DIVERSITY OF HABITATS RELATED TO AGRICULTURE AS HOTSPOTS FOR INVASION

Alla ALEKSANYAN, G. FAYVUSH
Institute of Botany of NAS of Armenia
0040, Acharyan 1, Yerevan, Armenia
alla.alexanyan@gmail.com

Abstract. *The article explains the urgency and the importance of study of the composition and status of invasive species, growing on disturbed habitats. We've evaluated the suitability and vulnerability of various habitats to invasion by alien plant species in Armenia. As a first step of current research, we have separated from all habitats of Armenia habitats directly or indirectly related to agricultural activities. As a next step it was carried out occurrence of invasive species and suitability of these habitats for their further spread. Based on this analysis it will be possible to develop control measures for further spreading of these species and for preventing the invasion into natural ecosystems and based on deepen research understand pathways of invasion in Armenia and adjacent countries.*

Key words: *habitats, invasive species, biodiversity, agriculture, Armenia*

INTRODUCTION

The problem of anthropogenic transformation of natural ecosystems is closely linked to the various political, economic and cultural processes: even speak about the antropogenic evolution of ecosystems and a new type of biodiversity called ksenobiodiversity formed by alien species.

The expansion of invasive alien species is consideredto be second the most significant threat to the biodiversity. Biological invasions, together with climate change is one of the most important global problems since the second half of the 20th century, and it's a priority area for achieving ecological security of each country. Today the high interest in invasive species can be explainedwith some reasons:

- Importance of conservation of natural habitats and biodiversity
- The possibility of unintended harmful consequences -with regard to genetically modified organisms (GMOs).
- Control and prevention of biosecurity risks, etc.

According to the generally accepted definition, alien invasive species are species whose introduction and/or spread poses a threat to biodiversity and natural ecosystems.

In many cases, invasion is linked to the transformation of the natural ecosystems due to the human activities. The introduction and spread of invasive species is closely related to the presence of disturbed habitats in the territory of each country. From the other hand the sustainability of natural ecosystems will be disturb under climate change, which impacts are visible nowadays and which also creates suitable condition for establishment and spread of invasive alien species.

Indisturbed habitatsinvasive species usually form monodominant communities, produce a huge number of seeds, and these territories are a reservoir, source of material for further invasions and spread of these species in natural ecosystems.

The natural restoration of vegetation, in the case of anthropogenic impact termination,is a complex process, usually requiring a very long time and not always leading to the restoration of previous ecosystems, with exactly same composition and structure.While exotic plant invasions are thought to lead to decline in native species, the long-term impacts of such invasions on community structure still are poorly investigated.

For the country like Armenia with small territory but high species richness and habitat diversity, the rapid establishment and spread of invasive plant species remains a threat to native ecological biodiversity. Freedom from natural predators, high seed production, and affinity for disturbed habitat sites all contribute to the success of invasive species, leaving native species to struggle for space and resources.

In recent decades, invasive alien species in Armenia much progress. A variety of natural conditions and habitats, vegetation mosaic extend the capabilities of the invasion and spread of alien species in the country. The number of these species in Armenia is several times larger than in lowland countries.

Another major environmental problem of our time is transformation of natural ecosystems, including expansion of agricultural lands (MOONEY, 2005).

Agriculture is situated at the interface between ecosystems and society. The overall driving force in agriculture is the increasing demand for food and fiber. As a result agriculture globally exerts increasing of pressure on the land and water resources, which often results in land degradation (KIRCHMANN, THORVALDSSON, 2000).

In agriculture invasive plant species usually include any weeds or/and exotic plants, which can interrupt the production of livestock, crops, and rangeland. But the same impact can have expanding species. For this study, we paid attention only to alien species. Since in the case of expanding species the mechanisms of spread, the methods of study and, accordingly, the results and their interpretation will be different.

Agriculture is one of the main branches of the Armenian economy, accounting for about 20% of the country's GDP (Statistical Yearbook of Armenia, 2014). It has to be noticed that the most part of rural population is engaged to agriculture and they intensively use and change naturalecosystems to agricultural arable lands. The share of plant growing in agriculture is about 70% (Agriculture in Armenia: Snapshot, 2014), which means that many ecosystems are under the anthropogenicinfluence, especially located near villages, arable lands and also pastures and hays.

The negative influence on the natural ecosystems continues to be the case nowadays unfortunately. The development of the mineral resource industry, infrastructure development and building of enormous number of accessory communications, intensification of agriculture, unsustainable use of natural resources leads to degradation and destroying of the natural ecosystems and as a result create suitable habitats for invasive species.

The aim of this paper is to review the presence of suitable habitats, knowledge on distribution and impact of invasive species on different habitats related to agriculture in Armenia.

MATERIAL AND METHODS

As a main materials for current study are used our own field observations and collected data from all over the country and from literature. As a main source of list of invasive species is used the unique publication “Invasive and expanding plant species of Armenia” (FAYVUSH,TAMANYAN, 2014) and additionally published new data (FAYVUSHET AL., 2015).

The main information about habitats of Armenia was taken from the latest monograph "Habitats of Armenia" (FAYVUSH, ALEKSANYAN, 2016).

The classification of habitats is given according to EUNIS habitat classification system. Studies concerning the distribution and occurrence of invasive species in particular habitatswere carried out during last 5 years. At the chosen sites, observations were made of different habitats in order to confirm or detect the occurrence of invasive species. Detailed studies of invasive species are conducting, using methodology developed by EU-COST action on "Sustainable management of *Ambrosia artemisiifolia* in Europe" (MÜLLER-SCHÄRER, LOMMEN, 2014). During these studiesinvestigation and monitoring of distribution, traits, population genetics and population dynamics are carried out. Based on this type of data it will be possible to predict and modeling further distribution and main impacts of these species.

RESULTS AND DICUSSIONS

Habitats related to agriculture

Based on main objectives and aim of current study from 750 habitats of different level we have chosen only 14 habitats of different levels from 2 first level habitats:

- H - Inland unvegetated and sparsely vegetated habitats
- I - Regularly or recently cultivated agricultural, horticultural and domestic habitats

The list of habitats is presented in table 1.

Table 1.

Habitats related to agriculture

N/N	Code of habitats	Name of Habitats
1	H5.324–AM	Abandoned sandy quarries
2	H5.343–AM	Artificial sandy hills
3	H5.51	Unvegetatedrecentlyburntground
4	H5.52	Sparselyvegetatedburntareas
5	H5.61	Unsurfacedpathways
6	H5.62–AM	Habitats trampled bydomesticated animals
7	I1.11	Large–scale intensive unmixed crops– >25ha
8	I1.12	Medium–scale intensive unmixed crops – 1–25ha
9	I1.13	Small–scale intensive unmixed crops – <1ha
10	I1.21	Large–scale market gardens and horticulture
11	I1.22	Small–scale market gardens and horticulture, including allotments
12	I1.51	Baretilledland
13	I1.52	Fallow uninnudated fields with annual weed communities
14	I1.53	Fallow uninnudated fields with annual and perennial weed communities

The invasive plant species are prevalent in disturbed habitats and in agricultural areas. Selected types of habitats directly or indirectly linked to agriculture. In this list we've included 3 habitats -H5.324–AM, H5.343–AM,H5.62–AM, which are new. They are absent in the original scheme of EUNIS'Habitat Classification and described by authors atfirst time.

The most part of these habitats are very common for all regions of Armenia. In one case the large territories can be covered by gardens and crop fields, in other case with habitats trampled by domesticated animals.

Particular attention should be given to "habitats trampled by domesticated animals", which are common forvillages,their vicinities, summer camps, watering places, where are cattle trail paths and the vegetation is overgrazed. During the economic and energy crisis in Armenia the overgrazing has destroyed the grasslands surrounding the villages and degraded the formerly

unspoilt pastures of remote mountains.Livestock grazing and, especially overgrazing, have tangible effects both on soil and vegetation and enlarge territories of this type of habitats (Pic. 1).This habitat is very common not only for Armenia but also in any country where the agricultural lands occupied huge territories.

Figure .1. H5.62–AMHabitats trampled by domesticated animals

All mentioned habitats are disturbed ecosystems and can provide necessary condition for introduction and establishment of invasive species. Some of them (I1.11, I1.12, I1.13, I1.21, I1.22)are permanent source for new invasive species, because people can bring new alien corps, fruiting trees or/and new ornamental, decorative plants (pic 2, 3).

Figure 2. 2. I1.11Large–scale intensive unmixed crops – >25ha

Figure3. 3. I1.13Small–scale intensive unmixed crops – <1ha

Particularly the studies of temporary or permanent abandoned fields were carried out(I1.51, I1.52, I1.53). Unfortunately, the area covered by these habitats in Armenia today is quite large andreaches almost 20% of all agricultural land in country(2051000 ha) (pic.4, 5).

After gaining independence agriculture of Armenia has undergone and is undergoing serious changes. After disintegration of Soviet Union, in Armeniathe privatization of agricultural lands was carried out, when lands of 869 collective farms were divided into 1.2 million individual plots. Currently there are 336,000 farms in Armenia, with an average of 3 plots for every individual, at different distances from each other. The processing of such small areas is associated with great difficulties and costs and as a result, a significant parts partially or completely not processed and belong to the category of "abandoned" (Avetisyan, 2010).

Figure . 4. I1.52Fallow uninnudated fields with annual weed communities

Figure 5. I1.53 Fallow uninnudated fields with annual and perennial weed communities

Invasive species in habitats

According to the conducted studies over the last 5 years, due to the influence of the anthropogenic factor anthropophilous or synanthropic species are dominatedin plant communities. Should be mentioned that many invasive species can be agricultural weeds, but not every weed is invasive. Although crops and other cultivated plants are not generally considered to be invasive plants, but some of them may have an invasive potential and, in the presence of optimal conditions for adaptation, may spread and become invasive.

The results of preliminary estimation of main threats of invasive species hasallowed us to prepare the list of more than 100 alien species requiring immediate attention, as an invasive or potentially invasive species, which is approximately 25% of all alien plants in Armenia.The most part of invasive plants in investigated habitats consisted mostly annuals and short-lived perennials.From this 100 species, about 30 species can be found in above-mentioned habitats.

Actually, large number ofinvasive species spread in suitable habitats, occupying relatively small areas (from 50 to 500 sq. km) but as a whole, the picture is rather concerning. But if we will calculate the total area occupied by them all, then it‘s about 10% of the total area of the country.

The most distributed species are:*Ambrosia artemisiifolia*,*Silybummarianum*, *Centaureaiberica*, *Centaureadiffusa*, *Conyzacanadensis*, *Amaranthusretroflexus*, *Cirsiumcongestum*, *Cuscutacampestris*, *Descurainiasofia*, *Xanthium spinosum*, *etc.*

The most part of these species are from*Asteraceae*family, which is natural, becauseit is the largest family in Holarctic region. Based on herbarium and fieldwork data we have compiled preliminary maps of distribution of each species, which will be presented after modeling.

Detailed studies have been conducted for *Ambrosia artemisiifolia* and *Silybummarianum*. It was investigatedthe distribution and main ways of spread, different traits (height, number of inflorescences, number of seeds, etc.), environmental and anthropogenic impact on their populations, population dynamics and genetics. As a result we have modeling current and future distributions under climate change (ALEKSANYAN, HOVHANNISYAN, 2015; ALEKSANYAN AT AL., 2016). These studies are continuing and will include more details and analysis. The same methodology will be used for other species.

CONCLUSIONS

The invasive plant species identified for mentioned habitats are not serious invaders for other habitat types representing in vegetation that is more natural, but they are still serious problem for habitats near roads, railways etc. This may reflect that these are primarily agricultural weeds and the majority of the species reported here occurred indeed on disturbed grounds and in arable fields. However, in this stage of study we still can’t be sure that these species are not spreading into undisturbed vegetation communities or whether they are confined to only disturbed sites within these habitats.

The high fraction of annual invasive plant species in studied habitats reflect a high number of agricultural weeds and may be due to the high elevations of this territories. Annuals contributed most to species not being serious environmental weeds elsewhere, indicating that they are mainly weeds of disturbed grounds.

In the case of perennials, research methods are much more complicated. For such species additional research will be required.

For deepen understanding of current and future distribution and effects of invasive species in mentioned habitats should be examined the effects of invasion on species richness and vegetation composition and structure changes.

Considering that many invasive plants over the last centuries have adapted to urban and agro-ecosystems, where their communities reach a maximum population density and the fact, that agriculture has intensive anthropogenic impact on the environment. It will increasingly promote formation of disturbed habitats for introduction, adaptation and spread of invasive species.

It is clear that control measures should be developed and policy and legislation of prevention and control of invasive plant species in Armenia should be improved.

In case of habitats related to agriculture one of theextremely important measures is the reclamation of abandoned agricultural lands or, at least, their use for other purposes. Besides, the prevention or elimination of risks for natural habitats and biodiversity these measures will increase productivity of agriculture.

The results of this study can be used for further researches of invasive species in different habitats and for prevention of new introduction and/or distribution of invasive plant species, which is a worthy goal, given the potential for harmful impacts, and a goal that is at least partially attainable.

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