

List of Threatened Weeds in the Continental Part of Croatia and their Possible Conservation

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SUMMARY

List of threatened weed species in terms of IUCN categories of endangerment is presented. This list provides a general insight into problems involved in endangerment of weed flora in the continental part of Croatia. It contains a total of 78 species as follows: 6 of them are extinct, 42 endangered, 12 vulnerable and 18 are rare. Extinct and the majority of threatened weeds are companions of flax crop and cereals. The intensified soil cultivation, an abundant fertilization, seed cleaning and chemical weed control (herbicides) are universally recognized as causes for a decline on floristic diversity in weed communities. The possibilities of preventing further endangerment of weed species and effective manners of conservation are: to promote organic farming and in conventional production to use less fertilization and the field edges not treated with herbicides. The measures of nature conservation include botanical and weed gardens. Botanical gardens with their systematic fields, can make a significant contribution to the weed conservation on the range of species. In weed gardens weeds grow with belonging crops and on condition of traditional agrotechniques. Further chance is an inclusion of attractive and suitable weed species in the concept of esthetic-paysage planning (e.g. in flower garden beds, making green of rockeries, road verges and etc). Nature, by itself, protects segetal weeds, which, owing to the seed bank and dormancy, are ready to survive in the soil waiting favourable time and space.

KEY WORDS

list of threatened weeds, extinct weeds, endangered weeds, vulnerable weeds, rare weeds, segetal weeds, continental part of Croatia, effective manners of conservation for weeds

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INTRODUCTION

Weeds are generally undesirable plants on arable fields. The weed flora is largely the result of man's agricultural activity. Through centuries the man has been destroying weeds by different manners and weeds have acquired the great vitality and ability to survive. In the late 19th and during the 20th century significant changes have happened in agricultural production and weeds became very threatened and some of them in certain parts of Europe became extinct.

Especially after 1950, in conditions of intensive agriculture, the segetal weeds have high quotes of endangered species (Aymonin 1976, Hilbig 1982, Wraber and Skoberne 1989, Albrecht 1995, Hulina 1998 a, Sicinski 2002). The reasons are various (Landolt 1974, Mittnacht et al. 1979, Diercks 1984, Hilbig 1985, Meisel 1985, Hüppe 1987, Sicinski 1994 and others), but herbicides are universally recognized as the primary cause for it.

So for instance, the quantitative analyses of changes in the arable weed flora of Germany during the last five decades indicate the reduction of the average number of weed species of 10 to 70% (Albrecht 1995). Eggers (1994) reported that 118 species, total more than one third of the 250 to 300 weed species potentially growing on arable land, gardens and vineyards in Germany are listed in the Red Data Books of Endangered Plant Species.

In the Report on threatened and rare vascular plants of Switzerland (Red Data Book, Landolt et al. 1982) in total of 201 weed species, 17 of them are listed as extinct, 71 as endangered, 113 are vulnerable.

Zajac M. et Zajac A. (2001) propose "List of old synanthropic species (archeophytes) endangered in Poland" in total 52 segetal weed species as follows: 4 extinct, 6 critically endangered, 13 endangered, 24 vulnerable and 5 data deficient. According to Sicinski (2002) in central part of Poland 8 segetal weed species are extremely threatened.

From the total of 258 weed species 30 species are legally protected and 51 species are listed in the Red Data Book of Hungary (Pinke 1995).

The Red Data Book of Slovenia (Wraber and Skoberne 1989) contains 6 extinct weed species.

The segetal weed flora in the continental part of Croatia consists of about 250 plant taxa (Hulina 1978, 1989, 1991, 1993, 1998 b, 2002 a, 2002 b, Rauš et al. 1985, Topić 1998, Vrbek 2000). In the Red Data Book of Croatia (1994) only one weed species (*Physalis alkekengi*) is listed as a vulnerable plant (Hulina 1994). A total of 14 weed species are listed in The Threatened Croatian flora and the Red Book (Nikolić and Topić 2005). They are *Cuscuta epilinum* /as regionally extinct/, further *Consolida*

ajacis, *Corynophorus canescens*, *Myosurus minimus*, *Papaver argemone*, *P. hybridum*, *Vaccaria hispanica* /as critically endangered/, and *Adonis aestivalis*, *A. annua* and *Hibiscus trionum* /as endangered taxa/. Weed species *Adonis flammea*, *Aphanes microcarpa*, *Montia fontana* and *Polycnemum arvense* are among taxa with too little data on their abundance and/or distribution to be possible to make extinction risk assessment.

However, the weed flora in the continental part of Croatia is really very threatened. With the extinction of flax culture in Croatia, the weeds of flax fields are totally disappeared. Also, due to the intensified soil cultivation, seed cleaning and chemical weed control a considerable decline in floristic diversity is noted in cereal crops and weed communities on acid and basic soils.

These facts suggest an increased need to preserve weed species as a part of plant diversity, existing wild biological and genetic resources and the natural beauty of the area. The passive waiting for natural miracle to conserve endangered weeds is the loss of time.

The aim of this paper is to analyse the current state of the segetal flora and to propose a list of threatened weed species in the continental part of Croatia. These data may be considered as an impulse for better understanding the problem of threatened weeds and manners its resolution in Croatia.

AREA OF INVESTIGATION

The investigated area is the continental part of Croatia between rivers Sava and Drava (Figure 1). This area belongs to the Pannonian Plain which is characterized by alluvial and diluvial valleys with different zonal and azonal soil types. The climate is a moderate continental (type) with moderately cold winters, warm summers and favourable annual distribution of precipitation. Due to orographic and soil properties and meteorological condition, this area is particularly favourable for crop production, both row crops as well as cereals.

Two sectors, public (enterprise) and private (family farms), can be clearly distinguished in the current Croatian agriculture. In the public sector agriculture with intensive use of fertilizers, pesticides and sophisticated machinery prevails. The private sector accounts for 78% of cultivated land (Karoglan et al. 1994). It is characterized by small sized family farms with conventional or extensive crop production.

METHODS

Two sources of floristical and phytosociological data on weed flora have been used:

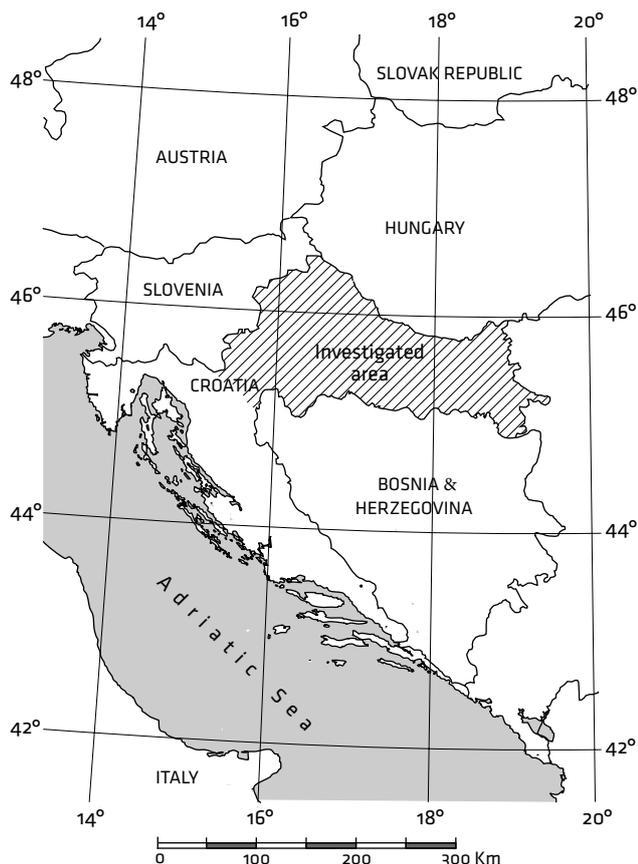


Figure 1. The investigated area: Continental part of Croatia

(1) data from the literature (Schlosser and Vukotinović 1869, Kovačević 1958, 1961, Ilijanić 1977, Rauš et al. 1985, Hršak 1997, Šoštarić and Marković 1998, Tomašević 1998, Topić 1998, Regula-Bevilacqua and Šegulja 2000, Vrbek 2000) and

(2) one's own (Hulina 1989, 1991, 1993, 1998 b, 2002a, 2002 b).

The degree of threat to weed species was determined by means of categories of IUCN (Walter and Gillet 1998) as follows:

1. Ex = extinct species, which are no longer known to exist in an area after repeated searches of type habitats in the continental part of Croatia;
2. E = endangered species. This category includes species which are under direct threat and the number of their populations have been critically reduced. They can become extinct in an area if the causal factors continue operating.
3. V = vulnerable species. They are likely to enter the E category in the near future if the causative factors continue their effect;
4. R = rare species. The species with small populations and usually localised within a limited geographic area or stands.

The nomenclature of weed species follows Ehrendorfer (1973).

RESULTS

Results are summarized, as follows:

1. Extinct species (6): *Asperula arvensis* L., *Camelina linicola* C. Schimper et Spenn., *Cuscuta epilinum* Weihe, *Chrysanthemum segetum* L., *Linaria arvensis* /L./ Desf. and *Polycnemum arvense* L. ;
2. Endangered species (42): *Adonis aestivalis* L., *Agrostemma githago* L., *Ajuga chamaepitys* /L./ Schreb., *Allium vineale* L., *Anchusa arvensis* /L./ MB., *A. officinalis* L., *Aphanes arvensis* L., *Buglossoides arvensis* /L./ I.M. Johnst., *Calepina irregularis* /Asso/ Thell., *Caucalis platycarpus* L., *Clinopodium vulgare* L., *Conringia orientalis* /L./ Dum., *Coronopus squamatus* /Forsk./ Asch., *Cynoglossum officinale* L., *Euphorbia falcata* L., *E. segetalis* L., *Falcaria vulgaris* Bernh., *Fumaria officinalis* L., *F. vaillantii* Loisel., *Hibiscus trionum* L., *Hyoscyamus niger* L., *Hypericum humifusum* L., *Lathyrus nissolia* L., *Legousia speculum-veneris* /L./ Chaix, *Lolium temulentum* L., *Lycchnis viscaria* L., *Lytrum hyssopifolia* L., *Melampyrum arvense* L., *Montia fontana* L., *Myagrum perfoliatum* L., *Myosoton aquaticum* /L./ Moench., *Myosurus minimus* L., *Nigella arvensis* L., *Nonea pulla* /L./ DC., *Orlaya grandiflora* /L./ Hoffm., *Scleranthus annuus* L., *Sberardia arvensis* L., *Spergularia arvensis* L., *Spergularia rubra* /L./ J.et K. Presl, *Torilis arvensis* /Huds./ Lk., *Trifolium arvense* L., *Vaccaria hispanica* /Mill./ Rauschert;
3. Vulnerable species (12): *Centaurea cyanus* L., *Centaureum erythraea* Rafn, *Consolida regalis* S.F. Gray, *Lamium amplexicaule* L., *Lathyrus latifolius* L., *L. tuberosus* L., *Papaver rhoeas* L., *Physalis alkekengi* L., *Ranunculus arvensis* L., *Stachys annua* /L./ L., *Vicia tetrasperma* /L./ Schreb., *Viola arvensis* Murray;
4. Rare species (18): *Adonis flamaea* Jacq., *Artemisia annua* L., *Astragalus cicer* L., *Bifora radians* MB, *Cerintbe minor* L., *Erigeron acris* L., *Gagea arvensis* /Pers./ Dumort., *Galium spurium* L., *Gnaphalium uliginosum* L., *Neslia paniculata* /L./ Desv., *Papaver argemone* L., *P. dubium* L., *Rapistrum rugosum* /L./ All., *Saxifraga tridactylites* L., *Scandix pecten-veneris* L., *Teucrium botrys* L., *Thymelaea passerina* /L./ Coss. et Germ. and *Veronica verna* L.

DISCUSSION

All weed species in the "extinct" category were noted by Schlosser and Vukotinović (1869) and also

by Kovačević (1961). These species after 1961 in literature data were not found.

Among extinct (6) and endangered (42) species prevail weeds of flax crop and cereals /winter wheat, oat, barley, rye/. Weeds of cereals are very sensitive on the intensified agriculture and some of them have become extinct in many parts of Europe (Holzner 1978). Also in Croatia the species like *Agrostemma githago*, *Adonis aestivalis*, *Legousia speculum-veneris*, *Lolium temulentum* and others have disappeared under seed cleaning and herbicide pressure. Some of endangered species are noted only on fields with extensive production (Vrbek 2000, Hulina 2002 b). Also weed species of acid and less or more heavy soils /e.g.: *Aphanes arvensis*, *Lytbrum hyssoipifolia*, *Scleranthus annuus*, *Trifolium arvense*, *Vaccaria hispanica*, *Hypericum humifusum*/ are found only on fields with extensive production (Hulina 2002 b).

The species *Allium vineale* deserves particular attention. Namely, its distribution has been noted by Schlosser and Vukotinović (1869) as “inter segetes totius Croatiae” and it is currently known from only a small area in the north-eastern part of Croatia (Panjković 1990, Zahirović 2000).

It is evident, that the chances for return of extinct and endangered weeds on fields are due to promote flax crop (*Cuscuta epilinum*, *Camelina linicola*) and traditional and extensive crop production (for all others).

The majority of vulnerable (12) as and rare (18) weed species are also companions of cereal crops.

The best way to conserve most plants is to protect the habitats where they grow. It is very hard and complexly in agroecosystems. It is due to the protection of full weed communities. At the same time, the presence of weeds in crops can reduce yields. The major challenge in recent agriculture is a shift in emphasis from how to kill weeds to how to live with them.

Generally, an effective conservation for segetal weed species will be possible by special crop husbandry and measures of nature conservation (Schumacher 1980).

Because in Croatia small family farms (78 %) prevail, the man may to ensure weed population equilibria by hoeing as weed control, crop rotation (three course system) and mixed cropping (e.g. maize with pumpkins, Hulina, 2002a). The possible conservation in agriculture is also to promote organic farming. In conventional agriculture, the concept of field edges not threatened with herbicides and less fertilization is a useful manner for the conservation of endangered, vulnerable and rare weed species (van Elsen, 1989, van Elsen and Scheller 1995).

The measures of nature conservation include botanical and weed gardens. But, botanical gardens with their systematic fields, can make a significant contribution to the weed conservation on the rang of species. Weed gardens are more efficient, because on small fields weeds grow with belonging crops and traditional agrotechniques. Such weed gardens yet are established in Germany (from Eggers, 1994) and the Czech Republic (in the area of White Carpathians).

Further chance is an inclusion of attractive and suitable weed species in the concept of esthetic-paysage planning (e.g. in flower garden beds, making green of rockeries, road verges and etc).

Nature, by itself, protects segetal weeds. Namely, the majority of weed species, owing to the seed bank and dormancy, are ready to survive in the soil waiting favourable time and space.

Also, weeds missing their habitats often colonise different ruderal habitats. Particularly, the roadsides and embankments have become important refuges for endangered weeds.

CONCLUSION

It may be concluded as follows:

1. The proposed list of threatened weed species contains a total of 78 weed species: 6 of them are extinct, 42 endangered, 12 vulnerable and 18 rare. It is about 40 % of the segetal flora in Croatia.
2. Extinct and the majority of threatened weeds are companions of flax crop and cereals.
3. The chances to return threatened weeds on the fields due to promote flax crop and extensive or organic crop production. In conventional production the fields edges not threatened with herbicides and less fertilization are useful manner for conservation threatened weeds.
4. Botanical gardens on their systematic fields can conserve the weeds on rang of the species and weed gardens in the forme of community. Weed gardens on their fields grow crops with belonging weeds by traditional agrotechniques.
5. An inclusion of attractive and suitable weed species in the concept of esthetic-paysage planning /e.g. in flower garden beds, making green of rockeries, road verges and etc. / is a further chance for the conservation of threatened weeds.
6. Nature, by itself, protects the segetal weeds. The majority of weed species owing to the seed bank and dormancy survive in soil for a long time waiting favourable time and space. Also, weeds missing their habitats colonise different ruderal habitats. Particularly, the roasides and embankments have become important refuges for threatened weeds.

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