AAB BIOFLUX
Advances in Agriculture & Botanics-
International Journal of the Bioflux Society

Ecological research concerning the forest vegetation at the pioneer stage in the Bucovina Ridges area, Suceava, Romania

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Abstract. The interactions occurred at the pioneer stage which subsequently directs the evolution of composition and vegetation structure still present many unknown facts, the studies being related to a reduced number of ecosystems. The study was conducted in two forest ecosystems from the Bucovina Ridges area, differentiated by ecological factors and component species but being at the same evolution stage (pioneer stage). The aim of this research was to determine the interactions and the interspecific association pattern according to certain ecological gradients, the species diversity and the interspecific competition's level. For the studied ecosystems, there were identified a number of 17 species for each type of habitat and 28 species in total, some of the species being common to both ecosystems. The identification of the constant species, the general and specialized ones has highlighted the influence of ecological conditions from the two habitats but also the type of disturbance. The types of identified associations can be used for ecological reconstruction works of similar habitats from the Bucovina Ridges. The species diversity pointed out the presence of certain ecosystems with low stability, an aspect characteristic for the pioneer stage. The two ecosystems differentiate themselves by their species diversity, the ecosystem from Gura-Humorului region being a bit more developed. It can be therefore concluded that at this successional stage, the type of disturbance has the main role in the distribution and composition of the forest vegetation. The two ecosystems already contain, at the pioneer stage, main species (spruce, beech), which will direct the ecosystems through relations with the other species towards those described by the specialty literature for those areas.
Key Words: Forest ecology, general and specialized species, interspecific associations, specific diversity, spruce, beech.

Rezumat. Interacțiunile care apar în stadiul pionier și care dirijează ulterior evoluția compoziției și structurii vegetației prezintă încă multe necunoscute, studiile fiind raportate la un număr redus de ecosisteme. Studiul s-a realizat în două ecosisteme forestiere din zona Obcinilor Bucovinei, diferențiate prin factorii ecologici și speciile componente, dar aflate în același stadiu de evoluție (stadiul pionier). Scopul lucrării a constat în determinarea interacțiunilor și a tiparului asocierii interspecifice în funcție de unii gradienți ecologici, a diversității specifice și a nivelului competiției interspecifice. Pentru ecosistemele studiate s-au identificat un număr de 17 specii lemnoase pentru fiecare tip de habitat și 28 de specii în total, existând și specii comune celor două ecosisteme. Identificarea speciilor fidele, a celor generaliste și specializate au indicat influența condițiilor ecologice din cele două habitate, dar și a tipului de disturbanță. Tipurile de asocieri identificate pot fi utilizate pentru lucrări de reconstrucție ecologică a unor habitate asemănătoare din zona Obcinilor Bucovinei. Diversitatea specifică a indicat prezența unor ecosisteme cu stabilitate scăzută, aspect caracteristic stadiului pionier. Cele două ecosisteme se deosebesc prin diversitatea specifică, cel din zona Gura-Humorului fiind puțin mai evoluat. Se poate deci concluziona că în acest stadiu successional tipul de disturbanță are primul cuvânt în distribuția și compoziția vegetației forestiere. Cele două ecosisteme prezintă deja în stadiul pionier specii principale (molid, fag), care vor dirija ecosistemele, prin relațiile cu celelalte specii spre cele descrise de literatura de specialitate pentru zonele respective.
Cuvinte cheie: Specii generaliste și specializate, specii lemnoase, asocieri interspecifice, diversitate specifică, molid, fag.

Introduction. The phenomenon which determines the modification and replacement of a type of phytocoenosis to another type is called succession (Cristea et al 2004). The succession of vegetation can have as a starting point, a nude field, on which there was any vegetation in the past, or a land where the vegetation was removed, as a result of a disturbance action, the colonization starting practically from zero (the primary

succession). Another case is represented by the one of the evolution starting from a pre-existing vegetal group, case in which the evolution will be more rapid (the secondary succession). The successional dynamics is made by chaining certain evolution stages which significantly modify the structure of the vegetal cover.

The pioneer stage of the vegetation represents the first evolution stage of phytocoenosis, the moment when the colonization with pioneer species starts (toleration to insolation and dryness) and when the ecological conditions realize a rigorous selection which allows the installation of a reduced number of species (Borza & Boscaiu 1965). The interactions which occur at the pioneer stage and which subsequently direct the evolution of composition and vegetation structure present many still unknown facts, the studies being related to a reduced number of ecosystems. The purpose of the research was the analysis of certain ecological aspects of the pioneer vegetation in the Bucovina Ridges area from two habitats differentiated by ecological factors and the succession type: i) the interactions between the component species and the type of interspecific association according to certain ecological gradients; ii) the species diversity of the vegetation characteristic for the two areas and aspects of the interspecific competition. The description of the area, the identification of interspecific associations and the determination of vegetation diversity in the studied locations offer information that can be used in studying the evolution directions of vegetation, the application of ecologic reconstruction works in similar areas and of biodiversity conservation.

Material and method

The study area. We included in this research two forest ecosystems around Bucovina Ridges (Figure 1) that are at the same evolution stage (pioneer stage), distinguished by ecological factors and component species.

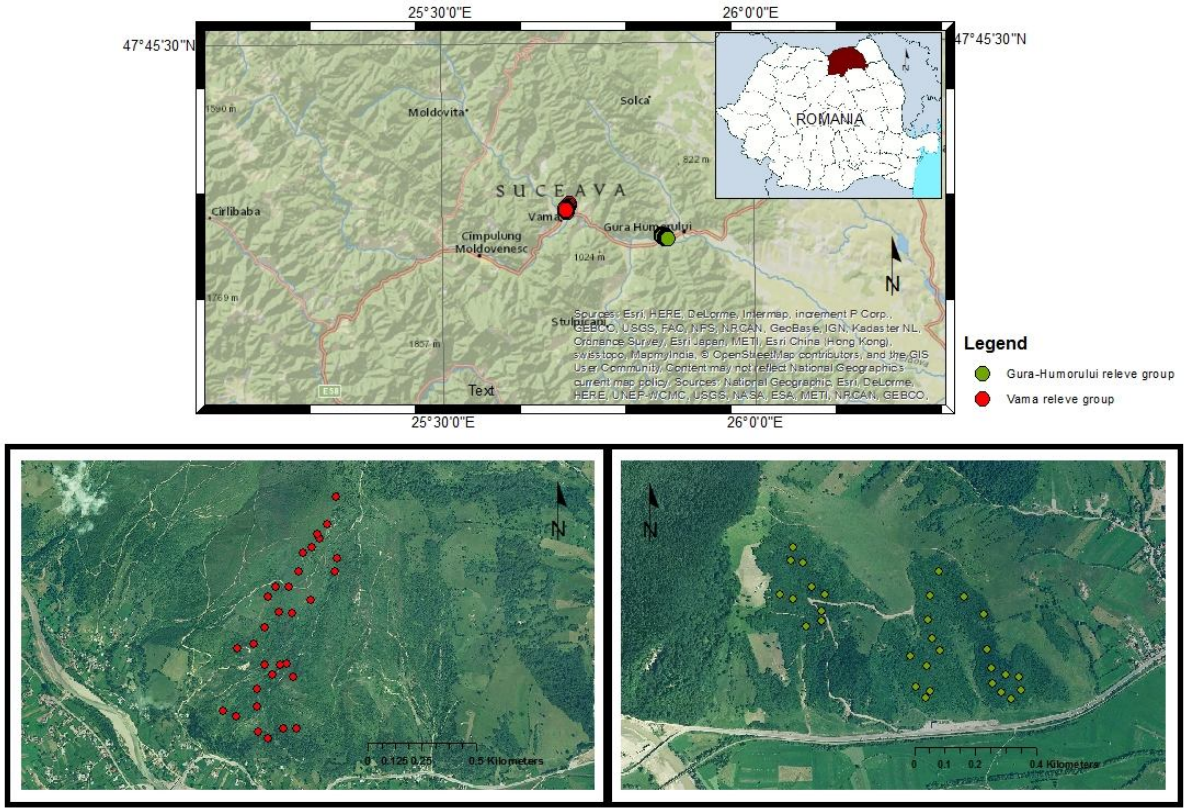

Figure 1. Study areas in the Suceava County (Obcinele Bucovinei).

Different types of disturbances affected these two ecosystems. Therefore, we have two types of successions. The ecosystem situated in the Vama area lies on the left flank of

Moldova River, bordering Moldoviţa River and Feredeu Ridge in the West and the Great Ridge in the North-East and it consists of spruce forests formerly affected by severe windfalls. On the other hand, the ecosystem from Gura-Humorului region lies on the same side of Moldova river, bordering Humor river in the West and the Great Ridge in the North and it comes under the pattern of the primary succession, the forestry vegetation being on a land degraded by grazing, on which there was no forest vegetation in the past or from which this was removed completely a long time ago.

Data collection. The data collection was made according to the methodology proposed by Piticar & Cenusă (2014) in a study conducted on forest vegetation in the pioneer stage of a primary succession. Data from the specified research was taken in order to make a comparison with the characteristics from the Vama study area. A number of 60 surveys were analyzed, 30 for each habitat. For a complete analysis, we determined the dominant abundance indices on the field, proposed by Braun-Blanquet & Pavillard (1928) visually appreciating the cover degree of each species from the surveyed area.

Data analysis. For the phytosociological characterization of the pioneer vegetation, we used quantitative phytopopulational and phytocenotic indices. The vegetation's analysis was realized with the help of Juice soft developed at Masaryk University of Brno, Czech Republic. In the present work, the optimized version Juice 7.0.45 was used.

Phytopopulational indices. The average cover proposed by Barkman (1989) implies its calculation by adding up the cover percentage from each survey and relating the value to the total number of surveys. This index allows the determination of the average cover for a group made up of several surveys. The surveys of the group for which the cover value is 0 are not excluded from the calculation (Tichý et al 2011). The frequency is defined as being the probability of a species to appear on a test area. For the present work we determined the species frequency for the two groups of surveys made in the studied areas.

Phytocenotic indices. The fidelity of species was determined with the help of phi coefficient. This is used in order to determine the association between species and associations or units of vegetation within a studied ecosystem and it is used as an index of fidelity (Tichý et al 2011). The determination of fidelity with the help of this coefficient eliminates the influence of abundance and dominance, taking into account only the presence or absence of species. With the help of the Fisher exact test, the significance level of the fidelity was also determined.

The social behaviour of species. The generalist plants are represented by species with a large ecological amplitude and tolerance towards anthropical disturbances, with high adaptability to habitat conditions and which play a very important role in the stability of phytocoenosis (Bărbos & Târziu 2009). Specialized plants are represented by species which tolerate certain habitat conditions, being less competitive. These have a lesser ecological amplitude but are very important in phytocoenosis researches, being sensitive indexes of them. The determination of generalist and specialist plants was made with the dissimilarity Pairwise Jaccard beta diversity index (Manthey & Fridley 2009) which is based on determining the average dissimilarities between all pairs of samples from each group where a certain species appears. The association of species was determined with the help of interspecific association function of Juice soft. This analysis was developed by (Bruelheide 2000) and represents an analysis method of the vegetation by determining the groups of species which appear together in large habitats or in different habitats. According to Bruelheide (2000) there are many methods to use Cocktail algorithm. The first one would be based on its application on known vegetation units, already delimited. The algorithm estimates the fidelity of species from the chosen group and chooses the species with the highest value of the Phi coefficient as the main species of the group. The second case is represented by the use of the algorithm in the case of certain preselected species which were tested, determining their capacity to form groups or associations. In the present work the Cocktail algorithm was used for testing interspecific associations between a selected species and the other species of the vegetation unit (Tichý & Bruelheide 2002).

Response of the species towards the modifications of certain stational conditions was studied with the help of the model proposed by Huisman et al (1993). This is based on the abundance or the presence/absence study of a species according to the modifications of certain ecological factors. The model simplifies reality, rendering the unimodal connection of the species to the ecological gradients. For the HOF model, in this study we determined the optimum and the tolerance of the species according to altitude, insolation, inclination and exposition. The optimum is a value of the ecologic gradient used, for which the species presents the highest probability to appear or spread. The tolerance represents the value of the gradient for which the probability of a species to appear is higher than half of the maximum apparition probability (Tichý & Jason 2006). The analysis in main components was also used for highlighting the vegetation's spatial distribution according to ecological factors.

The species diversity was determined with the help of Shanon Wiener index. It expresses the organisation degree of a system.

$$H = -\sum_{i=1}^{S} p_i \ln p_i \ ;$$

Where: p_i = ni/N; H- Shanon-Wiener index; pi – the cover percentage of each species; ni- number of individuals for each species; N – the total number of individuals of the studied area.

Ecological gradients (altitude, inclination, exposition and insolation) were determined for each survey according to geographical coordinates, the digital pattern of the land being made with the help of Arcgis 9.3 application.

With the help of these indexes we tested the species diversity of the vegetation classes and the influence of certain environmental factors over biodiversity. The statistical analysis of some of the data was made with the help of Xlstat, Juice and R softs.

Results and Discussion

The description of pioneer vegetation from the forest ecosystem studied with the help of quantitative phytopopulational and phytocenotic indices. For the studied ecosystems, a number of 17 wooden species for each type of habitat and 28 species in total were identified, some of the species being common to both ecosystems (Table 1). For the Bucovina Ridges area, the number of species for phytocoenosis in the pioneer stage is characteristic, also being met in other studies (Piticar & Cenușă 2014; Cenuşă et al 2004). The ecosystems in the pioneer stage from this area are characterized by the high frequency of pioneer species that succeed to colonize and use, in the first stage, the degraded lands affected by disturbances and which present deficiencies in supplying with nutrients.

The species with high fidelity for a certain habitat carry information related to the stational or even microstational modifications from a phytocoenosis. Being characteristic for certain types of associations, they were considered, in the Braun-Blanquet system, differential species, being used for delimiting vegetal associations (Jennings et al 2009).

The significance level of species fidelity for a certain habitat was determined with the help of Fisher test, for significance values of $p<0.001$, which means that there is a highly significant relation between constant species and the studied habitats conditions. In the ecosystem from Vama the main species, with the largest coverage are goat willow, spruce and poplar (Table 1). The ecosystem around Gura-Humorului area has as main species the hazel, the hawthorn and the hornbeam. The other species identified in the two ecosystems record cover percentages of up to 10%, appearing in a disseminated way or on limited areas with high coverage values in those surveys, aspect due probably to certain microstational differentiations which allowed their installation.

Table 1

Synoptic table of vegetation from two different habitats from Obcinile Bucovinei

Habitat characteristics		*Vama (forest ecosystem affected by windfalls)*		*Gura-Humorului (land degraded by grazing)*	
Number of surveys		30		30	
Average altitude (m)		713.08		566.01	
Average inclination (degrees)		16.91		23.51	
Insolation (kwh/m^2)		916.9		848.8	
Ecological index fitopopulational/quantitatives		Fr/Fid	Cover	Fr/Fid	Cover
Species					
Salix caprea L.	Vama ecosystem characteristic species	80 $^{81.6}$	31.8	. $^{---}$	---
Alnus incana (L.) Moench		3 $^{---}$	0.7	. $^{---}$	---
Betula pendula Roth		63 $^{68.1}$	9	. $^{---}$	---
Rubus hirtus Waldst. & Kit. s. l.		10 $^{---}$	2.7	. $^{---}$	---
Sorbus aucuparia L.		20 $^{---}$	4.7	. $^{---}$	---
Acer platanoides L.		3 $^{---}$	0.2	$^{---}$	---
Rubus idaeus L.		7 $^{---}$	4.4	$^{---}$	---
Salix viminalis L.		3 $^{---}$	0.5	$^{---}$	---
Larix decidua Mill.		7 $^{---}$	2.3	$^{---}$	---
Sambucus racemosa L.		3 $^{---}$	0.2	$^{---}$	---
Pyrus pyraster L. Burgsd.		3 $^{---}$	0.1	$^{---}$	---
Rosa canina L. s. l.	Common species	7 $^{---}$	0.6	30 $^{---}$	2
Corylus avellana L.		17 $^{---}$	4.8	83 $^{66.7}$	34.9
Fagus sylvatica L.		13 $^{---}$	2	43 $^{---}$	3.7
Populus tremula L.		60 $^{48.4}$	12.2	13 $^{---}$	4.6
Picea abies (L.) H. Karst.		77 $^{71.0}$	23.8	7 $^{---}$	0.2
Abies alba Mill.		3 $^{---}$	0.2	3 $^{---}$	---
Cornus sanguinea L.	Gura Humorului ecosystem characteristic species	---	---	67 $^{70.7}$	6.5
Carpinus betulus L.		---	---	77 $^{78.8}$	19.2
Crataegus monogyna Jacq. s. l.		---	---	83 $^{84.5}$	25.4
Juniperus communis L. s. str.		---	---	3 $^{---}$	0.08
Malus sylvestris Mill.		---	---	10 $^{---}$	0.2
Acer campestre L.		---	---	33 $^{44.7}$	4.7
Prunus avium (L.) L.		---	---	20 $^{---}$	0.3
Ulmus glabra Huds.		---	---	3 $^{---}$	0.1
Acer pseudoplatanus L.		---	---	3 $^{---}$	0.08
Tilia cordata Mill.		---	---	7 $^{---}$	0.1
Sambucus nigra L.		---	---	3 $^{---}$	0.2

Fr – frequency, Fid – fidelity, Cover – Barkman cover.

For the Vama area, the species loyal to the local stational conditions are the goat willow (*Salix capraea*) and the birch (*Betula pendula*) from the species which are found in the two ecosystems. From the common species, we distinguish as species loyal for this ecosystem, the spruce (*Picea abies*) and the poplar (*Populus tremula*), provided the placement of the ecosystem in the *P. abies* phytoclimatic floor. The presence of the *P. abies* as a loyal and dominant species in this ecosystem is due to the type of succession (secondary succession) which allows the ecosystem to return more quickly to its balanced state. Also, the habitat is situated in the *P. abies* ecological optimum zone, aspect which allows it to have a behavior similar to pioneer species.

The species that are loyal to the habitat from Gura-Humorului are the hawthorn (*Crataegus monogyna*), with the highest fidelity, followed by hornbeam (*Carpinus betulus*), dogwood (*Cornus sanguinea*) and field maple (*Acer campestre*). Among the common species, although distributed in both habitats, the hazel (*Corylus avellana*) is characteristic for the stational conditions from Gura-Humorului area.

This is due to grazing, disturbance which significantly influences the distribution of certain species. Among the common species of the two ecosystems, we can notice the particular case of species like *C. avellana*, respectively the *P. tremula*. *P. tremula* is found in both ecosystems but being less adapted to the type of disturbance which acts in the habitat from Gura-Humorului, it keeps its loyalty to the forest ecosystem, unaffected by this type of disturbing factor. On the other side, the *C. avellana*, a species with zoochoric dissemination and high vegetative regeneration capacity is perfectly adapted to the conditions from Gura-Humorului. Also, species like *C. monogyna*, *C. betulus* and *A. campestre* are species that can survive the anthropical pressure induced by intensive grazing. We can therefore say that besides the ecological characteristics, the type of disturbance influences the species' fidelity.

It can also be noticed that the cenotic fidelity of species is closely connected to the frequency of pioneer species identified, an aspect also mentioned by Borza & Boșcaiu (1965). Species with high frequency are also constant and loyal. The differentiated conditions and the type of disturbance which act in the two habitats led to the colonization of certain characteristic species.

The specialization and interactions between individuals from the vegetal community and the ecological factors. In the ecosystem from Vama region the generalist species are represented by the *S. capraea* and the *P. abies*, these two having a high ecological amplitude for the respective areas, covering all of the ecological niche and the specialized plants are represented by *B. pendula* and *P. tremula*, pioneer species which are resumed to the colonization of the ecological niche's area in which the stational conditions are less favorable (Table 2).

Table 2

Habitat specialization: generalist species, specialized species

Species	*Habitat type*	*Average richness*	*Fr.*	*Sp.*	*θ – Mean values*
Salix capraea	Vama (forest ecosystem affected by severe windfalls)	4	24	11	0.540
Betula pendula		4	19	9	0.478
Populus tremulla		4	18	9	0.415
Picea abies		4	23	11	0.522
Fagus sylvatica	Gura-Humorului (land degraded by grazing)	6	13	12	0.407
Cornus sanguinea		5	20	11	0.473
Coryllus avellana		5	24	12	0.499
Carpinus betulus		5	23	12	0.519
Crataegus monogyna		5	25	12	0.544

Fr –frequency, Sp. – the number of species from the sample group in which the analyzed species occurs,
θ – value based on betadiversity calculated from a fixed number of plots, where the analized species occurs,
θ >0.5 define a generalist species; θ < 0.5 define a specialized plant (Mayor et al 2015).

The generalist species typical to the ecosystem from Gura-Humorului area are represented by *C. monogyna* and *C. betulus*, plants which according to the "theta" values are considered moderately generalist species, covering almost entirely the ecological niche (Table 2). The specialized species are represented by beech (*Fagus sylvatica*), *C. sanguinea* and *C. avellana*, occupying only some portions of the niche. The average species richness (Table 2) of the surveys occupied by the generalist and specialized species from Vama area indicates the formation of certain vegetal groups similar in structure and stability. In the case of Gura-Humorului area, the species richness presents slightly higher values. This fact can be due to the intensive grazing which provokes a deceleration of the evolution at this stage, but stimulates vegetative regeneration and the zoochoric transportation of seeds (Walker & Del Moral 2003), also influencing the species diversity, aspect which directs the vegetation's evolution towards systems with higher complexity and functions.

The species response towards ecological gradients. The ecological gradients have a very important role in the spatial distribution of species in a phytocoenosis. In the studied habitats the influence of altitude, inclination, insolation and exposition over the pioneer species was analyzed (Figure 2).

The altitudinal gradient clearly limits the penetration of the *C. betulus*, the *C. sanguinea* and *C. monogyna* in the habitat from Vama area, their optimum and tolerance being limited in the altitudinal interval identified in the habitat from Gura-Humorului. *C. avellana* is also present in the habitat from Vama and the optimum of its distribution is registered between 500 and 600 m.

The species which colonizes the middle altitudinal interval (600-800 m) are represented by *P. abies*, *P. tremula* and *S. capraea* with differences due to local stational conditions.

F. sylvatica is the species which tolerates the entire altitudinal interval studied, but its optimum distribution is at 700 m altitude. *B. pendula* is the species which develops in the upper part, at high values of the altitudinal gradient, its optimum for the studied habitats being at 900 m altitude.

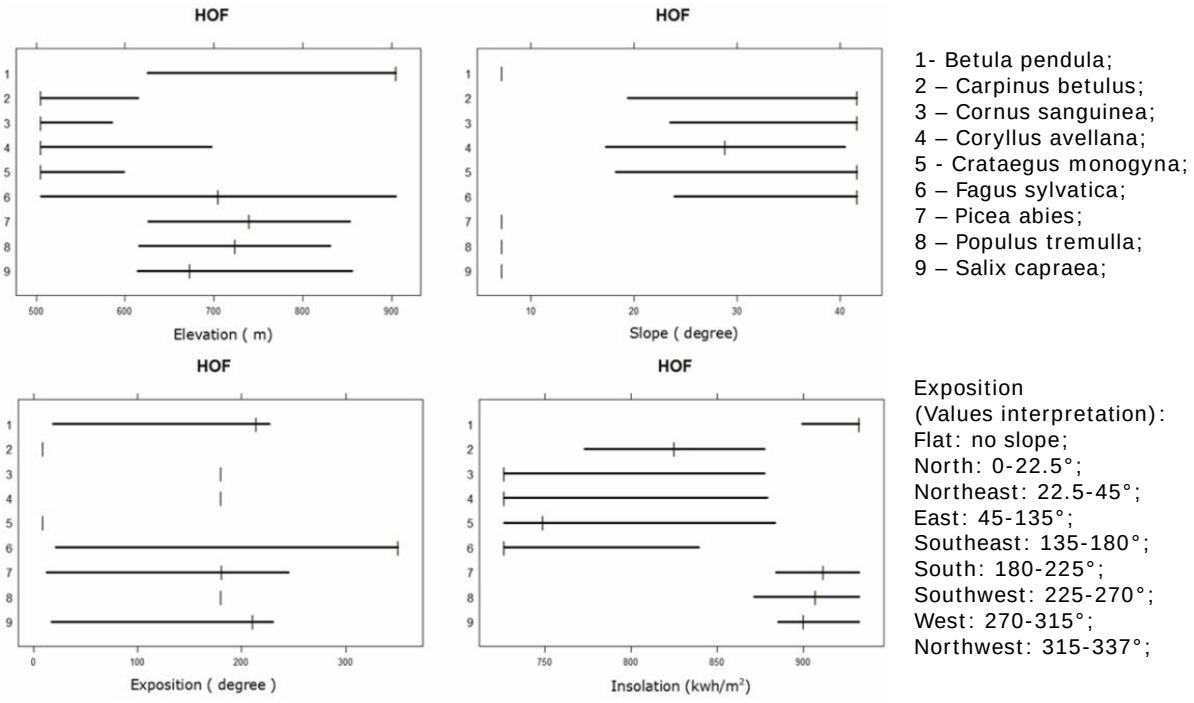

Figure 2. The optimum and the tolerance of species towards some ecological gradients.

Inclination. The study of the inclination's influence over the species indicates the presence of *P. abies*, *P. tremula*, *S. capraea* and *B. pendula* on slopes of not more than 10 degrees, these species occupying the areas with deeper soil and probably richer in nutrients. On the other side, *C. betulus*, *C. sanguinea*, *C. avelana*, *C. monogyna* and *F. sylvatica* colonize the areas with slopes between 20-40 degrees, with soils that are poorer in nutrients and a thinner.

In the studied areas the exposition is predominantly southern but we can distinguish the preferences of certain species for areas with other types of exposition. *B. pendula*, *C. sanguinea*, *C. avelana*, *P. abies* and *P. tremula* prefer south-eastern and southern expositions while *C. betulus* and *C. monogyna* prefer north-eastern expositions, less insolated. *F. sylvatica* is distinguished as a species with a strong shadow character, colonizing especially the areas with north-western and Northern expositions.

Insolation is one of the most important ecological gradients, partially including the effect of the altitude, of the inclination and the habitat's exposition. The species which colonize the strongly insolated areas of the habitat are exactly the species with a powerful pioneer

character (*S. capraea, B. pendula, P. tremula*), excepting *P. abies* which although it's a semi-shadow species, it strongly colonizes these areas, because it is situated its ecological optimum range. Insolation is not a limitation for this species in the studied habitats. On the other hand, *C. sanguinea*, *C. avelana*, *C. monogyna* and *F. sylvatica* have a higher tolerance towards this gradient but the distribution optimum has lower values for insolation. For *F. sylvatica* this aspect is normal, since it is a species with a strong shadow character. *C. betulus* is situated somewhere in the middle of the insolation interval, with values between 780-820 kwh/m^2.

The generalist and specialized species are found in two ecosystems situated in two different types of station. However, there are common species, which indicate that the two ecosystems are pretty close. Important species from Vama area (generalist – *B. pendula*, *P. tremula*; specialized – *P. abies, S. capraea*) are found according to Doniţă et al (2005) in the South-eastern Carpathian, *P. abies* and fir (*Abies alba*) forests with *Pleurozium schreberi* area in stations at 600-1000 m high, on slopes with low inclination, or plateaus, with precipitations of 700-900 mm, where we can find *P. abies*, *A. alba*, *B. pendula*, *F. sylvatica*, *C. avelana*, black elder (*Sambucus nigra*) and red elder (*Sambucus racemosa*). Moreover we can also find species from cut woods habitats from the broadleaf floor of *F. sylvatica* forests, situated between 700-1400 m, on slightly inclined slopes, with the same water regime and annual precipitations between 800-1200 m (raspberry tree *Rubus idaeus*, blackberry tree *Rubus hirtus*, *S. capraea*, rowan *S. aucuparia*, *P. tremula*). We can conclude that the habitat studied in the Vama area presents variations due to the existence of species that are characteristic for the two types of stations, some local ecological gradients limiting or facilitating their presence.

The Gura-Humorului area is characterized, at this stage, by species which are usually found in *C. avelana* shrubs situated in stations with altitudes between 600-1000 m, annual rains of 800-900 mm, from the hilly and mountainous areas (Doniţă et al 2005). In these habitats *C. avelana* dominates the shrub layer, aspect noticed in the studied area. A particular case is that of the abundant presence of *C. monogyna* in certain areas, this species having a very wide cover. This fact is due to successional aspects and also to the inclination which influences the edaphic characteristics. *C. avelana* next to *P. tremula*, avoids dry soils (Clinovschi 2005), these types of soils belonging to *C. sanguinea* and *C. monogyna*. *C. monogyna* and *C. betulus* are the species which tolerate most of the microstational modifications in Gura-Humorului area, being considered generalist species. The presence in a larger number of specialized species indicates stational variations. *C. avelana* although it is a predominant species, it is exclusively grouped in areas with more humid soils, giving up the less humid areas to the species mentioned above, being considered a specialized species. *F. sylvatica* appears generally in shadowy areas, with North-Eastern or North-Western exposition, slightly more humid.

Interspecific relationships. Studying the social behavior of species, we can determine the complexity of structures and associations made up inside habitats due to the variations of certain stational conditions or to the pronounced interspecific competition at this evolution stage.

For the ecosystem from Vama area, affected by windfalls, it seems that species which dictate the competition and the habitat's colonization make associations with a smaller number of species than in the case of the ecosystem affected by grazing and intense erosion from Gura-Humorului area (Table 3).

Therefore, in Vama, *S. capraea* will make up more complex structures, because it is positively associated to 10 wooden species, while *B. pendula*, due to its stronger pioneer character, will occupy a portion of the ecological niche where a small number of species are competitive. Among the main species of this ecosystem, it seems that *P. tremula* can vegetate in all conditions indicated by the other three species, while latter ones reject each other occupying particular areas of the ecological niche.

In Gura-Humorului the habitat has more complex structures, the main species associating with a larger number of disseminated or occasional species (Table 3).

Table 3

Interspecific associations in studied areas

Habitat type	*Vama – forest ecosystem affected by windfalls*				*Gura-Humorului (land degraded by grazing)*				
Species	*Salix capraea*	*Betula pendula*	*Populus tremulla*	*Picea abies*	*Fagus sylvatica*	*Cornus sanguinea*	*Coryllus avellana*	*Carpinus betulus*	*Crataegus monogyna*
Sc		-	+	-					
An	+	+	-	-					
Mac	+	-	-	-	-	-	-	-	+
Me	-		+	-					
Mu	+	+	+	-					
Sco	-	+	-	-					
Al		-	+	+	+	+		+	-
Fa	-	-	-	-		+	+	+	-
Pl	+	+		+	-	-	-	+	+
Mo	-	-	+		+	+	+	+	+
Pac	+	+	+	+			+		
Br	+	+	+	+	-	+	+	+	+
Par	+	-	+	+					
Zm	+	-	-	+					
Sv	+	-		+					
La	-	+	-	-					
Sr	+	-	-	+					
San					+		+	+	+
Ca					+	+	+		-
Pad					-	+	-	-	
Ie					+	+	+	+	+
Mar					-		-	-	+
Jug					-	+	-	+	-
Ci					-		-	+	+
Ul					-	-	+	+	-
Pam					+	+		+	+
Te					+	-	+	-	+
Sn					-	-	+	-	+

+ positive association, - negative association, Sc - *Salix capraea*, An – *Alnus incana*, Mac – *Rosa canina*, Me – *Betula pendula*, Mu – *Rubus hirtus*, Sco – *Sorbus aucuparia*, Al – *Corylus avelana*, Fa – *Fagus sylvatica*, Pl – *Populus tremula*, Mo – *Picea abies*, Pac – *Acer platanoides*, Br – *Abies alba*, Par – *Pyrus pyraster*, Zm – *Rubus idaeus*, Sv – *Salix viminalis*, La – *Larix deciduas*, Sr – *Sambucus racemosa*, San – *Cornus sanguinea*, Ca – *Carpinus betulus*, Pad – *Crataegus monogyna*, Ie – *Juniperus communis*, Mar – *Malus sylvestris*, Jug – *Acer campestre*, Ci – *Prunus avium*, Ul – *Ulmus glabra*, Pam – *Acer pseudoplatanus*, Te – *Tilia cordata*, Sn – *Sambucus nigra.*

F. sylvatica has the smallest number of species with which it is associated on the studied area, because it is a species which appears in the more developed stages of the vegetation dynamics, in this stage being practically isolated from the other more competitive species. On the other side, *C. betulus* and *C. monogyna*, due to the wider ecological amplitude, occupy to a greater extent the ecological niche, making up associations with most of the species. Among the main species, *F. sylvatica* prefers *C. sanguinea, C. avelana* and *C. betulus* as associating species. *C. monogyna* is the species which rejects most of the main species. It is associated only with *C. sanguinea*.

The association of some species is due to their ecological requirements which are overlapping. The ecological interactions can be finalized by facilitating or restraining the presence of certain species (Sutomo et al 2011). Thus, we can distinguish the spatial distribution of species from each habitat and their affinity for different groups (Figure 3).

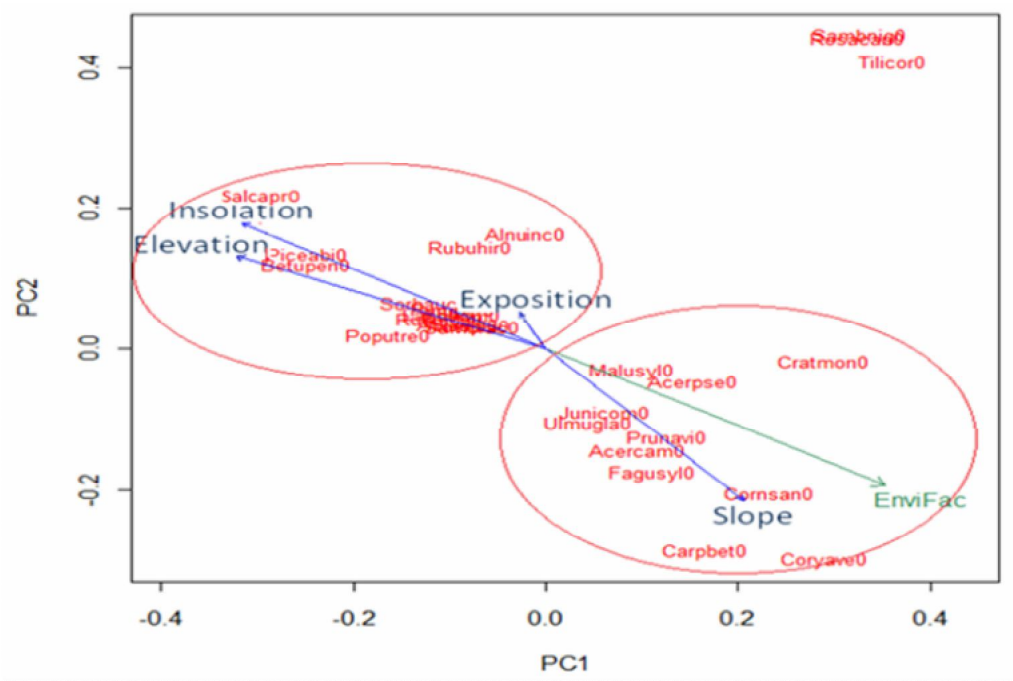

Figure 3. The influence of ecological gradients over the space distribution of vegetation.

The distance between generalist and specialized species expresses the dimension of the ecological niche and the interspecific interactions from the ecosystem of Vama area. Between *B. pendula* and *P. abies*, it seems that the inhibition has the most emphasized character because they occupy the same niche, having approximately the same ecological requirements. The climatic floor is the one of *P. abies* forests, aspect which helps *P. abies* to eliminate *B. pendula* in the future. *P. tremula* is the species which creates positive associations with most of species, being found in the most complex vegetal groups of the habitat.

In Gura-Humorului area, the inclination makes the difference in the plant species association. Due to the increased degradation of the land compared to Vama area, the inclination changes the edaphic characteristics (the soil humidity, nutrients, humus, etc.) determining the presence of xerophyte or mezoxerophyte species. Between *C. monogyna* and *C. sanguinea* there are positive interactions, aspect due to the ecological requirements of the two species. *C. monogyna* is a species which vegetates in strongly insolated and dry areas (Clinovschi 2005) and favors by its shadowing the presence of *C. sanguinea* which is tolerant to this factor. With the other generalist and specialized species, *C. monogyna* realizes negative associations, inhibiting each other.

Species diversity. The species diversity of the two areas has approximately the same value, a larger number of surveys with high species diversity being noticed in the case of the ecosystem from Gura-Humorului (Figure 4).

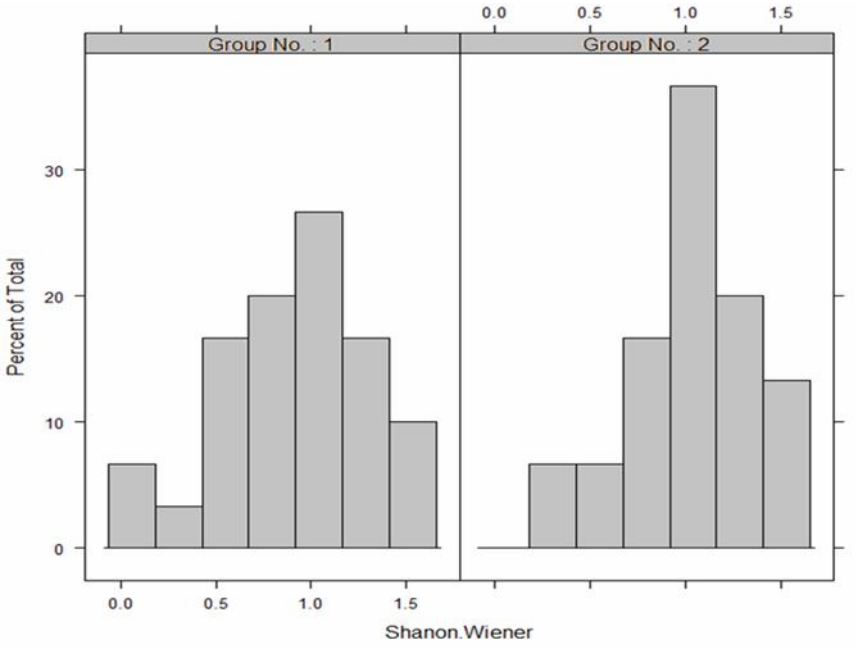

Figure 4. Vegetation diversity and stability in the pioneer stage.

Using the Shannon-Wiener index as a gradient, we studied the reaction of pioneer species towards the species diversity (Figure 5). Thus, for the two ecosystems from Bucovina Ridges, the species in the pioneer stage make up or participate to the development of different types of structures and associations. *C. sanguinea*, *C. avelana*, *S. capraea* and *F. sylvatica* make up associations in complex structures, with higher species diversity. On the other side, *P. abies* can be found in all of the structures present in the ecosystem, but prefers the ones with reduced species diversity. *B. pendula*, *C. betulus*, *C. monogyna* and *P. tremula* compose structures with a species diversity that is characteristic for this evolution stage, being more competitive than the ones in the composition of the most complex structures of the two habitats.

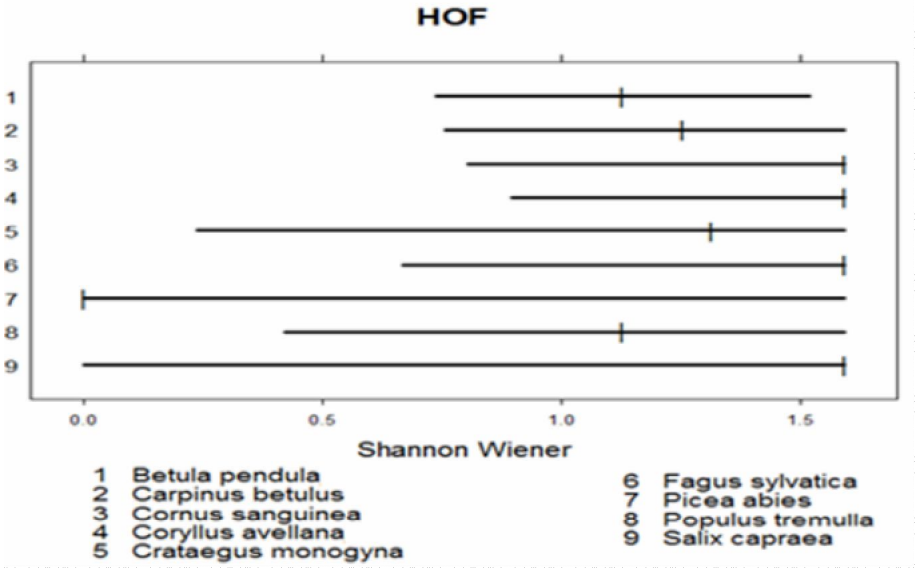

Figure 5. Response of generalist and specialist species to site diversity.

Species diversity explains the stability of the vegetal group's structure and the interspecific competition. Between the two studied habitats, it seems that the one from

Gura-Humorului has a slightly higher diversity. This aspect is due mainly to the type of disturbance (intensive grazing) which facilitated, by zoochoric transportation and soil degradation, conditions for the installation of a larger number of species. On the other side, the ecosystem from Vama is represented by strongly competitive species, which occupy large areas. *S. capraea*, *P. abies* and *B. pendula* are antagonistic species which reject each other and restrain or facilitate the presence of certain species, around them being created vegetal groups in different stages of cenotic balance.

Conclusions. The two studied ecosystems at the pioneer stage had as trigger different disturbance factors. The study pointed out the characteristics of the ecological niche and the affinity of the main species for the studied habitat. The loyal species of the two ecosystems clearly differentiate the two habitats. Among the ecological gradients used in this study, an important role in the spatial distribution of the vegetation for the habitat from Vama has the altitude and insolation and for Gura-Humorului area, the inclination is the one which determines the vegetation distribution's mosaic, because it controls the distribution of edaphic resources (the erosion harshens the vegetation conditions).

The identified generalist and specialized plants led to the definition of a species association pattern in the studied habitats and to the highlighting of certain important cenotical and interspecific interactions. The types of species associations indicate variations of the stational conditions in both habitats, aspect which must be studied in the future by delimiting certain vegetation classes which might highlight the interspecific connections and the relation between the type of vegetation and the ecological factors. Even so, the types of associations identified can be used for ecological reconstruction works of similar habitats from the Bucovina Ridges. The two ecosystems are distinguished by species diversity, the one in Gura-Humorului area being more complex. The interspecific competition is characteristic to the pioneer stage, being pronounced in both habitats.

We can conclude that at this successional stage, the type of disturbance has the most important role in the forest vegetation's distribution and composition. The two ecosystems already have, at the pioneer stage, main species (*P. abies* and *F. sylvatica*) which will direct the ecosystems towards the ones described by the specialty literature through relations with the other species.

Acknowledgements. This paper has been financially supported within the project entitled „SOCERT. Knowledge society, dynamism through research", contract number POSDRU/159/1.5/S/132406. This project is co-financed by European Social Fund through Sectoral Operational Programme for Human Resources Development 2007-2013. Investing in people!".

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Received: 01 September 2015. Accepted: 03 October 2015. Published online: 06 October 2015.
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How to cite this article:
Piticar M. A., Cenușă R. L., Grosu L., Dănilă I. C., 2015 Ecological research concerning the forest vegetation at the pioneer stage in the Bucovina Ridges area, Suceava, Romania. AAB Bioflux 7(3):174-186.