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THREAT TO ARABLE WEEDS IN POLAND IN THE LIGHT OF NATIONAL AND REGIONAL RED LISTS

ABSTRACT

The objective for the study is to present the current threats of arable weeds in Poland. The analysis was conducted on the Polish red lists of arable species (3 national and 22 regional and local) prepared in the period 1994-2008. A total of 105 weeds have been considered as weeds threatened in Poland. All regional and local red lists included a joint total of 184 taxa. The particular regions have between 13 and 95 threatened taxa. The species most frequently appearing in the listings are: *Agrostemma githago*, *Bromus secalinus* and *Camelina microcarpa*. Five taxa (*Bromus arvensis*, *Camelina alyssum*, *C. sativa*, *Cuscuta epilinum*, *Spergula arvensis* subsp. *maxima*) are considered extinct on the national scale, while in the individual regions this number ranges from 1 to 15. A relatively high share is allocated on many regional and local red lists to taxa with an indeterminate level of threat. The conducted comparison shows that there is an urgent need to compile similar listings for the remaining areas of Poland, making it possible to create an updated and real listing of threatened weeds. At the same time, it is necessary to update the existing red lists and to adopt more precise quantitative criteria for the threat estimation, in accordance with the estimation parameters introduced by the IUCN and currently in force.

Key words: arable flora, categories of threat, Poland, red list, threatened species, weeds

INTRODUCTION

The transformations in the flora expressed as population decline, disappearance of sites of occurrence and extinction of the species are among the most important consequences of human interaction with the plant cover. Arable weeds are a group of plants currently subject to some of the fastest and most profound transformations, since they die out due to very special requirements with regard to habitat conditions and mode of crop cultivation. The most vulnerable ones are specialised weeds connected with flax cultivations, most of which have already become extinct or are at the verge of extinction, such as e.g. *Camelina alyssum*, *Cuscuta epilinum*, a fast rate of decline has been recorded for thermophilous

weeds occurring on limestone soils, e.g. *Adonis aestivalis* and *A. flammea*. Some hygrophilous species, sensitive to mineral fertilisation, are also threatened, e.g. *Illecebrum verticillatum*, *Juncus capitatus*, *Lythrum hyssopifolia*.

As a result of the transformations that are in progress, weed species have been recognised in many countries among plants under direct risk and listed on red lists of species (Schneider *et al.* 1994, Warcholińska 1994, Byfield and Wilson 2005, Hulina 2005, Májeková and Zaliberová 2005, Pinke *et al.* 2008). The red lists and red books contain the basic source material for any practical activities with regard to protection of individual species as well as whole ecological groups. Still, the national listings of endangered and threatened species are generalised and they do not always reflect the actual threat to the listed species properly. Therefore, it is of increasing importance to reliably document threats to the flora and the phenomenon of its decline at the regional and local level (Piękoś-Mirkowa and Mirek 2003).

During the period of 15 years that have passed since the list of threatened arable weeds in Poland was published (Warcholińska 1994), a significant progress has been made in the recognition and evaluation of the threat to the arable flora in our country, the result of which is the publication of the numerous regional and local red lists – listings of endangered and threatened weed species (Jackowiak and Latowski 1996, Latowski and Jackowiak 2001, 2006 and literature cited therein).

The aim of the present study is to introduce the current threats and the problem of decline of weeds occurring in arable fields (that is segetal species) in Poland on the regional and local scale against the background of the threats to this group of plants on the national scale.

MATERIAL AND METHODS

The data and information about the threatened species were collated from botanical literature as well as own field studies. Twenty two regional and local red lists of arable weeds from the territory of Poland, prepared in the period 1994-2008, were subjected to analysis (Fig. 1, Table 1). Among the numerous published listings of endangered and threatened weeds, only complete “red lists” were selected for comparison, i.e. listings of threatened, rare and endangered arable weeds from all the field habitats in a given area, encompassing various cultivation types and diverse soil and agricultural conditions, with the threat categories clearly listed. Incomplete listings were not taken into account, such as those that referred only to a single type of soil or a single type of crop, as well as those where endangered species were not assigned IUCN threat categories.

The selected lists refer to territorial units of diverse character: physiographic units (e.g. Western Pomerania, Elbląg Heights, Trzebnica Ridge), nature protection units (e.g. Kampinos National Park, Spała Landscape Park, Mińsk Protec-

Table 1
Segetal weeds in the national and regional and local red lists in Poland

No.	Species	Regional and local lists																											
		National lists					Regional and local lists																				GGH		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			
1.	<i>Actinos arvensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	DD	-	-	-	-	-	-	-	-	AP		
2.	<i>Adonis aestivialis</i>	V	V	-	E	V	-	-	E	-	-	E	Ex	-	[EX]	V	-	-	Ex	CR	E	E	E	V	I	E	AR		
3.	<i>Adonis aestivialis</i> var. <i>citrina</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Ex	-	-	-	AR		
4.	<i>Adonis flammea</i>	E	E	CR	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	RE	-	Ex	-	-	-	-	AR		
5.	<i>Ae. cynapium</i> subsp. <i>agrestis</i>	I	-	-	-	-	E	V	I	-	-	-	-	-	[EX]	-	-	-	-	-	-	I	-	R	I	I	-	AR	
6.	<i>Agrostemma githago</i>	V	-	-	-	V	E	V	E	V	-	-	I	LC	V	VU	NT	-	VU	V	I	I	I	R	I	R	AR		
7.	<i>Allium oleraceum</i>	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	AP	
8.	<i>Allium vineale</i>	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	I	-	R	AP	
9.	<i>Alopecurus myosuroides</i>	I	-	-	-	-	-	-	-	-	-	E	I	-	-	-	-	-	E	-	-	-	-	-	-	-	Ex	-	AR
10.	<i>Alyssum alyssoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	DD	-	-	-	R	-	-	-	-	AP	
11.	<i>Amaranthus chlorostachys</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	KE	
12.	<i>Amaranthus retroflexus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	KE	
13.	<i>Anagallis arvensis</i>	-	-	-	-	-	E	V	-	-	-	-	-	-	NT	-	-	-	NT	-	-	-	-	-	-	-	-	AR	
14.	<i>Anag. arvensis</i> for. <i>azurea</i>	V	-	-	-	V	-	-	E	-	-	-	-	-	-	-	V	-	-	-	-	-	-	E	-	E	-	AR	
15.	<i>Anagallis foemina</i>	V	V	-	E	-	-	-	-	-	E	Ex	-	-	-	V	VU	RE	Ex	RE	-	E	E	E	R	-	-	AR	
16.	<i>Anchusa arvensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	LC	R	LR	NT	-	-	-	V	-	-	-	-	-	AR	
17.	<i>Anthemis coula</i>	-	-	-	-	-	-	-	-	-	-	-	Ex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AR	
18.	<i>Anthemis ruthenica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	AR
19.	<i>Anthemis tinctoria</i>	R	-	-	-	R	-	-	-	-	-	-	-	R	-	V	-	VU	-	-	-	-	-	-	E	V	R	-	AP

Table 1

Continued

No.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH	
20.	<i>Anthoxanthum aristatum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	KE
21.	<i>Aphanes arvensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AR
22.	<i>Aphanes inexpectata</i>	R	V	-	R	-	-	-	-	-	R	-	-	-	-	R	VU	RE	V	DD	V	-	-	-	-	-	-	AR
23.	<i>Arenaria serpyllifolia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I AP
24.	<i>Arnoseris minima</i>	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
25.	<i>Asperugo procumbens</i>	V	E	-	-	-	-	-	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
26.	<i>Avena orientalis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C
27.	<i>Avena strigosa</i>	E	-	-	-	-	-	-	-	-	-	-	E	-	DD	V	LR	VU	V	-	-	E	-	V	-	-	-	AR
28.	<i>Bromus arvensis</i>	Ex	E	-	R	-	-	E	-	-	R	E	-	-	[EX]	E	EN	-	-	-	-	-	E	E	-	Ex	-	AR
29.	<i>Bromus secalinus</i>	V	V	-	V	-	E	-	V	E	V	E	V	E	[EX]	V	VU	-	-	VU	E	I	V	I	V	-	-	AR
30.	<i>Bupleurum rotundifolium</i>	E	E	-	Ex	-	-	-	-	-	-	Ex	-	Ex	-	V	-	-	-	-	RE	-	E	-	-	-	-	AR
31.	<i>Cam. abyssum</i> subsp. <i>abyssum</i>	Ex	Ex	Ex	Ex	-	-	Ex	-	-	Ex	-	Ex	-	-	-	-	-	-	-	RE	-	-	-	-	-	-	AR
32.	<i>Camelina microcarpa</i>	V	-	-	-	V	E	V	V	-	V	-	-	R	EX/CR	V	VU	VU	-	LC	V	V	V	R	V	V	-	AR
33.	<i>Camelina sativa</i>	Ex	-	-	R	-	-	-	E	-	R	-	-	-	-	E	EN	RE	-	-	-	-	-	-	-	-	-	AR
34.	<i>Campan. rapunculoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	LR	DD	-	-	I	-	-	-	-	-	-	AP
35.	<i>Caucalis platycarpus</i>	V	E	-	I	-	-	-	-	-	Ex	-	-	-	-	V	-	-	-	RE	-	E	-	E	V	-	-	AR
36.	<i>Centauraea cyanus</i>	I	-	-	-	-	I	I	-	-	-	-	-	-	-	R	VU	-	-	-	-	-	-	I	-	-	-	AR
37.	<i>Centauraea scabiosa</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V AP
38.	<i>Centaurium pulchellum</i>	R	-	-	-	-	-	-	V	-	R	-	PE	V	-	V	-	-	-	-	-	E	-	-	-	-	-	AR

Table 1

No.	Species	Continued																									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH
58.	<i>Erophila verna</i> .	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AP
59.	<i>Euphorbia esula</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	AP
60.	<i>Euphorbia exigua</i>	V	-	-	-	V	-	Ex	-	-	E	V	[EX]	R	EN	-	-	LC	I	V	V	I	-	-	-	-	AR
61.	<i>Euphorbia platyphyllos</i>	-	-	-	-	-	-	-	-	-	Ex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[*]
62.	<i>Euphorbia peplus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AR
63.	<i>Falcaria vulgaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	I	LR	EN	-	-	R	R	-	I	-	-	-	AP
64.	<i>Filago arvensis</i>	I	-	-	-	-	-	I	-	-	-	-	EX/CR	V	VU	EN	I	-	R	-	-	-	-	-	-	-	AP
65.	<i>Filago minima</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	NT	-	-	-	-	-	-	-	-	-	-	-	AP
66.	<i>Filago vulgaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	-	-	-	-	-	-	-	AP
67.	<i>Fumaria officinalis</i>	I	-	-	-	-	V	I	-	I	-	-	I	VU	R	LR	VU	-	-	-	-	-	I	I	I	-	AR
68.	<i>Fumaria schleicheri</i>	E	R	-	R	-	-	E	-	-	R	-	-	-	E	-	-	DD	-	-	DD	-	-	E	-	E	AR
69.	<i>Fumaria vaillantii</i>	V	-	-	R	-	-	-	-	-	R	E	-	-	V	EN	VU	-	CR	-	R	R	V	R	-	-	AR
70.	<i>Gagea arvensis</i>	R	E	-	I	-	-	R	-	-	I	-	-	-	-	-	-	DD	-	-	DD	-	-	-	-	-	AR
71.	<i>Gagea pratensis</i>	I	V	-	-	-	E	-	R	I	-	-	R	NT	R	VU	NT	-	-	V	-	E	R	I	-	-	AP
72.	<i>Galeopsis angustifolia</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	-	-	-	R	-	R	-	AP
73.	<i>Galeopsis ladanum</i>	-	-	-	-	-	-	-	-	-	-	PE	-	-	R	-	-	-	-	R	-	-	I	-	-	-	[*]
74.	<i>Galeopsis speciosa</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AP
75.	<i>Galium spurium</i>	I	-	-	-	-	V	V	-	Ex	-	-	-	-	VU	EN	-	-	I	I	V	-	I	V	-	-	AR
76.	<i>Galium tricornutum</i>	V	V	-	E	-	-	-	-	-	Ex	-	-	-	V	-	-	Ex	DD	-	V	-	-	-	-	-	AR

Table 1

No.	Species	Continued																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH	
77.	<i>Geranium columbinum</i>	R	-	-	-	-	-	-	R	-	-	-	-	-	-	R	-	RE	-	-	V	V	R	-	E	-	[*]	
78.	<i>Geranium dissectum</i>	V	-	-	-	V	E	-	I	-	-	-	-	-	-	V	-	-	-	LC	V	R	-	I	I	R	AR	
79.	<i>Geranium molle</i>	R	-	-	-	-	-	-	R	-	-	-	-	-	-	R	-	-	-	-	-	-	-	R	-	Ex	-	AR
80.	<i>Geranium pusillum</i>	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
81.	<i>Gnaphalium luteo-album</i>	V	-	-	-	-	-	-	V	-	V	-	PE	-	EN	V	VU	RE	-	-	-	-	-	-	-	V	-	AP
82.	<i>Gypsophila muralis</i>	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AP
83.	<i>Herniaria glabra</i>	I	-	-	-	-	-	-	I	-	I	-	-	R	NT	I	DD	NT	-	-	-	-	-	V	-	R	-	AP
84.	<i>Herniaria hirsuta</i>	V	-	-	-	-	-	-	-	-	V	R	-	-	-	V	VU	RE	-	-	-	-	-	-	-	R	-	AR
85.	<i>Holosteum umbellatum</i>	I	-	-	-	-	E	-	I	-	-	-	-	R	NT	R	VU	VU	-	-	-	R	R	R	R	R	-	AP
86.	<i>Hypericum humifusum</i>	V	-	-	-	V	-	-	V	-	I	-	-	-	NT	R	VU	NT	-	-	E	-	-	-	R	V	AP	
87.	<i>Hypochoeris glabra</i>	-	-	-	-	-	-	-	-	-	-	-	E	-	-	-	EN	-	-	-	-	I	-	-	-	-	-	AP
88.	<i>Hypochoeris maculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AP
89.	<i>Mecebrum verticillatum</i>	V	V	-	-	-	-	-	-	-	V	-	-	-	[EX]	V	-	RE	-	-	E	-	-	-	V	-	AP	
90.	<i>Isolepis setacea</i>	-	-	-	-	-	-	-	-	-	I	-	-	-	-	R	-	-	-	-	-	R	V	-	-	-	-	AP
91.	<i>Juncus capitatus</i>	R	-	-	-	-	-	-	V	-	R	-	Ex	-	EN	R	VU	EN	-	-	R	R	-	-	R	-	AP	
92.	<i>Juncus tenageia</i>	-	-	-	-	-	-	-	-	-	-	-	Ex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
93.	<i>Kickxia elatine</i>	V	E	-	R	-	-	-	R	-	-	R	E	V	-	V	-	-	V	LC	V	-	-	R	Ex	-	AR	
94.	<i>Kickxia spuria</i>	-	E	CR	R	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	CR	-	-	-	-	-	-	AR
95.	<i>Lamium amplexicaule</i>	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	V	AR

Table 1

Continued

No.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH	
96.	<i>Lamium incisum</i>	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AR
97.	<i>Lappula squarrosa</i>	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
98.	<i>Lathyrus pratensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I AP
99.	<i>Lathyrus tuberosus</i>	I	-	-	-	-	E	-	R	-	-	-	R	-	R	-	V	VU	-	-	-	I	V	V	I	I	I	AR
100.	<i>Lilium bulbiferum</i>	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
101.	<i>Linaria arvensis</i>	F	-	-	R	-	-	-	F	-	-	R	Ex	-	-	-	Ex	-	F	-	-	-	-	-	-	-	-	AR
102.	<i>Lithospermum arvense</i>	-	-	-	-	-	I	V	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AR
103.	<i>Lolium peregrine</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	-	AP
104.	<i>Lolium remotum</i>	E	E	-	E	-	-	-	Ex	Ex	-	Ex	-	Ex	[EX]	E	CR	-	-	RE	-	-	E	-	E	-	V	AR
105.	<i>Lolium temulentum</i>	E	V	-	R	-	-	-	E	-	-	R	-	V	-	E	-	RE	-	-	-	-	V	E	-	V	AR	
106.	<i>Lysinachia nummularia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I AP
107.	<i>Lythrum hyssopifolia</i>	V	V	LR	-	-	-	-	-	-	-	-	-	V	-	E	-	-	-	-	-	-	-	-	-	-	-	AP
108.	<i>Mulva pusilla</i>	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	DD	-	-	-	-	-	-	R	I	-	AR
109.	<i>Medicago falcata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	DD	-	-	-	-	I	-	-	-	-	AP
110.	<i>Melampyrum arvense</i>	V	-	-	-	V	-	-	V	-	-	-	-	-	-	-	V	-	-	-	-	V	R	V	V	I	R	AP
111.	<i>Melampyrum cristatum</i>	-	-	-	-	-	-	-	-	-	-	-	Ex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
112.	<i>Melandrium noctiflorum</i>	I	-	-	-	-	I	-	-	-	I	-	-	I	EX/CR	R	VU	-	-	-	-	R	V	V	I	R	-	AR
113.	<i>Misopates orontium</i>	E	-	-	R	E	-	-	-	-	R	E	-	R	E	-	[EX]	E	EN	-	-	VU	E	-	E	-	Ex	AR
114.	<i>Montia fontana</i>	-	V	VU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	AP

Table 1

No.	Species	Continued																											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH		
134.	<i>Plantago arenaria</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP	
135.	<i>Plantago inetermedia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	AP	
136.	<i>Polycnemum arvense</i>	V	V	-	I	-	-	E	-	V	R	E	V	[EX]	V	EN	RE	-	-	I	-	-	-	-	-	V	-	[*]	
137.	<i>Polyg. lapathifolium</i>	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	AP	
138.	<i>Portulaca oleracea</i>	R	-	-	-	-	-	R	-	-	-	-	I	[EX]	-	-	-	-	-	-	-	-	-	-	-	V	-	AR/KE	
139.	<i>Potentilla argentea</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	AP
140.	<i>Radiola linoides</i>	V	V	-	-	-	-	V	Ex	V	-	Ex	-	CR	R	VU	CR	-	-	-	E	-	-	-	-	V	-	AP	
141.	<i>Ranunculus arvensis</i>	V	V	-	R	V	-	E	-	-	R	E	V	-	V	EN	-	E	VU	V	V	-	E	V	V	-	-	AR	
142.	<i>Ranunculus bulbosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	-	AP	
143.	<i>Ranunculus sardous</i>	I	-	-	-	-	-	I	-	I	-	PE	R	EX/CR	V	VU	-	-	-	I	-	-	-	-	-	-	-	AP	
144.	<i>Rhinanthus alectorolophus</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	V	R	-	V	V	-	AP	
145.	<i>Rhinanthus serotinus</i>	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	R	V	-	-	-	-	-	AP	
146.	<i>Sagina ciliata</i>	-	-	VU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	V	-	-	-	-	-	AP	
147.	<i>Sagina procumbens</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	AP	
148.	<i>Salvia verticillata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	AP	
149.	<i>Saxifraga tridactylites</i>	R	-	-	-	-	-	E	-	-	-	-	-	EX/CR	R	RN	RE	-	-	R	-	-	-	-	-	Ex	-	AP	
150.	<i>Scandix pecten-veneris</i>	V	E	CR	Ex	-	-	-	-	-	Ex	-	Ex	-	V	-	-	-	RE	-	E	-	-	-	-	V	-	AR	
151.	<i>Sedum maximum</i>	I	-	-	-	-	-	-	-	-	-	-	-	I	-	I	DD	-	-	-	-	-	-	-	R	V	I	I	AP
152.	<i>Senecio vernalis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	KE	

Table I

Continued

No.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH
153.	<i>Setaria verticillata</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	-	-	-	-	I	E	-	AR
154.	<i>Setaria pumila</i>	-	-	-	-	-	-	-	-	-	-	-	PE	-	-	-	-	-	-	-	-	-	-	-	-	-	AR
155.	<i>Sherardia arvensis</i>	V	-	-	R	V	-	-	Ex	-	R	Ex	-	-	-	V	-	RE	-	LC	V	V	V	V	I	-	AR
156.	<i>Silene dichotoma</i>	R	-	-	-	-	-	-	R	-	-	-	-	-	-	V	-	-	-	-	-	-	-	-	-	R	KE
157.	<i>Silene gallica</i>	V	V	-	-	-	-	-	-	-	-	-	-	-	-	V	VU	-	-	CR	Ex	-	E	-	R	-	AR
158.	<i>Silene vulgaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	AP
159.	<i>Sinapis arvensis</i>	I	-	-	-	-	I	-	R	-	-	-	-	-	-	I	VU	-	-	-	-	-	-	I	-	-	AR
160.	<i>Sonchus asper</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V AR
161.	<i>Sp. arvensis</i> subsp. <i>maxima</i>	E	Ex	-	-	Ex	-	Ex	Ex	-	-	-	-	-	-	E	EN	-	-	-	-	-	-	-	-	E	AR
162.	<i>Spergula morisonii</i>	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	AP
163.	<i>Spergularia rubra</i>	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP
164.	<i>Stachys annua</i>	V	-	-	-	-	-	-	V	-	-	E	-	-	-	R	EN	CR	-	CR	-	E	V	V	I	-	AR
165.	<i>Stachys arvensis</i>	-	V	-	E	-	-	-	-	-	-	Ex	-	-	-	-	-	-	-	CR	-	-	-	-	-	-	AR
166.	<i>Teesdalea nudicaulis</i>	-	-	-	-	-	-	-	R	-	-	-	PE	-	-	-	-	-	-	-	R	V	-	I	-	-	AP
167.	<i>Thal. minus</i> subsp. <i>minus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	-	AP
168.	<i>Thlaspi perfoliatum</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	EN	-	-	-	R	R	-	AP
169.	<i>Thymelaea passerina</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	E	AR
170.	<i>Vaccaria hispanica</i>	R	E	-	-	-	-	-	E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	E	AR
171.	<i>Valerianaella dentata</i>	I	-	-	-	-	E	-	R	-	-	PE	R	-	-	R	VU	EN	-	-	-	I	V	V	R	I	AR

Table 1

Continued

No.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	GGH		
172.	<i>Valerianella locusta</i>	R	V	-	-	R	-	-	R	-	-	-	Ex	-	-	V	-	-	-	-	R	V	-	-	R	-	AR		
173.	<i>Valerianella mixta</i>	V	-	-	-	-	-	-	-	-	-	-	-	-	-	V	-	-	-	-	-	V	-	-	E	-	[*]		
174.	<i>Valerianella rimosa</i>	V	-	-	R	-	-	-	E	-	-	R	Ex	-	-	V	EN	-	-	LC	V	E	E	V	AR	-	AR		
175.	<i>Veronica agrestis</i>	.	-	-	-	-	-	-	-	-	LR	-	-	-	-	-	-	VU	-	-	-	R	V	-	I	-	-	AR	
176.	<i>Veronica dillenii</i>	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	AP	
177.	<i>Veronica opaca</i>	V	-	-	-	-	E	E	-	V	-	-	PE	-	[EX]	V	VU	-	-	-	-	V	V	E	-	V	-	AR	
178.	<i>Veronica polita</i>	V	-	-	-	-	E	V	I	-	I	-	-	R	-	R	LR	RE	-	-	V	-	V	I	-	-	-	AR	
179.	<i>Veronica praecox</i>	V	E	CR	-	-	-	-	-	-	-	-	-	PE	-	-	-	-	-	-	-	-	-	-	-	-	-	AP	
180.	<i>Veronica triphyllos</i>	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-	AR	
181.	<i>Vicia grandiflora</i>	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	R	-	R	-	-	KE	
182.	<i>Vicia sativa</i>	.	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AR	
183.	<i>Vicia tenuifolia</i>	.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-	I	AP
184.	<i>Viola tricolor</i>	.	-	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AP	
Total number of species		101	37	10	27	15	27	16	70	20	25	28	41	40	38	95	59	45	13	32	86	58	48	48	95	32			

Explan.: 1 – Polish red list of segetal weeds (Warcholińska 1994), 2 – Polish red list of vascular plants (Zarzycki and Szeleg 2006), 3 – The Polish Red Data Book of Plants (Kazmierczakowa and Zarzycki 2001), region & loc. "red lists" of segetal weeds, 4 – West Pomerania (Ratyńska and Boratynski 2000), 5 – Szczecin Lowland (Kutyna and Leśnik 1998), 6 – Elbląg Heights (Szmaja 1998), 7 – Charzykowy Plain (Szmaja 1998), 8 – N-E Poland (Komiak 1998), 9 – Białowięza Clearing (Pajbianek 1996), 10 – Minsk Area of the Protec. Landsc. (Skrajna, Skrzyżczyńska and Rzymowska 2006), 11 – Wielkopolska reg. (Ratyńska and Boratynski 2000), 12 – Gniezno Lake Distr. (Chmiel 1998), 13 – Konin Industrial Distr. (Pawlak 1998), 14 – Kampinos Nat. Park (Bomanowska 2008), 15 – Central Poland (Warcholińska 2002), 16 – Łódź Heights (Warcholińska 2006), 17 – Spala Landsc. Park (Pułaska and Bomanowska 2009), 18 – S-W Poland (Kuzniewski 1998), 19 – Lower Silesia (Amiol-Kwiatkowska 2003), 20 – Trzebnica Ridge (Amiol-Kwiatkowska 1998), 21 – Częstochowa Upland (Wnuk 1998), 22 – Silesian Upland (Nowak and Węgrzynek 1998), 23 – buffer zone of Roztocze National Park (Trajba and Ziemińska 1998), 24 – Lublin reg. (Fijałkowski and Nycz 1998), 25 – form. Rzeszów voivod. (Wnuk 1998), GGH – geograph.-histor. group: AP – apophyte, AR – archaeophyte, KE – kenophyte, ERG – ergasiophyte, C – cultivated species, [*] – taxon of uncertain status in Polish flora, likely to be an anthropophyte. Categories of threat: EX – extinct species, RE – regionally extinct, [EX] – locally extinct, EX/CR – probably locally extinct, CR – critically endangered, E, EN – endangered, V, VU – vulnerable, R – rare, LR – least concern, NT – near threatened, I – indeterminate threat, DD – data defic., PE – potent. endang.

ted Landscape Area), administrative units (e.g. Białowieża Clearing), which differ in the surface area, agroecological conditions, agricultural peculiarities and the level of transformation of weed flora. In order to fully document the phenomenon of threat to weeds flora, local listings were analysed in parallel to the regional list for a given area wherever possible.

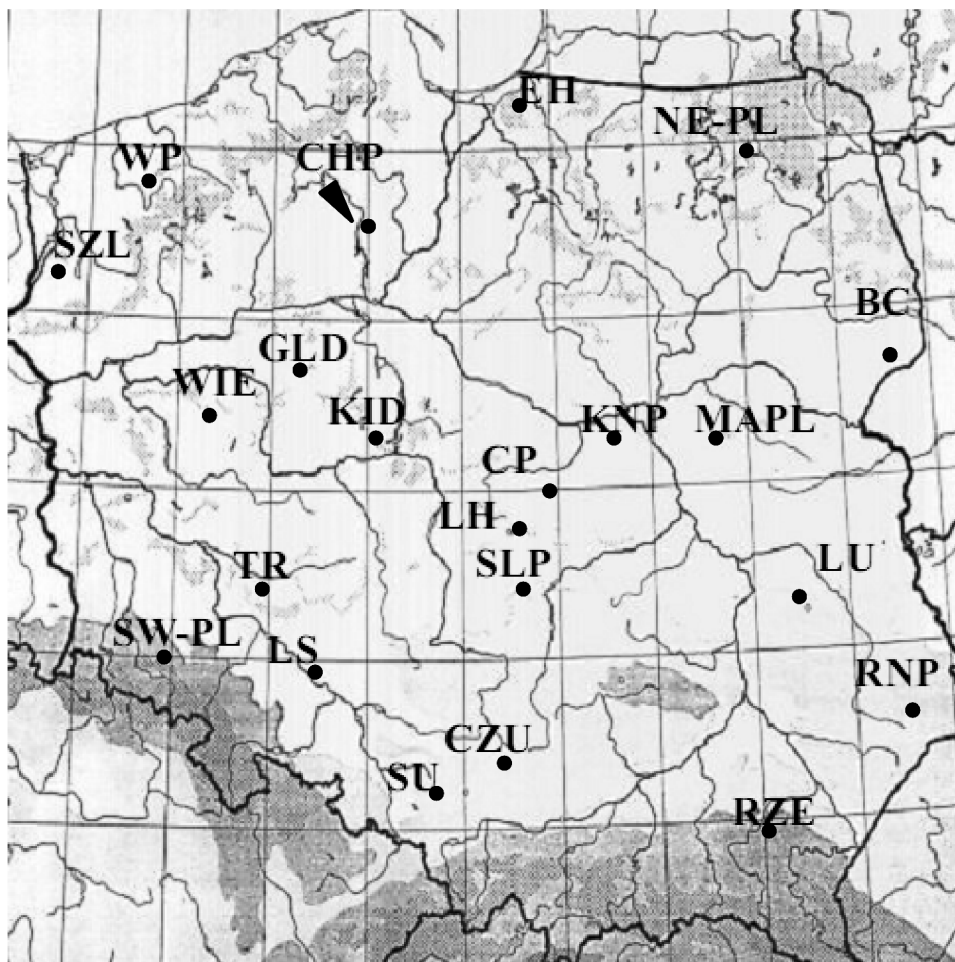


Fig. 1. Location of territorial units taken under study: WP – Western Pomerania, SZL – Szczecin Lowland, EH – Elbląg Heights, CHP – Charzykowy Plain, NE-PL – North-Eastern Poland, BC – Białowieża Clearing, MAPL – Mińsk Area of the Protected Landscape, WIE – Wielkopolska region, GLD – Gniezno Lake District, KID – Konin Industrial District, KNP – Kampinos National Park, CP – Central Poland, LH – Łódź Heights, SLP – Spała Landscape Park, SW-PL – South-Western Poland, LS – Lower Silesia, TR – Trzebnica Ridge, CZU – Częstochowa Upland, SU – Silesian Upland, RNP – buffer zone of Roztocze National Park, LU – Lublin region, RZE – former Rzeszów voivodeship

The results of analysis were compared with those national listings of threatened species which include weeds. The main point of reference was the list of endangered and threatened field weeds in Poland (Warcholińska 1994), supplemented with information on threatened segetal plants derived from the

red list of vascular plants in Poland (Zarzycki and Szeląg 2006) and the Polish Red Data Book of Plants (Kaźmierczakowa and Zarzycki 2001).

Comparative analysis of the regional and local red lists was made difficult by the application of various types of IUCN threat categories as well as the arbitrary selection of rules and criteria for the threat evaluation. In the majority of lists (18) the authors applied the older IUCN threat categories which had been in force until 1994 (Anonymous 1980), although they were not precise and often strongly dependent on the subjective regard of the authors of the estimation on threat to individual species. The new, less ambiguous guidelines introduced in 1994 (Anonymous 1994) were adopted in the red list of weeds of Łódź Heights (Warcholińska 2006). The modified categories with their parameters adjusted to the regional studies (Anonymous 2001, 2003, Gärdenfors *et al.* 2001) were applied only in three red lists: for Lower Silesia (Anioł-Kwiatkowska 2003), Kampinos National Park (Bomanowska 2008) and Spała Landscape Park (Pułaska and Bomanowska 2009). An often emerging problem with the comparison of regional and local listings was also the divergent scope of inclusion in analysed lists of critical taxa, subspecies and varieties. This is reflected, often relatively strongly, in the numerical coefficient values obtained in the process of comparing various lists.

The nomenclature of species was adopted from Mirek *et al.* (2002). The status of individual species in the geographical-historical division of the flora according to Kornaś (1977) was determined using the works of Zając (1979), Mirek *et al.* (2002) and Tokarska-Guzik (2005). The threat categories for species were quoted after the authors of analysed studies.

RESULTS AND DISCUSSION

The national red list of field weeds (Warcholińska 1994) includes 101 species of vascular plants. However, if we take into account the remaining two national listings of endangered and threatened species, this number increases to 105. The red list of vascular plants in Poland (Zarzycki and Szeląg 2006) includes 37 weed species, including three species (*Kickxia spuria*, *Montia fontana* and *Stachys arvensis*) that were not considered in the national list of threatened weeds. The Polish Red Data Book of Plants includes only ten segetal species (Kaźmierczakowa and Zarzycki 2001), but this number includes also the above-mentioned *Kickxia spuria* and *Montia fontana* (Table 1).

The high number of weeds on the national list of threatened segetal species in Poland is rather exceptional. For example, in Slovakia the red list of weeds contains 41 species (Májeková and Zaliberová 2005), in Hungary – 41 species (Pinke *et al.* 2008), in Great Britain – 61 species (Byfield and Wilson 2005), in Croatia – 78 species (Hulina 2005). A similar, high number of threatened weeds can be observed in Germany, where the list of nationally rare or threatened ar-

able weeds species included 143 taxa (Schneider *et al.* 1994).

The regional and local red lists of arable weeds in Poland include a total number of 184 taxa, including all those from the national list (Table 1, Fig. 2). This number is nearly twice as high as the one quoted for Poland at large, which may lead to the conclusion that a large number of regionally threatened weed species are not threatened on the national scale. Typical examples are e.g. *Euphorbia platyphyllos*, *Juncus tenageia* and *Melampyrum cristatum* which are extinct species in Gniezno Lake District (Chmiel 1998), while they have not found their place in the national red list. The number of threatened taxa in the individual regions is very diverse and ranges from 13 (South-Western Poland) to 95 (Lublin region and Central Poland) taxa (Table 1, Fig. 1).

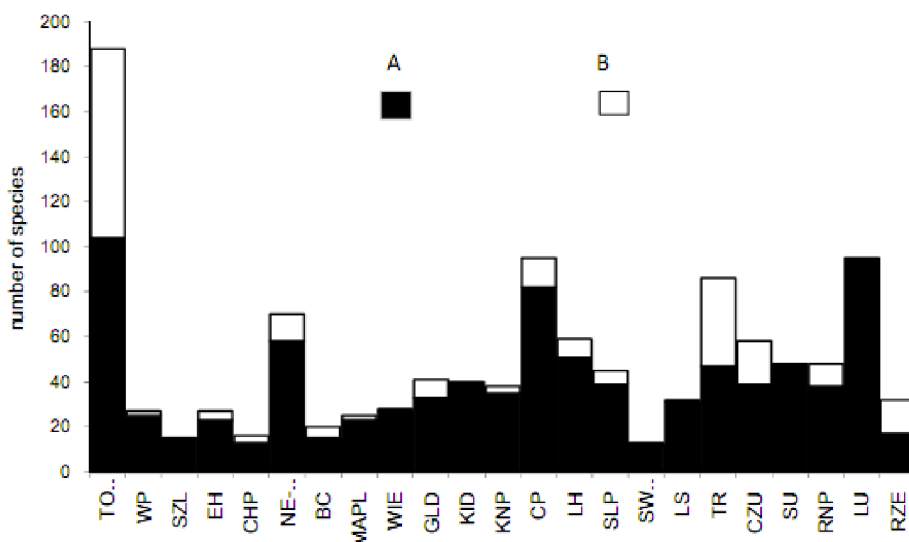


Fig. 2. Numbers of species included in the regional and local "red lists" of segetal plants: A - species from the national red lists, B - species included only in the regional or local "red lists"; other abbreviations as on Fig. 1.

All the compared regional lists were dominated by the species that are also threatened on the national scale, while the share of species which are threatened only regionally or locally was in most cases small and ranged from 1 (Western Pomerania) to 19 species (Częstochowa Upland). An exception was the red list of weeds of Trzebnica Ridge which includes 39 species that are only threatened regionally (Anioł-Kwiatkowska 1998). In four cases (Szczecin Lowland, Konin Industrial District, Silesian Upland and Lublin region), on the other hand, no species subjected exclusively to regional threat was included (Fig. 2).

The taxa appearing most often in regional and local listings include: *Agrostemma githago* (on 18 lists), *Bromus secalinus* and *Camelina microcarpa* (on 17 lists) as well as *Papaver dubium* (on 16 lists). The frequent species (29) which are included in the majority of lists (11 or more regional listing) consti-

tute 15.8% of all taxa. However, there is a clear predominance in analysed lists of taxa included only in a single list (57 species; 31%) or in two-three lists (32; 17.4%). This group encompasses species that are locally rare (*Juncus tenageia*, *Melampyrum cristatum*, *Sagina cilliata*), those that reach their geographical range limit (*Aphanes arvensis*, *Arnoseris minima*, *Filago minima*), as well as those that have scattered localities in Poland (*Galeopsis speciosa*, *Ornithopus perpusillus*, *Veronica agrestis*). Sometimes, species which are frequent or even common in Poland were considered locally and regionally threatened, such as e.g.: *Centaurea scabiosa*, *Erophila verna*, *Lathyrus pratensis*, *Lolium perenne*.

The analysed red lists include both species of native and alien origin. Among the nationally threatened species, archaeophytes (63 taxa) predominate over native species (34). On the other hand, in the regional and local lists the share of both these groups is similar and they include respectively 84 apophytes and 81 archaeophytes. Furthermore, some listings include a total of 9 kenophytes and 8 species with uncertain status in the Polish flora (Table 1). It is rather alarming that the authors of some red lists chose to include kenophytes which are generally thought to be invasive in Poland (Tokarska-Guzik 2005): *Amaranthus retroflexus* (Częstochowa Upland), *Anthoxanthum aristatum* (Trzebnica Ridge) and *Vicia grandiflora* (South-Western Poland, Częstochowa Upland, buffer zone of Roztocze National Park).

Among the species included in the analysed red lists, typical arable field weeds predominate, especially those linked to traditional types of cultivation, with the most strongly threatened usually being flax field weeds, e.g. *Camelina alyssum*, *Cuscuta epilinum*, *Lolium remotum*, and obligate speirochores, e.g. *Agrostemma githago*, *Bromus secalinus*, *Neslia paniculata*. A numerous group is formed by limestone soil species from the *Caucalidion lappulae* alliance, i.a. *Adonis flammea*, *Scandix pecten-veneris*, *Sherardia arvensis*. Many lists, including the national one, include a numerically strong representation of the native species from oligotrophic wet habitats from the *Nanocyperion flavescens* alliance, i.a. *Lythrum hyssopifolia*, *Myosurus minimus*, *Peplis portula*. Taxa which have their phytosociological optimum in other types of communities appeared rarely, e.g. grassland species (*Allium oleraceum*, *A. vineale*, *Centaurea scabiosa*) or meadow species (*Lysimacha nummularia*, *Lathyrus pratensis*, *Pastinaca sativa*).

A good indicator of the degree of transformation of the arable weed vegetation is the number of extinct taxa (EX, Ex, RE) and those belonging to higher threat categories (CR, E, EN, V, VU). On the national scale, 5 species are considered to be extinct (*Bromus arvensis*, *Camelina alyssum*, *C. sativa*, *Cuscuta epilinum*, *Spergula arvensis* subsp. *maxima*), while in individual regional listings there were between 1 (Elbląg Heights) and 15 (Spała Landscape Park) extinct taxa (Table 1, Fig. 3). As many as 8 regional lists do not include any species in this group at all. Analogously, the share of weeds threatened with

high risk of extinction in the national list is 46 species, while in the local and regional red lists it is very diversified and ranges from 4 (Wielkopolska region) to 55 (Central Poland; Fig. 3). The most threatened weed species in Poland are: *Adonis aestivalis*, *A. flammea*, *Anagallis foemina*, *Bupleurum rotundifolium*, *Lolium remotum*, *Misopates orontium*, *Scandix pecten-veneris*, *Sherardia arvensis*, *Valerianella rimosa* (Table 1). The risk of extinction of these plants is more than likely because they have a few localities and are often represented by small populations. The comparison of the proportion of the extinct and strongly threatened species in various listings showed conspicuous incongruities in threat categories assigned in the case of several species. This refers mainly to the species which were broadly distributed in the fields until recently (*Agrostemma githago*, *Centaurea cyanus*, *Papaver rhoeas*, *Sinapis arvensis*), as well as those with a diversified pattern of distribution within the territory of Poland (*Chenopodium polyspermum*, *Gagea pratensis*).

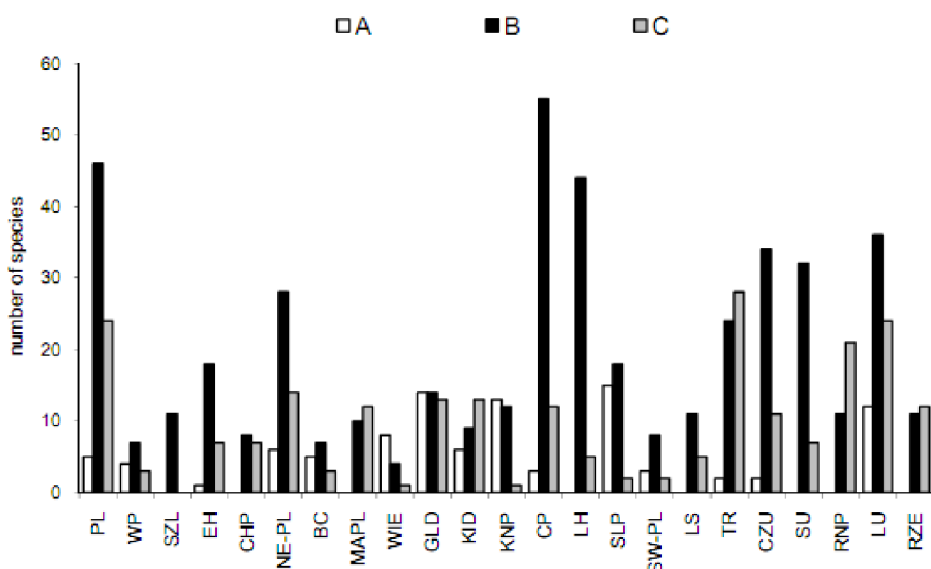


Fig. 3. Numbers of extinct taxa (A), taxa with high level of threat (B) and taxa with indeterminate level of threat (C) in the Polish national and regional red lists of segetal plants. Explanations: PL – Poland, other abbreviations as on Fig. 1

The majority of red lists include a relatively high share of taxa with undetermined threat level (I, DD). The national list records 24 species within this category, which constitutes as many as 23.1% of all taxa on the list. In the regions, the highest number of species with unknown threat level were included in the red lists of weeds of Trzebnica Ridge (28 taxa), Lublin Province (24), buffer zone of Roztocze National Park (21), while the lowest numbers occur in the red lists of weeds from Kampinos National Park (1) and Wielkopolska region (1; Fig. 3). A high share of species belonging to the deficient data category testifies

to inadequate knowledge on the distribution, resources and dynamic tendencies of populations of many species.

CONCLUSIONS

The conducted comparative analysis of the national, regional and local red lists leads to the conclusion that although the current knowledge on threatened and endangered arable weeds in Poland is large, the level of detail varies geographically. There is an urgent need to compile similar listings for the remaining areas of Poland (i.e. Gdańsk Pomerania, Kujawy region, Masovia, Świętokrzyskie region, Małopolska region), making it possible to create an updated and real listing of threatened weeds in whole area of Poland as well as to determine the sources of threat and to provide some suggestions for practical means of their protection.

The conducted comparison shows that updates and supplements are strongly needed, both to the existing national list of weeds and to regional and local red lists. Older listings of threatened weeds should be updated due to dynamic changes occurring in the field communities which may have resulted in change of status for some species included in the lists.

When updating the national red list of weeds, available regional and local listings should be taken into account in order to establish the actual threat to every species. It will make it possible to assign precise threat categories for species which were previously listed under the I (indetermined) category. It is necessary to supplement the national list with taxa that are threatened just in one region of Poland, as well as with species which are currently more frequent, but they are threatened in many regions, which hitherto eluded identification as threatened on the national scale, e.g. *Anchusa arvensis*, *Papaver argemone*, *Stachys arvensis*, *Veronica agrestis*. It will be worthwhile to take into account data from other national listings and to include in the red list of Polish weeds those three species from the red list of vascular plants and from the Polish Red Data Book of Plants that hitherto were excluded from that list.

Both, when updating existing lists and when preparing new listings of threatened species, some limitations have to be taken into account. These lists should not include species which have their habitat optimum in entirely different communities and occur in arable fields casually and accidentally. Non-native invasive species should be absolutely excluded from red lists.

It is necessary to adopt more precise quantitative criteria of threat evaluation according to the IUCN estimation parameters currently in force. The assumption of new, regional criteria in the threat evaluation will make it possible to determine the rate and level of population decline for species even in small territorial units, as well as will enable the comparison and collation of threat estimates for species from various regions. This will facilitate the appearance of synthetic

studies with a broader scope.

Documentation of the actual threats to segetal flora of Poland, materialised as regional and local red lists as well as national list, will provide possibilities of efficient protection of valuable elements of the field flora. Their extinction would lead to a decline in biological diversity not only in agrocoenoses, but generally in the entire Polish flora.

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