# Chapter 6
# The Status of Arable Plant Habitats in Eastern Europe


**Gyula Pinke**

**Abstract** Today large parts of Eastern Europe can be considered as strikingly species-poor "agrarian-deserts". Nevertheless, the region also retains relatively large areas of species-rich farmland. Changes in the weed flora in this region, with special regard to the disappearing weed species, is the subject of relatively small numbers of international scientific studies compared to the western part of Europe. The average weed species number per plot seems to have declined less in eastern than in western countries since the Second World War. However, by the turn of the Millennium the number of threatened weed species had increased considerably, which is apparent in the recently updated national weed red lists. Many studies indicate that lower farming intensity and diversified farming systems at higher altitudes provided better conditions for the occurrence of rare species and greater diversity than intensively farmed lowlands. Unfortunately, only a few traditionally managed small fields remain in extreme habitats, and they are continuously being abandoned. Regrettably, Eastern Europe mostly lacks any conservation initiatives which directly target the preservation of rare and threatened arable weeds, consequently further declines are anticipated.

**Keywords** Collectivisation · Land abandonment · Stubbles · Extensive farming · Marginal habitats · Urbanisation · Agricultural intensification

## 1 Setting the Scene

The current status of arable plant diversity in Eastern Europe is a product of two contrasting patterns. In this region, the agricultural intensification which dramatically changed the European weed flora after the Second World War (Storkey et al. 2012; Richner et al. 2015; Albrecht et al. 2016), was also associated with forced

G. Pinke (✉)
Faculty of Agricultural and Food Sciences, Széchenyi István University, Mosonmagyaróvár, Hungary
e-mail: pinke.gyula@sze.hu



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collectivization (Constantin and Bauerkämper 2013). In the newly consolidated, large fields of big cooperatives, industrialized methods of plant production quickly led to the rapid decline of weed diversity (Pinke and Pál 2005). At the same time, some countries like Poland and the former Yugoslavia escaped collectivisation and, in more or less remote Eastern European regions, traditional farming systems still remain. Consequently, although today large parts of Eastern Europe can be considered as strikingly species-poor "agrarian-deserts" with weed infestations of, at most, a few troublesome weeds, nevertheless, according to Sutcliffe et al. (2015) it also retains relatively large areas of species-rich farmland of international importance for weed conservation; fields in any transitional state between these two extremities also exist.

Changes in the weed flora in Eastern Europe, with special regard to the disappearing weed species, is the subject of relatively small numbers of international scientific studies compared to the western part of Europe. However, in Poland where farms managed to resist collectivization but generally could not avoid intensification, the response of weed communities gained the interest of many botanists. A decreasing trend in weed diversity was first reported by Kornas (1961) who highlighted the disappearance of specialized flax weeds (e.g. *Lolium remotum*, *Silene linicola*, *Camelina alyssum*, *Spergula maxima* and *Cuscuta epilinum*) in a mountainous district in southern Poland ten years after traditional flax growing had ceased. In the following decades these species were also no longer found within intensively cultivated flax crops and considered to be extinct in the entire country (Heller 2010). The main causes of broader declines in arable plants were roughly the same as elsewhere in Europe (Storkey et al. 2012) – Sicinski and Sieradzki (2010) identified the following factors as being particularly responsible for the changes in Poland: herbicides, mineral fertilizers, seed cleaning, simplification of crop rotation and intensive soil cultivation. According to Lazarski (2015) the introduction of new, more competitive, high-yielding varieties of cereals is an additional threat to rare weeds. High-yielding crops in conjunction with the use of mineral fertilizers result in higher crop densities which increases the shading of lower vegetation layers. This has resulted in species that are poor competitors for light, such as *Scandix pecten-veneris* (Fig. 6.1), disappearing from crop habitats. Skrajna et al. (2012) highlighted that on acidic soils, the number of sites of occurrence as well as population abundance of *Illecebrum verticillatum* and *Radiola linoides* have also drastically decreased after the turn of the Millennium in Eastern Poland. This retreat and the decline of other acidophilous species were associated with increasing nitrophilous species caused by the increase of intensive maize production in the region.

Early stubble ploughing has also been a decisive factor responsible for the declines of farmland biodiversity observed in some Eastern European cropping systems. Formerly, weeds on stubbles were grazed by livestock and also provided resources for bees, representing a high nature value type of farming. Since the 1950s, however, farms have tended to plough the stubble as soon as possible after the harvesting of cereals. As a consequence, the range and population size of weeds typical of stubble fields has reduced significantly, because these species fail to flower and set seeds. An example of one such typical stubble-weed species is *Stachys annua*

**Fig. 6.1** *Scandix pecten-veneris*, an example of a weed that has dramatically declined in Poland partly owing to the increased competitiveness of crop canopies. (Photo G. Pinke)

(Fig. 6.2), which before agricultural intensification in Hungary frequently covered stubble fields in dominant stands during late summer and early autumn (Fig. 6.2). This species is an outstanding nectar-producer and it was one of the most important honey plants in Hungary providing beekeepers with profitable stubble-honey until the 1950s (Fig. 6.2). Studies revealed that where remnants of this habitat remain, it provides significant food sources for pollinating insects and farmland birds (Pinke and Pál 2009). Even though stubble weed communities are clearly of high conservation priority for biodiversity, the decline in the area it covers has dramatically accelerated in the last two decades, mainly due to the large expansion of the invasive competitive weed, *Ambrosia artemisiifolia* (Fig. 6.3). On the one hand this species is invading and overwhelming more and more habitats of *Stachys annua*. On the other hand, the allergenic pollen of this invasive plant has resulted in greater emphasis being placed on the importance of early ploughing of stubbles. Authorities can even impose financial penalties in case farmers fail to plough stubbles at the right time. The impact of this invasive plant is, therefore, impacting biodiversity through indirect effects on management as well as direct biotic effects.

**Fig. 6.2** *Stachys annua* (*top left*), a species that has declined in Hungary because of the loss of stubbles and is a particularly valuable source of resource for pollinators (*top right*). (*Bottom*): Stubble field covered with *Stachys annua* (2005, Kálóz, Hungary). (Photos G. Pinke)

## 2 Historical Changes in Weed Communities in Eastern Europe

According to Richner et al. (2015) the average weed species number per plot seems to have declined less in eastern than in western countries since the Second World War. However, by the turn of the Millennium the number of threatened weed species had increased considerably in the region, which is apparent in the recently updated national weed red lists. The continental part of Croatia has 78 endangered weed species (Hulina 2005), while Slovakia has 150 (Eliás et al. 2007), Poland 105 (Bomanowska 2010) and Hungary 149 (Pinke et al. 2011) threatened weed species, respectively. As reported by these lists, specialized flax weeds can be regarded extinct in all these countries, but mainly because of the modern seed

**Fig. 6.3** Stubble field covered with *Stachys annua* with patch-like infestation of *Ambrosia artemisiifolia* (2011, Mosonudvar, Hungary). (Photo G. Pinke)

**Fig. 6.4** Examples of weed species that have declined in Eastern Europe for different reasons discussed in the text: *Adonis flammea* (*left*) and *Papaver argemone* (*top middle*) have been selected against by the increased use of fertilisers and, for *P. argemone*, liming of more acidic soils. *Agrostemma githago* (*middle bottom*) has declined because of more efficient seed cleaning and *Lathyrus aphaca* (*right*) is threatened by expanding urbanisation in Poland. (Photos G. Pinke)

cleaning technologies specialised cereal weeds, like *Agrostemma githago* and *Bromus secalinus* (Fig. 6.4) are also among the most symbolic endangered weeds, with varying conservation status across the countries. Weeds, typical for acidic soils,

like *Arnoseris minima* and *Papaver argemone* (Fig. 6.4) have become vulnerable mainly because of liming and the application of fertilizers. One of the most threatened and fascinating arable weed communities of this region is the Caucalidion alliance, with species like *Adonis flammea* (Fig. 6.4), *Caucalis platycarpos*, *Turgenia latifolia*, *Scandix pecten-veneris*, *Vaccaria hispanica*, *Bupleurum rotundifolium* and *Galium tricornutum*. These communities are distributed from the Balkans up to Poland, tending to become more specialized to the north, where they occupy ever more calcareous, warmer and drier habitats and become especially susceptible to the methods of modern agriculture (Pinke 2004; Wegrzynek and Nowak 2010, Silc et al. 2014). After 1950, the number of occurrences of this weed community decreased significantly, but surprisingly in the 1990s, some new sites for these weed species were recorded in the Czech Republic. This trend is presumably associated with a reduction in the application of herbicides and fertilizers after the socio-economic changes in 1989 (Lososová 2003).

A similar phenomenon has also been observed in Hungary, partly because of the chaotic changes in farming practices following the collapse of many large cooperatives in the post-communist period after 1990. The distribution of one of the most emblematic endangered weeds, *Agrostemma githago* significantly retreated after the 1950s; this once common arable weed had only 22 known localities in Hungary at the end of the 1980s. However, between 1995 and 2005 it was reported from 366 Hungarian localities. Although, it should also be noted that at this time field botanical research was also significantly boosted. Therefore, it is difficult to assess whether the temporary reduction in the intensity of farming or the more thorough surveys were to a greater extent responsible for this increase in observations (Pinke et al. 2006). Most of the new occurrences were discovered in extensively cultivated small fields from the hilly and sandy regions of Hungary, which mostly avoided the attention of botanists in the former decades. Unfortunately, there are no records of the share of permanent low intensity farming habitats, which already existed before the 1990s, and were not the temporary products of the economic crisis in the early 1990s that allowed the possible beneficial effects of changes in farming practice on arable weeds to be quantified with certainty.

## 3 Important Habitats for Arable Plant Conservation in Eastern Europe and Future Threats

Arable mosaics combined with grasslands and other semi-natural habitats usually result in the greatest arable plant diversity in Eastern Europe, particularly in hilly regions (Kovács-Hostyánszki et al. 2011; Loos et al. 2015). Mountainous areas tend to preserve traditional farming practices in contrast with the great plains, where crop production has been easier to intensify. Many studies indicate that lower farming intensity and diversified farming systems at higher altitudes provided better conditions for the occurrence of rare species and greater diversity than intensively farmed

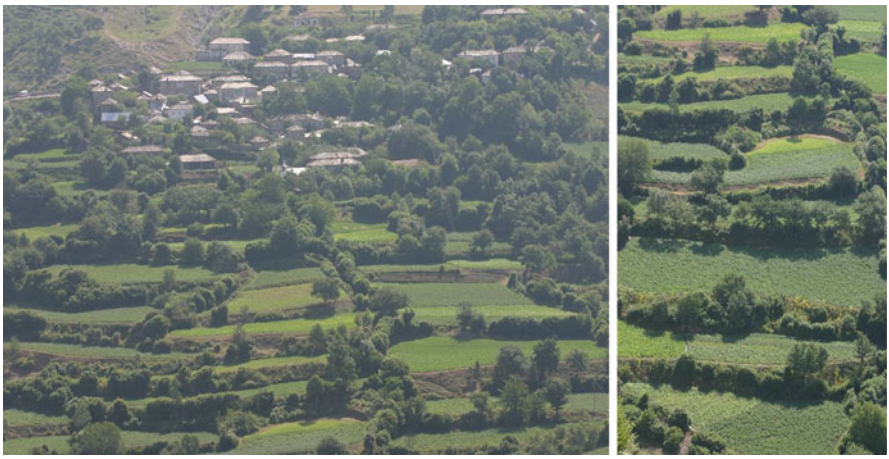

**Fig. 6.5** Example of a traditional farming landscape (2007, Zagradi, Albania) that can still be found in parts of Eastern Europe and are particularly important for conserving arable plant communities. (Photos G. Pinke)

lowlands. This trend has been reported by Vrbnicanin et al. (2009) in Serbia, by Kolarová et al. (2013) in the Czech Republic, by Nagy et al. (2018) in Romania and by Májeková et al. (2019) in Slovakia. Barina et al. (2017) reported that, in Albania, both at higher and lower altitudes small cultivated fields are still typical (Fig. 6.5) and weeds that have become threatened at a European scale, like *Agrostemma githago*, *Vaccaria pyramidata*, *Scandix pecten-veneris* and *Adonis flammea* are still relatively frequent. Further eastwards outside Europe, closer to the centre of their distribution area, many of these weed species can still occur even in large populations (Nowak et al. 2014).

In extensive, or in other words in the "traditional low-intensity farming systems" intensification of arable land use is usually unprofitable due to extreme soil conditions or difficult topography. In these habitats the absence or low use of agrochemicals benefits a wide range of flora and fauna throughout the food chain (Beaufoy et al. 1994). To validate this assumption, the floristic composition and conservation value of the weed vegetation of winter cereal fields on base-rich soils in western Hungary was compared between extensively and intensively managed fields. The findings showed that total weed cover was, on average, six times higher in extensively compared with intensively managed fields (Pinke and Gunton 2014). In addition, Red List and insect-pollinated plant species occurred more frequently in extensively managed fields (Pinke et al. 2009). Community responses to arable intensification using functional trait analyses were also characterized. The response of weeds to intensification in these cereal fields was best described by a functional classification based on species' flowering duration, maximum height and seed weight. One of the groups particularly associated with the extensive fields is characterized by medium stature, the largest seeds and the shortest flowering duration. This could be identified as a particular conservation concern and includes many

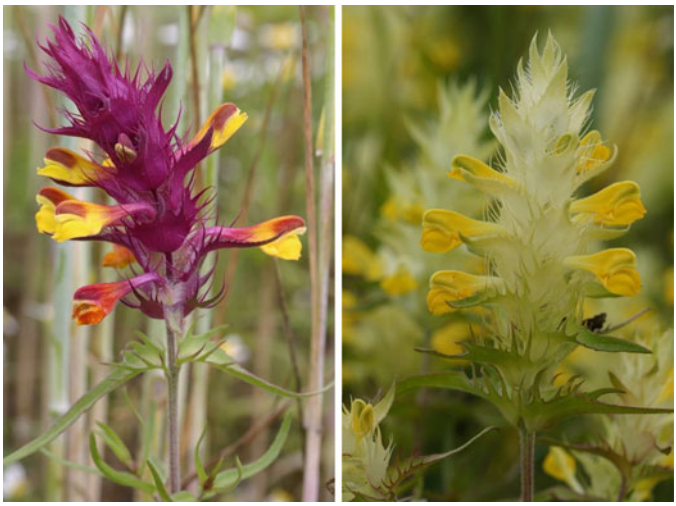

**Fig. 6.6** Two species of *Melampyrum, M. arvense* (*left*) and *M. barbatum* (*right*) that are only found in extensively managed fields and display a rare weed traits syndrome of large seed, intermediate stature and short flowering duration. (Photos G. Pinke)

of the most threatened and declining arable weed species in Hungary (e.g. *Agrostemma githago*, *Caucalis platycarpos*, *Galium tricornutum*, *Ranunculus arvensis*, *Turgenia latifolia*, *Melampyrum arvense* and *M. barbatum* (Fig. 6.6)). The medium stature reflects competitive exclusion of weeds of similar height to cereal crops in intensive fields, seed size is negatively correlated with persistence in the seed bank and low seed production, and short flowering period also represents a short phenology making this species unable to re-emerge after herbicide applications (Pinke and Gunton 2014). This shows some congruence with the rare weed trait syndrome of short stature, large seeds and late flowering proposed by Storkey et al. (2010) – see also Chap. 2 in this volume.

These results show that extensively managed fields have greater conservation value compared with intensively managed fields. Therefore, extensively managed arable habitats should have a high priority for biodiversity conservation. Unfortunately, only a few traditionally managed small fields remain in extreme habitats (Fig. 6.7), and they are continuously being abandoned. Extensive fields are usually owned by old farmers, who grow cereals to feed their own livestock. There is no market orientation in their farm business and they do not receive any financial support for this environment-friendly cropping. After the demise of this older generation, who are the last members of the traditional peasant culture, there will be no younger generation continuing this traditional lifestyle. Extensive fields are, therefore, likely to be abandoned (Fig. 6.8), intensified or built up. This is a dramatically accelerating trend; more than 90% of the extensive fields, which were sampled for the study of Pinke et al. (2009) in 2007, were lost in the following decade in North-Western Hungary. Expanding Hungarian towns are also

**Fig. 6.7** Last remnants of extensively managed fields in Western Hungary with rich arable floras including abundant populations of *Centaurea cyanus* in Öskü taken in 2007 (*top left*) and 2011 (*top right*), *Melampyrum barbatum* and *Anthemis austriaca* (*bottom left*) and *Centaurea cyanus*, *Agrostemma githago* and *Anthemis austriaca* (*bottom right*) taken in Öskü 2019. (Photos G. Pinke)

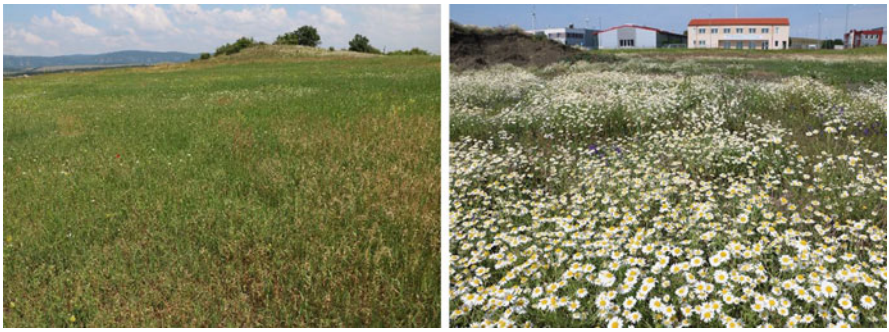

**Fig. 6.8** Abandoned extensive fields in Western Hungary (2019, Öskü) (*left*) and an expanding town incorporating once extensively managed small fields in its vicinity (*Anthemis austriaca* at the building site; 2017, Mosonmagyaróvár, Hungary) (*right*). (Photos G. Pinke)

increasingly incorporating small fields in their vicinity (Fig. 6.8), while around villages once extensively managed fields turn to be more and more intensified or abandoned. A considerable part of the Eastern European region is likely to be involved in this land use trend with negative impacts on arable plant habitats. For instance, Nobis et al. (2011) reported that although extensively managed fields provided suitable habitats for the threatened *Lathyrus aphaca* (Fig. 6.4), a species

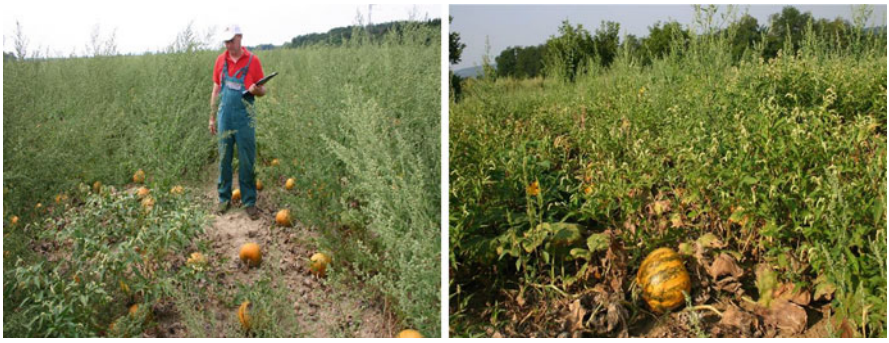

**Fig. 6.9** Oil pumpkin field with massive populations of *Chenopodium album* and *Persicaria lapathifolia* (2015, Vasszentmihály, Hungary). (Photo G. Pinke)

of Mediterranean-Irano-Turanian origin around the Polish city of Kraków; the progressive development of the city, and especially by numerous building investments as well as the discontinuation of cultivation threaten its survival. Mehmeti et al. (2009) noted that the abandonment of cultivation, especially on shallow calcareous soils threaten the existence of rare weed species in Kosovo. According to Öllerer (2013) small-sized subsistence household farms in Romania are continuously being abandoned due to economic constraints. Furthermore, Batáry et al. (2015) highlighted that Eastern European agriculturally marginal areas, where the productivity of land is limited by biophysical or socioeconomic constraints and are currently home to the highest concentrations of biodiversity and host the largest populations of threatened species are also under the highest pressure from agricultural intensification and abandonment. Storkey et al. (2012) also pointed out that the factor most commonly identified as causing national declines in arable floras in Eastern Europe was the abandonment of marginal land.

There are some examples of specialised cropping systems that remain important refugia for threatened plant species. Before the intensification of rice production, flooded paddy fields in the region provided habitat for a great diversity of wetland species, which have also drastically diminished since the 1960s. Nevertheless, studies suggest that waterlogged arable fields, including temporary pools and rice paddy fields even today can harbour many endangered plants (e.g. *Elatine triandra*, *E. alsinastrum*, *E. hungarica*, *Lindernia procumbens*, *Alisma gramineum*) and high species diversity, especially when the fields are cultivated less intensively (Lukács et al. 2013; Pinke et al. 2014). The weed vegetation of oil pumpkin fields in the region can be also remarkable, because it is often cultivated in “eco-friendly” ways. Even in conventional farms growers usually rely on mechanical weed management rather than herbicides. They regularly do not control weeds from midsummer, partly because they consider them beneficial, as they can provide some shelter from wind and heliosis for the ripening pumpkin fruits (Pinke et al. 2018). Although most of the weed flora are recruited from the commonest plants in these fields, they can possibly supply farmland birds with important seed food sources and cover (Fig. 6.9).

## 4 The Future of Arable Plant Habitats in Eastern Europe

Unfortunately, Eastern Europe lacks any conservation initiatives which directly target the preservation of rare and threatened arable weeds. Even in Poland, where scientists have payed attention to this issue for a long time (Dostatny 2004, Sicinski and Sieradzki 2010), the concepts of arable conservation areas in national and landscape parks, as well in botanical gardens and open air museums have still remained largely unimplemented proposals. In Hungary, the applied agri-environment schemes do contain certain elements that indirectly could be beneficial for the weed flora, although not directly targeted at these taxa. They include subsidies for long lasting green fallow as well as the bee-foraging margins and farmland bird protection zones (Sztahura and Rezneki 2015). Although these programs are benign in terms of arable plants, they are not focussing on the last remnants of the vanishing extensively managed fields, thus they fail to account for and preserve the most important "biodiversity hotspots" of rare and threatened arable weeds. Among the applied conservation options reviewed by Albrecht et al. (2016) the most appropriate way to save these habitats in Eastern Europe would be to create new programs similar to the German project "100 Fields for Diversity", in which a sustainable network of sanctuaries for permanent conservation of endangered arable weed species is established through long lasting maintenance of extensive farming practices (Meyer et al. 2010) – see Chap. 5 in this volume. Finally, it should be noted again that agricultural biodiversity and its conservation strategies in Eastern Europe is also relatively under-represented in the international literature (Sutcliffe et al. 2015). In addition, the adopted western European type agri-environment schemes seem to be generally ineffective in this region and there is a great need for better locally adapted strategies (Babai et al. 2015; Sutcliffe et al. 2015; Reif and Hanzelka 2016; Spulerová et al. 2017). Sutcliffe et al. (2015) also emphasised that the biodiversity benefits for Europe of existing low-intensity farmland, particularly in the eastern states, should be harnessed before they are lost as they represent important biodiversity hotspots at the European scale. Instead of waiting for species-rich farmland to further decline, targeted research and monitoring to create locally appropriate conservation strategies for these habitats is needed now.

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