SYNECOLOGICAL STUDY TO ESTABLISH THE ECOLOGICAL SIGNIFICANCE OF SPECIES *PINUS NIGRA* SSP. *BANATICA* WITHIN A PHYTOCOENOSIS

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Abstract. The study has proposed to establish the ecological significance of the species Pinus nigra ssp. banatica within a phytocoenosis from the National Park Domogled - Cerna Valley, but also the degree of ecological similitude of the studied phytocoenoses of the investigated biotopes, as well as the degree of coenotic affinity existing between the identified species, through synecological analysis using specific environmental indicators. To achieve the established goal and objectives there have been used quantitative research methods of biocoenoses, and there were calculated an analytical ecological indicator (constancy, K), and two synthetic ecological indicators (coefficient of ecological similitude Sörensen and the Jaccard index of coenotic affinity). The results showed that the species Pinus nigra ssp. banatica was encountered in all five studied areas, belonging to the class V of constancy. Related to the other species of the analyzed phytocoenosis, Pinus nigra ssp. banatica has 100% coenotic affinity with only two species, 80% coenotic affinity with 9 species, 60% coenotic affinity with 14 species, 40% coenotic affinity with 38, and 20% coenotic affinity with 83 species. The greatest ecological similitude as species composition between the studied biotopes was 44%.
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Key words: Pinus nigra ssp. banatica, ecological significance, constancy, Sörensen, Jaccard, National Park Domogled - Cerna Valley, phytocoenosis.

INTRODUCTION

Pinus nigra ssp. *banatica* (black pine of Banat) is a species of the Phyllum *Pinophyta*, Class *Pinopsida*, Order *Pinales*, Family *Pinaceae*. Black pine of Banat is spreaded in the west part of our country, approximately 90% in the National Park Domogled – Cerna Valley (sub-Mediterranean habitat), and 10% in the Natural Park Porţile de Fier and in the Geo-Park Platoul Mehedinţi [HARALAMB, 1967].

Pinus nigra ssp. *banatica* is considered a glacial relict, famous for its resistance and capacity of adaptation to the environment of the calcareous geosyncline of the Domogled, its image being associated with the steep and rocks of this zone [6].

MATERIAL AND METHODS

The working methodology consisted of quantitative research of biocoenoses, and there were calculated an analytical ecological indicator (constancy), and two synthetic ecological indicators (coefficient of ecological similitude Sörensen and the Jaccard index of coenotic affinity) [DUMITRESCU, 2003; GOMOIU AND SKOLKA, 2001; IORDACHE AND BORZA, 2008].

Pinus nigra ssp. *banatica* has been studied related to the other plant species in five sample-surfaces of the Naţional Park Domogled – Cerna Valley (table 1).

The list of the plant species found in the five sample-surfaces has been provided by the Administration of the Naţional Park Domogled – Cerna Valley [5] and consisted of 147 plant species which can be found in table 4.

Table 1

Characteristics of the sample-surfaces [5]

Characteristic	Crucea Albă	Domogled pine under fire	Tesna	Vârful Suscu	Crovul Mare
Altitude (m)	588	830	890	150	1172
Exposition	NNE	NNE	NNV	VSV	V
Slope	40	45	40	45	45
Surface (km^2)	100	900	100	100	100
General coverage (%)	50	50	80	70	70
Rocks (%)	25	-	-	-	-
Height of the trees (m)	20	-	12	18	12
Coverage of the shrubs (%)	10	-	5	60	5
Coverage of the herbs (%)	30	75	80	70	70

RESULTS AND DISCUSSION

Data showed that the great part of the species found within the phytocoenoses containing *Pinus nigra* ssp. *banatica* is represented by species found in a single relevé of five. *Pinus nigra* ssp. *banatica* was identified in all five sample-surfaces, being classified as *class V of constancy* (table 2, figure 1).

Table 2

The repartition of plant species depending on K indicator (constancy) (number of total)

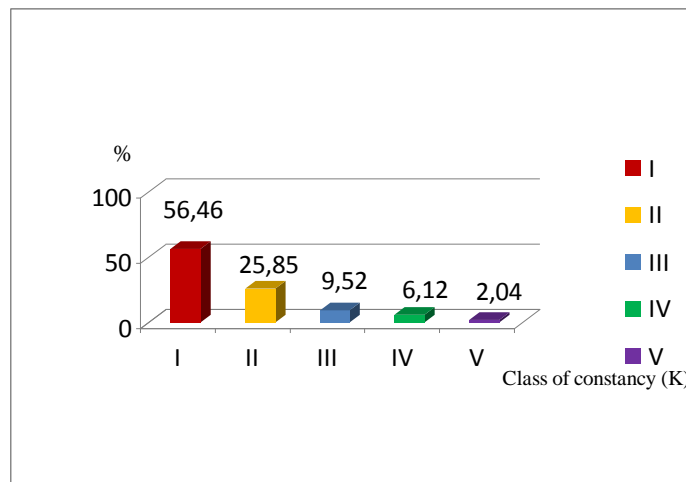| No.	Class of constancy (K)	Number of species
1	I	83
2	II	38
3	III	14
4	IV	9
5	V	3

Figure 1. The repartition of plant species depending on K indicator (constancy) (% of total)

The values of the index Sörensen (Ss) of ecological similitude were calculated for pairs of samples (P). The diagram of the indices Sörensen (Ss) showed that the highest value of ecological similitude as species compositions was reached by the pairs $P_1 - P_2$ and $P_3 - P_5$

(44%), followed by the pairs $P_1 - P_4$, $P_3 - P_4$ and $P_4 - P_5$ (31%), and the lowest ecological similitude as species composition was reached by the pair of samples $P_1 - P_3$ (17%) (table 3).

Table 3

The ecological similitude of the sample-surfaces as species composition according to Sörensen index (Ss)

	Sample-surface 1 Crucea Albă	Sample-surface 2 Domogled pine under fire	Sample-surface 3 Tesna	Sample-surface 4 Vârful Suscu	Sample-surface 5 Crovul Mare
Sample-surface 1 Crucea Alba	-	44%	17%	31%	25%
Sample-surface 2 Domogled pine under fire	44%	-	27%	20%	29%
Sample-surface 3 Tesna	17%	27%	-	31%	44%
Sample-surface 4 Vârful Suscu	31%	20%	31%	-	31%
Sample-surface 5 Crovul Mare	25%	29%	44%	31%	-

In table 4 there are presented the values of the indicator Jaccard (q), respectively the coenotic affinity of the species *Pinus nigra* ssp. *banatica* with the other species found in the research areas.

Table 4

Values of the indicator Jaccard (q) describing the coenotic affinity (%) of species *Pinus nigra* ssp. *banatica* with the other species found in the research areas

		Pinus nigra ssp. *banatica*
1	*Polygala vulgaris*	q = 40%
2	*Populus tremula*	q = 20%
3	*Draba lasiocarpa*	q = 20%
4	*Saxifraga paniculata*	q = 20%
5	*Euphorbia amygdaloides*	q = 80%
6	*Thymus comosus*	q = 20%
7	*Cerastium banaticum*	q = 20%
8	*Jovibarba heuffelii*	q = 40%
9	*Saxifraga rotundifolia*	q = 40%
10	*Silene saxifraga*	q = 20%
11	*Teucrium montanum*	q = 60%
12	*Thymus jankae*	q = 20%
13	*Teucrium chamaedrys*	q = 80%
14	*Helianthemum nummularium*	q = 80%
15	*Hepatica nobilis*	q = 40%
16	*Lilium martagon*	q = 20%
17	*Polygonatum odoratum*	q = 20%
18	*Allium flavum*	q = 20%
19	*Allium saxatile*	q = 20%
20	*Convallaria majalis*	q = 20%
21	*Doronicum columnae*	q = 20%
22	*Epipactis atrorubens*	q = 40%
23	*Geranium macrorrhizum*	q = 20%
24	*Thesium linophyllon*	q = 20%
25	*Athamanta turbith*	q = 20%
26	*Edraianthus graminifolius ssp. kitaibelii*	q = 20%
27	*Moehringia muscosa*	q = 40%
28	*Asplenium ruta-muraria*	q = 20%
29	*Asplenium trichomanes*	q = 40%
30	*Carex humilis*	q = 40%
31	*Laserpitium latifolium*	q = 60%
32	*Pedicularis comosa ssp. campestris*	q = 20%
33	*Stachys recta ssp.recta*	q = 40%
34	*Carex digitata*	q = 40%
35	*Mycelis muralis*	q = 60%

36	*Poa nemoralis*	q = 80%
37	*Campanula persicifolia*	q = 80%
38	*Campanula rapunculoides*	q = 40%
39	*Galium mollugo*	q = 60%
40	*Peucedanum oreoselinum*	q = 80%
41	*Viola hirta*	q = 20%
42	*Vincetoxicum hirundinaria*	q = 20%
43	*Asperula capitata*	q = 20%
44	*Dianthus petraeus ssp. petraeus*	q = 20%
45	*Festuca xanthina*	q = 100%
46	*Hieracium villosum*	q = 20%
47	*Pedicularis verticillata*	q = 20%
48	*Phyteuma orbiculare*	q = 20%
49	*Sesleria rigida ssp.rigida*	q = 60%
50	*Achnatherum calamagrostis*	q = 60%
51	*Acinos alpinus ssp majoranifolia*	q = 20%
52	*Ajuga genevensis*	q = 20%
53	*Alyssum petraeum*	q = 20%
54	*Aquilegia nigricans*	q = 20%
55	*Arabis procurrens*	q = 40%
56	*Aremonia agrimonoides*	q = 40%
57	*Asperula ciliata*	q = 40%
58	*Brachypodium sylvaticum*	q = 20%
59	*Bromus benekeni*	q = 20%
60	*Campanula glomerata*	q = 20%
61	*Campanula rotundifolia*	q = 20%
62	*Centaurea atropurpurea*	q = 20%
63	*Cephalaria laevigata*	q = 60%
64	*Chelidonium majus*	q = 20%
65	*Clematis recta*	q = 20%
66	*Coronilla varia*	q = 20%
67	*Cruciata glabra*	q = 20%
68	*Dactylis glomerata*	q = 40%
68	*Dianthus banaticus*	q = 40%
70	*Digitalis grandiflora*	q = 60%
71	*Epilobium angustifolium*	q = 40%
72	*Euphorbia villosa*	q = 20%
73	*Ferulago sylvatica*	q = 40%
74	*Fragaria vesca*	q = 40%
75	*Galium purpureum*	q = 20%
76	*Hieracium maculatum*	q = 20%
77	*Hieracium murorum*	q = 20%
78	*Hypericum rochelii*	q = 20%
79	*Inula ensifolia*	q = 20%
80	*Kernera saxatilis*	q = 20%
81	*Lathyrus hallersteinii*	q = 40%
82	*Lathyrus vernus*	q = 40%
83	*Linum uninerve*	q = 80%
84	*Luzula sylvatica*	q = 60%
85	*Origanum vulgare*	q = 40%
86	*Peucedanum longifolium*	q = 40%
87	*Phleum montanum*	q = 40%
88	*Pimpinella saxifraga*	q = 40%
89	*Poa molinieri*	q = 20%
90	*Potentilla micrantha*	q = 20%
91	*Primula veris ssp. columnae*	q = 60%
92	*Scabiosa columbaria ssp.pseudobanatica*	q = 80%
93	*Seseli gracile*	q = 40%
94	*Seseli libanotis*	q = 40%
95	*Solidago virgaurea*	q = 20%
96	*Stipa pulcherrima*	q = 20%
97	*Taraxacum hoppeanum*	q = 20%
98	*Taraxacum officinale*	q = 20%
99	*Valeriana officinalis*	q = 20%
100	*Veronica chamaedrys*	q = 40%
101	*Veronica crassifolia*	q = 80%

102	*Veronica jacquinii*	q = 20%
103	*Veronica teucrium ssp. crinita*	q = 20%
104	*Viola suavis*	q = 20%
105	*Calamagrostis arundinacea*	q = 60%
106	*Euphorbia cyparissias*	q = 20%
107	*Rhamnus saxatilis ssp.tinctorius*	q = 20%
108	*Corylus colurna*	q = 20%
109	*Cotinus coggygria*	q = 40%
110	*Cotoneaster tomentosus*	q = 20%
111	*Quercus cerris*	q = 20%
112	*Salix caprea*	q = 20%
113	*Sorbus borbasii*	q = 40%
114	*Sorbus graeca*	q = 20%
115	*Syringa vulgaris*	q = 20%
116	*Fraxinus ornus*	q = 60%
117	*Acer platanoides*	q = 40%
118	*Acer pseudoplatanus*	q = 20%
119	*Carpinus orientalis*	q = 20%
120	*Sorbus torminalis*	q = 20%
121	*Tilia cordata*	q = 60%
122	*Tilia tomentosa*	q = 20%
123	*Carpinus betulus*	q = 20%
124	*Fagus sylvatica*	q = 40%
125	*Betula pendula*	q = 20%
126	*Genista radiata*	q = 20%
127	*Chamaecytisus glaber*	q = 100%
128	*Rosa pendulina*	q = 40%
129	*Cotoneaster integerrimus*	q = 20%
130	*Rosa pimpinellifolia*	q = 20%
131	*Rubus scaber*	q = 40%
132	*Sorbus torminalis*	q = 20%
133	*Daphne mezereum*	q = 20%
134	*Clematis vitalba*	q = 40%
135	*Cardaminopsis arenosa*	q = 60%
136	*Euphrasia salisburgensis.*	q = 40%
137	*Geranium robertianum*	q = 40%
138	*Solanum nigrum*	q = 20%
139	*Erysimum comatum*	q = 20%
1 40	*Arabis hirsuta*	q = 20%
141	*Arabis turrita*	q = 40%
142	*Sedum hispanicum*	q = 20%
143	*Linum catharticum*	q = 20%
144	*Acinos arvensis*	q = 20%
145	*Orobanche sp.*	q = 20%
146	*Verbascum lychnitis*	q = 20%

There was observed that the species *Pinus nigra* ssp. *banatica* has coenotic affinity q = 100% with only two species, *Festuca xanthina* and *Chamaecytisus glaber*. With 9 species found within the studied phytocoenoses, *Pinus nigra* ssp. *banatica* shows a coenotic affinity q = 80%, with 14 species shows a coenotic affinity q = 60%, and with most of the species (83) shows a coenotic affinity q = 20%, respectively a coenotic affinity q = 40% with 38 species (table 4).

CONCLUSIONS

The following conclusions have been established through this study:

- *Pinus nigra* ssp. *banatica* has been found in all five research areas, being classified as *class V of constancy* (K = 100%).
- The values of the indicator Sörensen (Ss) of ecological similitude showed the highest ecological similitude as species composition for the sample-surfaces Crucea Albă - Domogled pine under fire and, respectively, Tesna - Crovul Mare (Ss = 44%), followed by the

surface-pairs Crucea Albă - Vârful Suscu, Tesna - Vârful Suscu and Vârful Suscu - Crovul Mare (Ss = 31%), and the lowest value of Ss index was found for the surface-samples Crucea Albă - Tesna (Ss = 17%).

- *Pinus nigra* ssp. *banatica* has coenotic affinity q = 100% with only two species, *Festuca xanthina* and *Chamaecytisus glaber*. With 9 species found within the studied phytocoenoses, *Pinus nigra* ssp. *banatica* shows a coenotic affinity q = 80%, with 14 species shows a coenotic affinity q = 60%, and with most of the species (83) shows a coenotic affinity q = 20%, respectively a coenotic affinity q = 40% with 38 species.

- Considering the indicators *constancy (K), Sörensen (Ss, ecological similitude)* and *Jaccard (q, coenotic affinity),* it was found that species *Pinus nigra* ssp. *banatica* is *ecologically significant* in the phytocoenoses, respectively in the studied biotopes.

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