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Vascular Flora from Ecoton Zones of the Slatioara Secular Forest

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Abstract

The purpose of this study is to generate essential scientific information regarding the floristic composition and the structures of the ecotone vegetation in the natural forest Codrul Secular Slătioara, because so far no such studies have been carried out in this reserve. Also, the results of this study provide important data, which can be the basis for the development of strategies for the conservation and sustainable use of some herbaceous species, valuable due to genetic and socio-economic, respectively of a regular forest monitoring program. The floristic studies were carried out in the 2020 to 2021 vegetation season. Based on the specialized literature, plant species were identified and then processed from the point of view of bioforms, floristic elements and ecological indices. The economic categories in which the identified species fall were also analyzed. Thus, a total of 292 species belonging to 46 botanical families were identified and their distribution by ecosystems is as follows: in the forest, 90 species were identified, in the lands adjacent to the forest, in the meadows, 202 species were found and in the area of border, 120 species of vascular plants were identified. Most of the species identified in the study area are hemicryptophytes, heliophiles, and eurytherms, which grow on dry to moderately moist, eurytrophic soils. More than 50% of the identified species belong to several categories of useful plants (fodder, medicinal, melliferous, edible).

Keywords

Flora, Border, Bioforms, Floristic Elements, Ecological Indices, Economic Categories

1. Introduction

In the virgin forests, the phylogenetic development of the species, of their intraspecific variability, was not influenced by the artificial selection generated by man, thus the adaptive processes of the interactions of the species with their living environment remained intact.

Thus, the existence of this genetic diversity at the population level is vital for counteracting climate change and identifying the origins of tree and vascular plant species that adapt to these changes (Hohnwald et al., 2020).

At the same time, virgin forests that present a high degree of naturalness provide a living environment with relatively homogeneous ecological characteristics in which narrowly specialized (niche) species that depend on these constant environmental conditions grow and develop.

Forest edges, especially virgin forests, have received considerable attention in ecological literature, because they are key structural and functional components of landscapes (Kolasa, 2014; Guirado et al., 2006) influencing the flow of organisms, materials and energy (Cadenasso et al., 2003) and phytopopulation interactions (Fagan et al., 1999), these ecotone areas being niche habitats for many vascular plant species (Forman & Moore, 1992).

From a biodiversity conservation perspective, woodland edges can also be extremely important components of landscapes, as their habitat-scale diversity is sometimes expected to be greater than that of either of the two adjacent grasslands and woodlands (Kent et al., 1997).

Most studies of edge vegetation have focused on woody species, and consequently little is known about the impact of the edge on the vascular flora as a whole or how the edge flora may change over time (Matlack, 2012).

In this paper we aim to highlight certain botanical aspects present in the *Slatioara secular forest* reserve: species inventory and analysis of the main ecological indicators (humidity, temperature and soil reaction), bioforms and geographical elements of the identified species.

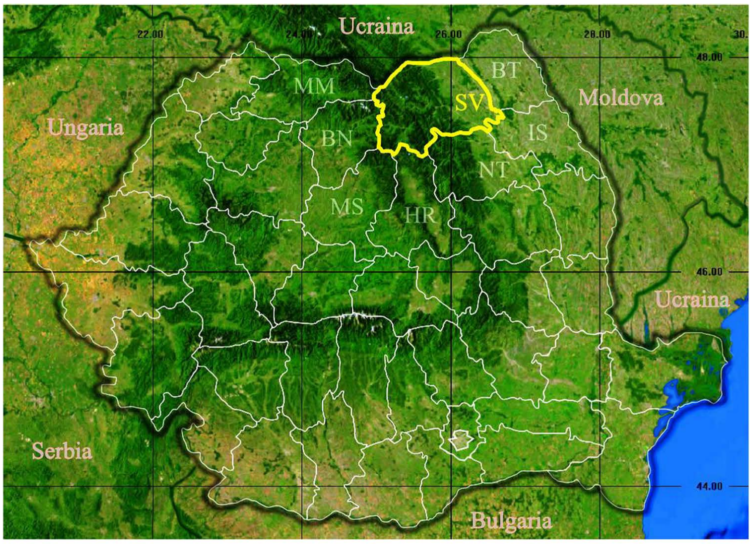
2. Materials and Methods

The research within this study was located in the *Slatioara secular forest* (Suceava county), area of the spruce forests of the Eastern Carpathians, on the eastern slope of the Rarău Massif (47˚27'N and 025˚38'E) at an altitude between 790 m and 1510 m (**Figure 1**).

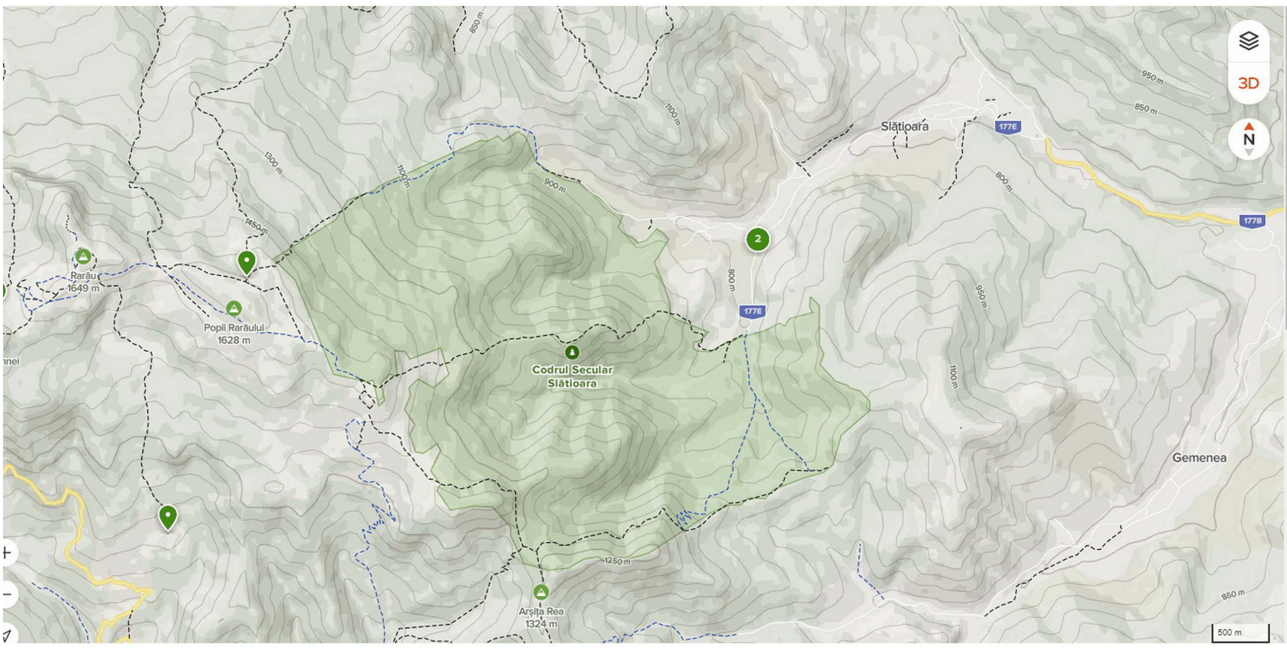
This natural reserve corresponds to IUCN forth category (management area for habitats/species: protected area managed especially for conservation), being one of the few old-growth forests which still exist in Romania and past management was based on very low intensity interventions, with no visible changes in the structure of the natural tree.

Slatioara secular forest has a moderate temperate continental climate, characteristic of the mountain climatic floor of coniferous forests, located in the interference zone between the climate of resinous and beech mixtures, relatively warmer and less humid (800 - 1100 m) with the climate of cold and wet spruce trees (1200 - 1600 m).

The composition of tree species consists of beech (*Fagus sylvatica*), fir (*Abies*



(a)



(b)

Figure 1. Location of the study area, the Slatioara secular forest reserve. (a) Marking the level curves in the Slatioara secular forest reserve; (b) Representation of the map of Romania specifying the position of Suceava county.

alba) and spruce (*Picea abies*) up to altitudes of about 1350 m and only the two conifer species at higher elevations where they alternate with pastures. At the same time, the vertical profile is very varied, multi-layered and heterogeneous with a composition and consistency dictated by the natural selection process of the species (Cenuşa et al., 2002). In order to achieve the objectives proposed by this study, we consulted the bibliographic material and the studies carried out by specialists in the area of interest.

In 2019, the field activity was carried out in the studied area, carrying out a systematic sampling through which a predetermined itinerary was followed in which the border areas were identified (shape and size), the presence of the species mentioned by the botanists in the analyzed works was checked, as well as the appearance new species.

Thus, 5 inventory areas were identified (**Figure 2**), these being visited in 2020-2021, several times during two growing seasons, in order to capture the period of maximum affirmation of the individuals of all the species present, starting with the pre-spring ones and ending with the summer-autumn ones.

The location of the sample areas was done subjectively to minimize the topographical variation within them and to avoid areas where the structure of the stand could be influenced by edaphic limitations.

In the 5 sampling areas, the 8 transects perpendicular to the edge were located, in which the vascular species present both in the forest habitats and the adjacent land (meadow) and in the respective edges were sampled (the edge of the forest was defined as a line of -along the ultra peripheral mature trees of a wooded area).

In order to standardize the characteristics of the edges, the transects were placed as follows: one transect each in zones 1 and 5 and two transects each in zones 2, 3 and 4 (**Figure 3**).

From the data recorded on the field, it was highlighted that areas 4 and 5 are adjacent to meadows in which anthropogenic intervention has taken place, being managed as meadows for hay (by mowing), while areas 1, 2 and 3 are adjacent to meadows in which grazing is carried out.

In the studied border areas, they had a particularly rich and natural aspect, where there have been no fires for more than 50 years, the adjacent meadows are not crossed by roads (the edges bordering roads, tracks or watercourses) and do not adjoin buildings or residences.

For the identification of the taxa and for the systematization of the data, specialized works were used: Ciocârlan, 2009; Sârbu et al., 2013; Flora Europaea (http://rbg-web2.rbge.org.uk/FE/fe.html).

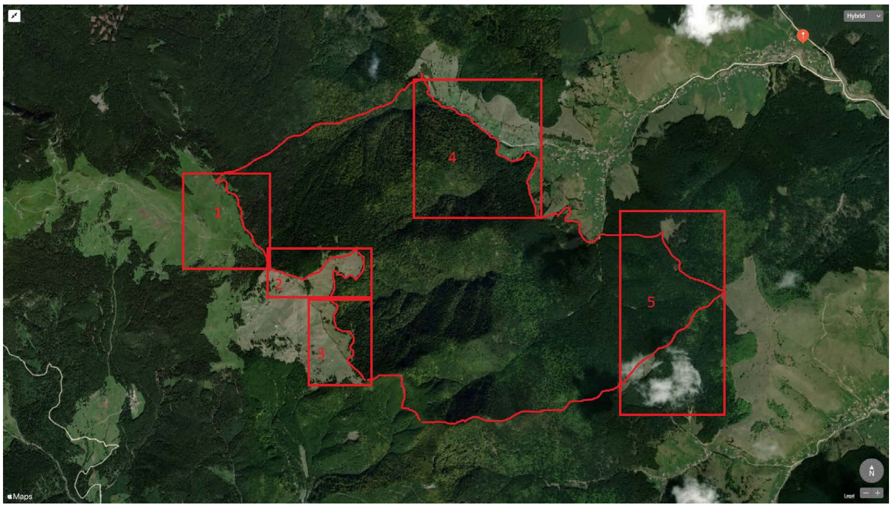


Figure 2. Layout of areas of interest in the Slătioara Secular Forest (scale 1:2000).

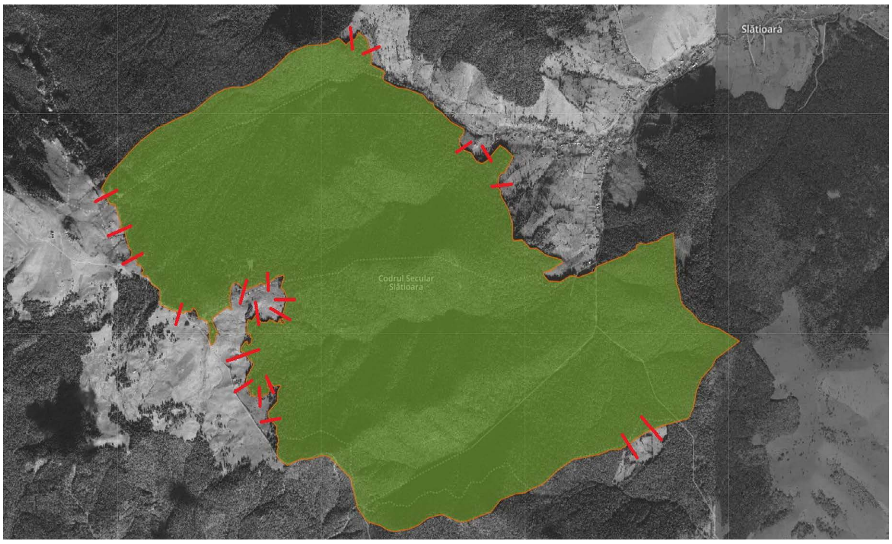


Figure 3. Location of transects used to sample grassland/edge/forest interior areas (scale 1:2000).

Based on specialized literature, the bioform (Ciocârlan, 2009; Sârbu et al., 2013), the floristic element (Ciocârlan, 2009; Sârbu et al., 2013), ecological indices (Sârbu et al., 2013) were indicated for each species; (Păcurar & Rotar, 2014) and economic importance (Crăciun et al., 1976-1977; Kovács, 1979; Cîrnu, 1980; Pop, 1982; Popescu, 1984; Bărbulescu & Motcă, 1987; Pârvu, 2000, 2002-2005; Vîntu et al., 2004; Muntean et al., 2007; Dihoru & Boruz, 2014; https://www.rhs.org.uk/; Janzon, 2009; Šircelj et al., 2007; Lin et al., 2016; Walesiuk et al., 2016; Grey-Wilson, 2000; Nichols et al., 2019; PFAF, 2010-2020. Plants For A Future. Published on the Internet PFAF/user/Default.aspx (accessed on 17 December 2020; Shinjiro & Narayama, 1977; Online Atlas of the British and Irish flora: https://plantatlas.brc.ac.uk/ OABI; Forest Life Index: https://www.upmforestlife.com).

Affiliation to the higher syntax was made according to Coldea (2012) and Mucina et al. (2016) and the systematic classification of species was done according to the classification system adopted by Ciocârlan (2009).

The classification of threatened species in the study area is based on the IUCN Red List (Bilz et al., 2011) and the National Red List (Oltean et al., 1994).

In the study carried out on the vegetal carpet, we used the principles conceived and perfected by the Central European floristic-phytocenological school (Zurich-Montpellier), adapted to the particularities of the vegetal carpet in the continental temperate zone of our country by Borza (1934) and with the recommendations of the Cluj school (Cristea, Gafta, & Pedrotti, 2004).

Taking into account the periods in which the phytosociological surveys of various types of phytocenoses are carried out, the recommendations made by Ivan & Spiridon (1993), and completed by Cristea (1991), but also the assessment made in the field, the interval in which the surveys were carried out was May-September.

3. Results

The floristic overview for the entire inventoried area includes a total of 292 cormophyte taxa (species and subspecies) belonging to 46 botanical families (Figure 4, Table A1).

In Figure 4 you can see the families with the most representatives are: Asteraceae (59 species), Poaceae (24 species), Ranunculaceae (18 species), Apiaceae (17), Lamiaceae, Fabaceae and Caryophyllaceae (15 species), Rosaceae (14 species), which can be correlated with the type of ecosystem in which the observation was made, namely: meadow-forest-forest edge. The rest of the botanical families participate with less than 10 species.

The floristic overview from the areas located inside the forest from all 5 inventoried areas, presents 90 species that are included in 34 botanical families, the most common are the families Asteraceae (9 species), Poaceae (8 species), Ranunculaceae (6 species), Rosaceae, Apiaceae and Boraginaceae (5 species) and the rest of the botanical families participate with a number of less than 5 species (Figure 4).

Regarding the floristic view of the lands adjacent to the forest, the meadow area, they include 202 species that are included in 38 botanical families, and as a representation of the number of species we have the following families: Asteraceae (45 species), Poaceae (18 species), Fabaceae (14 species), Orchidaceae and Campanulaceae (8 species), Caryophyllaceae (12 species), Ranunculaceae (10 species) (Figure 4).

In the inventoried border areas, the floristic view highlighted the following botanical families:

Asteraceae (20 species), Poaceae and Rubiaceae (10 species), Lamiaceae and

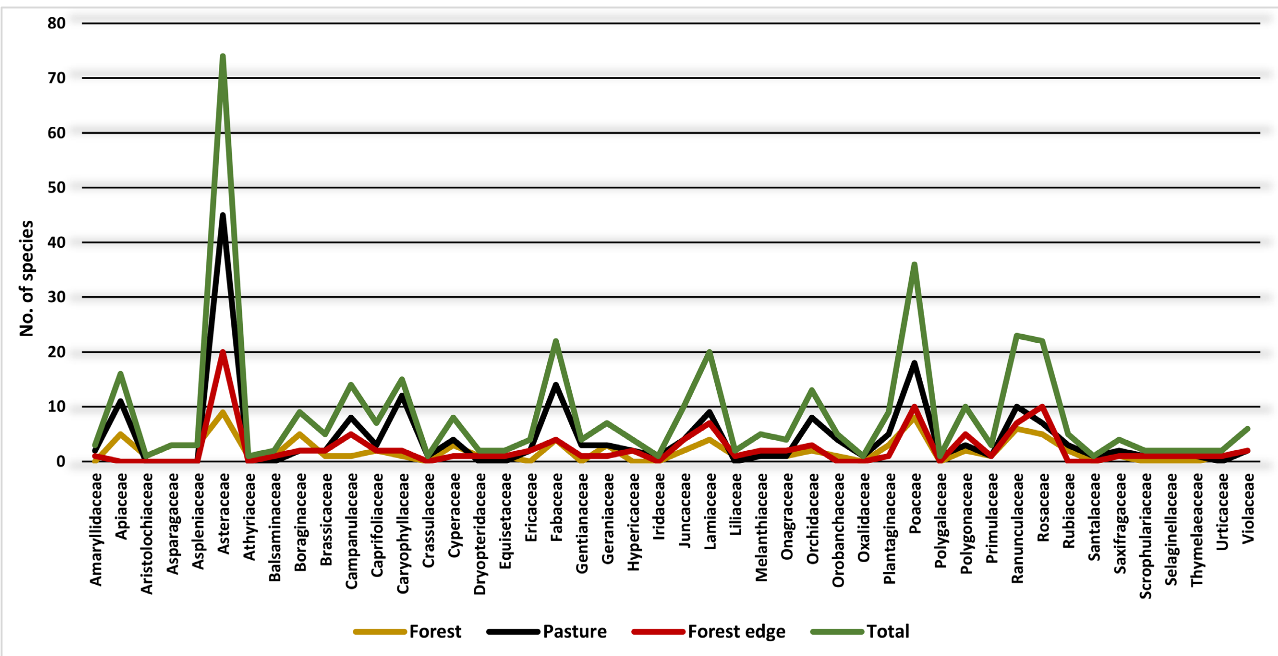


Figure 4. Distribution of species by botanical families.

Ranunculaceae (7 species) and the rest of the botanical families participate with a number of less than 5 species (Figure 4).

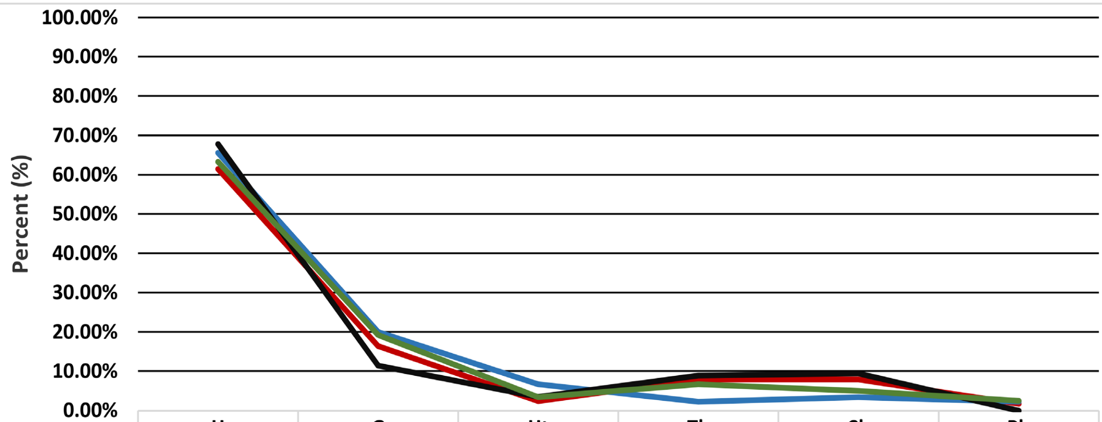
The percentage distribution, according to the numerical method, of bioforms is reproduced in the spectrum of bioforms evaluated over the entire area of interest, from which it results that the highest percentage is owned by hemicryptophytes—65.56%. These bioforms are followed by geophytes (cryptophytes)—20%, therophytes—6.67%, phanerophytes—2.25%), chamaephytes—3.33% and hemitherophytes—2.25%.

The spectrum of bioforms in the areas adjacent to the forest (meadow) consists of Hemicryptophytes 137 (H = 67.82%), Geophytes (Cryptophytes) 23 (G = 11.39%), Therophytes 18 (T = 8.91%), Chamaephytes 19 (Ch = 9.41%), Hemitherophytes 7 (Ht = 3.47) (Figure 5).

In the edge zone, the spectrum of bioforms revealed the preponderance of Hemicryptophytes 76 (H = 63.33%), Geophytes (Cryptophytes) 23 (G = 19.17%), Therophytes 8 (T = 6.67%), Chamaephytes 6 (Ch = 5.0%), Hemitherophytes 4 (Ht = 3.33%), Phanerophytes 3 (Ph = 2.5%) and in the forest also Hemicryptophytes (H = 65.56%), Geophytes (Cryptophytes) (G = 20 %) and Hemitherophytes (Ht = 6.67%).

The spectrum of phytogeographical elements represented for the entire inventory area is dominated by Eurasian = 95 taxa (32.53%), European = 68 taxa (23.28%), Circumpolar = 33 taxa (11.30%), Mountain European = 15 taxa (5.14%) followed by Alpine-Carpathic and European mediterranean = 11 taxa (3.77%) and Endemic Carpathians = 7 taxa (2.40%).

As for the interior of the forest, the dominant elements are all Eurasian = 33 taxa (36.67%) followed by European = 18 taxa (20%), Circumpolar = 10 taxa (11.11%) while in the areas adjacent to the forest, the grassland area the predominant



	H	G	Ht	Th	Ch	Ph
Total	61.43%	16.38%	2.39%	7.85%	7.85%	1.71%
Forest	65.56%	20.00%	6.67%	2.22%	3.33%	2.22%
Pasture	67.82%	11.39%	3.47%	8.91%	9.41%	0
Forest edge	63.33%	19.17%	3.33%	6.67%	5.00%	2.50%

Figure 5. The spectrum of the categories of bioforms present in all the inventoried ecosystems (meadows/edges/forests).

geoelements are Eurasian with a much higher percentage forest face, Eurasian = 68 taxa (33.66%), European = 48 taxa (23.76%), Circumpolar = 20 taxa (9.90%) and mountain European = 13 taxa (6.44%) and in the border area the following phytogeographical elements were encountered Eurasian = 40 taxa (33.33%), European = 26 taxa (21.67%), Circumpolar = 20 taxa (16.67%) and Mountain European = 13 taxa (6.44%) and Cosmopolitan = 8 taxa (6.67%) (**Figure 6**).

In order to have an overview of the flora that makes up the vegetation of the three ecosystems in the Codrul secular Slătioara reserve, ecological indices were also analyzed.

In the first analysis, we took into account all the vascular plant species identified in all the inventoried surfaces in the area of interest. These were analyzed according to their behavior towards the main ecological factors that reproduce through their numerical, spectral interpretation, the weight of species with certain ecological valences in relation to U, T, R, and the interpretation of the values was carried out in accordance with the information regarding the framework natural, vegetation history and anthropogenic influences.

The ecological characteristics of the species identified in all three types of ecosystems are presented in **Table A1**, **Figure 7**.

Analyzing the grassland ecosystems, it can be observed, compared to the temperature factor, the predominance of eurythermic species (Tx = 21.29%) and micro-mesothermic species (T3 = 20.30%) they develop on mesophilic soils (U3 = 21.78%) and meso-hygrophilous (U4 = 16.83%) represented by herbaceous hay species such as: *Alopecurus* sp., *Agrostis* sp., *Juncus* sp., *Carex* sp. Regarding the soil reaction, we can see the presence of species that support wide pH variations,

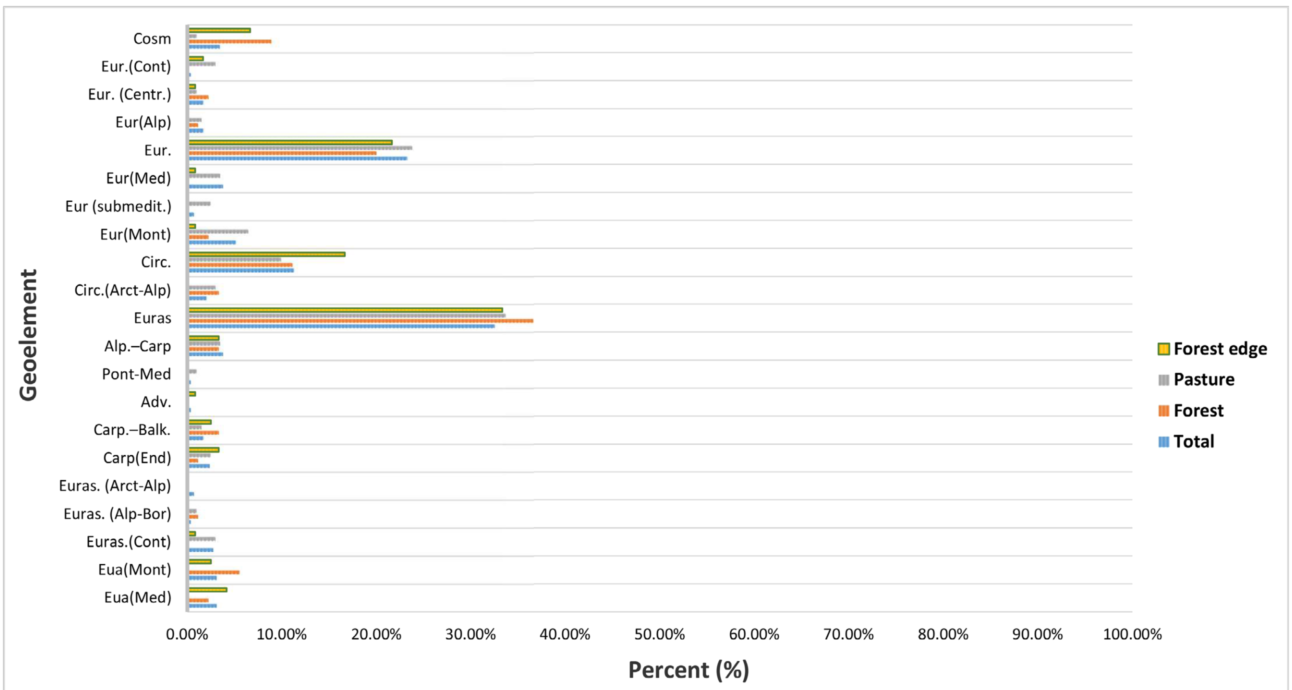


Figure 6. The spectrum of phytogeographical elements present in all the inventoried ecosystems (meadows/edges/forests).

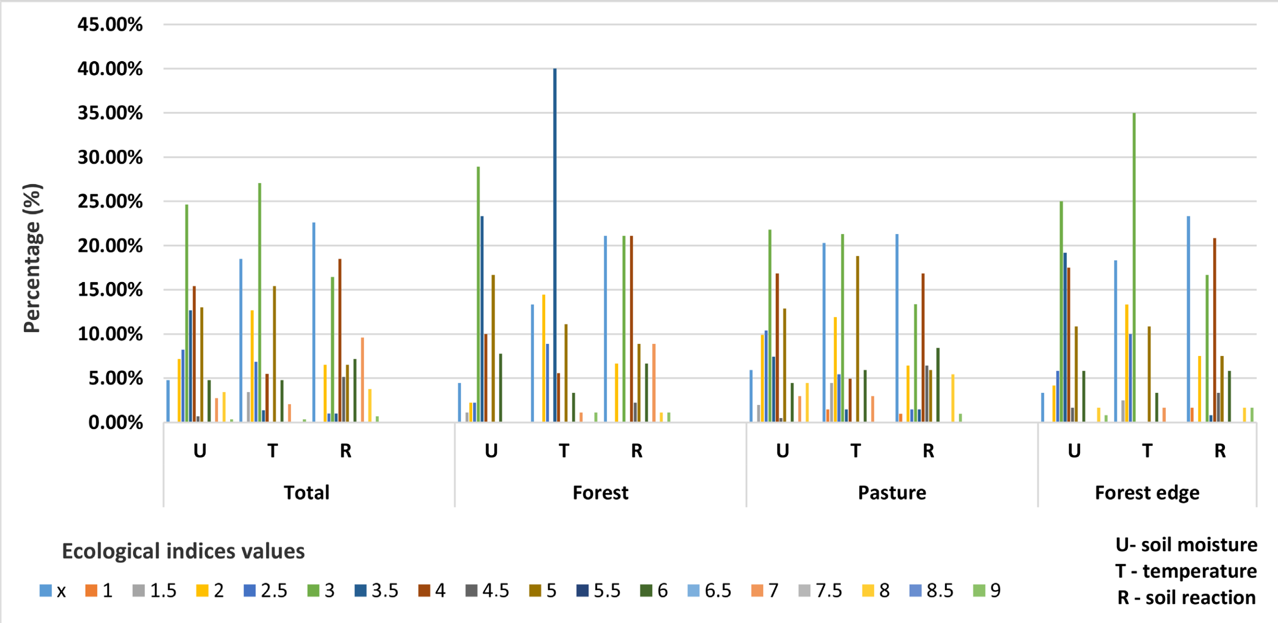


Figure 7. The ecological indices spectrum.

without affecting their growth, development and reproduction, amphitolerant (euriionic Rx = 21.29%) but also those that grow on poor, weakly acid soils—neutrophils (R4 = 16.83%).

In the inventoried natural forest ecosystems, it was noted that the degree of closeness to the crown is between 0.7 - 0.9, thus, the amount of light that penetrates the interior of the forest is reduced, which amplifies the existing abundant humidity. These factors do not favor the presence of a rich flora, which is nevertheless very rich in mesophilic (U3 = 28.89%) and micro-mesothermic (T3.5 = 40%) species represented by species such as *Astrantia major* L., *Asplenium scolopendrium* L., *Circaea lutetiana* L., *Asarum europaeum* L. *Stellaria nemorum* L. these being also amphitolerant species to soil reaction (Rx = 21.29%).

In forest edge areas where the environmental parameters were very little modified, they created conditions that are slightly different from the adjacent habitats, having in their composition species both from the forest and from the open habitats (meadows). Thus, the presence of mesophilic meadow species (U3 = 25%) and a greater abundance of meso-hygrophilous species (U4 = 17.50%) were identified.

The presence of shade and semi-shade species was also highlighted, which relative to the temperature factor, the micro-mesotherm ones are dominant (T3 = 35.00%) due to the microclimatic peculiarities that characterize this transitional ecosystem that presents defined characteristics in space and time, as well as interactions squeezed between these adjacent systems, meadow and forest.

Eurythermic species (Tx = 18.33%) are predominant, due to their ability to occupy various substrates and not being related to a certain type of soil, they are the least affected by the modification of habitats and the transition between two ecosystems.

From the total of 292 species identified, 272 species are of economic importance, being grouped as follows: 40 species with fodder value, which we have divided into legumes and forage grasses as seen in Table 1(a) and Table 1(b).

In the category of medicinal plants, 191 species have been identified, known and less known, but whose therapeutic action has been scientifically confirmed. Among these we list: *Plantago media* L., *Plantago lanceolata* L., *Achillea millefolium* L., *Anthyllis vulneraria* L., *Arnica montana* L., *Cichorium intybus* L., *Geum urbanum* L., *Inula helenium* L., *Melilotus officinalis* L., *Rumex acetosa* L., *Rumex crispus* L., *Thymus serpyllum* L., *Valeriana officinalis* L., etc. For each individual species, the parts of the plant that have therapeutic value have been mentioned.

The presence of species with economic value in the forest ecosystem of Codrul Secular Slatioara can be structured as shown in Figure 8, Table A2.

Table 1. (a) The economic importance of fodder species (legumes); (b) The economic importance of fodder species (grasses).

(a)

Species	Productivity	Fodder value	Remarks
Anthyllis vulneraria L.	Medium	Medium	resistant to frost and dryness
Galega officinalis L.	High	Medium	slightly poisonous, suspected to be poisonous for sheep
Genista tinctoria L.	Low	Low	-
Lathyrus pratensis L.	High	Medium	fodder plant, honeydew plant, decorative plant species with a hanging stem, high waist, lends itself to mowing. It is resistant to excess moisture
Lotus corniculatus L.	High	Good	it lends itself more to use as hay, lasts 4 - 8 years on meadows, resistant to drought, fall, winter, acidity, dries well, does not produce weathering in animals
Medicago lupulina L.	Low	Good	species with a weaker rotting power, drought resistant it is part of the Group of secondary taxa (TG-2) of *Medicago sativa*; *Medicago truncatula*
Melilotus officinalis (L.) Pall.	High	Medium	melliferous species, tall, suitable for grazing and mowing, can also be used as green manure. resistant to frost and drought it is part of the Tertiary Taxon Group (TG-3) of the *Melilotus albus*
Trifolium alpestre L.	Medium	Good	species with a bush, small in size, suitable for grazing, is part of the frost and drought resistant, weakly rotting Tertiary taxon group (TG-3) of *Trifolium pratense*
Trifolium montanum L.	Medium	Good	drought resistant
Trifolium pannonicum Jacq.	Medium	Good	lends itself to grazing, poisons hard after mowing
Trifolium pratense L.	Very high	Very good	species with a high wilting power, sensitive to frost and drought, wilts strongly after mowing, cultivated species high content in proteins, essential amino acids, fats, carotene, vitamins. high regeneration capacity after mowing. enriches the soil with nitrogen and restores its texture

(b)

Species	Productivity	Fodder value	Remarks
Briza media L.	Low	Medium	resistant to drought and frost
Bromus arvensis L.	Very high	Very good	species with low economic value but can be used as a source of resistance to biotic and abiotic stress factors
Calamagrostis arundinacea (L.) Roth	High	Low	rough leaves, hard to poison
Dactylis glomerata L.	High	Very good	tall species, very productive very early height, poisons well after mowing and grazing
Deschampsia caespitosa (L.) Beauv.	High	Low	species with thick bush, found on soils with high humidity does not withstand drought, tolerates grazing well
Deschampsia flexuosa (L.) Trin.	Low	Low	it resists grazing well, it hardens
Festuca pratensis Huds.	High	Very good	medium-sized species, suitable for mixed use, sensitive to drought, hardens well, cultivated species
Festuca pseudovina Hack. ex Wiesb.	Low	Medium	-
Festuca rubra L.	High	Good	lends itself very well to grazing found on moderately to strongly inclined slopes resistant to frost and drought has great regenerative power
Holcus lanatus L.	Mijlocie	Low	sensitive to drought, grows well
Phleum phleoides H.Karst.	Low	Medium	medium-sized, poorly productive species
Phleum pratense L.	Very high	Very good	has high winter hardiness and medium fall hardiness, drought sensitive, cultivated species
Poa nemoralis L.	Low	Good	-

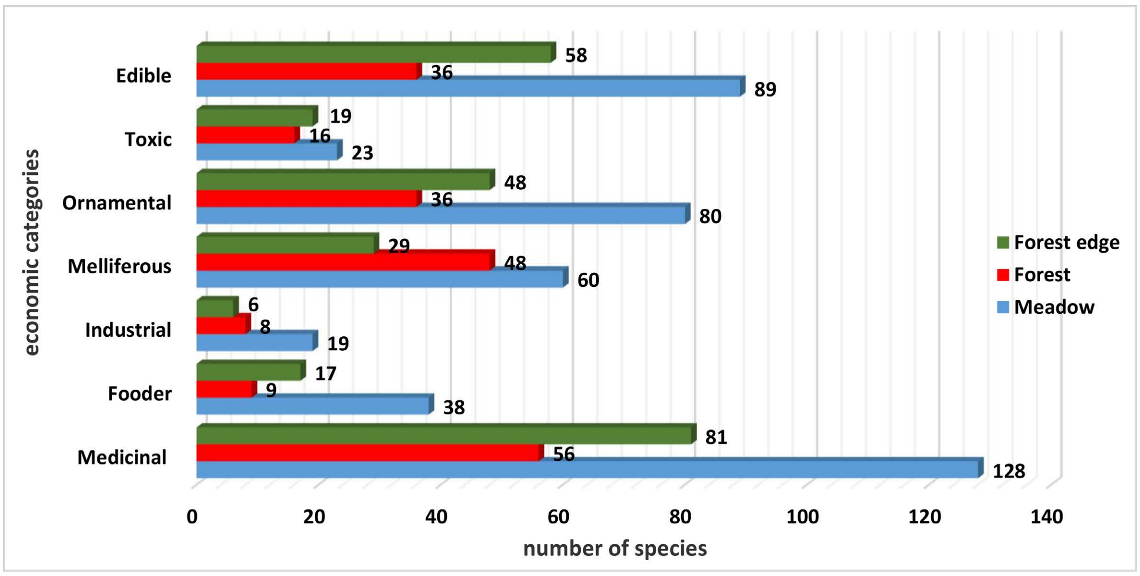


Figure 8. Distribution of species according to economic categories.

- 56 medicinal species that have multiple uses in prophylactic and curative medicine. From the most well-known medicinal species, we mention a few encountered in the study area: *Digitalis grandiflora* Mill.; *Lamium galeobdo-*

lon (L.) Nath.; *Pulmonaria officinalis* L.; *Rumex acetosa* L.; *Tanacetum vulgare* L., *Veronica officinalis* L. In most of these species, the whole plant is used in natural remedies and treatments.

- 9 species with medium and good fodder value: *Trifolium pratense* L., *Trifolium hybridum* L., *Lathyrus vernus* (L.) Bernh.; *Festuca heterophylla* Lam.
- 18 melliferous species that have white flowers (white-yellowish *Symphytum cordatum* Waldst. & kit.; white-*Fragaria vesca* L.), yellow (*Salvia glutinosa* L.; *Lamium galeobdolon* (L.) Nath.) blue (*Veronica officinalis* L.; *Vicia sepium* L.) and red (*Epipactis atrorubens* (Hoffm.) Besser., *Trifolium pratense* L.). Most of these species were found inside the forest up to a distance of 10 m from the forest edge.
- 36 species with food value, which are important for nutrition and food security worldwide. The consumption of these plants, mainly by families who do not have enough food and income, besides this, they also have cultural reasons, taste and aroma (Shumsky et al., 2014; Thakur et al., 2017). Among the most used, we mention: *Geum urbanum* L.; *Rumex acetosa* L.; *Equisetum arvense* L.; *Fragaria vesca* L. etc. 16 toxic species, when consumed fresh produce serious poisoning at horses, sheep and pigs (*Equisetum palustre* L.; *Veratrum album* L.; *Digitalis grandiflora* Mill.
- 8 industrial species, of practical interest, which are used as raw materials in various industries: 3 species in the textile industry (*Circaea lutetiana* L.; *Symphytum cordatum* Waldst. & Kit.; *Urtica dioica* L.), 3 species in the dye industry (*Clematis alpina* (L.) Mill.; *Rumex acetosella* L.; *Scilla bifolia* L.; *Trifolium pratense* L.;) and 3 species in the cosmetic industry (*Fragaria vesca* L.; *Tussilago farfara* L.; *Urtica dioica* L.).
- 36 species with ornamental value whose quality can be highlighted by the flowers, of the leaves, the fruits, the size or habit of the plants, the aesthetic combinations of shape and color between species, as well as the geometry of the inflorescences.

The economic value of the species identified in the border area and the adjacent lands (meadow) of the forest can be exemplified as follows:

- Meadows: 128 medicinal species, 38 fodder species, 60 honeydew species, 23 toxic species, 80 ornamental species, 89 species with culinary value of which 11 aromatic and seasoning species, 19 species with industrial value of which, 10 species for the dye industry, 6 species for the cosmetics industry and 3 species for the textile industry.
- Forest edge: 81 medicinal species (*Achillea distans* Waldst. & Kit.; *Gentiana asclepiadea* IT.; *Pimpinella major* (L.) Huds.), 17 fodder species (*Brachypodium pinnatum* (L.) P. Beauv.; *Deschampsia cespitosa* (L.) P. Beauv.; *Festuca rubra* L.; *Holcus lanatus* L.; *Phleum pratense* L.; *Poa nemoralis* L.; *Trifolium pratense* L.; *Trifolium montanum* L.), 29 melliferous species (*Gymnadenia conopsea* (L.) R.Br.; *Medicago lupulina* L.; *Trifolium pratense* L.; *Salvia glutinosa* L.), 19 species toxic (*Equisetum arvense* L.; *Galanthus nivalis* L.; *Ranunculus repens* L.), 48 ornamental species, 58 species with culinary value

of which 11 aromatic and seasoning species (Geum rivale L.; *Pimpinella major* (L.) Huds.; *Salvia glutinosa* L.), 6 species with industrial value of which, 3 species for the dye industry, 1 species for the cosmetics industry and 2 species for the textile industry.

Populations smaller than 8000 individuals appear to be affected by the loss of genetic variation, with the smallest variation being recorded in the smallest populations. Unfortunately, rare and threatened species often have small and isolated populations, leading to a rapid loss of genetic variation.

The analysis of threatened species was carried out in accordance with the Red List of Endangered Species in Romania (Oltean et al., 1994), the Red Book of Vascular Plants in Romania (Dihoru & Negrean, 2009), the Carpathian List of Endangered Species (Kukuła et al., 2003), Carpathian red list of forest habitats and Carpathian species list of invasive alien species (Kadlečík, 2014). Thus, in the three types of ecosystems in the study area, the presence of 12 rare species was identified, of which 7 are vulnerable species, in which 3 Carpathian endemics are found (*Symphytum cordatum* Waldst. & Kit.; *Phyteuma tetramerum* Schur.; Centaurea phrygia L. *subsp. carpatica* (Porc.) Dostál) (**Table 2**).

4. Conclusion

The Slatioara secular forest reserve presents a relatively high plant biodiversity; in this study 292 species of vascular plants were identified in 170 genera and 46

Table 2. Sozology of the species and the type of ecosystem in which they are present.

Taxon name	World Red List (Gillett & Walter, 1997)	Endemic status in Romania	Red List (Oltean et al., 1994)	Type of ecosystem		
				Forest	Meadow	Forest edge
Campanula carpatica Jacq	VU	near endanger	R	-	-	X
Centaurea phrygia L. subsp. *carpatica* (Porc.) Dostál	-	Carpathian endemism	R		X	X
Streptopus amplexifolius (L.) DC.	VU	-	R	X	-	X
Trollius europaeus L. subsp. *europaeus*	VU		R		X	X
Symphytum cordatum Waldst. & Kit.	LC	Carpathian endemism	R	X	-	-
Allium schoenoprasum L. ssp. *sibiricum* (L.) Čelak.,	LC	-	R	-	X	-
Epipactis atrorubens (Hoffm.) Schult.	VU	-	R	X	X	X
Gymnadenia conopsea (L.) R.Br. subsp. *conopsea*	VU	-	R	-	X	X
Daphne cneorum L.	VU	-	-		X	X
Trollius europaeus L. subsp. *europaeus*	VU	-	R	-	X	X
Hieracium pojoritense Woł.	LC	near endanger	R	-	X	-
Phyteuma tetramerum Schur.		Carpathian endemism	R			

botanical families. If we refer to the three types of ecosystems inventoried, we have the following statistics: the forest ecosystem: 90 species belonging to 34 families; the meadow ecosystem: 202 species belonging to 38 families and the edge ecosystem (forest edge); 122 species belonging to 34 families.

Because the environmental conditions (microclimatic variations) in the forest edge were fluctuating from one transect to another (orientation classes, topographical position), from one area to another, the diversity of these ecotone areas is lower than that of its adjacent (meadow) ecosystem, but greater in relation to the forest ecosystem.

The European character of the flora is confirmed by the dominance of Eurasian, European and Central European phytogeographical elements that represent more than half of the total species identified, and the presence of circumpolar species is in direct correlation with the geographical position of the study area.

Spectrum of bioforms is dominated by hemicryptophyte species (65.56%) whose winter buds are formed on underground stems, so that they are protected by litter, are followed by geophytes (20%) which have a maximum development in the spring, before the beginning of the vegetation period.

The analysis of humidity indices (U) illustrates that in the flora of the 3 types of ecosystems, mesophilic species (U3) predominate with a weight of 21.78% and 16.83% of meso-hygrophilic ones (U4) in meadows, in ecosystems of in the forest, the proportion is 28.89% of mesophilic species (U3) and 23.33% of meso-hygrophilic ones (U3.5) and in the transition areas between these two ecosystems, mesophilic species (U3) also predominated in proportion of 25% and 17.50% of meso-hygrophilic species (U4).

In terms of temperature requirements, the most numerous species in the flora of the meadow ecosystems studied are eurytherms (Tx) with 21.29% followed by mesotherms with spread in the mountain floor (T3) with 20.30%, highlighting the fact that most of the existing species are capable of withstanding wide temperature fluctuations that are characteristic of these high altitude grasslands and different exposures. In the ecotone areas, the mesothermal species (T3) were predominant with 35% and the eurythermal species (Tx) with 18.33%, thus the species with medium heat requirements are predominant, being protected by the tree crowns existing in these transition zones between ecosystems.

Inside the forest, species intermediate between mesothermal and thermophilic, respectively micro-mesothermal (T3.5) have developed in a proportion of 40% species with shade and semi-shade temperature.

From the point of view of adaptations to the reaction of the soil solution (R), the flora species of the studied areas fall into five ecological categories. Predominant are amphitolerant species (R0)—21.11% in the forest ecosystem, 21.29% in the meadows and 23.33% in the transitional ecosystem.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table A1. List of plant species from the Slatioara secular forest.

https://docs.google.com/document/d/1q3KKBs0hx491o8RpRvo4QfIsGSR_7usO/edit?usp=sharing&ouid=102461246726400003877&rtpof=true&sd=true

Table A2. List of plant species from the Codrul secular Slătioara by economic potential.

https://docs.google.com/document/d/1fEhz8kS7BFYSl-0D380ESdM7V_B59AWN/edit?usp=sharing&ouid=102461246726400003877&rtpof=true&sd=true