Distribution of Leguminosae taxa in habitat types of northern Greece

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Abstract

The plant family of Leguminosae includes many taxa of high economical and ecological value. The present paper aims at the investigation of Leguminosae taxa distribution in habitat types of northern Greece. Published data from floristic and vegetation works, as well as, unpublished field data were used to explore their habitat preferences. Results revealed that Leguminosae taxa found in salt meadows and dunes are few; most of them occur in (sub-) continental forests and grasslands: a) a group including taxa growing at lowland grasslands (e.g. *Trifolium cherleri*), b) another group comprised of taxa occurring at higher altitudes and mainly at subalpine grasslands (e.g. *Anthyllis montana* ssp. *jacquinii, Onobrychis montana* ssp. *scabrica*), c) a third group representing taxa found mainly in thermophilous scrubs (e.g. *Calicotome villosa*, *Anthyllis hermanniae*), d) a fourth group concerning taxa occurring in azonal forests (e.g. *Gleditsia triacanthos*, *Robinia pseudoacacia*), and e) a fifth group of taxa found in submediterranean and subcontinental forests (e.g. *Vicia grandiflora*, *Trifolium alpestre, Lathyrus vernus,*). Some species have a broad niche breadth, such as *Trifolium fragiferum, T. campestre* and *Lotus corniculatus*, occurring in a high variety of habitats.

Key words: legumes, natural ecosystems, Macedonia, Thrace.

Introduction

Leguminosae include some of the most valuable species of the plant kingdom due to their high ecological and economic value. Their ecological value lies mainly in their ability to bind nitrogen from the atmosphere and thus improving soil fertility, contributing decisively to the productivity of natural ecosystems. Their economic value lies to their extensive usage as food for both humans and animals (as hay or forage material) due to their high protein content (Papanastasis et al. 1999, White et al. 2002). This is the reason that many countries (eg. New Zealand, Australia, Argentina) have introduced non-native legume species to use them as animal feed (Real et al. 2008). In addition, legumes are also used in pharmacology, in beekeeping, dye industry etc. (Ricciarelli et al. 2000, Merou et al. 2007). Northern Greece has a high diversity of habitats including ammophilous plant communities and maquis at the lower altitudes up to beech and spruce forests on the high mountains (Dafis et al. 2001). These habitats host many species of the legume family (Strid & Tan 1991, Merou et al. 2007).

The aim of this study is to investigate the legume taxa distribution in habitat types in the area of northern Greece.

Materials and Methods

The study area comprises northern Greece and covers, specifically, Macedonia and Thrace. In this area, many habitat types and species of high conservation value occur, a fact that is evident from the high number of sites dedicated to conservation of biodiversity (e.g. NATURA 2000 sites, Ramsar sites; Dafis et al. 2001). The main vegetation types found in the area are coastal, wetland, grassland (natural and semi-natural), shrubland, deciduous broadleaved forests, sub-continental broadleaved deciduous forests and coniferous forests. In the lowlands, natural vegetation is scarce, replaced mainly by rural and urban lands.

Data used in the analyses come from published and unpublished relevés concerning the study area. A database was created including, approximately, 3700 relevés of different authors and from different localities (reference list of data sources are available from the authors upon request). Additionally, 1123 unpublished relevés were included in the data base. Relevés data were imported in Juice 7.0 (Tichý 2001) software. Taxa with absolute constancy equal or lower to four were omitted before the analyses to reduce noise. Relevés were classified by means of TWINSPAN analysis (Hill 1979). Three pseudospecies cut-levels, namely 0, 5 and 25, were used. In the analyzed data, 127 legume taxa occurred. The relative constancy of these species in the distinguished vegetation units was used to determine their fidelity to certain vegetation types, applying the algorithm of Tsiripidis et al. (2009).

Nomenclature of taxa follows Strid & Tan (1997, 2002), Greuter et al. (1984-1989), Strid (1986), Strid & Tan (1991) and Tutin et al. (1968-1993).

Results and Discussion

TWINSPAN analysis distinguished at the second level of divisions the coastal vegetation (170 relevés), the inland aquatic vegetation (130 relevés) (these two former vegetation types host few Leguminosae taxa; e.g. *Trifolium tomentosum*), the synanthropic vegetation (58 relevés), where 12 Leguminosae taxa are found (mainly of genus *Vicia*), and the sub-continental forests and grasslands. Higher levels of divisions were applied in the latter vegetation group (see Table 1), where most of the Leguminosae taxa occur. These divisions revealed the existence of several generalists legumes (e.g. *Trifolium nigrescens, Medicago rigidula, Trifolium tenuifolium*), occurring in many vegetation types, albeit their preference to

the thermophilous deciduous broadleaved forests. Most of these species are not diagnostic of forest vegetation classes (Braun-Blanquet (1964) hierarchical classification), but of vegetation types without tree cover (see Mucina 1997). These species have entered in the thermophilous deciduous broadleaved forests because of the forest structure (e.g. coppice forests) as well as their degradation due to intense logging or grazing (Theodoropoulos 1991, Fotiadis 2004).

Table 1. Relative constancy of Leguminosae taxa in the vegetation units of northern Greece. Dark grey color indicate a positive fidelity of taxa to certain vegetation groups and light grey color indicate a negative fidelity vs. the former vegetation groups and a positive one vs. the rest groups. (1: coastal vegetation, 2: inland aquatic vegetation, 3: synanthropic vegetation, 4: lowland meadows, 5: subalpine grasslands, 6: shrublands of low canopy and degraded, and shrub like oak forests, 7: thermophilous shrublands of evergreen and deciduous broadleaved species, 8: azonal forests, 9: thermophilous, sub-Mediterranean deciduous broadleaved forests, 10: sub-continental broadleaved deciduous forests)

Groups	1	2	3	4	5	6	7	8	9	10
Lotus preslii	100	0	0	0	0	0	0	0	0	0
Medicago marina	100	0	0	0	0	0	0	0	0	0
Trifolium tomentosum	91.7	0	0	0	0	8.33	0	0	0	0
Lotus glaber	66.7	25	0	0	0	0	0	8.33	0	0
Melilotus albus	52	20	0	0	0	0	0	24	4	0
Ononis spinosa	44.4	27.2	0	0	0	8.36	12	0	0	0
Lathyrus annuus	0	0	100	0	0	0	0	0	0	0
Trigonella foenum-graecum	0	0	100	0	0	0	0	0	0	0
Vicia hybrida	0	0	100	0	0	0	0	0	0	0
Vicia narbonensis	0	0	97.3	0	0	0	0	0	2.7	0
Vicia peregrina	0	0	97.3	0	0	2.7	0	0	0	0
Vicia lutea	0	0	96	0	0	0	0	0	4	0
Lathyrus cicera	0	0	91.2	0	0	0	2.94	0	5.88	0
Vicia pannonica	0	0	88.9	0	0	0	0	0	11.1	0
Melilotus indicus	28.6	0	64.3	0	0	0	0	7.14	0	0
Coronilla scorpioides	0	0	56	0	24	4	4	0	12	0
Lotus pedunculatus	0	33.3	0	66.7	0	0	0	0	0	0
Trifolium cherleri	0	0	0	100	0	0	0	0	0	0
Trifolium strictum	0	0	0	100	0	0	0	0	0	0
Lotus angustissimus	0	0	0	92.3	0	0	7.69	0	0	0
Trifolium purpureum	14.3	0	0	71.4	0	14.3	0	0	0	0
Medicago monspeliaca	0	0	0	37.5	0	25	0	25	12.5	0
Hippocrepis ciliata	0	0	0	57.1	0	14.3	28.6	0	0	0
Onobrychis caput-galli	0	0	0	38.5	0	0	15.4	0	30.8	15.4
Trifolium tenuifolium	0	0	0	43.8	0	0	18.8	0	37.5	0
Trifolium scabrum	0	0	0	56.7	0	0	16.7	0	26.7	0
Medicago minima	0	0	0	38.4	6.85	4.11	17.8	1.37	31.5	0
Genista lydia	0	0	0	21.6	37.8	0	0	0	8.11	32.4
Anthyllis aurea	0	0	0	0	100	0	0	0	0	0
Anthyllis montana ssp. *jacquinii*	0	0	0	0	100	0	0	0	0	0
Onobrychis montana ssp. *scardica*	0	0	0	0	100	0	0	0	0	0
Astragalus angustifolius	0	0	0	0	93.3	0	0	0	6.67	0
Hippocrepis comosa	0	0	0	0	92.9	0	0	0	7.14	0
Genista depressa	0	0	0	0	84.6	0	0	0	0	15.4
Chamaecytisus polytrichus	0	0	0	0	83.3	0	0	0	0	16.7
Anthyllis vulneraria	0	0	0	18.2	72.7	3.03	0	0	6.06	0
Trifolium heldreichianum	0	0	0	0	71.1	0	0	0	20	8.89
Trifolium fragiferum	25.7	11.4	0	0	0	60	0	0	0	2.86
Onobrychis gracilis	0	0	0	0	0	57.9	31.6	0	10.5	0
Pisum sativum ssp. *sativum*	0	0	0	0	0	0	100	0	0	0
Calicotome villosa	0	0	0	0	0	0	96.2	0	3.77	0
Cercis siliquastrum	0	0	0	0	0	0	88.2	0	11.8	0
Cytisus villosus	0	0	0	0	0	0	83.3	0	16.7	0
Trifolium grandiflorum	0	0	0	0	0	0	80	0	20	0
Spartium junceum	0	0	0	0	0	0	78.9	0	21.1	0
Anthyllis hermanniae	12.1	0	0	8.62	0	3.45	60.3	0	15.5	0
Lupinus angustifolius	0	0	0	0	0	0	66.7	0	33.3	0
Gledítsia triacanthos	0	0	0	0	0	0	0	100	0	0
Amorpha fruticosa	0	7.14	0	0	0	0	0	92.9	0	0
Robinia pseudoacacia	0	0	0	0	0	0	0	92	8	0
Melilotus officinalis	14.3	0	0	0	0	28.6	7.14	35.7	14.3	0
Medicago polymorpha	0	0	31.1	0	0	2.22	2.22	17.8	46.7	0
Vicia sativa	0	0	49.4	0	0	0	2.33	30.2	60.5	6.98
Trifolium nigrescens	5	5	0	35	0	25	0	7.5	22.5	0
Trifolium campestre	0	0	0.96	26.3	2.87	16.7	8.13	0.96	40.7	3.35
Astragalus onobrychis	0	0	0	38	0	20	4	4	34	0
Trifolium angustifolium	0	0	0	29.5	0	22.8	10.2	0	41.8	0
Medicago rigidula	0	0	0	23.1	7.69	7.69	23.1	0	30.5	0
Melilotus neapolitanus	0	0	0	0	0	20	40	20	20	0
Medicago falcata	0	0	25	2.27	2.27	27.3	6.82	0	36.4	0
Trifolium hirtum	0	0	0	0	0	35.8	1.49	0	62.7	0
Trifolium stellatum	0	0	0	0	0	27.8	27.8	0	44.4	0
Medicago arabica	0	0	13.5	0	0	21.2	0	32.7	32.7	0
Hippocrepis emerus ssp. *emeroides*	0	0	0	0	10.8	0	28.8	6.31	51.4	2.7

Groups	1	2	3	4	5	6	7	8	9	10
Bituminaria bituminosa	0	0	0	0	0	0	50	0	50	0
Astragalus monspessulanus	0	0	0	0	9.09	3.03	33.3	0	54.5	0
Trifolium patens	0	4.76	9.52	0	0	0	23.8	23.8	38.1	0
Trifolium physodes	0	0	0	0	0	0	0	0	100	0
Trifolium leucanthum	0	0	0	0	0	0	0	0	100	0
Medicago sativa	0	7.14	0	0	0	0	0	0	92.9	0
Lathyrus sphaericus	0	0	0	0	0	3.37	2.25	2.25	92.1	0
Lathyrus digitatus	0	0	0	0	0	0	0	10	90	0
Lens nigricans	0	0	0	0	11.1	0	0	0	88.9	0
Trifolium striatum	0	0	0	0	0	12.5	0	0	87.5	0
Lathyrus inconspicuus	0	0	0	0	12.5	0	0	0	87.5	0
Vicia tenuifolia	0	0	0	0	2.5	0.83	5	0	84.2	7.5
Trifolium aureum	0	0	0	0	0	0	0	0	83.3	16.7
Lathyrus nissolia	0	0	0	0	0	15.5	1.72	0	82.8	0
Trifolium sebastianii	0	0	0	0	0	0	20	0	80	0
Vicia grandiflora	0	0	0	0.9	0	4.48	2.69	10.3	79.4	2.24
Dorycnium pentaphyllum	0	0	0	0	0	0	0	0	13.8	79.3	6.9
Vicia hirsuta	0	0	0	0.4	0	2.39	3.59	4.78	78.9	9.96
Trifolium subterraneum	0	0	0	1.79	0	10.7	1.79	7.14	78.6	0
Vicia tetrasperma	0	0	0	0	0	1.53	0	0.76	77.9	19.8
Trifolium ochroleucon	0	0	0	0	4	0	0	0.8	76.8	18.4
Chamaecytisus triflorus agg.	0	0	0	0	2.16	0	3.88	0	76.7	17.2
Vicia cassubica	0	0	0	0	0	0	0	2.5	75	22.5
Cytisus procumbens	0	0	0	0	25	0	0	0	75	0
Trifolium alpestre	0	0	0	0	6.49	1.62	1.35	0.27	74.3	15.9
Dorycnium herbaceum	0	0	0	10.2	6.12	6.12	3.06	0	73.5	1.02
Colutea arborescens ssp. *arborescens*	7.14	0	0	0	0	0	0	7.14	71.4	14.3
Lathyrus aphaca	0	0	19	0	0	0	1.59	7.94	71.4	0
Vicia villosa	0	0.66	25.2	0	0	4.46	6.25	17.9	69.6	1.79
Adenocarpus complicatus	0	0	0	15.4	0	0	15.4	0	69.2	0
Medicago lupulina	0	2	0	0	0	4.08	4.08	4.08	67.3	20.4
Chamaecytisus supinus	0	0	0	0	1.89	3.77	7.55	3.77	66	17
Genista tinctoria	0	0	0	0	4.92	0	18	0	65.6	11.5
Vicia lathyroides	0	0	0	2.56	0	19.2	7.69	5.13	65.4	0
Medicago orbicularis	0	0	25	0	0	12.5	0	0	62.5	0
Ornithopus compressus	0	0	0	11	0	19.5	6.1	1.22	62.2	0
Trifolium glomeratum	0	4.76	0	19	0	4.76	9.52	0	61.9	0
Dorycnium hirsutum	0	0	4.08	12.3	0	0	20.4	4.08	59.2	0
Lathyrus grandiflorus	0	0	18.2	0	0	0	0	0	54.6	27.3
Ononis pusilla	0	0	0	0	18.2	9.09	18.2	0	54.5	0
Genista carinalis	0	0	0	0.28	12.2	5.82	5.26	0	54.3	22.2
Trifolium arvense	3.91	0	0	18	0	20.3	14.1	1.56	39.8	2.34
Trifolium repens	0	9.52	9.52	0	16.7	2.38	0	3.57	39.4	19
Trifolium hybidum	0	0	0	0	25	0	0	12.5	12.5	37.5
Chamaecytisus eriocarpus	0	0	0	0	31.1	0	0	0	11.1	57.8
Astragalus glycyphyllos	0	0	0	0	0	0	0	17.9	54.7	27.4
Securigera varia	0	0	0	0	15.9	0	2.27	0	56.8	25
Trifolium medium	0	0	0	0	1.9	0	0	5.24	61.4	31.4
Trifolium pignantii	0	0	0	0	0	0	0	0.59	70.6	28.8
Trifolium pratense	0	0	0	0	17.6	8.82	0	17.6	29.4	26.5
Vicia cracca	0	0	0	0.63	3.13	1.88	0	1.25	61.9	31.3
Vicia laeta	0	0	0	0	0	0	0	4.76	42.9	52.4
Lathyrus laxiflorus	0	0	0	0	0	0	0	0	58.1	41.9
Lathyrus niger ssp. *niger*	0	0	0	0	0	0	0	0	70.8	29.2
Lathyrus venetus	0	0	0	0	0	0	0	0	54.3	45.7
Trifolium velenovskyi	0	0	0	0	0	0	0	6.67	93.3
Lathyrus vernus	0	0	0	0	0	0	0	4.17	4.17	91.7
Lathyrus alpestris	0	0	0	0	1.79	0	0	0	8.93	89.3
Vicia sepium	0	0	0	0	13.6	0	0	0	0	86.4
Genista sagittalis	0	0	0	0	18.8	0	0	0	0	81.3
Chamaecytisus austriacus	0	0	0	0	0	0	0	0	21.8	78.2
Lathyrus pratensis	0	0	0	0	17.8	0	0	1.11	17.8	63.3
Lotus corniculatus	1.39	2.78	0	9.72	13.9	11.1	5.56	1.39	22.2	31.9

Taxa showing a higher fidelity in the distinguished vegetation groups (Table 1) can be divided in five categories: a) taxa occurring most in lowland grasslands (e.g. *Trifolium cherleri*), b) those found in subalpine grasslands (e.g. *Anthyllis montana* ssp. *jacquinii, Astragalus angustifolius*); these taxa show a quite similar preference all over eastern Mediterranean (Güleryüz et al. 1998) and south Europe (Hennenberg & Bruelheide 2003), as well, c) taxa occurring in thermophilous shrublands (e.g. *Calicotome villosa, Anthyllis hermanniae*), d) taxa occurring more in azonal forests (e.g. *Amorpha fruticosa, Gleditsia triacanthos, Robinia pseudacacia*), and e) taxa preferring most the Sub-Mediterranean and sub-continental forests (e.g. *Trifolium striatum, Vicia grandiflora, Trifolium alpestre, Lathyrus vernus, Chamaecytisus austriacus*).

Results show that many legume taxa from those included in our analyses show a preferential occurrence to certain habitat and thus have a more or less narrow niche breadth. However, their distribution to habitat types in northern Greece has been affected by the history of disturbances and land use, factors which seems to have broadened legume species niche and not to have restricted their distribution. Furthermore, the Mediterranean climate of the study area, and its transition to sub-continental at the higher altitudes and the northern latitudes, as well as the traditional management practices seems to have modified some legume species niche from what it is known from other parts of their distribution (natural or man-made) area.

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