

Distribution and habitats of *Bunias orientalis* in the northern sub-Tatra region

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Abstract. Present distribution of invasive species *Bunias orientalis* in the northern sub-Tatra region (Southern Poland, Western Carpathians) is characterized, and its syntaxonomical position and status in the flora are discussed.

Key words: *Bunias orientalis*, status, the Carpathians, invasive plant, plant communities

Introduction

Bunias orientalis is an Eastern-European species showing strong expansion to the west and north. Presently, the species occurs almost in all Central European countries and in large part of Western and Northern Europe (Meusel *et al.* 1965). It is also widespread in the Polish Lowlands, and, in several places, inhabits the lower mountain areas as well.

Material and methods

The elaboration encompasses the northern sub-Tatra region area. The species distribution was investigated in 1980-1983. Detail mapping (Fig. 1) was only done in the area, in which occurrence of the species was noted. Habitats, in which *B. orientalis* occurs, were characterized by soil texture, humidity, and reaction (pH in H₂O and in KCl). Syntaxonomical status of the species was characterized from 15 releves according to Braun-Blanquet's method.

Results and discussion

History of *Bunias orientalis* in the area investigated

The occurrence of *B. orientalis* was noted for the first time in the Northern Tatra and sub-Tatra region in 1930 (Pawłowski 1956). It grew in one locality in a few specimens at Strążyska valley close to Zakopane. Taking into consideration that the valley was one of the most busy ones and frequently visited by many botanists, it may be supposed that it was really the first finding of the species in this area. This supposition is also validated by the fact that the area had hitherto elaborated solid floristical monograph by Kotula (1890). Precise documentation of further spreading is not possible due to lack of proper cartographical materials or other documents from the years 1931-1980. Present distribution of the species is displayed in Fig. 1.

Local distribution

B. orientalis is not evenly distributed in the sub-Tatra region, but is only limited to the Zakopane Basin and closely adjacent areas where is relatively frequent. The species was found in the groups of ten or more specimens (Fig. 1), mainly concentrated at the bottom of Zakopane Basin: on river terraces and in lower parts of gentle downhill slopes. The species occurs continuously from 730 to 900 m a.s.l. The highest, isolated stand was found on the northern slopes of Gubałówka range at 1,040 m. In spite of its frequency in the northern sub-Tatra region, the species does not enter the Tatra Mts. The only known isolated locality was found in the Tatra National Park in Kościeliska Valley in 1980 (Fig. 1). The species was found at Stare Kościeliska Glade (Mirek, Piękoś-Mirkowa 1987).

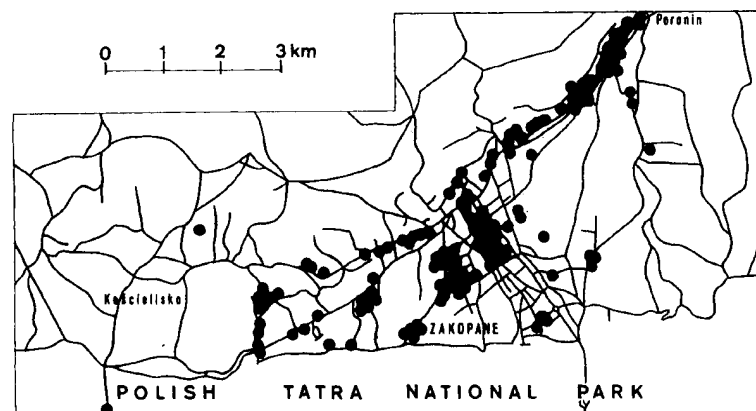


Fig.1. Distribution of *Bunias orientalis* L. in Zakopane Basin and in the adjacent area.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of record	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Altitude m a.s.l.	880	735	850	750	750	755	910	870	850	735	775	750	850	875	870
Exposure	N	-	NE	-	-	-	N	-	N	-	W	-	ENE	N	-
Inclination	3	0	10	0	0	0	5	-	3	0	30	0	30	3	-
Herb layer cover	100	100	100	100	100	95	100	100	95	100	95	95	95	45	100
Surface in m	200	100	50	100	50	50	100	100	150	50	40	25	10	150	75
<i>Bunias orientalis</i>	2	2	4	2	3	4	2	4	3	3	4	5	4	2	3
<i>Dactylis glomerata</i>	+	+	1	3	1	3	3	2	2	+	+	1	2	1	1
<i>Heracleum sphondylium</i>	2	3	3	4	+	2	1	2	+	3	2	1	3	+	1
<i>Taraxacum officinale</i>	3	3	3	1	2	2	2	1	2	2	1	+	+	+	2
<i>Poa trivialis</i>	+	2	+	3	3	2	2	4	+	4	+	+	+	0	4
<i>Ranunculus repens</i>	1	1	1	3	2	1	1	1	2	3	3	1	+	0	
<i>Veronica chamaedrys</i>	2	1	1	3	1	1	2	3	2	+	1	0	+	+	1
<i>Crepis biennis</i>	2	2	1	1	+	+	1	2	1	+	+	0	0	+	1
<i>Trisetum flavescens</i>	3	4	3	4	4	3	3	2	4	1	0	+	0	+	1
<i>Rumex acetosa</i>	1	3	1	3	1	+	2	1	3	+	+	0	0	0	1
<i>Trifolium repens</i>	3	3	3	+	1	2	3	1	1	4	0	0	0	1	1
<i>Alchemilla sp. div.</i>	3	+	1	1	3	2	2	1	3	+	2	0	0	0	+
<i>Festuca pratensis</i>	+	1	1	+	0	+	1	1	2	+	0	0	0	+	+
<i>Cardaminopsis halleri</i>	1	2	0	1	2	0	2	+	3	0	+	0	0	0	+
<i>Lathyrus pratensis</i>	1	1	1	2	0	0	+	1	+	0	+	0	0	+	0
<i>Ranunculus acris</i>	+	1	+	+	+	0	0	2	1	0	0	0	0	+	1
<i>Trifolium pratense</i>	3	1	3	0	+	0	1	3	0	+	0	0	0	+	5
<i>Achillea millefolium</i>	1	1	0	0	0	0	2	1	+	1	+	0	0	+	1
<i>Vicia cracca</i>	1	1	1	+	0	0	+	0	0	1	1	0	0	+	0
<i>Alopecurus pratensis</i>	0	2	+	+	+	+	0	+	+	0	0	0	0	0	+
<i>Cerastium holosteoides</i>	1	1	1	0	1	+	1	2	+	0	0	0	0	0	+
<i>Campanula patula</i>	2	2	0	0	+	0	1	0	+	+	0	0	0	r	1
<i>Vicia sepium</i>	+	+	0	1	1	r	0	1	0	+	0	0	0	0	0
<i>Pimpinella maior</i>	+	0	+	+	0	+	2	0	0	0	+	0	0	1	0
<i>Rumex obtusifolius</i>	0	0	r	+	+	+	0	+	0	2	0	0	0	0	+
<i>Phleum pratense</i>	r	+	0	2	0	0	0	+	1	+	0	0	0	0	+
<i>Poa pratensis</i>	0	0	+	0	3	+	+	1	0	0	0	0	0	+	0
<i>Anthoxanthum odoratum</i>	1	+	0	+	0	0	0	0	+	0	r	0	0	+	0
<i>Galeopsis sp.</i>	0	r	0	0	r	0	+	r	0	0	r	0	0	0	1
<i>Leucanthemum vulgare</i>	0	0	0	+	+	0	+	0	0	0	r	0	0	+	2
<i>Rhinanthus minor</i>	2	+					+	+							+
<i>Plantago lanceolata</i>	1	+	0	0	0	0	1	+	0	0	0	0	0	1	+
<i>Viola tricolor</i>	0	0	0	0	0	0	+	1	+	0	r	0	0	0	+
<i>Carum carvi</i>	1	1	3	0	0	+	0	0	0	0	0	0	0	+	0
<i>Galium mollugo</i>	r	0	r	0	0	0	+	0	0	0	1	0	0	+	0
<i>Agropyron repens</i>	0	0	0	0	0	0	0	0	+	+	1	0	0	+	+
<i>Campanula rapunculoides</i>	1	0	0	1	0	0	0	1	0	0	0	0	0	1	1
<i>Cruciata glabra</i>	0	1	0	0	0	0	1	+	0	0	1	0	0	1	0
<i>Myosotis caespitosa</i>	0	+	0	0	+	+	1	0	0	0	0	0	0	0	0
<i>Veronica arvensis</i>	0	+	0	0	+	r	0	+	0	0	0	0	0	0	0
<i>Centaurea jacea</i>	0	0	1	+	0	0	+	0	0	0	0	0	0	+	0
<i>Hypericum maculatum</i>	1	0	0	0	0	0	0	+	0	0	+	0	0	+	0
<i>Arthenatherum elatius</i>	0	0	0	0	0	0	0	0	0	r	r	0	0	0	0
<i>Arctium tomentosum</i>	0	0	0	0	0	0	0	0	0	+	0	+	0	0	0

Table 1. Composition of communities with *Bunias orientalis* in Zakopane Basin. Other species: *Aegopodium podagraria* 13; *Acer pseudoplatanus* 11,14; *Agrostis capillaris* 1,2; *Alnus incana* 11; *Alchemilla xanthochlora* 5; *A. glaucescens* 3; *Arabis hirsuta* 14; *Anthemis arvensis* 15; *Arctium tomentosum* 10,12; *Arthenatherum elatius* 10,11; *Ammoracia rusticana* 2,10,13; *Bellis perennis* 2,3,7; *Brassica rapa* 15; *Briza media* 2,3,14; *Bromus hordeaceus* 2,6,15; *Calamagrostis varia* 14; *Cardamine impatiens* 13; *Cardaminopsis arenosa* subsp. *borbasii* 14; *Carex caryophyllea* 14; *Carex digitata* 14; *Carex firma* 14; *Carex pallescens* 14; *Carex panicea* 14; *Carduus personata* 6; *Carlina acaulis* 14; *Cirsium rivulare* 8; *Chamaenerion angustifolium* 11; *Cynosurus cristatus* 1,3,14; *Equisetum arvense* 13; *Euphrasia sp.* 14; *Festuca rubra* 7,9,11,14; *Fragaria vesca* 14; *Fraxinus excelsior* 2,11,14; *Galium anisophyllum* 14; *Geranium pusillum* 15; *Geranium silvaticum* 8; *Geum urbanum* 11; *Glechoma hederacea* 8,11,15; *Gypsophila repens* 14; *Hesperis matronalis* 15; *Hieracium lactucella* 14; *Knautia arvensis* 14; *Lamium purpureum* 15; *Lapsana intermedia* 15; *Leontodon hispidus* 14,7,2; *Leontodon hispidus* subsp. *hastilis* 1,3,14; *Linum catharticum* 14; *Lotus corniculatus* 2,3,14; *Luzula multiflora* 1; *Lychnis flos-cuculi* 2,5; *Medicago lupulina* 8,14,15; *Melandrium album* 2,10,15; *Melandrium rubrum* 7; *Myosotis arvensis* 2,8,15; *Papaver rhoeas* 15; *Petasites albus* 12; *P. kablikianus* 13; *P. hybridus* 6; *Phyteuma orbiculare* 14; *Plantago major* 8; *P. media* 2,3,14; *Polygala amara* subsp. *brachyptera* 14; *Polygonum bistorta* 2,8; *Picea abies* 2,11,14; *Polygonum viviparum* 14; *Populus tremula* 11; *Potentilla erecta* 14; *Primula elatior* 2,7,11; *Prunella vulgaris* 8,11,13; *Rubus idaeus* 11; *Rumex crispus* 15; *Salix silesiaca* 14; *Salvia verticillata* 14; *Secale cereale* 15; *Senecio subalpinus* 7; *Silene vulgaris* 7; *Sinapis arvensis* 1,2,8; *Thymus carpathicus* 14; *Trifolium medium* 14; *Tussilago farfara* 8,11,13; *Matricaria maritima* subsp. *inodora* 15; *Ulmus glabra* 11; *Urtica dioica* 3,10,13; *Vicia dasycarpa* 15; *Viola sp.* 3; *Veronica serpyllifolia* 8. Localities: 1- Kościelisko-Potoczanskie; 2,10- Poronin; 3,13- Zakopane, ul. Strązyska; 4,12 - between Zakopane and Poronin; 5,6- Zakopane-Ustup; 7- Zakopane-Krzepiówki; 8,15- Zakopane- Spadowiec, between Droga od Daniela and Potok Spadowiec; 9- Zakopane, Wyznia Równi Krupowa; 11- Zakopane- Guty; 14- Zakopane, Droga do Daniela. Numbering of records as in Fig. 3. Nomenclature after Mirek et al. (1995).

Habitats and phytocoenoses

In the northern sub-Tatra region, *B. orientalis* mainly occurs at the river terraces or gentle downhill slopes (lower parts). As a rule it grows in two types of habitats. The first are ruderal sites, e.g. eutrophic places near fences, rubbish dumps, and dug waysides and squares. The second encompasses more stabilised sites, e.g. fresh, hay-growing meadows of floristical composition related to *Gladiolo-Agrostietum* association and these are the most frequent type of habitats of the species in the northern sub-Tatra region. In spite of atypical appearance of some of records, their affinity to the *Molinio-Arrhenatheretea* class and *Polygono-Trisetion* alliance, is beyond all doubt (Fig. 2). The floristical composition of 15 phytosociological relevés spread over the whole area (Fig. 3) is shown in Table 1. In relevés, from 24 to 36 of vascular plant species were usually noted. Only two stands (relevés no. 9 and 10) were poorer (11 and 13 species). All stands developed on fresh or, less often, on temporarily slightly drying out soils. Their characteristics are shown in Fig. 4. Soil texture from the rhizosphere zone (app. 5-10 cm below the surface) is shown in Table 2. The clays are typical for fresh meadow communities in this area (Pawłowski *et al.*, 1960).

Status in the local flora

In spite of relatively short history of *B. orientalis* in the northern sub-Tatra region having slightly more than 50 years, the species well established in the

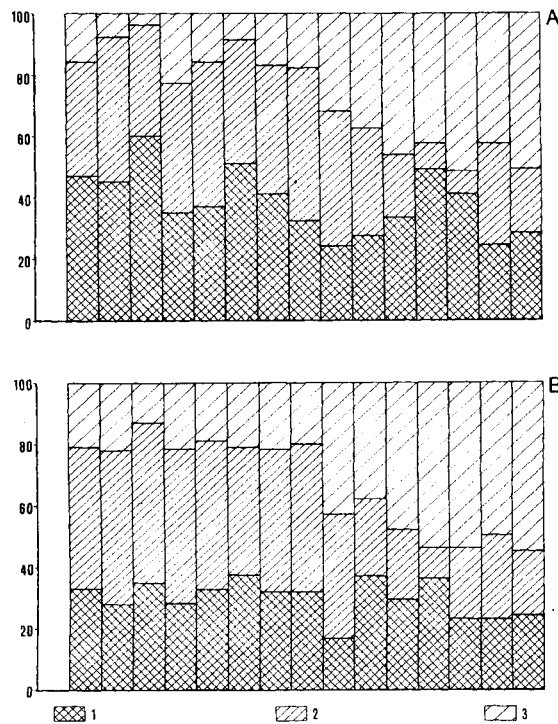


Fig. 2. Participation of species representing various groups in phytosociological relevés with *Bunias orientalis*: A - number of species of each group (in %) in relevé; B - total coverage by the species representing particular groups: 1 - species characteristics of *Molinio-Arrhenatheretea* and *Arrhenatheretalia*, 2 - species characteristic of *Polygono-Trisetion* alliance and *Gladiolo-Agrostietum* association, 3 - others.

area. It is abundant in ruderal sites as well as in meadow communities. According to classification of synanthropic plants (Kornaš 1990), it may be treated as an hemiagriophyt, i.e. alien species established in seminatural communities - in our case, the fresh and hay-growing meadows. The species may be also found in open, natural sites as, e.g. in riverine landslides; however, such localities are scarce and always occur in the vicinity of synanthropic or seminatural communities.

Dispersion in meadow communities

RN	Percentages of fractions (diameter in mm)						All fractions below 0.02 mm
	1.0- 0.1	0.1- 0.05	0.05- 0.02	0.02- 0.006	0.006- 0.002	0.002	
1	16	19	16	32	13	4	49
2	21	15	27	17	15	5	37
3	33	17	19	15	10	6	31
4	6	19	11	37	24	3	64
5	11	10	22	30	26	1	57
6	10	9	20	24	33	4	61
7	4	12	15	30	35	4	69
8	11	26	19	19	20	5	44
9	26	16	15	24	11	8	43
10	56	10	5	18	7	4	29
11	36	15	5	27	15	1	43

Table 2. Granulometric composition of rhizosphere in the localities of *Bunias orientalis*. RN - record number, for the numbers of records see Table 1.

Origin of population	Population from Strażyska Street			Population from Ustup		
	Various conditions of sawing	on 3cm below surface	5cm below surface	on 3cm below surface	5cm below surface	18-S
after one year	3-S	14-S	21-S	2-S	14-S	18-S
after two years	9-S 1-F	23-S 1-F	21-S 5-F	6-S 0-F	17-S 1-F	15-S 7-F
Total	Σ=10	Σ=24	Σ=26	Σ=6	Σ=18	Σ=22

Table 3. Number of individuals developed from 100 seeds germinating at various conditions in experimental plots at the Tatra Field Station (Zakopane, 910 m); F - flowering and fruiting plants, S - sterile plants.

Process of entering meadow communities and establishing of *B. orientalis* in these types of phytocoenoses probably displays a constant pattern. So, while manuring or getting hay - especially on meadow lately mown, where seeds ripen (flowering phenology is in Fig. 5), the seeds are unintentionally dispersed on vehicles' wheels coated with clay. In the following years, the plant appears mainly on molehills, which are the only open spots in dense-grass mat. Germinating plants quickly consolidate by long top root forming magnificent rosette. In the second year, some of the plants are in flowers (Table 3) and produce plenty seeds, which in turn get into new-formed molehills. The species is, hence, distributed sparsely or in groups with few specimens dispersed randomly, and its spatial structure corresponds to the spatial pattern of molehills. The penetrating of

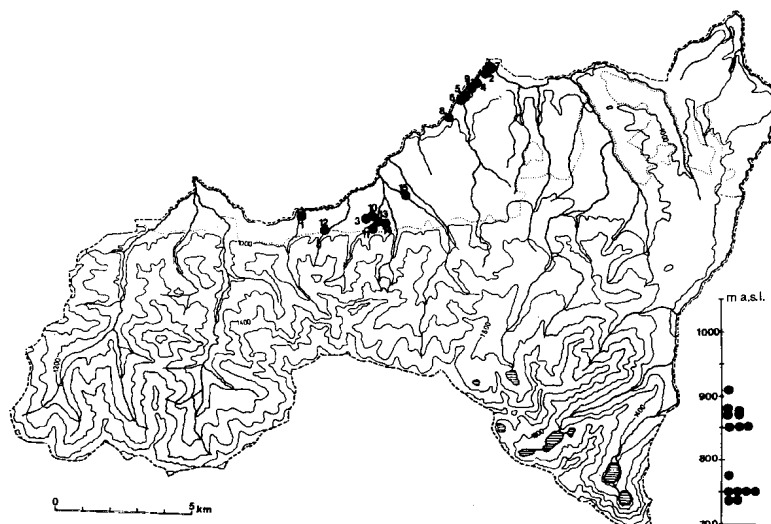


Fig. 3. Stands of phytosociological relevés. Stand numbers correspond to the releve numbers in Table 1.

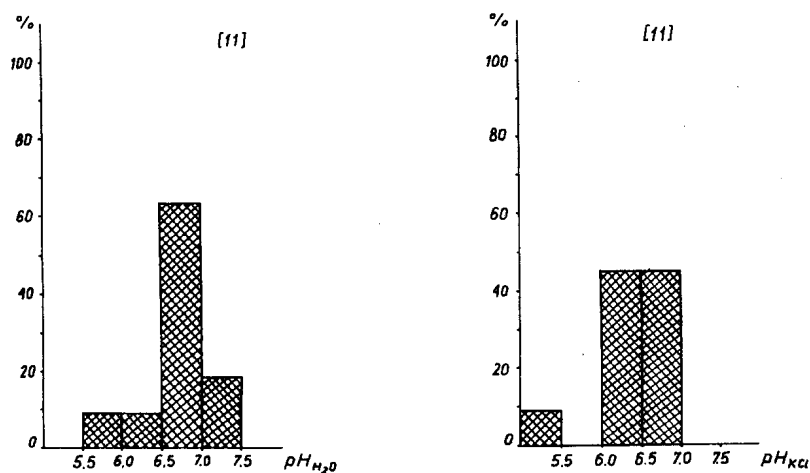


Fig. 4. Soil acidity in the investigated localities of *Bunias orientalis*. In brackets - number of samples.

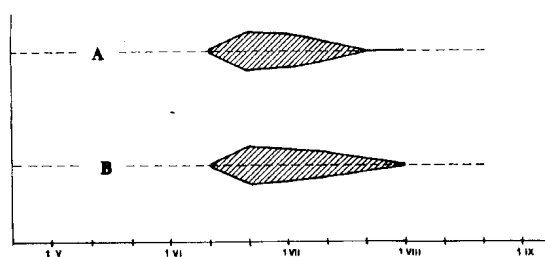


Fig. 5. Flowering phenology of *Bunias orientalis* in Zakopane during two years: A - 1982, B - 1983.

meadow communities by *B. orientalis* is also facilitated by the old management methods in the northern sub-Tatra area. For example, after a few years of cultivation as a ploughfields, the fields lie fallow, and then change for greenland or pastures. Seeds of *Bunias*, accumulated in soils, may quickly germinate and colonise these sites. Data on growth rate are partially presented in Table 3.

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