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Distribution, Characteristics and Ecological Role of Protective Forest Belts in Silistra Municipality, Northeastern Bulgaria

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Abstract. Protective forest belts are developed as a defense against dry winds and soil moisture loss and considered as natural capital nowadays. Silistra municipality's protective forest belts were investigated about their distribution, floristic composition, vegetation structure and syntaxomony. During 2018 field season 32 relevés were collected following the Braun-Blanquet approach. Data about diversity of invasive and melliferous plants were collected also. Vegetation types were identified by numerical classification using hierarchical agglomerative clustering (PC-ORD). Descriptive statistics about the cover of tree, shrub and herb layers as well as cover of invasive and melliferous plants were graphically summarized in vertical box-and-whisker plots. The forest belts syntaxonomical diversity is represented by 2 associations (*Cotino coggygriae-Quercetum cerris*, *Bromo sterilis-Robinietum*) and *Amorpha fruticosa-Morus alba* plant community. *Cotino coggygriae-Quercetum cerris* has closed horizontal structure with dominants *Quercus cerris* and *Cottinus coggygria* in tree and shrub layers respectively. *Bromo sterilis-Robinietum* is characterized by poor species composition and vegetation dominated by *Robinia pseudoacacia* and *Fraxinus americana*, whereas *Amorpha fruticosa-Morus alba* community has local distribution and represents a final stage of vegetation degradation. Totally five alien species (*Acer negundo*, *Amorpha fruticosa*, *Erigeron annuus*, *Fraxinus americana* and *Robinia pseudoacacia*) and 26 melliferous plants were identified within the forest belts. The highest cover of invasive species and melliferous plants were found within *Bromo sterilis-Robinietum* and *Amorpha fruticosa-Morus alba*. The main melliferous plant species were *Robinia pseudoacacia, Amorpha fruticosa*, *Morus alba* and *Prunus cerasifera*. The investigated forest belt vegetation bears the characters of a long-standing anthropogenic impact. They have been subject to cutting, burning and pasturing during the last 50-60 years.

Key words: alien invasive plants, Braun-Blanquet approach, mapping, melliferous plants, numerical classification, vegetation structure.

Introduction

Protective forest belts are of a particular historical importance for shielding against dry winds and for preserving soil moisture. The contemporary interpretation considers them as natural capital, providing regulating, cultural and few direct material ecosystem/landscape goods and services, but significant indirect material ecosystem/landscape goods and services, as

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a product of the nearby agricultural areas (pollination of crops and other plants, purification of water and air, etc.). Geographically determined, the first protective forest belt emerged in the Kingdom of Russia under the influence of a Russian forester, named Nestor Karlovich Genko (1839-1904). The continental climate, characterized by insufficient rainfall and the emergence of dry winds, leading to erosion and drying of the soil, is a prerequisite for the creation of protective forest belts, particularly in this part of the world. These processes, along with the destruction of the European forests in the period 1750-1850, provoked the need of the foundation and development of the forestry science (POPOV *et al.*, 2017). During the period 1886-1903 protective forest belts in Ulyanovska Oblast have been established and today they are a protected natural object. The total aerial coverage of the forest belts "Genko stripes" in Samara Oblast is nearly 9 000 hectares and their total length is around 150 km, while their width is 640 m.

As Genko was working on the plantation of the protective forest belts, the same idea was adopted in the neighboring country of Romania, where BRAD (1850) created the first plantations as "shelters against wind". Romania had a leading role in the creation of protective forest belts with its Barăgan plain for forest belts from 1906, which is more than 39 years younger than the plan of Roosevelt and 42 years younger than the plan of the Soviet Union for transformation of nature, following BUCUR (2016). In 1936 the plantation of forest belts in the villages of Karvuna (Balchik Municipality) and Rogozino (Dobrich Municipality) started and two years later plantations were finished. The work in Karvuna village continued in 1939 and 1940 when according to the Treaty of Craiova these lands were returned to Bulgaria, POPOV *et al.* (2017).

The October Revolution in 1917 ceazed plantations, but after World War I, special measures for the creation of new forest belts were applied in Romania. During this period the first plantations of protective forest belts in the occupied Bulgarian Southern Dobrudzha have been established.

The end of World War II saw nationalization of lands in Bulgaria and Romania. State act (№ 236) was adopted in Bulgaria in 1951, concerning the development of agriculture, water supply and electrification in Dobrudzha and in parallel with this a plan-program for the creation of protective forest belts was also brought to light. Soon after that an expedition, studying forest belts in Dobrudzha, was led and a book was published by STOYANOV & KITANOV (1955), where soil scientists, hydrologists, botanists and zoologists made contributions also.

According to POPOV *et al.* (2017) the bulgarian government ordered the creation of nine protective forest belts, covering 21 997 ha in total and with 800 km length (fig. 1).The belts have 70-90 m in width and plantations were planted in 1951 –1958. The tree species *Quercus robur*, *Quercus petraea*, *Fraxinus excelsior*, *Robinia pseudoacacia*, *Gleditsia triacanthos*, *Juglans regia* and *Populus ssp.* were planted according to POPOV *et al.* (2017). As of 1980 the average height of the belts was 5-15m and the stock are 389 000 m^3. Forest belts are protecting agricultural area with cells 500-600 m wide and 1200-2000 m long. The prevailing winds in this territory come from the north, so the main belts are oriented in east-west direction, having a distance of 500 m in-between. According to GEORGIEV (1960) the impact of the belts is divided in an equal distance from them, multiplied by 25-30 height.

The protective effect of the forest belts can be summarized in the following way: the wind effect has been reduced with 25-30%, air moisture deficit has been reduced by 15-20% and physical evaporation has been reduced by 7-20%, according to VACHOVSKI & DIMITROV (2003). Snow cover started to accumulate equally at the direction of the snowfall within the belts, while soil moisture was kept in the horizon between 100 and 200 cm with an increase of 45-50%. Among the existing protective forest belts in Bulgaria, the ones in Dobrudzha have the best status, according to Popov *et al*. (2017).

Forest belts can be analyzed as linear elements in landscape structure that directly influence ecological processes, following Forman & Baudry (1984) and landscape functions, according to Marshall & Moonen (2002). European history of agriculture acknowledges constructive role of linear elements in the formation and functioning of a wide variety of rural landscapes, following Zimmermann (2006). The understanding of landscape's pattern interactions – arable fields (matrix) and adjacent green corridors (linear elements), are essential for biodiversity complexity explanation, according to Meyer *et al*. (2012). Linear landscape elements are a valuable indicator for the biological diversity in agro-landscapes, following Billeter *et al*. (2008).

Landscape Ecology considers linear elements as sources of important ecosystem services, according to van der Zanden *et al*. (2013) and stimulates multi-functional landscape utilization. Depending on the geographical circumstances and land management priorities the primary role of physical fluxes regulation (erosion and wind reduction, increased water infiltration, enhanced carbon sequestration, pollution control) can be expand with the functions of biological corridors (or, in particular, nectar corridors), or even cultural services (recreation, aesthetics). For this reason substantial for land management is linear elements' investigation and modelling (number, mean size, length, mean shape) in the landscape scale, according to Mücher *et al*. (2009).

The aims of the study are: (1) research of the published Bulgarian and foreign literature related to development of forest belts; (2) investigation of distribution, floristic composition and vegetation structure of protective forest belts in Silistra municipality; (3) mapping of forest belts on the territory of municipality; (4) analysis of the anthropogenic influence and distribution of alien and melliferous plants of studied forest belts.

Materials and Methods

Study area

Protective forest belts in the municipality of Silistra were the object of the current investigation and they were built-up date back from 1951-1958. Its area covers 51589.1 ha of which 38754.4 ha are agricultural territories, 6827.3 ha forest areas, 3622.6 ha urbanized territories, 1809.0 ha water areas, 51.0 ha quarries and transport infrastructure takes up to 524.8 ha. Silistra Municipality comprises around 18% of the territory of the whole province (Silistra). There are also eighteen villages and one town - Silistra, which is the center of the province and the municipality (Municipal development plan 2014-2020). The plain relief reaches up to 200 m a.s.l. The fertile lowland of Baltata, located near Aidemir village, is also situated here and the southwestern part of the plain is taken by Srebarna Lake. "Srebarna Nature Reserve" represents the core zone of the "Srebarna Biosphere Park", created in 2017, following the Seville Strategy (1995) after Vladimirov (2011). The biosphere park consists of a core zone, a buffer zone and a transition zone and the whole area of Silistra Municipality is located within its boundaries.

From biogeographic point of view, the municipality is a part of the biogeographic province of Lower Danube River and the region of Dobrudzha and belongs to the biome of *Aestiduriherbosa*, according to Assenov (2006).

Data collection and statistical analysis

During 2018 field season 32 reléves (vegetation plots) were collected, following the approach by Braun-Blanquet (1965). The plot size was 400 m^2, as recommended for forest communities by Chytrý & Otýpková (2003). For every reléve all species were recorded as well as information about altitude, aspect, slope, total vegetation cover, cover of tree, shrub, herb and cryptogam layers, soil depth, bedrock type, locality, GPS coordinates.

All reléves were stored in the Balkan Vegetation Database (VASSILEV *et al.*, 2016). The numerical classification was performed by PC-ORD, following MCCUNE & MEFFORD (1999) and JUICE 7.0 by TICHÝ (2002) software packages using Bray-Curtis distance and flexible beta algorithm on square-root transformed and three cut levels (0, 5, and 25) were used.
The diagnostic species were determined by calculating the Phi-coefficient by CHYTRÝ *et al.* (2002). Two values were given for each species in the synoptic table: "Fidelity" expressed by the Phi-coefficient and "Constancy" expressed in percentage. All clusters were standardized to equal size, following CHYTRÝ *et al.* (2006). Only the statistically significant Phi-coefficient values evaluated by Fisher's exact test (*P<0.05) were considered.

Descriptive statistics about the cover of tree, shrub, herb, invasive and melliferous plants layers were graphically summarized in vertical notched box-and-whisker plots. Individual points in-line with the whiskers were used for plotting the outliers (°).The Shapiro-Wilk test was used for testing the normality of the data. Since only the data set of the invasive species cover met the assumption of normal distribution, the t-test was applied for comparing the groups of samples. In all other cases the Mann–Whitney *U* nonparametric test was applied. Statistical computing and box-plot data visualization were performed by R software environment (R Core Team, 2019).

The nomenclature of vascular plants followed DELIPAVLOV & CHESHMEDZHIEV (2003). The list of alien species was created after merging data from DELIPAVLOV & CHESHMEDZHIEV (2003), ASSYOV & PETROVA (2012), PETROVA & VLADIMIROV (2012, 2018), PETROVA *et al.* (2012), STOYANOV *et al.* (2014), TUTIN *et al.* (1964-1980). It includes totally 450 species. Also a generalized list of melliferous plants from Bulgarian flora was created, which contains 493 vascular plants (STOYANOFF, 1933; PETKOV, 1979; BRATANOV, 1987; BIZHEV, 2003; TASHEV & PANCHEVA, 2009; TASHEV *et al.*, 2015).

During the field work we also mapped forest belts and measured their width in two edges and central part. Later in ArcMap 10 they were mapped as linear polygons.

Results and Discussion

Forest belt structure and distribution

The measurements made show that the area of the protective forest belts and the existing forests in the municipality of Silistra represents 4.7% of the total area (1.4% for protection forest belts and 3.3% for forests, Fig. 2).

The forest belts are widely distributed on the territory of Silistra municipality and a total number of 144 forest belts were identified (Fig. 2). Their length varies between 107.5 m and 7610.7 m (average 1949.6 m), whereas the width is between 6 m and 146 m (average 43.4 m). They represent linear polygons around other polygons in the landscape pattern (arable fields, woodlands, pastures, scrubland vegetation, etc.).

Vegetation types of forest belts

Forest belts in Silistra municipality comprises 3 vegetation types (Fig. 3; Table 1) – ass. *Cotino coggygriae-Quercetum cerris* Rousakova & Tzonev 2003 , ass. *Bromo sterilis-Robinietum* (Poćs 1954) Soó 1964 and *Amorpha fruticosa-Morus alba* community.

Ass. *Cotino coggygriae-Quercetum cerris* ROUSAKOVA & TZONEV (2003). This vegetation represents widely distributed forest belt type, e.g. 23 studied forest belts (Fig 3, clusters 1-23; Table 1). It is found on flat to slightly-inclined terrains. Soils are moderately-deep to deep. The length and width of forest belts is between 275.7 m and 7082.2 m and 29.8 m and 76 m, respectively.

It has closed horizontal structure with vegetation cover 95-100%. Tree layer has cover between 50 and 95% and *Quercus cerris* is the dominant species. Other species with higher cover and abundance are *Fraxinus americana* and in some stands *Robinia pseudoacacia*. Shrub layer is well developed with cover between 10 and 95% (average 77%), where *Cotinus coggygria* is a dominant species and subdominant is *Ligustrum vulgare*. In stands, where tree layer has been cut during last 10-15 years cover of shrubs vegetation has been increased and are also found *Rosa canina*, *Prunus spinosa* and *Rubus caesius*. Herb layer has cover between 1 and 100% (average 31%) and species with higher cover and abundance are *Geum urbanum* and *Myrroides nodosa* (Fig. 4).

Cotino coggygriae-Quercetum cerris was established from central Danubian plain according to ROUSAKOVA & TZONEV (2003) and floristically and ecologically is similar to phytocoenosis from Silistra municipality. The high cover of *Cotinus coggygrya* is a result of successional changes in communities, where it has faster growing than other shrub species (such as *Crataegus monogyna*, *Prunus spinosa*) and is a result of human influence of the given phytocoenoses. Similar trend has been also observed from ROUSAKOVA & TZONEV (2003).

Ass. *Bromo sterilis-Robinietum* (Poćs 1954) Soó 1964. This association includes planted *Robinia pseudoacacia* plantations (Fig. 3, clusters 24-30; Table 1). Seven researched forest belts were classified to this vegetation type. The width and length of forest belts is between 32.2 m and 57.2 m and 130.2 m and 3862.2 m, respectively.

It is characterized by poor species composition. Dominant species is *Robinia pseudoacacia* (25-95%) and subdominant is *Fraxinus americana* (10-55%). Tree layer is well-developed and has total cover between 70-100%. In two stands *Robinia pseudoacacia* represent a high shrub formed shrubby vegetation. The shrub layer is formed by young trees of above mentioned species as well as *Crataegus monogyna*, *Rosa canina*, *Prunus cerasifera*. Herb layer has cover between 30 and 100% and is well developed mainly by *Bromus sterilis*, *Galium aparine* and *Geum urbanum* (Fig. 4).

Amorpha fruticosa-Morus alba plant community.

Communitiy of *Amorpha fruticosa* and *Morus alba* is locally distributed and was identify in only one forest belt (Fig. 3; Table 1). It characterize the final stage of degradation of vegetation, which has been fired and cut in the past. Total vegetation cover is 95%. Tree layer is formed by *Morus alba* (50%) and *Pyrus pyraster* (15%). The shrub layer is dominated by *Amorpha fruticosa* (70%). Undergrowth is formed mainly by *Bromus sterillis* and *Geum urbanum*.

Distribution and species richness of alien and melliferous plants of forest belts

Forest belts floristic diversity is represented by 80 vascular plants. Forest belts are reservoir of alien and melliferous plants in Danubian plain. Totally five alien species (*Acer negundo*, *Amorpha fruticosa*, *Erigeron annuus*, *Fraxinus americana* and *Robinia pseudoacacia*) were found in the species composition. Their coverage and distribution in the studied region depended on the vegetation type. *Robinia pseudoacacia* and *Amorpha fruticosa* have lower coverage in communities of *Cotino coggygriae-Quercetum cerris* association. *Amorpha fruticosa* covers between 0.5 and 10% as a shrub or juvenile species and was registered only in 4 relevés, whereas *Robinia pseudoacacia* was found in 5 relevés and has cover between 3 and 40% as a low-tree, shrub and juvenile plant. The coverage of invasive species is increasing in communities of *Bromo sterilis-Robinietum* and *Amorpha fruticosa-Morus alba.* The higher coverage of alien species in ass. *Bromo sterilis-Robinietum* is a result of dominance of *Robinia pseudoacacia* (coverage between 15 and 95%), whereas in *Amorpha fruticosa-Morus alba* communities *Amorpha fruticosa* is a dominant species (coverage 70%). *Fraxinus americana* is a constant species in tree, shrub and herb (as juvenile plant) layers in *Cotino coggygriae-Quercetum cerris* and *Bromo sterilis-Robinietum* associations.

Diversity of melliferous plants in forest belts is significantly higher and includes 26 species (e.g. *Acer campestre*, *A. negundo*, *A. tataricum*, *Agrimonia eupatoria*, *Amorpha fruticosa*, *Berteroa incana*, *Buglossoides purpurocaerulea*, *Cirsium arvense*, *Clematis vitalba*, *Consolida regalis*, *Cornus mas*, *Crataegus monogyna*, *Eryngium campestre*, *Fraxinus ornus*, *Glechoma hederacea*, *Juglans regia*, *Lamium purpureum*, *Ligustrum vulgare*, *Morus alba*, *Prunus cerasifera*, *Pyrus pyraster*, *Robinia pseudoacacia*, *Sambucus nigra*, *Syringa vulgaris*, *Tilia platyphyllos*, *Vicia varia*). The number of melliferous plants in vegetation plots of three types of forest belts is similar (between two and six), but their coverage is different. Communities of *Cotino coggygriae-Quercetum cerris* association have average cover of melliferous plants 40%, whereas it is increasing to 72% for communities of *Bromo sterilis-Robinietum* association. This is determined by higher cover of *Robinia pseudoacacia*, which is a widespread melliferous plant in the region. In species composition of *Amorpha fruticosa-Morus alba* community cover of melliferous plants is 95%, which is determined by dominance of *Amorpha fruticosa*, *Morus alba* and *Prunus cerasifera*.

Discussion

Forest belts represent forest plantations dating back to 1950-1960's of the twentieth century. Species used for planting have been *Quercus cerris*, *Robinia pseudoacacia*, *Gleditsia triacanthos*, *Fraxinus americana*. The three identified vegetation types represent different successional stages as a result of continuing anthropogenic pressure. Communities of *Cotino coggygriae-Quercetum cerris* association are formed during last 50 years and their species composition and structure are very close to its semi-natural phytocoenoses in Danubian plain. Phytocoenoses of *Bromo sterilis-Robinietum* association represent anthropogenic vegetation, which has replaced communities of *Cotino coggygriae-Quercetum cerris* as a result of cutting of woody vegetation followed by successional processes. Here *Robinia pseudoacacia* is a dominant species. Its communities have semi-open horizontal structure, which leads to higher cover of herb species (Fig. 4).

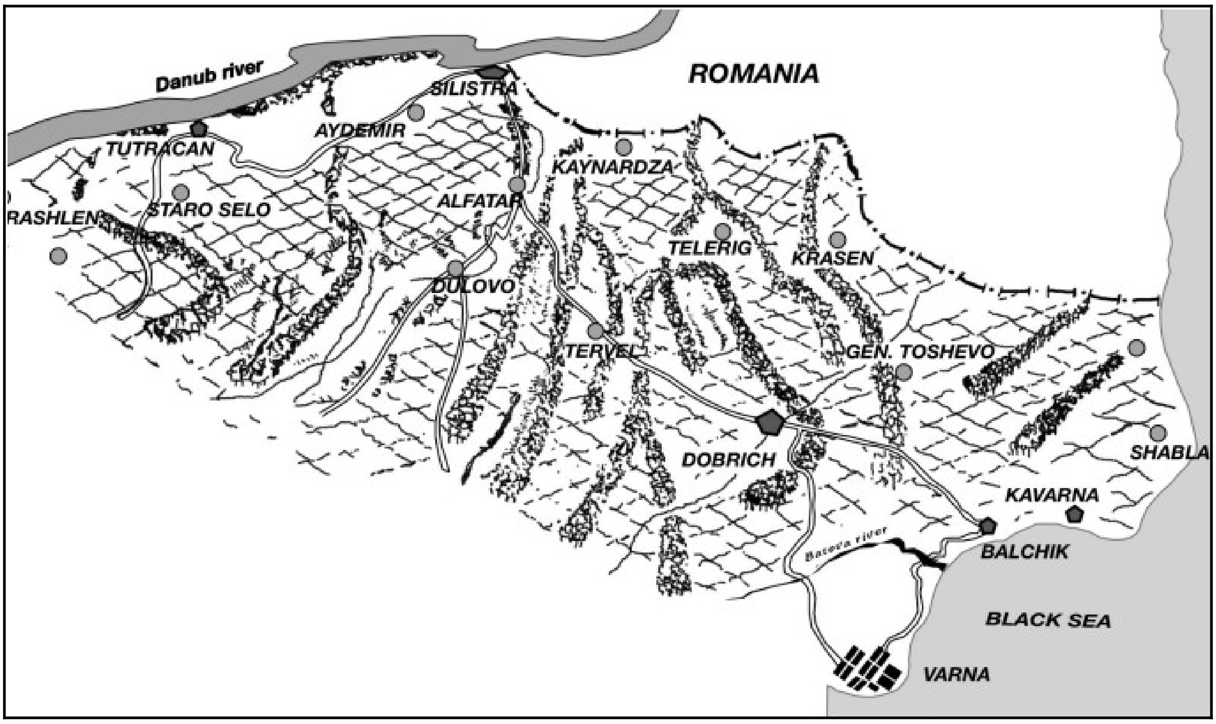

Fig. 1. Protective forest belts in Dobrudzha (Popov *et al.*, 2017, processed after Vachovski & Dimitrov, 2003; Dobrev & Peshev, 1957; Zahariev, 1959).

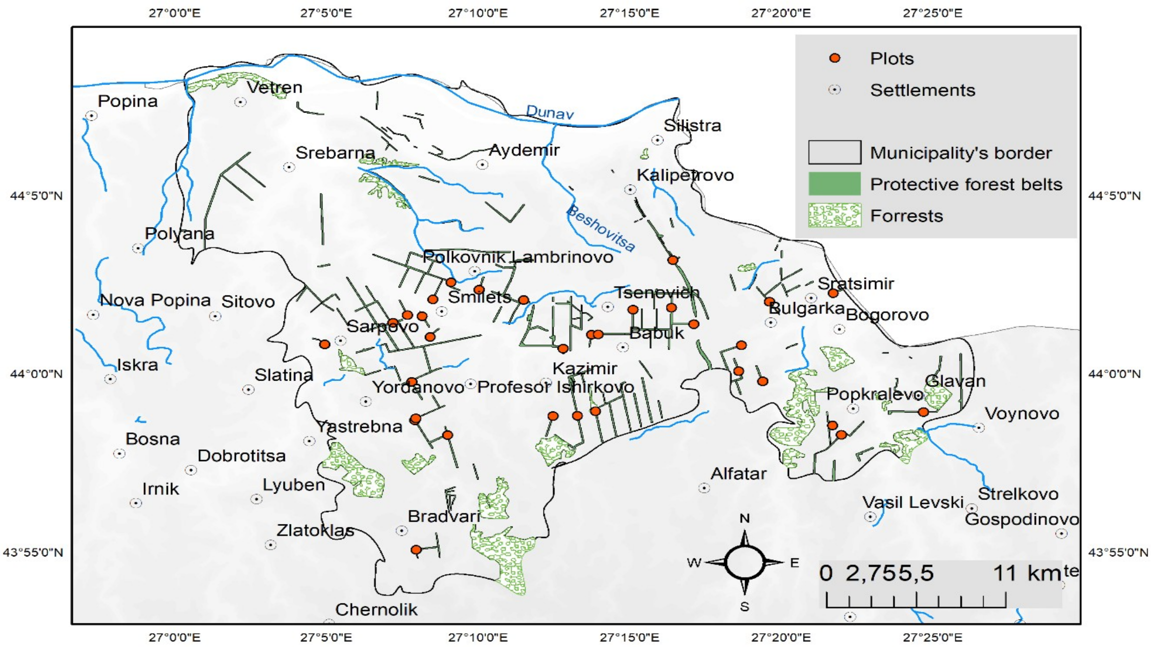

Fig. 2. Map of Silistra Municipality highlighting forest protection belts, mapped vegetation plots and existing forest vegetation outside the belts.

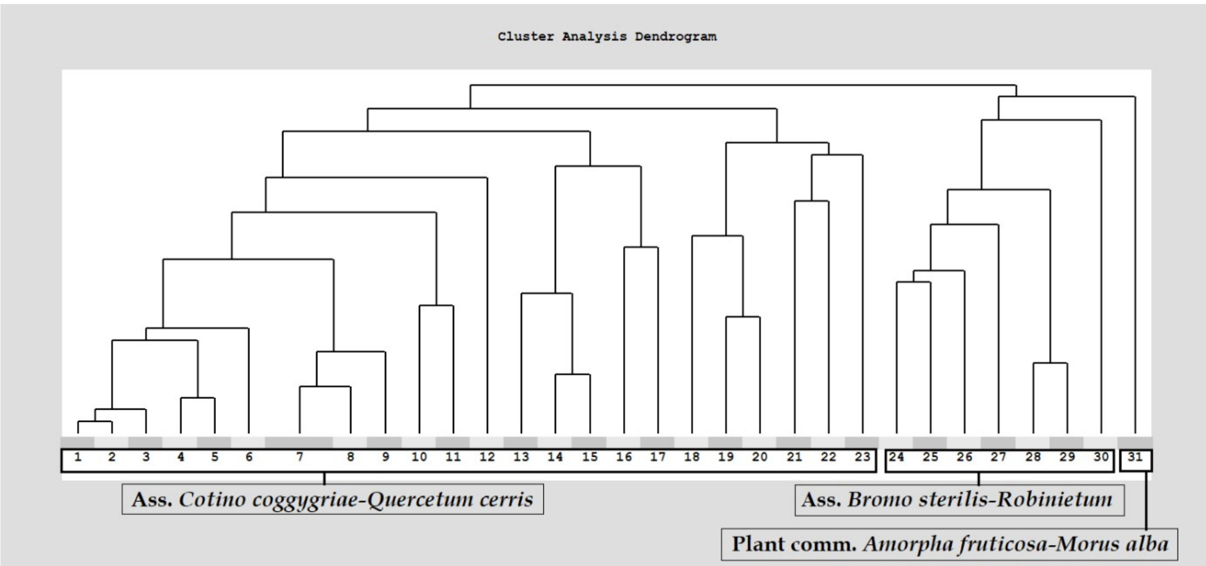

Fig.3. Vegetation types of forest belts in Silistra Municipality.

Photo 1. Phytocoenosis of association *Cotino coggygriae-Quercetum cerris.*

Photo 2. Phytocoenosis of *Amorpha fruticosa-Morus alba* community.

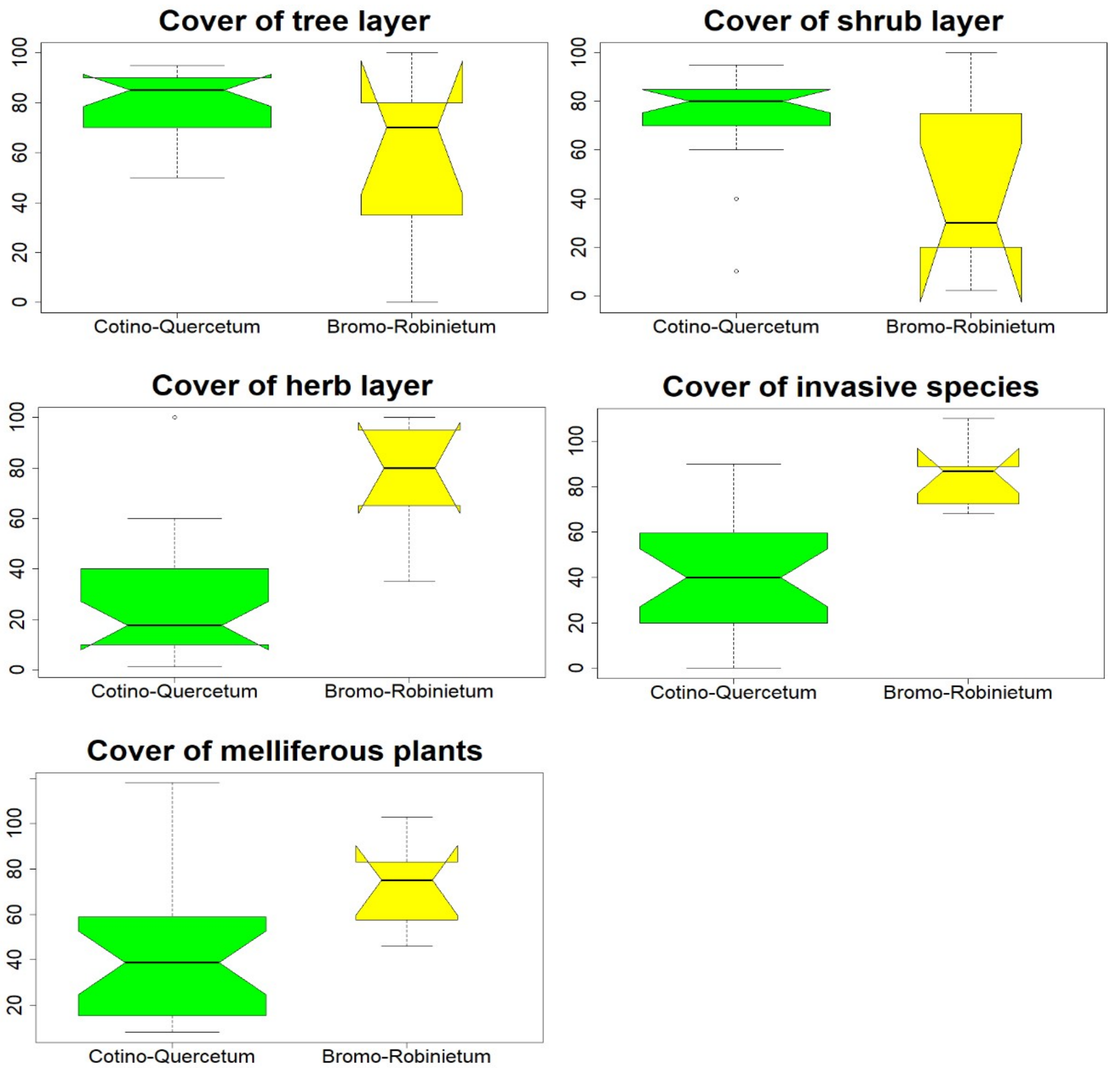

Fig. 4. Overall patterns about cover of tree, shrub, herb, invasive and melliferous plants layers visualised by notched box-and-whisker plots. Cover is presented in percentages. Statistically significant differences at *P < 0.05 between groups observed for the cover of herb, invasive and melliferous plants only.

Coverage and diversity of woody species, which formed tree and shrub layers, is higher in communities of *Cotino coggygriae-Quercetum cerris* association, which form closed horizontal structure and significant degree of shading. Finally, communities of *Amorpha fruticosa* and *Morus alba* represent final stage of degradation of vegetation. *Morus alba*, which traditionally has been used as fruit tree during centuries, has been planted closely to villages, around arable fields.

In the period of their existence the forest belts have been subject to increased anthropogenic pressure such as cutting, burning, some forest belts are used as pastures during summer months, etc. The small width of belts and long-term anthropogenic pressure around them has changed their species composition and lead to increasing of alien species in their community.

The field research of the forest belts in the municipality of Silistra shows that the most significant changes were made in subsection b of section 607, classified as object № 1814, state/municipal property, contracted by Silistra State Forestry under contract No. 5/16.01.2018 for logging with Les green Ltd. As a result of the implementation of this contract, logging was carried out in the appointed section and the rest of the section was cut 15 years ago and turned into a bush-like outgrowth of a belt. Given the small share of the forest cover of the municipality of Silistra (4.7%), it is hardly environmentally appropriate to carry out logging from the forest protection belts, especially since according to the law on forests, bare cuttings are forbidden. In the studied forest belts in individual places were recorded traces of felling of individual trees, which can be classified as poaching. In both cases, there were no traces of tree species disease. Subsection 607 b is located at the southernmost and relatively high in altitude part of the municipality. In the forest protection belt itself, a wooden observation post, probably for the identification of fires, has been constructed after the cutting of the tall trees due to the lack of visibility before that. We can assume that in the highest part of the relief of the municipality located away from the erosion bases of the Danube River, the protective belts serve to keep the snowfall, thus provide a reserve of soil moisture rather than to protect against wind erosion. Also, field studies have shown that in places, where asphalted roads provide direct access to forest protection belts, the border areas for penetration through agricultural lands have been deeply plowed in order to prevent the access of cars and heavy vehicles.

Conclusion

The authors believe that the forest protection belts condition in the municipality of Silistra is very good and they play their role in maintaining the soil moisture and protecting against water and wind erosion. Forest protection belts also play the role of nectar corridors, which in this area of small share of forest cover are vital for carrying out the pollination ecosystem service. Regardless the involvement of invasive species in the forest belts, they do not pose an immediate threat through the continuous expansion of their area, because the agricultural areas on both sides of the belts are being plowed every year and the herbicides used do not allow the invasive species to spread.

By its nature, this study is innovative with the attempt to establish the syntaxonomic relation of the forest protection belts and to show their role as nectar corridors in the country especially for municipalities and regions with very small share of forest cover.

Acknowledgements

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Table 1. Synoptic table of forest belts vegetation types of Silistra municipality. The species are represented by two indicators: Fidelity measure, expressed by the Phi-coefficient (Chytrý & al. 2002) and Constancy, expressed in percentages. Original cover/abundance scale assessments used for *Amorpha fruticosa-Morus* alba plant community since it is presented by one reléve only.

Vegetation type	Ass. *Cotino coggygriae - Quercetum cerris*	Ass. *Bromo sterilis-Robinietum*	*Amorpha fruticosa-Morus alba* **community**
Number of reléves	24	7	1
Average species	14	16	14

number per relevé					
Fidelity / Constancy	Phi	C	Phi	C	
Diagnostic species of ass. *Cotino coggygriae-Quercetum cerris*					
Cotinus coggygria	86.7	96	---	14	---
Quercus cerris	78	96	---	29	---
Diagnostic species of ass. *Bromo sterilis-Robinietum*					
Robinia pseudoacacia	---	21	86.1	100	---
Bromus sterilis	---	33	37.8	100	2
Diagnostic species of *Amorpha fruticosa-Morus alba* plant community					
Amorpha fruticosa	---	17	---	57	4
Morus alba	---	0	---	14	4
Diagnostic species of cl. *Quercetea pubescentis*, ord. *Quercetalia pubescenti-petreae* & all. *Quercion confertae*					
Crataegus monogyna	---	100	---	100	---
Euonymus verrucosus	---	33	---	14	---
Brachypodium sylvaticum	---	29	---	29	---
Acer tataricum	---	25	---	14	---
Poa nemoralis	---	25	---	57	---
Fraxinus ornus	---	17	---	0	+
Buglossoides purpurocaerulea	---	4	---	0	---
Carpinus orientalis	---	4	---	0	---
Syringa vulgaris	---	4	---	0	---
Viola hirta	---	4	---	0	---
Alliaria petiolata	---	21	---	29	---
Diagnostic species of cl. *Robinietea*, ord. *Chelidonio-Robinietalia pseudoacaciae* & all. *Balloto nigrae-Robinion pseudoacaciae*					
Galium aparine	---	25	23.9	86	2
Urtica dioica	---	33	---	29	2
Sambucus nigra	---	8	---	14	---
Diagnostic species of cl. *Carpino-Fagetea sylvaticae*					
Ulmus minor	---	21	---	0	---
Dactylis glomerata	---	8	---	0	---
Acer campestre	---	8	---	0	---
Arum maculatum	---	4	---	0	---
Carpinus betulus	---	4	---	0	---
Polygonatum latifolium	---	4	---	0	---
Tilia platyphyllos	---	4	---	0	---
Diagnostic species of cl. *Crataego-Prunetea*					
Ligustrum vulgare	72.5	63	---	0	---
Prunus cerasifera	---	71	---	57	2
Rosa canina	---	58	---	43	---
Cornus sanguinea	---	29	---	29	---
Cornus mas	---	8	---	0	---

Prunus spinosa	---	4	---	14	---
Other species					
Lapsana communis	---	0	---	14	---
Anthriscus cerefolium	---	21	---	14	---
Erigeron annuus	---	4	---	0	---
Dasypyrum villosum	---	0	---	14	---
Eryngium campestre	---	4	---	0	---
Arctium lappa	---	13	---	0	+
Euphorbia verrucosa	---	4	---	14	---
Chenopodium album	---	4	---	0	---
Elymus repens	---	4	---	0	+
Cephalaria transsylvanica	---	4	---	0	---
Acer negundo	---	4	---	0	---
Achillea millefolium	---	0	---	14	---
Carex otrubae	---	0	---	14	---
Rubus caesius	---	21	---	29	+
Conium maculatum	---	29	---	43	+
Carduus acanthoides	---	0	---	14	---
Consolida regalis	---	0	---	14	---
Fraxinus americana	---	96	---	100	---
Capsella bursa-pastoris	---	0	---	14	---
Lolium perenne	---	0	---	14	---
Clematis vitalba	---	8	---	0	---
Lactuca serriola	---	0	---	14	---
Artemisia vulgaris	---	4	---	0	---
Gleditsia triacanthos	---	21	---	57	---
Onopordum acanthium	---	0	---	14	---
Aristolochia clematitis	---	13	---	0	---
Cirsium arvense	---	0	---	14	---
Lamium purpureum	---	25	---	43	+
Glechoma hederacea	---	4	---	0	---
Lycopus europaeus	---	8	---	14	---
Hordeum murinum	---	0	---	14	---
Morus nigra	---	4	---	0	---
Geum urbanum	---	96	---	71	2
Agrimonia eupatoria	---	8	---	0	---
Galium album	---	8	---	0	---
Pyrus pyraster	---	33	---	14	2
Juglans regia	---	17	---	14	---
Poa annua	---	0	---	14	---
Torilis arvensis	---	8	---	29	---
Berteroa incana	---	0	---	14	---
Vicia varia	---	0	---	14	---

Pinus nigra	---	4	---	0	---
Brachypodium pinnatum	---	4	---	0	---
Malva sylvestris	---	0	---	14	---
Myrrhoides nodosa	---	46	---	57	---
Geranium molle	---	0	---	14	---
Galium sp.	---	0	---	14	---

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