main topics in the fields of ecology, phytogeography and taxonomy. As it was remarked by Tokarska-Guzik (2005) the development manifested itself among others through trade, transport and tourism intensification resulted in enormous increase of introductions, both intended and casual. The influence of alien plants on native vegetation seems to be a serious threat for biodiversity in global scale. According to the quoted author the recognition of threats brought by invading aliens to the Polish native vegetation is still insufficient.

The aim of study was to analyze the current spreading of neophytic bryophytes (sensu Meusel 1943) in Poland and to attempt to estimate their influence on native bryoflora. Although numerous new localities of *Orthodontium lineare* Schwaegr. and *Campylopus introflexus* (Hedw.) Brid. have been recorded in our country in the last years (many of them not published yet – see: Table 1) these species' impact upon native bryoflora has not been discussed so far. The paper provides the most current distribution maps of these species in Poland (Figs 1 and 2).

## EUROPEAN BRYO-NEOPHYTES AND THEIR CURRENT DISTRIBUTION IN POLAND

European bryophyte flora is hardly affected by the process of anthropogenic changes (i.e. encroachment and establishment of aliens), brought about by wide geographical ranges of holarctic mosses. Söderström (1992) gives 22 species which are considered as 20th century bryological immigrants on European continent, only few of them however have managed to spread widely. In Poland have been recorded so far: *Orthodontium lineare* Schwaegr. (Ochyra 1982) and *Campylopus introflexus* (Hedw.) Brid. (Lisowski, Urbański 1989), originating from antipodes and the recently found subtropical *Leptophascum leptophyllum* (Mull. Hall.) J. Guerra & M.J. Cano (Szczepański – unpublished).

First observations of these species in Europe came from Britain: *Orthodontium lineare* was recorded for the first time in 1911 close to Manchester, *Campylopus introflexus* – in 1941 in Sussex (after Ochyra 1983), *Leptophascum leptophyllum* – in 1965 (Frahm 2002). Their further expansion on the European continent followed probably along the coast of France, Belgium and Holland (Söderström 1992; Hassel and Söderström 2005). The presence of *Leptophascum leptophyllum* on the continent was not documented until 1988 in Germany (Frahm 2002).

*Orthodontium lineare* and *Campylopus introflexus* are widely spread in the Western and Central Europe from France and Germany to the Czech Republic, Poland and Scandinavia (Ochyra 1983; Berg, Meinunger 1989; Söderström 1992). These species show tendencies to expand towards the east (Rasgulyaeva et al. 2001). The distribution of *Leptophascum leptophyllum* on the continent is still hardly documented and most localities of this moss come from Germany.

*Orthodontium lineare* establishes itself both in secondary forests and in natural communities. It grows on decaying wood and at the feet of trees with acid bark (pines, oaks). It is also quite frequently found on mineralized peat and on sandstones in the mountains (Herben 1987; Söderström 1992). It usually produces sporogons with a great number of spores. The Central European bryologists gave it a nickname of “bryological weed” because of its strong tendencies to colonize all available substrata. As Herben claims (1990, 1994), it supersedes other species from their habitats. Hedenäs et al. (1989), who studied the spreading of *Orthodontium lineare* in Sweden, claim that the species has low neophytic tendencies and does not replace other species.

The first record of *Orthodontium lineare* in Poland came from Mierzeja Helska (Ochyra 1982). The moss is currently widespread in western and central Poland, especially along the coast and northern lakelands. Most records come from Wielkopolska, Lower and Upper Silesia and Western Pomerania (Berdowski and Piszczek 1991; Fudali 1993, 1996, 1999; Gos L. and Gos K. 1993; Rusińska and Urbański 1993; Stefanek and Urbański 1993; Stebel 1994, 1997, 2002; Mindur 1998; Fojcik and Stebel 2001; Konstanciak 2002; Rusińska 2003; Górski and Urbański 2004; Bednorz et al. 2004; Stebel et al. 2005). A few years ago it was noted, yet low in abundance, in central part of the country (Wolski-unpublished), in south-eastern Poland (Podkarpackie and Pogórze Dynowskie, Armata 2005) and in Eastern

Pomerania (Pojezierze Chełmińsko-Dobrzyńskie, Szczepański 2007). In ATMOS squares grid system it covers 83 squares (Fig. 1).

From an ecological point of view, these localities are similar to those noted in other European countries. The species was observed mostly at the bases of trees (most frequently of pines and oaks which are tree species occupied only by few native epiphytic bryophytes) and on decaying wood, mainly in deciduous or mixed forests of rather natural character. Although it has a great number of localities, nothing indicates that the presence of that species has negatively influenced the epixylic or epiphytic communities of bryophytes in which it appeared. The moss always occurred in small turfs. It seems the species has utilized microhabitats' gaps within forest ecosystems and filled them.

*Campylopus introflexus* is regarded as an aggressive invader (Söderström 1992). Similarly to the previous species it frequently produces sporogons with many spores. Moreover, it spreads through fragments of stems, which helps to make big cushions and to expand on new territories.

All European localities of this moss are ecologically very similar. It grows on sandy edges of forest roads in pine or in mixed oak-pine forests, as well as in young pine plantations and heath-lands; less frequently *Campylopus introflexus* was recorded on dried peat (Frahm 1984; Berg 1985).

In Poland the first specimens were collected in 1986 in Wielkopolska (Pojezierze Sierakowskie – Lisowski and Urbański 1989). Afterwards it has been found in Western Pomerania (Gos 1991; Fudali 1992; Rusińska and Urbański 1993; Urbański 1994), Wzniesienia Gubińskie (Fojcik 1998) and Bory Dolnośląskie (Stefańska et al. 2006), as well as in southern Poland: Wyżyna Śląska (Stebel 1994, 1997; Fojcik and Stebel 2001; Stebel and Fojcik 2005) and Wyżyna Krakowsko-Częstochowska (Stebel and Fojcik 2005), Beskid Wysoki (Stebel and Fojcik 2005). It has also been noted, however in few places, in south-eastern Poland: Beskid Mały (Stebel 1995), Kotlina Sandomierska (Fojcik and Gumieniak 1999, Pogórze Dynowskie (Armata 2005). Recently the moss has also been recorded in Pojezierze Chełmińsko-Dobrzyńskie (Szczepański – unpublished) and in Mazowsze region (Wolski – unpublished). There have been no observations so far from north-eastern Poland. To the date published localities of *Campylopus introflexus* cover 67 squares of ATMOS grid system (Fig. 2). In some of its western localities the moss covered quite big surfaces, of about 3-4 square meters. It seems that the species colonizes mainly disturbed habitats and ecosystems; it was noted mostly at the edges of pine plantations, on the road sides in coniferous forests, frequently in pine stands growing on the acidophilous oak forests' habitat. In such places only few common native species can grow: e.g. *Dicranum scoparium* and *Ceratodon purpureus*.

*Leptophascum leptophyllum* was the last discovered neophytic invasive species in Europe (Frahm 2002). It grows frequently in warm open habitats, mostly of anthropogenic character. It was noted in xerothermic habitats and on fields, fallow grounds and even on walls. In Europe it is sterile, so new areas are probably colonized by fragments of leaves easily spread by wind (Oesau 2002). Its distribution is fostered by agriculture which promotes spreading rhizoids and pieces of leaves in the fields.

This subtropical moss was noted in Poland for the first time by M. Szczepański in spring 2007 in Pojezierze Cheł-

TABLE 1. New unpublished localities of *Campylopus introflexus*, *Orthodontium lineare* and *Leptophascum leptophyllum*. Nomenclature of communities after Matuszkiewicz (2001).

ATMOS square	Forest inspectorate	Locality	Habitat	Leg.	Date	Herbarium	Remarks
<i>Campylopus introflexus</i>							
Ba-16	Gryfice	Pustkowo	edge of the path in pine forest ( <i>Empetro nigri-Pinetum</i> community)	S. Lisowski	15.07.1995	POZG	
Bb-56	Czaplinek	forest unit 111b	dried peat in the transitional mire	P. Górski	24.07.2007	POZG	
Bb-73	Świerczyna	forest unit 29d	dried peat on the edge of degenerated <i>Vaccinio uliginosi-Betuletum pubescentis</i> community	P. Górski	21.07.2007	POZG	
Bd 88	Lidzbark	2 km W from Rumienica	mineral soil in the forest cutting	M. Szczepański	21.07.2005	private of M.Sz.	
Be-73	Jedwabno	close to the Konopne Lake, 2 km SE from Baldy	peat on the edge of peat-bog, within a birch forest	M. Szczepański	01.08.2007	private of M.Sz.	
Cb-61	Międzychód	0.5 km S from Drzewce	mineral soil in pine forest ( <i>Leucobryo-Pinetum</i> community)	K. Gos	1.05.2008	private of E.F.	
Cb-63	Sieraków	in vicinity of the Kubek lake	mineral soil on the edge of the forest cutting	R. Zubeł	3.05.2008	private of E.F.	
Cb-64	Wronki	between Sieraków and Rzecin, near Dębogóra	edge of pine forest ( <i>Leucobryo-Pinetum</i> community)	W. Rakowski	28.09.2001	POZG	
Cb-71	Międzychód	E shore of Młyńskie Lake, forest section 205f	sandy soil in the <i>Spergulo-Corynephorretum canescens</i> community, on the sand dune affected by man (along "education path")	A. Rusińska	24.09.2006	POZG	
Cb-72	Sieraków	N of Kobylamia	edge of pine forest close to nature reserve "Mszar nad Jeziorem Mnich"	A. Stebel	03.05.2008	SOSN	
Cd 08	Lidzbark	N shore of Lidzbarskie Lake	mineral sandy soil in a hornbeam forest	M. Szczepański	04.04.2007	private of M.Sz.	
Cd 08	Lidzbark	Jeleń near Lidzbark	mineral soil on the edge of mid-field peat-bog	S. Rosadzkiński	27.04.2007	POZG	
Cd 18	Lidzbark	1 km NW from Jamielnik close to Lidzbark	dried peat on the edge of ditch	M. Szczepański	07.08.2004	private of M.Sz.	
Da-04	Rzepin	1 km N from the shore of Limie Lake	mineral soil on the edge of pine forest	A. Rusińska	29.09.2007	POZG	2 localities
Da-54	Lubsko	neighbourhoods of villages Starosiedle, Chęciny and Pole – forest units: 4j; 22c	mineral soil on the edge of pine forest	S. Rosadzkiński	01.08.2007	POZG	2 localities
Da-55	Lubsko	1,5 km S from Dobrze – forest unit 87c	<i>Corniculario-Cladonietum</i> on the road edge in a pine forest	S. Rosadzkiński	01.08.2007	POZG	
Da-63	Lubsko	3 km SW from Jezioro Dolne – forest units: 154f; 202b, c, e; 326e	mineral soil in a young pine stand and in the heath	S. Rosadzkiński	30.07.2007	POZG	5 localities

TABLE 1. Cont.

ATMOS square	Forest inspectorate	Locality	Habitat	Leg.	Date	Herbarium	Remarks
Da-64	Lubsko	nature reserve "Mierkowskie Wydmy" close to Mierków; Drutów Lake close to Proszów; SE from Biecz – forest units: 280f; 281d, h; 285o, 287i, 328b	mineral soil in pine forests ( <i>Cladonio-Pinetum</i> , <i>Leucobryo-Pinetum</i> communities) and young pine stands, dried peat on the degenerated peat-bog and decaying birch bark	S. Rosadziński	31.07.2007	POZG	8 localities
Da-75	Lubsko	forest units: 13s, 17c, 56j, 72a	dried peat on the degraded peat-bog; mineral soil in the <i>Spergulo-Corynephorum canescens</i> community and in the pine forest	S. Rosadziński	02.08.2007	POZG	4 localities
Da-76	Lubsko	forest units: 184a, 232l	mineral soil in the beech plantation on the habitat of acidophilous oak forest and on the road edge in a pine forest	S. Rosadziński	03.08.2007	POZG	2 localities
Db-12	Wolsztyn	forest units: 5a, 74f, 92b, 224b	mineral soil on the roadside in the young pine stands and in pine forest ( <i>Cladonio-Pinetum</i> community)	S. Rosadziński	23.07.2007	POZG	3 localities
Db-18	Babki	1,5 km N from Sasinowo	dry edge of pine forest	S. Lisowski	17.08.1997	POZG	
Db-23	Grodzisk	shore of Kuźnickie Lake near Kuźnica Zbąska	mineral soil on the edge of pine forest	S. Lisowski	17.08.1997	POZG	
Db-60	Nowa Sól	peninsula on the river Odra, close to Bobrowniki	mineral soil in the <i>Spergulo-Corynephorum canescens</i> community	S. Rosadziński	01.08.2007	POZG	
Ed-09	Smardzewice	forest among Tomaszów Mazowiecki town and villages: Niebrów, Zawada, Dąbrowa	mineral soil in a young pine stands	G. Wolski	10.05.2006	LOD	
<i>Orthodontium lineare</i>							
Ba-16	Gryfice	Pobierowo	rotten wood in pine forest ( <i>Empetro nigri-Pinetum</i> community)	S. Lisowski	04.09.1996	POZG	
Ba-36	Gryfice	1 km N from Samolino	dried peat	K. Ziarnek	09.2007	POZG	
Bb-65	Czaplinek	forest unit 337f	rotten wood on the edge of peat-bog	P. Górski	06.09.2007	POZG	
Bb-67	Czarnobór	forest unit 73f	dried peat on the edge of transitional mire	P. Górski	01.08.2007	POZG	
Bb-75	Czaplinek	forest units 49b, 86d	peat in <i>Vaccinio uliginosi-Pinetum</i>	P. Górski	11.09.2007	POZG	2 localities
Be-90	Nidzica	close to Kolonia Gardyny 1,5 km S from Turów	peat on uprooted tree ( <i>Vaccinio uliginosi-Pinetum</i> community)	M. Szczepański	31.07.2007	private of M.Sz.	
Bd-99	Lidzbark	forester lodge Kostkowo close to Rybno	decaying root in wet pine forest ( <i>Vaccinio uliginosi-Pinetum</i> community)	M. Szczepański	21.04.2006	private of M.Sz.	

TABLE 1. Cont.

ATMOS square	Forest inspectorate	Locality	Habitat	Leg.	Date	Herbarium	Remarks
Bd 99	Lidzbark	peat-bog Bagna Jeleńskie close to Jeleń	peat in wet pine forest ( <i>Vaccinio uliginosi-Pinetum</i> community)	M. Szczepański	19.03.2004	private of M.Sz.	
Cb-61	Międzychód	0,5 km S from Drzewce	the base of pine tree in pine forest ( <i>Leucobryo-Pinetum</i> community)	K. Gos	1.05.2008	private of E.F.	
Cb-61	Międzychód	NE from the Sowa Góra village	the base of pine tree in pine forest ( <i>Leucobryo-Pinetum</i> community)	A. Stebel	1.05.2008	SOSN	
Cb-63	Sieraków	N from the shore of lake Kubek	rotten wood in the carr	A. Rusińska	03.05.2008	POZG	
Cb-68	Oborniki	between Dąbrówka Leśna and Lipa	humic soil at the base of pine ( <i>Leucobryo-Pinetum</i> community)	T. Herben	21.06.1989	POZG	
Cb-71	Międzychód	in vicinity of protected area "Makąty", forest unit 209a	the base of alder tree	A. Stebel	2.05.2008	private of E.F.	
Cb-72	Sieraków	in vicinity of nature reserve "Mszar nad Jeziorem Mniach"	the base of pine tree	A. Stebel	3.05.2008	private of E.F.	
Cb-83	Pniewy	2 km SW from Kwilcz	rotten wood in the degenerated hornbeam forest ( <i>Galio silvatici-Carpinetum</i> community)	S. Balcerkiewicz	07.10.2001	POZG	
Cd 08	Lidzbark	designed nature reserve "Las Nadwelski" in the valley of river Wel close to Lidzbark	bark of willow in a carr	V. Plasek	29.04.2007	private of M.Sz.	
Dc-02	Czermiejewo	nature reserve "Modrzew Polski in Noskowo"	rotten wood in the forest	S. Lisowski	10.05.1997	POZG	
Dd-88	Brzeziny	nature reserve "Łaznów" near Rokiciny	trunks of pine and fir trees	G. Wolski	10.10.2007	LOD	3 localities
Eb 80	Śnieżka	Upper Karpacz, on the edge of path to the Wang Temple	soil at the base of fallen spruce tree in the bilberry heath	M. Szczepański	14.07.2007	private of M.Sz.	
Fb-14	Zdąroje	Szczelimec Wielki, 915 m above sea level	base of spruce on the edge of sandstone rock	T. Herben and P. Szmajda	27.06.1989	POZG	
<b><i>Leptohascum leptophyllum</i></b>							
Bd 72	Jamy	close to the nature reserve "Dolina Osy" near Słupski Młyn	flat, clayey ant-hill on dry and sunny slope, without sporogons, together with: <i>Barbula unguiculata</i> , <i>Tortula lanceolata</i> , <i>Pleuroidium subulatum</i> , <i>Funaria fascicularis</i> , <i>Weissia longifolia</i>	M. Szczepański	08.04.2007	private of M.Sz.	

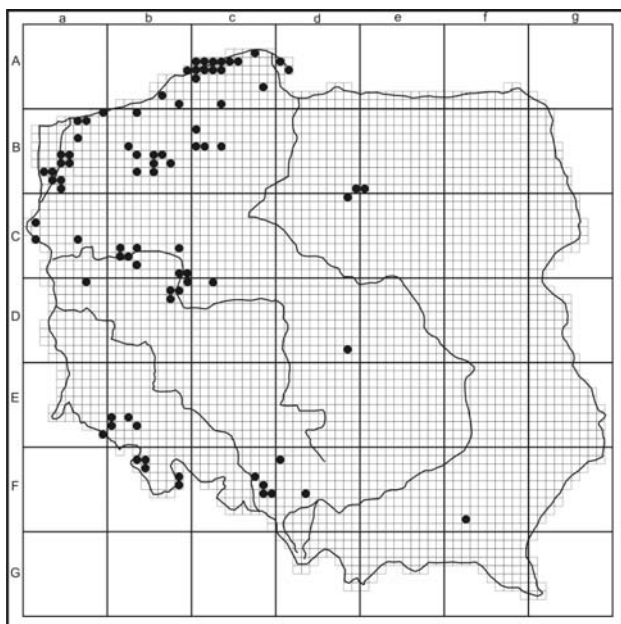


Fig. 1. Current distribution of *Orthodontium lineare* Schwaegr. in Poland (based both on published so far literature data and the author's recent records and material from herbaria not published yet – see: Table 1).

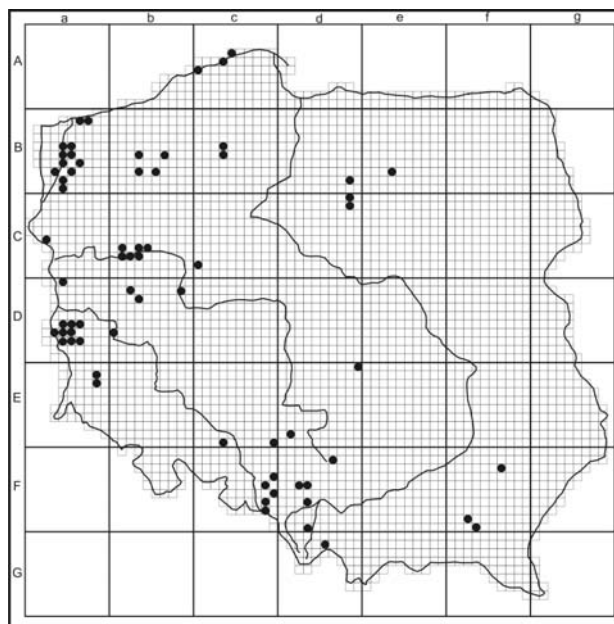


Fig. 2. Current distribution of *Campylopus introflexus* (Hedw.) Brid. in Poland (based both on published so far literature data and the author's recent records and material from herbaria not published yet – see: Table 1).

mińsko-Dobrzyńskie, on an ant-hill. It was noted once only (Fig. 3). The nearest locality of the moos is situated on the western bank of the Odra River (Frahm 2002). Probably it has migrated through the northern lakeland areas.

The ephemeral character of the bryophytes occurring in the fields may be one of the reasons of poor knowledge of the actual distribution of this species in Poland. Moreover, *Leptophascum leptophyllum* can be mistaken with common *Tortula truncata*, which grows in similar microhabitats.

### CONCLUSIONS

Data concerning the current distribution of the two bryoneophytes *Orthodontium lineare* and *Campylopus introflexus*

in Poland clearly indicate their constant spreading towards the east, it seems however that they have migrated to the Polish territory both from the west (Germany) and south (Czech Republic). They are acidophilous species and the acidification of the environment probably promotes their expansion. Compiled data suggest the species still colonize and establish themselves on the country area, but in the western part they could have entered upon a new, more advanced phase of invasion, the expansion stage. However, it should be kept in mind that the eastern part of Poland is still under-investigated bryologically. There is no direct evidence that the species have been limiting the occurrence of native moss species.

The recognition of the actual distribution of *Leptophascum leptophyllum* needs further detailed studies.

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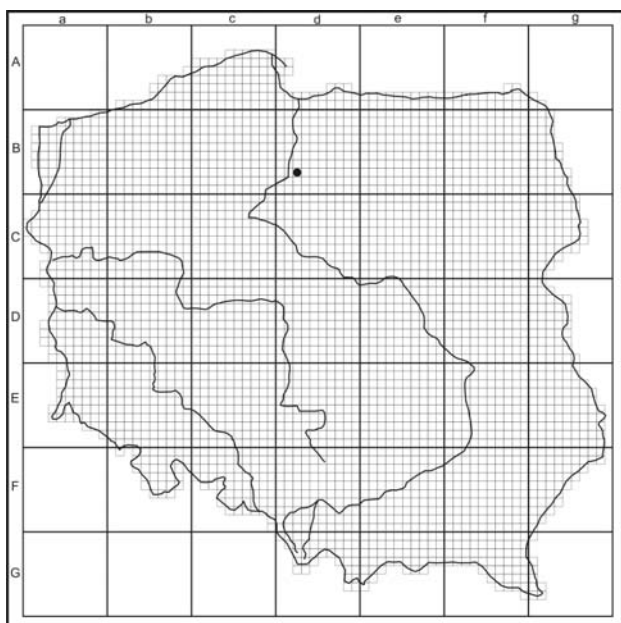


Fig. 3. The first locality of *Leptophascum leptophyllum* Mull. Hal. in Poland (found by M. Szczepański).

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