ASSESSING THE INVASIVE SPECIES IMPACT ON THE GRASSLANDS FROM WESTERN ROMANIA

ESTIMAREA IMPACTULUI SPECIILOR INVAZIVE ASUPRA PAJIŞTILOR DIN VESTUL ROMÂNIEI

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Abstract: *The purpose of this work is to present a synthesis of the researches realised on 28 grasslands from Banat during 2003-2005 concerning the impact of some species on grassland and the determination of their invasive character. Most of the studied species have acted as invasive, this fact being manifested through the increase of the coverage index of the surface from a year to another. Even this study is realised at local scale, the results, respectively the study method can be applied at a regional scale too. Also, in this way can be characterised other species that are suspected from the invasivity point of view to be noxious.*

Rezumat: *Scopul acestei lucrări este de a prezenta o sinteză a cercetărilor efectuate pe 28 de pajişti din Banat, în perioada 2003-2005, cercetări privind impactul unor specii asupra pajiştilor şi determinarea caracterului invaziv al acestora. Cea mai mare parte a speciilor studiate s-au comportat ca invazive, acest fapt manifestându-se prin creşterea coeficientului de ocupare a suprafeţei de la an la an. Chiar dacă acest studiu s-a desfăşurat la scară locală, rezultatele, respectiv metoda de studiu, poate fi aplicată şi la scară regională. De asemenea, în acest mod pot fi caracterizate şi alte specii care prezintă suspiciune din punctul de vedere al invaziei ca fiind dăunătoare.*

Key words**:** *grassland, invasive species, vegetation, spreading coefficient.*
Cuvinte cheie: *pajişte, specie invazivă, vegetaţie, coeficient de ocupare a suprafeţei.*

INTODUCTION

VERMEIJ (1996) cited by BOOTH *et al*. (2003) defines invasion as the geographical expansion of a species in an area unoccupied previously by this species. This definition includes also the idea that the most of the invasive species are non-native, but this is not a necessary condition.

In this way BOOTH *et al.* (2003) presents as example the researches of DE LA CRETAZ *et* KELTY (1999) referring to invasive species *Dennstaedtia punctilobula* (scent grassland fern) that became invasive when is intensively grazed by white tail deer. They are lowering the woody vegetation density, or even are destroying it. In this way the fern is in advantage because it has a higher amount of light available, and forms a dense carpet that is not allowing the other species regeneration.

Plant invasion is difficult to be understood and controlled because the processes and factors that intervene in it are known insufficiently. Finding the dominant elements that determine an invasion to succeed at any scale, and the efforts concerning their control, those must help to the increase of the efficiency in the control of this phenomenon. Ecologic and economic impact of the invasive species is perceived from local level to global scale. Researchers, landowners, and the public generally become more aware to the impact of this phenomenon. Ecological invasion is considered the second serious threat for natural habitats, after their fragmentation and lose (RANDALL 1996 cited by KELLY, 2003). The role of ecosystem's disturbances in promotion of invasive plant species is essential. From the natural agents that determine ecosystem's disturbance and that determines the increase of invasion incidence, the most important are: volcanic eruptions, fire, overgrazing and undergrazing (PAUCHARD, 2002).

All degradation elements are affecting these ecosystems, implicitly the herbaceous vegetation communities, offering proper conditions for the development and proliferation of the invasive plant species. The actual state of the most Romanian grassland is deeply influenced by the agricultural activities from the communist period, and from the actual period too, because after 1989 a lot of these surfaces were irrationally used or abandoned. Also, the number of animals that are using these permanent grasslands decreased powerful.

MATERIALS AND METHOD

Researches from this work were realized during 2003-2005 on 28 permanent grasslands situated in places with different environmental conditions, and on different relief forms.

The research methods used in this work are:

- mapping the coverage of invasive plant species (shrubs and herbs) on 100 square meters, squares method;
- calculus of the coverage index for studied species.

This study is realized at local scale (Table 1). Vegetation data are compared with anterior references, as species lists and grassland vegetation descriptions from this area realised during ’70s and ‘80s.

Table 1

Conceptual frame for the understanding of interpretation scale role on the plant invasion process (after PAUCHARD, 2002)

Element \ Scale	Global	Regional	Ecosystem (area)	Local
Invasion process	Introduction	Regional expansion	Setting new placements	Infested areas, small patches expansion
Temporal scale	centuries or millennia	decennia or centuries	decennia	**years**
Impact	Increase of exotic flora and global homogenisation of flora	Changes in bio-geo-chemical cycles and regimes disturbance, agricultural production loses	Regional impact is concentrated on the landscape specific elements (e.g.: reserves, riparian areas)	Changes in vegetation communities, competition relationships and native species replacement
Study methodology and monitoring	Species list, tester specimens, first mention. Research of the species predicted as potentially invasive	Geo-references of the new invaded areas and advances monitoring (e.g.: districts, other regional divisions)	Determination of infestation centres, corridors, and new patches, establishment of the bio-geo-chemical changes and cycles disturbance	Changes establishment in plant communities, leading to population studies including the control of that plant, species interactions with diseases and pests
Control	Limitation of new species introduction, their early detection and quick feed-back	Concentrated efforts on the rapid expansion of the fronts, species list check.	Control of the new patches and of the dispersion local mechanisms, control priorities control priorities evaluation	Direct control of invasive species

RESULTS AND DISCUSSION

Plant species studied in this work have become frequent in western Romanian grasslands in the past 15 years, these being the next:

- herbaceous: *Euphorbia cyparissias* L., *Juncus effusus* L., *Carduus acanthoides* L., *Eryngium campestre* L., *Dipsacus laciniatus* L., *Carlina vulgaris* L., *Xanthium spinosum* L., *Carthamus lanatus* L., *Pteridium aquilinum* (L.) Kuhn;

- shrubs: *Rosa canina* L., *Crataegus monogyna* Jacq., *Prunus spinosa* L., *Rubus caesius* L., *Ononis spinosa* L.

Biological features of invasive plant species determinates their ability to occupy a surface, respectively they make an invasion to succeed. We have focused on some of these, such as: reproduction type, genera and species number from a botanical family, chromosomes number, and ploidy degree.

Many authors (LEAKEY, 1981; BAKER, 1986; LODGE, 1993) consider that this feature as very important to make an invasion to succeed, because a series of plants have vegetative reproduction.

In table 2 is represented the reproduction type of studied invasive species from Western Romania grasslands.

From the species plants studied in this work 60% are reproducing sexual (with seeds), and vegetative. Similar results have been obtained by PYŠEK (1997) in Czech Republic, where 62% from the species that have invaded natural habitats are reproducing vegetative. From his point of view, vegetative reproduction of invasive species is favourable for their proliferation in natural and seminatural habitats (as are the grasslands).

Another aspect considered by other researchers (GOODWIN *et al.*, 1999) as necessary for species invasion is a big number of genera taxa. In this way, he said that the probability that a species being invasive from this point of view is 70%.

Thus SCOTT & PANETTA (1993) cited by GOODWIN *et al.* (1999) explain the reasons for that the species number from a genera determinates the invasive capacity of a one or more species to get contact with dispersal agents; as a species is more spread this determinates its adaptation to a wider range of environmental conditions, increasing the possibility for it to grow in a new environment.

Table 2

Reproduction type of studied invasive species (KOVACS, 1979)

Species	Reproduction type
Euphorbia cyparissias L.	5
Juncus effusus L.	5
Carduus acanthoides L.	1
Eryngium campestre L.	1
Dipsacus laciniatus L.	1
Carlina vulgaris L.	1
Xanthium spinosum L.	1
Carthamus lanatus L.	1
Pteridium aquilinum (L.) Kuhn	5
Rosa canina L.	5
Crataegus monogyna Jacq.	5
Prunus spinosa L.	5
Rubus caesius L.	5
Ononis spinosa L.	5
Sarothamnus scoparius (L.) Wimmer	5*

1 – amphymictic (sexuat); 5 – amphymictic + apomyctic through vegetative reproduction and polychormic

* PÂRVU, 2000

Other authors (DAEHLER, 1998 cited by BOOTH *et al.*, 2003) say that when a botanical family is greater the probability to contain more invasive species is increasing. In this way, in table 3 is represented the genera and species number of botanical families for the species analysed in this work.

Table 3

Genus and species number for studied botanical families

Family	Genus number*	Species number*
Juncaceae	10	500
Asteraceae	1000	20000
Rosaceae	100	3500
Fabaceae	350	10000
Euphorbiaceae	300	8000
Apiaceae	50	122
Dipsacaceae	11	200
Dennstaedtiaceae	40**	500**

* HODIŞAN *et* POP, 1976

** www.ars-grin.gov2/cgi-bin/npgs/html/family.pl1227 (accessed at 20/03/2006)

In this table can be noticed that *Asteraceae* family has the greatest number of genera (1000) and species (2000) in comparison with the others studied here. PYŠEK (1998; 2001) analysing invasive species from 26 regions of the world consider that *Asteraceae* family is one of the most frequent from this point of view.

From speciation perspective, LEVIN (2003) says that herbaceous species have a greater invasive potential in comparison with woody species that present a low diversity degree.

Also, some researchers say that is difficult to relate taxonomic models with invasivity because species taxonomy isn't solid everywhere worldwide (HEYWOOD**,** 1989 cited by BOOTH *et al.*, 2003).

Other aspects considered as determinant for species invasivity are chromosomes number (REJMANEK, 2000) and ploidy degree (CHAN**,** 2005*;* BLOSSEY**,** 2003). In table 4 is represented the chromosomes number and ploidy degree of the invasive species studied in this work.

Species presented in table 4 show a great variety of the chromosomes number, from species with small chromosomes number as is the case of *Carthamus lanatus* (2n = 14), to a great chromosomes number as in the case of *Pteridium aquilinum* (xn = 52).

Table 4

Chromosomes number and ploidy degree of studied invasive species

Species	Chromosomes number*	Ploidy degree*
Euphorbia cyparissias L.	20, 40	P
Juncus effusus L.	40	P
Carduus acanthoides L.	22	D
Eryngium campestre L.	14, 28	P
Dipsacus laciniatus L.	16, 18	D
Carlina vulgaris L.	20	D
Xanthium spinosum L.	36	P
Carthamus lanatus L.	14	D
Pteridium aquilinum (L.) Kuhn	52	P
Rosa canina L.	21, 28, 35	D
Crataegus monogyna Jacq.	34	D
Prunus spinosa L.	32	P
Rubus caesius L.	28	P
Ononis spinosa L.	30, 32	D
Sarothamnus scoparius (L.) Wimmer	46	D

D – diploid; P - polyploid

* KOVACS, 1979

CHAN (2005) shows that invasive species have in average 50 chromosomes, and the rare and endangered species have 30; but REJMANEK (2000) support the reverse of this affirmation, associating the invasivity of a species with a small chromosomes number, respectively a small genome.

Concerning the ploidy degree of the analysed species can be noticed that diploids are 53% from total, and polyploids are 47%, the difference between these two categories being small.

CHAN (2005) has noticed in a sample of 1182 species that from the diploids total 70% are rare or endangered, and from the ployploids total 80% are invasive.

BLOSSEY *et al.* (2003) shows that one of the most spread worldwide invasive species (*Phragmites australis*) has populations with different ploidy degrees: triploid, tetraploid and hexaploid, but tetraploids dominate from all of these.

Some of the analysed grasslands are invaded by few species in the same time. In western Romania are frequent two or three invasive species in the same plot, e.g.: Cheglevici (*Rosa canina* and *Prunus spinosa*), Cenei (*Xanthium spinosum* and *Carduus acanthoides*), Stamora (*Carduus acanthoides* şi *Carhamus lanatus*), Ionel (*Carduus acanthoides, Eryngium campestre* şi *Ononis spinosa*), Cenei 2 (*Eryngium campestre, Euphorbia cyparisias*, and *Ononis spinosa*), Gelu (*Carduus acanthoides, Eryngium campestre*, and *Euphorbia cyparissias*), Sânnicolau Mare (*Eryngium campestre* and *Carduus acanthoides*), Bucoşniţa 2 (*Crataegus monogyna, Rosa canina, and Eryngium campestre*), Bucoşniţa 4 (*Crataegus monogyna and Rosa canina*), Surduc (*Crataegus monogyna, Prunus spinosa, and Rosa canina*).

As BOOTH *et al.* (2003) says, when set, an invasive species can facilitate the invasion of other species. Following this theory, vegetation community became more invasible, making possible the increase of species number that invades that ecosystem.

After other authors (LEVINE & D'ANTONIO**,** 1999) the presence of some invasive species in the same community is determined by the fact that the biotope is favourable for a wide range of species.

For every species studied here, we have realised the diagram for the dynamics of grassland surface occupation, having in view to establish the invasive potential of these plants (fig. 1 and fig.2).

Surface covering models presented in fig. 1 and fig. 2 are framing in the radial expansion model described by COUSENS & MORTIMER (1995), which shows that the invasive plants are expanding through a circular advancing front. Thus, initial surface occupied is increasing whit a half from the radius of the former generation, and the expanding rate is constant.

The small differences appeared in the most of the cases can be explained with a theory formulated by MAXWELL *et al.* (2003), which says that some individuals from the former population are spreading at a smaller or bigger distance far from the invasion source forming a satellite population of that species. Satellite populations will act as a new invasion source continuing to increase in the same way with the original source.

In this study we have a species that isn't respecting the expanding rules presented before. This is represented by *Xanthium spinosum*, which in 2004 is doubling the surface occupation coefficient from $1m^2$ to $2.08m^2$ showing an explosive increase of the population, and during 2005 is almost stopped ($2.24m^2$). An explanation for this comportment can be that the environment became improper for the own species, probably through the accumulation of some substances that disturb the development of their own descendants.

These results can be important in the study and prediction of these species spread in grasslands from this geographical area. Also, they can be used as model for other species study during short time intervals (3-4 years), and for protected areas.

These can be useful in the management of these problems, and in the ecological reconstruction of the areas affected by plant invasion, through the establishment of the priorities, or to anticipate the potential impact of these species on the native vegetation.

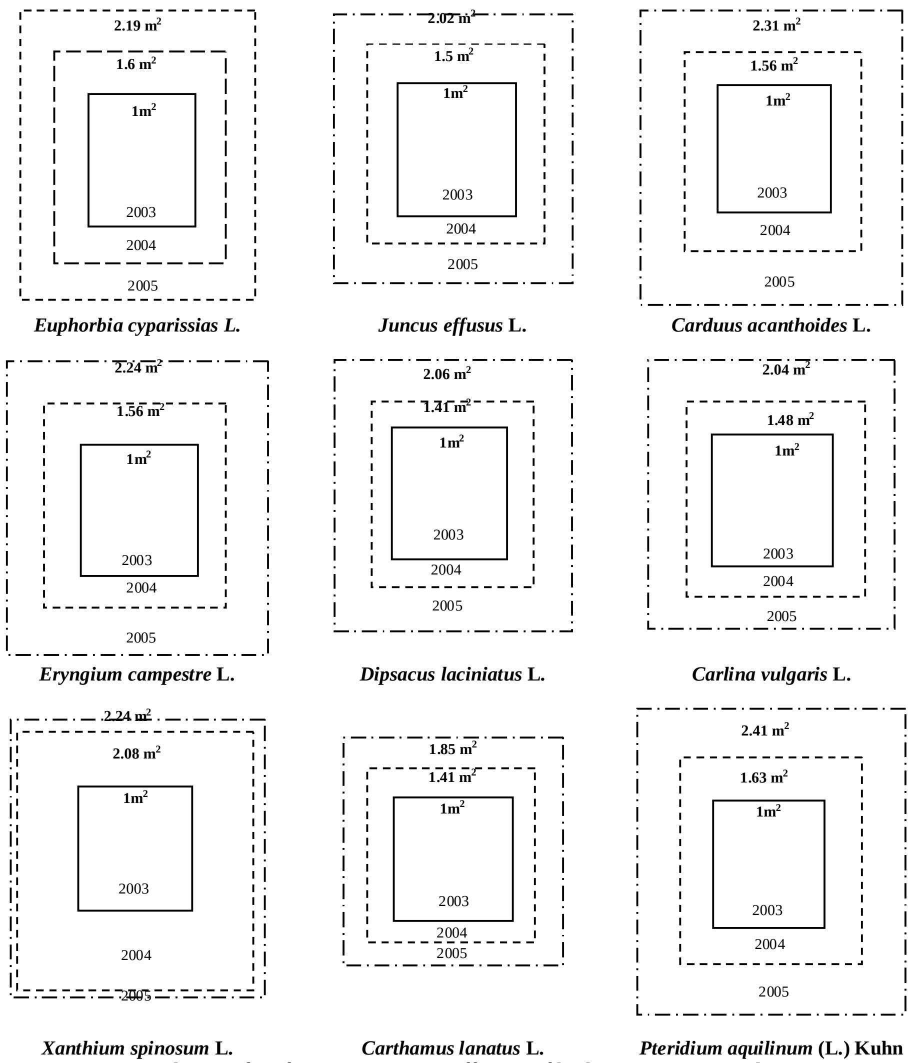

Figure 2. Evolution of surface occupation coefficient of herbaceous invasive plant species

CONCLUSIONS

After the analysis of our results, we can conclude:

- grasslands affected by plant invasion are usually invaded by more than one species;
- surface covering models of the studied species follows the dynamics of invasive species (except *Xanthium spinosum*) expanding through a circular advancing front; some small differences appeared in the most of the cases can be explained with the satellite population theory;

• although this study is realized at local scale, the results obtained are applicable at regional scale, in this case western Romania.

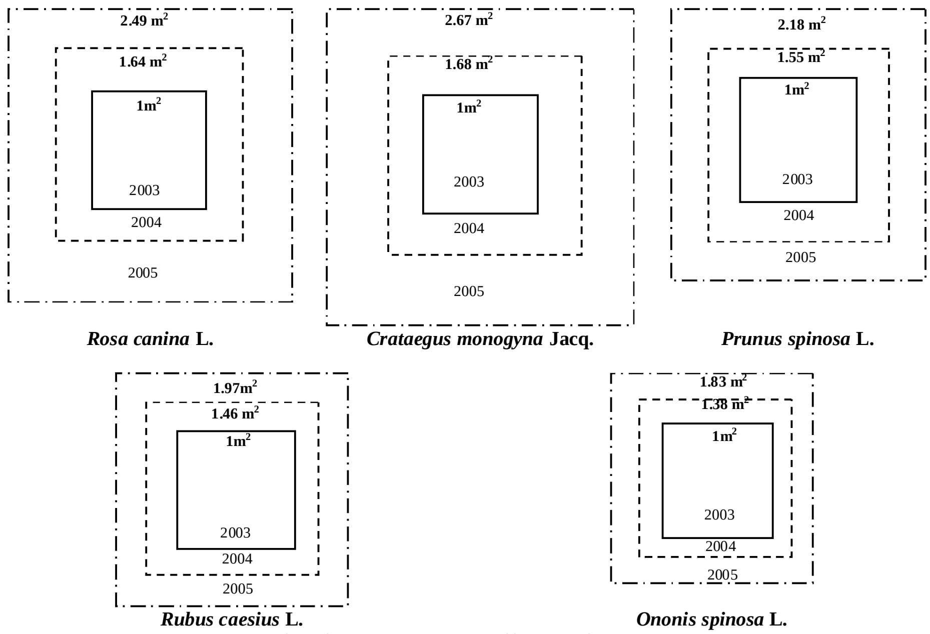

Figure 3. Evolution of surface occupation coefficient of shrub invasive plant species

Results presented here can be important in prediction of invasive species spread in grasslands at this regional level. We can anticipate the evolution trend of coverage index of these invasive species only determining its relative coverage at a certain moment. The methods used for this species can be applied also for the study of other invasive or potentially invasive species.

These results will be used finally as tools for ecological reconstruction of the grassland surfaces affected by invasive plant species especially for prevision necessary for a proper control of this species.

We are looking far to apply them also for any herbaceous communities from protected areas. We need this kind of tools to prevent the habitat loses of the native species in these areas, which are affected more or less by invasive species.

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