

Apophytes as invasive plants in the vegetation of Poland

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Abstract: Apophytes are native synanthropic plants, i.e. those found in disturbed habitats. Some apophytes with a limited geographic range, which are native to one part of a country, migrate out of their natural communities as “invasive” plants. We selected from the group of apophytes in Poland (more than 220 species) examples of such plants, which after World War II colonized new areas and often new habitats. They include, for instance, coastal species of dunes and salt marshes, or plants used as ornamentals. Moreover, some species of fresh meadows in the south of Poland, are now found in the north in ruderal habitats. The speed of colonization is high, such that in the last 20 years, starting from a few locations, some have taken over almost the entire area of Poland. The expansion of apophytes can be much faster than that of anthropophytes because apophytes have a higher number of diaspores or a shorter period of adaptation in new localities.

Key words: apophytes, invasive plants, Poland

1. Introduction

The term “invasive” plants has had an extraordinary career in recent decades. The etymology of the word “invasion” has its psychological and sociological contexts. It is often combined with the word “alien” and treated as having a pejorative connotation. In the great majority of uses in botany, “invasive” means “geographically alien”, i.e. originating from a distant area, being part of another flora.

In Central Europe the vegetation cover has been transformed significantly and thus alien species are a common component of synanthropic or damaged and disturbed natural communities. Such species occur much less often in semi-natural communities, somewhat fixed by centuries of human activity (e.g. fresh meadows). In Poland, one of the largest countries in Central Europe, 220 plant species are neophytes (= kenophytes) that arrived here after the end of the 15th century according to Zając *et al.* (1998). According to a new source of data (Tokarska-Guzik 2005) their number is even higher: about 300 species. This number includes also species with a very minor role in the vegetation, which are found in a very limited area, e.g.

Parietaria pensylvanica Müh ex Willd. in Bydgoszcz (Sawilska & Misiewicz 1998).

2. Apophytes as invasive plants

Much less attention has been devoted to another group of invasive plants, which are far more dangerous to the preservation of the natural status of ecological systems in Central Europe. These are species with a limited geographic range, native to one part of a country (apophytes), which have migrated out of their natural communities. The term “apophyte” can be defined in a broader sense as a synanthropic plant species indigenous to a country or a large geographic region (e.g. Thellung 1918-1919), or in a narrow sense, indigenous to a part of a country (Kornaś 1955). In this paper, species considered as apophytes are indigenous at least to a part of Poland. Several years ago, a list of apophytes for Poland was compiled. Only the species that occur in ruderal and segetal habitats were considered (Zając M. & Zając A. 1992). The list includes 238 taxa. According to the classification of Holub and Jirásek (1967), most of them are classified as macroautoapophytes, i.e. the species that occur

predominantly in synanthropic habitats and only rarely in natural ones.

Usually we do not regard them as “invasive species”, but the only reason is that their penetration into anthropogenic or semi-natural communities took place long ago. When the apophytes extend their ranges or greatly increase the number of sites, these phenomena are often overlooked even in detailed floristic or phytosociological studies.

We, nevertheless, draw attention to some spectacular contemporary invasions by apophytes. Why did they get noticed? The answer is simple: these plants had limited distribution ranges in Poland (like in other parts of Central Europe) and additionally were associated with particular habitats.

3. Examples of “invasive” apophytes in Poland

Alnus viridis (Chaix) DC. occurs in Poland in natural habitats in the eastern part of Polish Carpathians (Bieszczady Mts.) above the timberline. Edaphically, it is a substitute for *Pinus mugo* Turra. After World War II, the human population of Ukrainian origin was forcibly moved out of this mountain range. There were many deserted villages, some of them located rather high up the slopes, and their arable fields and meadows extended

incana (L.) Moench. This is an example of invasion of a species beyond the limits of its former distribution within a single mountain range.

Telekia speciosa (Schreber) Baumg. (Fig. 1) and *Centaurea mollis* Waldst. & Kit. were cultivated as ancient ornamental plants but now are cultivated very rarely. They show unaided expansion, especially within the areas with climate similar to that in their native habitats. *Telekia speciosa* is typical of mountain carrs and tall herb communities, but spreads in similar habitats at lower altitudes and in lowlands. Its native range covers only a small area in the Western Bieszczady Mts. Currently, it has taken over a number of river valleys in the adjacent mountain range of Beskid Niski. Further expansion of this species is still observed, sometimes covering great distances. *Centaurea mollis* is a high-mountain species occurring in the alpine meadow zone, which extends its range to lower mountain sites as well as into the foothills, where it is found in ruderal communities with *Onopordetea acanthii*.

Scrophularia scopolii Hoppe ex Pers. is again a species of mountain character. This taxon occurs in tall herb communities (*Adenostyletalia alliariae*) and is a ruderal species in the submontane zone (wherever precipitation is sufficient). In Poland there are some problems with interpretation of its lowland distribution in the

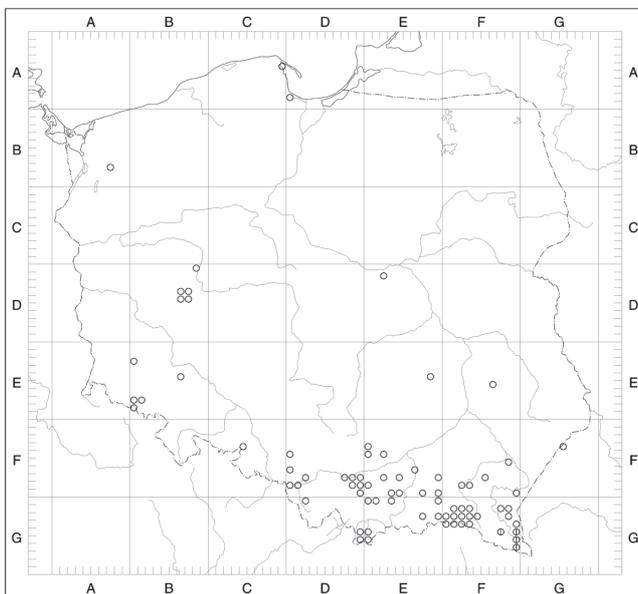


Fig. 1. Distribution of an “invasive” apophyte in Poland: *Telekia speciosa* (Schreber) Baumg.

Explanations: empty circle – synanthropic, crossed circle – status uncertain

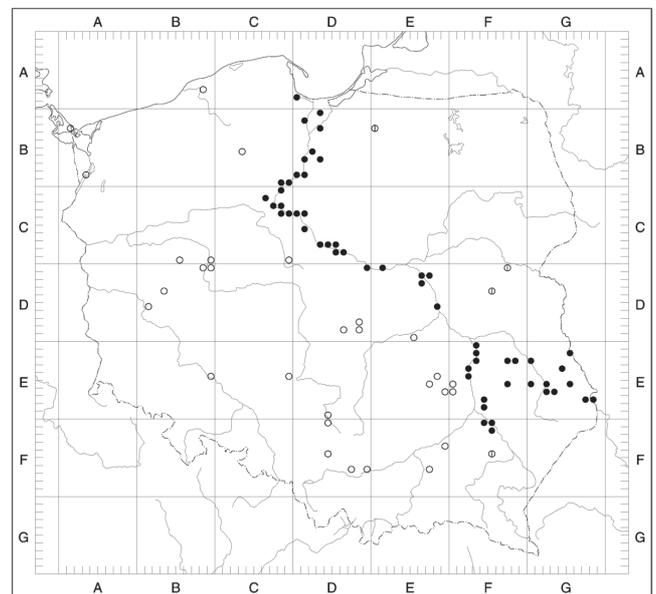


Fig. 2. Distribution of an “invasive” apophyte in Poland: *Artemisia scoparia* Waldst. & Kit.

Explanations: black circle – natural, empty circle – synanthropic, crossed circle – status uncertain

to yet higher altitudes. *Alnus viridis* colonized these abandoned farmlands. The species multiplied the number of its sites and markedly extended its altitudinal range. It also formed many mixed populations with *Alnus*

upper Oder river basin, where it occurs in disturbed carrs. This may represent an after-effect of an earlier phase of expansion, because this species is equally common in ruderal communities.

Artemisia scoparia Waldst. & Kit. (Fig. 2) is native to the Vistula river valley, where it usually grows on alluvial sites. It has recently spread throughout ruderal habitats, also westward beyond the broad valley of the Vistula. It is likely that certain ecological and edaphic similarities between alluvial and ruderal habitats facilitate its expansion.

Another species with a limited and small native distribution range in Poland is *Salvia nemorosa* L., associated with xerothermic vegetation (*Festuco-Brometea*). This species spreads in open habitats, e.g. on railway embankments, like several other species of the same plant formation. This species has been noticed because it started its expansion relatively recently.

The origin of meadow species is problematic in Central Europe (particularly of fresh meadows). Although this problem was studied by many botanists (e.g. Landolt 1970; Pawłowska 1965; Rybniček & Rybničkowa 1974; Scholz 1975) it is still far from being solved. A species commonly occurring on meadows in southern Poland is *Trisetum flavescens* (L.) Beauv. (Fig. 3). The last half-century has seen its expansion into northern Poland, where it is increasingly often found in ruderal habitats. This is an example of a species that a long time ago had completed the first stage of its expansion, into secondary habitats, and now has entered a new stage of this process,

The causes of this phenomenon are variable. *Ammophila arenaria* (L.) Link. (Fig. 4), a species of coastal sand dunes, has been used to stabilize sands in inland areas, especially after the cutting down of dry pine forests. At present it shows unaided expansion into semi-natural sand dunes and ruderal sites on sandy soils. *Sorbus intermedia* (Ehrh.) Pers. is a species of the Polish Baltic coast, whose origin is unclear. In eastern and western Germany, Haeupler and Schönfelder (1988) as well as Benkert *et al.* (1996) regard this species as an anthropophyte. In Poland, Browicz and Gostyńska (1963) regarded some of the coastal sites as natural, but in the *Distribution Atlas of Vascular Plants in Poland* (Zajac A. & Zajac M. 2001) it was designated as “of unknown origin”. There is no doubt, however, as to the status of its local inland populations. Some of them occurred as a result of earlier planting of this species in certain areas, but recently an unaided expansion of this species into ruderal habitats has been observed. A very interesting issue, studied only partly in Poland, is the origin of 2 subspecies within *Angelica archangelica* L.: subsp. *archangelica* and subsp. *litoralis* (Fries) Thell. These two taxa, with their taxonomic features still to be fully studied, have two separate natural distribution ranges in Poland, and the course of their invasion differs, too. *A. archangelica* subsp.

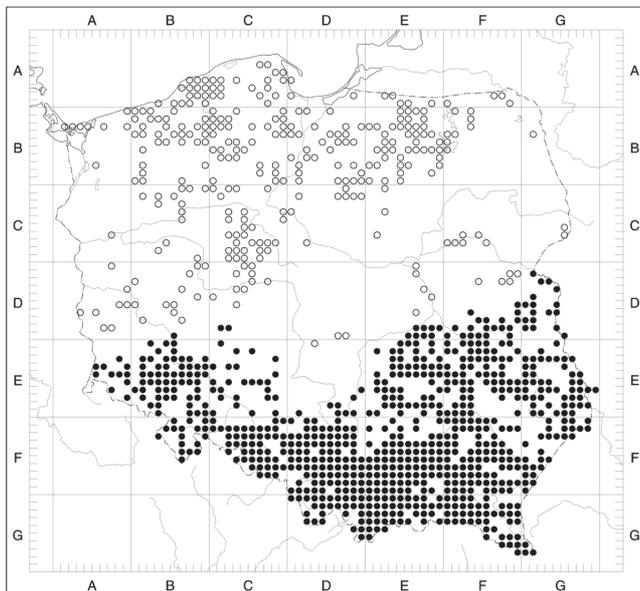


Fig. 3. Distribution of an “invasive” apophyte in Poland: *Trisetum flavescens* (L.) Beauv.
 Explanations: black circle – natural, empty circle – synanthropic

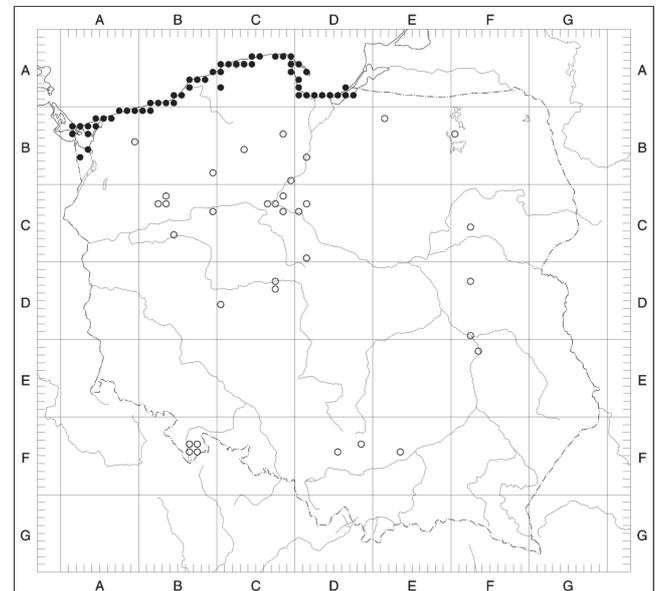


Fig. 4. Distribution of an “invasive” apophyte in Poland: *Ammophila arenaria* (L.) Link.
 Explanations: black circle – natural, empty circle – synanthropic

expanding its distribution range into new geographic areas.

After World War II, invasion of species naturally occurring in some coastal communities was also noticed.

archangelica is found in tall herb communities in the Sudetes and Carpathians. It has been cultivated for centuries, both as a medicinal plant and for other uses (famous herb liqueurs). The habit of cultivating this

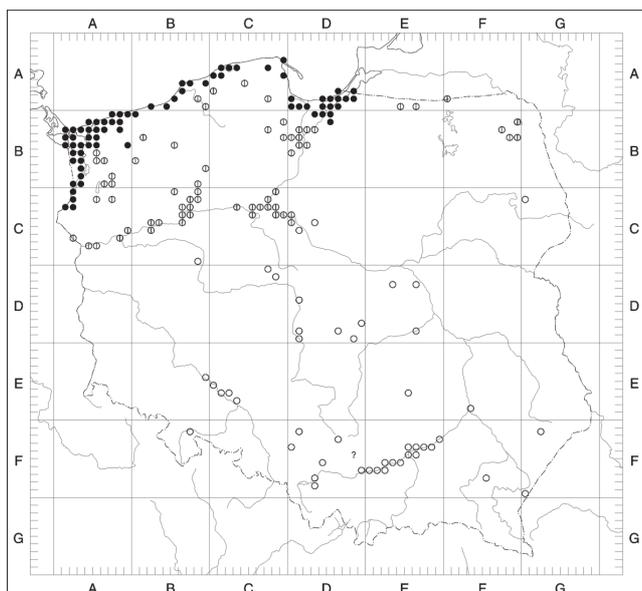


Fig. 5. Distribution of an “invasive” apophyte in Poland: *Angelica archangelica* L. subsp. *litoralis* (Fries) Thell.

Explanations: black circle – natural, empty circle – synanthropic, crossed circle – status uncertain

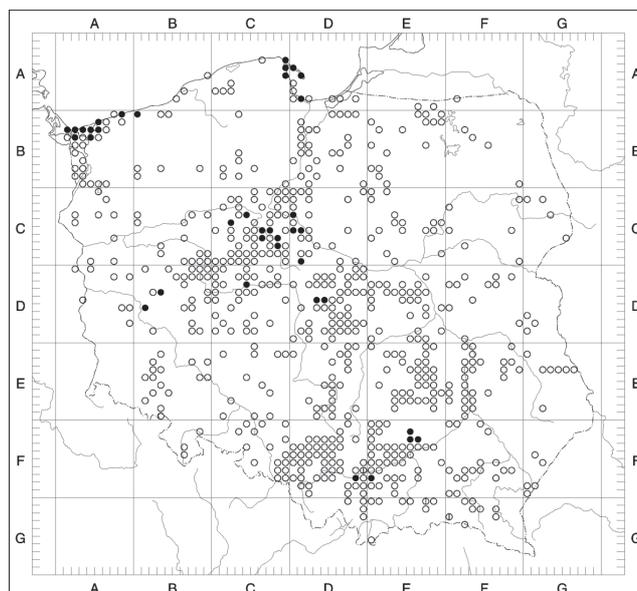


Fig. 6. Distribution of an “invasive” apophyte in Poland: *Puccinellia distans* (L.) Parl.

Explanations: black circle – natural, empty circle – synanthropic, crossed circle – status uncertain

plant was more widespread in the Sudetes and their foothills than in the Carpathians. This taxon spreads as a synanthrope, particularly in Silesia. It occurs in various communities along streams but also in ruderal habitats. For many of its sites it is not possible to determine their status. Because of this, the map shows an area where the origin of this species is considered doubtful. The greater the distance from mountains, the more often this species is found in ruderal habitats. In contrast, *A. archangelica* subsp. *litoralis* (Fig. 5) is a native component of coastal vegetation. For some 30 years, southward invasion of this species has been noticed, where it again occurs most often in emergent vegetation of ponds and

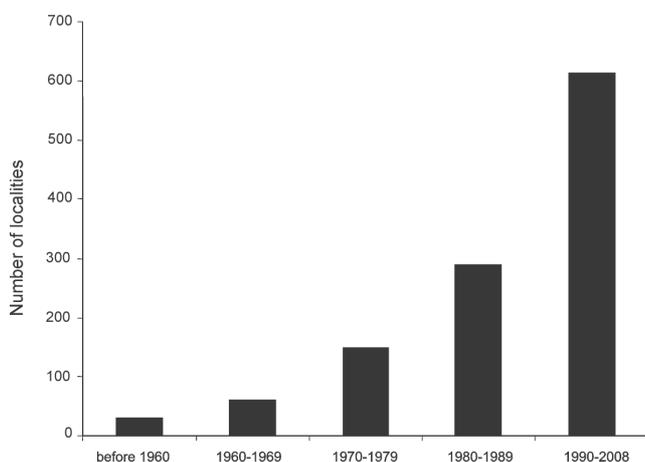


Fig. 7. Invasion of *Puccinellia distans* (L.) Parl. to synanthropic habitats, presented in time intervals

artificial lakes, but sometimes also in natural habitats, e.g. in oxbow lakes. Fortunately for botanists, the expansion of these two subspecies started from two different directions, hence the possibility of monitoring. In future, the possibility of occurrence of hybrids between these taxa should be also considered. The hybrid may be even more expansive.

A unique example among contemporary invasive species native to Central Europe is *Puccinellia distans* (L.) Parl. (Fig. 6). Its distribution in Poland was studied by Jackowiak (1984-1985, 1996). Within two decades, *P. distans* has colonized almost the entire area of Poland (Fig. 7). Its natural habitats were coastal and inland saline soils (the latter are extremely rare in Poland). Its invasion is associated chiefly with the fact that kitchen salt is commonly used to melt snow on roads. Certainly there were some earlier records of this grass appearing on ruderal sites, e.g. near sedimentation ponds for industrial waste resulting from soda production (Trzcińska-Tacik 1966). These were, however, rather sporadic cases. Apart from roadsides, this species often occurs on mineral-rich sites near dumps of organic waste (manure pits). For botanists it is an example of an unusually rapid recent expansion of a species that had a very limited distribution in Poland.

4. Conclusions

The above examples of recent expansion of apophytes allow us to conclude that they represent an equally important phenomenon of plant biology as the

invasion of anthropophytes from geographically distant areas. In many cases, the former behave like agriophytes, penetrating semi-natural and often natural plant communities. As they are native to the area concerned, their anthropogenic distribution and in many cases the expansion of their ranges escapes the attention of botanists studying the synanthropization of flora. The above considerations encouraged us to suggest several hypotheses regarding the direction of future studies on apophytes, which in part are implied by the above considerations and in part constitute a much wider research problem.

- The recent invasion of apophytes is conspicuous in species with limited natural distribution ranges or those occurring in specific habitats.
- The speed of colonization of new areas depends first of all on the appearance of specific synanthropic habitats, when the invasion can be extremely rapid. In other cases the development of an anthropogenic range is gradual.
- The invasive species among mountain taxa colonize only areas with similar climatic conditions. Any

further occurrences are rather accidental and no data are available to decide if they are repeated occurrences, to classify them as ephemeroxytes.

- Molecular studies of the taxa are needed to determine what proportion of the natural population is expanding (e.g. in common apophytes, like *Lapsana communis* L.).
- The recent expansion of apophytes provides magnificent material for studies on the rate of colonization of new areas by plant species. The apophytes are more suitable for this purpose than kenophytes, because the latter need a longer adaptation period before the initial populations form new ecotypes capable of expansion. In the case of apophytes their native populations are in close proximity, so their expansion can be much faster because of the high number of available diaspores. In most cases, kenophytes are widely distributed in their homelands. The apophytes whose expansion can be seen recently, often exceed the limits of their historically determined limits of distribution.

References

- BENKERT D., FUKAREK F. & KORSCH H. 1996. Verbreitungsatlas der Farn- und Blütenpflanzen Ostdeutschlands. 615 pp. Gustav Fischer Verlag, Jena.
- BROWICZ K. & GOSTYŃSKA M. 1963. *Sorbus intermedia* (Ehrh.) Pers. In: BIAŁOBOK S. & CZUBIŃSKI Z. (eds.). Atlas of Distribution of Trees and Shrubs in Poland, 2: 7-8. Zakład Dendrologii i Arboretum Kórnickie PAN, PWN, Poznań.
- HAEUPLER H. & SCHÖNFELDER P. 1988. Atlas der Farn und Blütenpflanzen der Bundesrepublik Deutschland. 768 pp. Verlag Eugen Ulmer, Stuttgart.
- HOLUB J. & JIRÁSEK V. 1967. Zur Vereinheitlichung der Terminologie in der Phytogeographie. Folia Geobot. Phytotax. 1(2): 69-113.
- JACKOWIAK B. 1984-1985. Chorologiczne i synekologiczne aspekty ekspansji *Puccinellia distans* (Jacq.) Parl. w Polsce. Bad. Fizjogr. Pol. Zach. seria B-Botanika 35: 67-91.
- JACKOWIAK B. 1996. Chorological-ecological model of spread of *Puccinellia distans* (Poaceae) in Central Europe. Fragm. Flor. Geobot. 41(2): 551-561.
- KORNAŚ J. 1955. Charakterystyka geobotaniczna Gorców. Monogr. Bot. 3: 1-216.
- LANDOLT E. 1970. Mitteleuropäische Wiesenpflanzen als hybridogene Abkömmlinge von mittel- und südeuropäischen Gebirgssippen und submediterranen Sippen. Feddes Repertorium 81: 61-66.
- PAWŁOWSKA S. 1965. La provenance de la flore des prairies fauchables de la partie septentrionale des Tatras et de la Région Subtatrique. Fragm. Flor. Geobot. 11(1): 33-52.
- RYBNIČEK K. & RYBNIČKOVÁ E. 1974. The origin and development of waterlogged meadows in the central part of Šumava Foothills. Folia Geobot. Phytotax. 9: 45-70.
- SAWILSKA A. K. & MISIEWICZ J. 1998. New localities for *Parietaria pensylvanica* (Urticaceae) in Poland. Fragm. Flor. Geobot. 43(2): 231-236.
- SCHOLZ H. 1975. Grassland evolution in Europe. Taxon 24: 81-90.
- THELLUNG A. 1918-1919: Zur Terminologie der Adventiv- und Ruderalflora. Allg. Bot. Zeitschr. Karlsruhe, 24: 36-43.
- TOKARSKA-GUZIĆ B. 2005. The Establishment and Spread of Alien Plant Species (Kenophytes) in the Flora of Poland. Prace naukowe Uniw. Śląskiego w Katowicach 2372: 1-192.
- TRZCIŃSKA-TACIK H. 1966. Flora and vegetation of the spoil mounds of the Cracow Soda Factory. Fragm. Flor. Geobot. 12(3): 243-319.
- ZAJĄC A. & ZAJĄC M. (eds.). 2001. Distribution Atlas of Vascular Plants in Poland. xii+714 pp. Edited by Laboratory of Computer Chorology, Institute of Botany, Jagiellonian University, Cracow.

ZAJĄC A., ZAJĄC M. & TOKARSKA-GUZIŁ B. 1998. Kenophytes in the flora of Poland: list, status and origin. In: J. B. FALIŃSKI, W. ADAMOWSKI & B. JACKOWIAK (eds.). Synantropization of plant cover in new Polish research. *Phytocoenosis* 10 (N.S.) Suppl. *Cartogr. Geobot.* 9: 107-116.

ZAJĄC M. & ZAJĄC A. 1992. A tentative list of segetal and ruderal apophytes in Poland. *Zeszyty Naukowe UJ, Prace Bot.* 24: 7-23.