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Endemism and relictness of the Eastern Sredna Gora Mt floristic sub region, South Bulgaria

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Abstract

These days the progress of human civilization depends more than ever on the attitude towards the environment. The trend of exploring and describing the biotic diversity of ecosystems is still maintained in the scientific society. A number of measures are taken, and legal provisions approved of worldwide, aiming its preservation. Priorities are studies on species of conservation status, endemic and relict taxa. They give a specific vision of floras; reveal the geological past of the territory, and are used as a principled criterion for determining the status of protected areas. Data for endemic and relict species in the Sredna Gora Mt are scarce, taking into account the low altitude and the anthropogenic load of the area. The present research objective is to describe the endemic and relict species in the Eastern Sredna Gora Mt floristic sub region, South Bulgaria. The current status of their populations is examined. 33 relicts (31 tertiary and 2 quaternary) and 14 endemic species are established. The investigation accomplishes the data base for distribution of these two groups in the Sredna Gora Mt. Moreover - supports the idea, that even the anthropogenically loaded low altitude mountain chains can be both, center of species formation, form creation, and refugium of the relict species. In accordance with the adopted in Rio de Janeiro (1992) Global Biodiversity Strategy and measures in Hague (CBD, 2002) to slow the loss of biodiversity and preserving the integrity of habitats, it is recommended that the endemic and relict species registered and their populations to be placed under protection and included in the national network of protected areas.

Keywords: Endemic plant species, Relicts, The Eastern Sredna Gora Mt, South Bulgaria

1. Introduction

Biodiversity is the foundation of life on Earth. If today we define its global loss as the sixth extinction, it is more dangerous than the preceding with the constancy of the damage it causes (Myers, 1988). One of the measures for preserving of the biota in a regional scale is the creation of a system of hotspots the so called "Habitat islands" (Myers, 1990) - places with high concentration of endemic species growing on a limited area and strongly altered habitats. 25 hotspots are defined on the entire surface of the Earth according to this principle (Mittermeier *et al.*, 1998), later their number increases to 34 (Brooks *et al.*, 2006). Plant (respectively animal) is a principled criterion for hotspot status determination (Behera *et al.*, 2002).

Three major factors determine the spread of endemics species - geographic area, ecologic plasticity and isolation. 6190 endemic taxa are described for Europe (Kruckeberg and Rabinowitz, 2002) with the closest hotspot - Mediterranean basin containing biota result of prolonged geographical isolation (Hewitt, 1999). Most of the species from Southern Europe are concentrated here, unlike the flora of Northern Europe, which is extremely poor as a result of glacial cycles. 614 taxa are identified as endemic on the Balkan Peninsula (Peev *et al.* (ed.), 2012), 287 of them as Balkan endemics, 66 local. The number of Bulgarian and Balkan endemics varies with the authors - Kuzmanov (1981) categorizes as endemic 330 taxa - 92 Bulgarian and 238 Balkan species; Petrova and

Vladimirov (2010) classify 270 taxa as Balkan endemics.

And while endemism gives specific vision of the floras, relictness establishes their age, and in many cases proves long-standing relations between seemingly remote regions (Milne, 2006).

Current distribution of biota in the Northern hemisphere is highly influenced by the climatic fluctuations in the last 65 million years (the Quaternary and Tertiary) (Milne and Abbott (2002). They give their impact on the floras by the relict species - with genesis older than the majority of plant and animal communities. In this way, local sections of the territories in Eastern Asia, Western and Northeastern North America, and Southwestern Eurasia become refugium to a number of relict species, providing them with favorable abiotic conditions during the last glaciation.

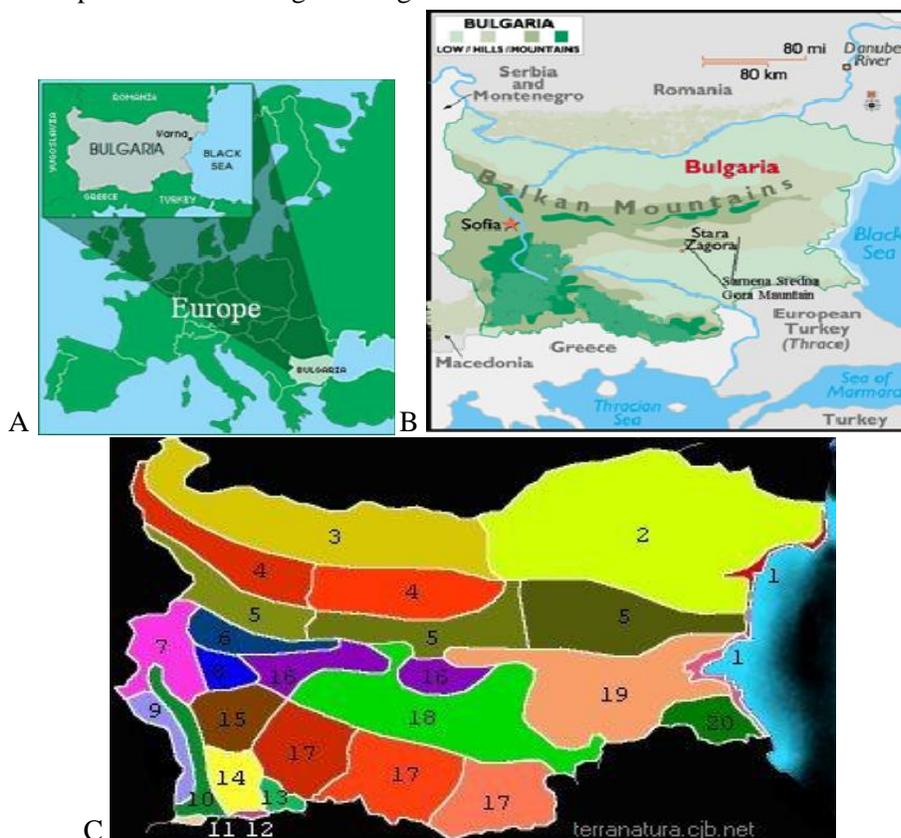
Relicts are associated mainly with the parameter time and its impression on the specific of floras: floristic composition - Hooker (1904) describes floristic diversity in sub continental India as a result of the migration of various species from neighbouring

countries, routes of migration of the species - Connor *et al.* (2013) show the region of Bulgarian Trakia as one of the corridors in which tertiary flora spreads to continental Europe; changing the area boundaries of the species (Filipova - Marinova *et al.*, 2010).

The present survey intends to analyze the plant variety in the Stara Zagora region with the purpose establishing endemic and relict species and the status of their populations.

2. Materials and Methods

As the sixth biggest town in Bulgaria, Stara Zagora (137 000 inhabitants, area of 85, 7 km²) is well known with its developed industry and transport. It is situated in the foot of the low eastern part of the Sredna Gora Mt - the Sarnena Sredna Gora (length of 153 kilometers, area 2280 km² and an average altitude of 416 meters) with the highest peak Morulei (895 m above sea level), but comprises also part of the Stara Zagora field (Map 1).



Map 1. A, B - Location of Stara Zagora town and the Sarnena Sredna Gora Mt;

C - Floristic regions and subregions in Bulgaria (according to Assyov *et al.*, 2002): 1. Black Sea coast; 2. Northeastern Bulgaria; 3. Danubian Plain; 4. Predbalkan (Western, eastern); 5. Stara Planina Mt (Western, central, eastern); 6. Sofia Region; 7. Znepole Region; 8. Vitosha Mt; 9. Western Frontier Mts; 10. Struma Valley; 11. Belasitsa Mt; 12. Slavyanka Mt; 13. Mesta Valley; 14. Pirin Mt; 15. Rila Mt; 16. Sredna Gora Mt (Western, eastern); 17. Rhodopes Mt (Western, central, eastern); 18. Thracian Lowland; 19. Tundja Hilly Plain; 20. Strandja.

Earlier examinations, those of Stanev (1986), Yordanov (1944) indicate the existing relationship between the flora of the Sredna Gora Mt chain and floral complexes of the Western Rhodopes, Besaparski Hills, St. Iliya Heights and Bakadzhitsite.

The studies on the Ihtimanska and Sashtinska Sredna Gora Mt, completed by Veltchev *et al.* (1968) establish the presence of endemic and relict species, such as *Paeonia mascula* (L.) Mill., *Verbascum nobile* Vel., *Alkanna primuliflora* Griseb., *Crocus olivieri* J. Gay. The same species are mentioned also in the works of Gantchev and Dentchev (1963), Gantchev (1965), Stanev (1973, 1975) for the Sarnena Sredna Gora Mt, and for the Eastern Sredna Gora Mt, and Stara Zagora field in particular.

For the region of the Sashtinska Sredna Gora Mt. Parpulova (2013) registered Balkan enedemics, such as *Verbascum nobile* Vel., *Moehringia grisebachii* Janka, *Crocus olivieri* J. Gay, *Acer heldreichii* Orph., and the following Bulgarian endemics: *Geum rhodopaeum* Stoj. & Stef., *Oenanthe millefolia* Janka.

Their registration refutes the notion of scarcity of the endemic element in the Sredna Gora Mt, and supports the thesis of the decisive role of the Sredna Gora chain in the processes of form creation and species formation. The finding of various floral elements confirms the probably existing genetic connection among Strandzha Mt, the low altitude mountains along the Tundzha Plain, the Eastern Stara Planina Mt, and the Sarnena Sredna Gora Mt towards the end of Tertiary and the early Quaternary.

In floristic terms the territories analyzed fall in the Sredna Gora Mt floristic region - the Eastern Sredna Gora Mt sub region, featuring transient-continental climate. The altitude varies in the range of 300 - 850 m. Bedrock is limestone and soil - maroon forest.

The study covers the period 2008-2013; plant diversity was investigated by routing method. For each species, a short morphology characteristic is made, and the current status of populations and habitat in the area are defined.

Results and Discussion

RELICT TAXA

TERTIARY RELICTS

The group includes 31 taxa, belonging to 29 genera and 21 families. They are divided into three biological groups:

Wood biotype includes the following species:

Aceraceae Family

- ***Acer campestre* L.** - it is a deciduous tree with a highly developed root system. Life parts are 5, flowers are hermaphrodite. The fruit is a samara with two winged achenes aligned at 180°. The species is ubiquitous in the area, blooms and fruits annually.
- ***. pseudoplatanus* L.** - it is a tree with broad crown, reaching up to 35 m in height. The leaves are 5 lobed, with ovate shares, double serrated, with unisexual flowers, fruiting wings at an acute angle. The taxon is widespread in the area.
- ***. tataricum* L.** - it is a low tree with underdeveloped crown and opposite, simple, broadly ovate leaves, unlobed or with three or five shallow lobes. The flowers are small, whitish-green, produced in spreading panicles in spring as the leaves open. The fruit is a paired reddish samara. It is disseminated in the area.

Betulaceae Family

- ***Carpinus orientalis* Mill.** - a tree up to 18 m in height, with ovoid crown, light gray twisted and ribbed stalk, dark green ribbed leaves and nut fruits with roof flakes, resembling to a small scaled asymmetric leaves. The taxon is the major species in deciduous forests.

Fagaceae Family

- ***Fagus sylvatica* L.** - tree species, reaching sizes up to 30 m, with wavy edge ovate leaves and fruits - triangular nuts, located in barbed box. The species rarely forms numerous populations in the area.
- ***Quercus cerris* L.** - leaves r with short tapered lobes, with stellate hairs below. Acorns longitudinally striated, covered by a cup-shaped dome with long, styliform and backward flakes. It is the main species in the mixed forests in the area.
- ***Q. dalechampii* Ten.** - leaves are deeply and improperly shared, often the main and the lateral veins form a network. Scales of the cupule are almost rhombic, gray or gray-greenish. The species participates in the composition of deciduous communities in the region.

- *Q. polycarpa* Schur. - leaves are shallow lobed, intermediate veins are missing. Acorns are several on a twig, the cupule is with egg-shaped brownish, bold knotted scales. The species is presented by single individuals, sparsely distributed.

Cornaceae Family

- *Cornus mas* L. - it is a tree-shrub with yellow flowers, appearing before leafing, egg-shaped leaves with arched venation and red fruits. It is widely occurring as undergrowth in the deciduous forests on the region.

Juglandacea Family

- *Juglans regia* L. - it is a tree, up to 30 m high, with extremely branched crown and cracked bark. The leaf laminas are from 5 to 9 pieces with elliptical shape. The fleshy shell of the fruit is green, with bright dots. The tree is ubiquitous, capable of self - displacement.

Lythraceae Family

- *Punica granatum* L. - it is a tree, reaching 8 m in height, with beautiful orange flowers and spherical fruits with many coral-red seeds. It is spread mainly near settlements.

Oleacea Family

- *Fraxinus ornus* L. - the flowers are with whorls and cup, entrenched in ripe fruit. Inflorescences develop at the tips of the branches after foliation. It is the major species in the mixed woods in the region.
- *F. excelsior* L. - it is a high deciduous tree with imparipinnate leaves, monoecious or dioecious, with samara fruit. The tree is prevalent in the region.

Salicaceae Family

- *Populus alba* L. - it is a dioecious species 25 m in height. Young twigs and buds are with dense hairs. The leaves are 4 - 15 cm long, five-lobed, dark green above, white below, with white scurfy layer. The flowers are catkins up to 8 cm long, produced in early spring; they are dioecious, with male and female catkins on separate trees. The species usually develops along rivers.

- *P. tremula* L. - it is a dioecious taxon with oval leaves on long stalks. The flowers are in catkins. The species is moisture-loving plant.
- *Salix alba* L. - the species is a dioecious cold-resistant and moisture-loving tree. Leaves are lanceolate in form; the flowers are simple without perianth, forming catkins. The tree is ubiquitous around water sources.
- *S. caprea* L. - the species is a low moisture-loving tree with lanceolate leaves and flowers in fluffy catkins. The species is common for water basins.

Tiliaceae Family

- *Tilia tomentosa* Moench. - it is a deciduous tree, growing from 20 to 35 m in height. The leaves are alternately arranged, rounded to triangular-ovate, 4-13 cm long and broad with a 2,5 - 4 cm petiole, green and mostly hairless above. The flowers are pale yellow, hermaphrodite, produced in cymes. The fruit is a dry nut-like drupe 8-10 mm long, downy, and slightly ribbed. The tree forms numerous populations in the region.

Ulmaceae Family

- *Ulmus minor* Mill. - the tree typically grows less than 30 m high. The bark of the trunk is rough, lightly furrowed in older trees to form a block pattern. The leaves are generally with fewer than 12 pairs of side veins, and asymmetric leaf base. The samara fruit are typically ovate and notched, the notch reached to the central seed. The species is ubiquitous in shady and moist places.

To the shrub biotype belong the following species:

Anacardiaceae Family

- *Cotinus coggigria* Scop. - it is a shrub with yellow wood and hermaphrodite flowers in clusters on the top. The immature flowers transform to downy hairs. The species is widespread in open, sunny places.

Araliaceae Family

- *Hedera helix* L. - the species is an evergreen climbing plant with two types of leaves: palmate five-lobed juvenile leaves on creeping

and climbing stems, and unlobed cordate adult leaves on fertile flowering stems. The flowers are small, greenish-yellow, collected in umbels. The fruits are purple-black to orange-yellow berries. The taxon is common for the region.

Betulaceae Family

- ***Coryllus avelana* L.** - it is a shrub, reaching 3-8 m in height with deciduous leaves, softly hairy on both surfaces. The flowers are produced very early in spring, before the leaves, and are monoecious with single-sex wind-pollinated catkins. The fruit is a nut, held in a short leafy involucre. The species occurs as a lower floor of deciduous plant communities.

Liliaceae Family

- ***Ruscus aculeatus* L.** - the species is an evergreen shrub with flat shoots (cladodes), similar to spine-tipped leaves. Small greenish flowers appear in spring, and are borne singly in the centre of the cladodes. The female flowers are followed by a red berry. The species forms sparse populations in the undergrowth of deciduous forests.

Oleacea Family

- ***Syringa vulgaris* L.** - it is a small tree, ranging from 2 to 10 m in size. The leaves are opposite in arrangement, simple and heart-shaped, flowers are bisexual, with four-lobed corolla, the fruit is a dry, brown capsule. The species is pervasive.
- ***Jasminum fruticans* L.** - it is a low shrub with triple petals and yellow flowers. The species is distributed around the settlements, secondary savage.

The group of herbaceous species includes:

Amaryllidaceae Family

- ***Galanthus nivalis* L.** - it is a perennial bulbous species with white 3 lobed flowers. The species is an early spring plant, which is spread everywhere.

Boraginaceae Family

- ***Anchusa stylosa* MB** - it is an annual species, covered with bristly hairs. The flowers are blue-violet, 5 type; sepals united at their bases,

and petals forming a narrow tube facing upwards, forming several axillary cymes. The species is common in open grasslands.

Cucurbitaceae Family

- ***Ecbalium elaterium* (L.) A. Rich.** - it is a perennial taxa with accumbens ribbed, rough-bristly stem, triangular leaves and unisex yellow flowers and rough fruit. The species is prevalent on open, sunny places with rocky soils.

Dioscoreaceae Family

- ***Dioscorea communis* (L.) Caddick et. Wilkin** - the species is a climbing herbaceous dioecious plant with tuberous rhizome. Leaves are spirally arranged, heart-shaped; flowers are inconspicuous, greenish-yellow, collected in the racemes (male flowers) and clusters (female flowers). The fruit is a bright red berry. Single specimens are distributed in the deciduous forests in the region.

Fabaceae Family

- ***Medicago falcat* L.** - it is a perennial herb with rhizome and multiple erect shooting out stems. Leaves are alternate, composed of 3 ovate, hairy leaflets. Flowers are yellow, in oblong clusters in leaf axils. The fruit is a curved pod. The species occurs in the region.

Liliaceae Family

- ***Erythronium dens - canis* L.** - the species is a bulbous herbaceous perennial plant with white and pink flowers. The petals are reflexed at the top and yellow tinted at the base. It forms small populations in the undergrowth of the deciduous forests in the region.

Polygonaceae Family

- ***Rumex acetosa* L.** - it is an herbaceous plant with solitary erected juicy stem and large ovate leaves. The small pinkish flowers are unisexual, collected in loose clusters. The species is pervasive.

Ranunculaceae Family

- ***Clematis vitalba* L.** - the species is a climbing shrub with branched, grooved stems,

deciduous leaves, and scented greenly-white flowers with fluffy underlying sepals. It is widely spread, including in anthropogenically loaded habitats.

- *Anemone apennina* L. - it is a perennial species with bulbous puffy rhizomes, palmate lobed leaves and white single flowers. The taxon is sparsely distributed in the region.
- *Isopyrum thalictroides* L. - it is a perennial species with creeping rhizome, lobed leaves and white or violet flowers. The species forms multiple populations in the oak forests undergrowth in the region.

Rhamnaceae Family

- *Paliurus spina-christi* Mill. - the species is a deciduous shrub with modified in spines stipules, oval-shaped leaves, small yellow flowers, collected in groups to the leaves stalks. The fruit is a dry woody nutlet, centered in a circular wing. It is well-known species in the region.

Rutaceae Family

- *Dictamnus albus* L. - it is a perennial plant with complex leaves, covered with black punctate glands. Flowers are pink, with lemon fragrance. The taxon occurs in open, sunny slopes on limestone.

Orchidaceae Family

- *Limodorum abortivum* (L.) Sch. - The species is a saprophytic herbaceous rhizomatous plant, growing up to 85 cm in height with fleshy, violet colored stem, reduced to scales leaves and lax inflorescence of 10-20 violet flowers. The taxon is prevalent in open woodlands.

QUATERNARY RELICTS

Polygonaceae Family

- *Bistorta major* L. - it is a perennial herbaceous species with thick snake curved, in breaking pink-red rhizome. The stems are simple, erected and ended with thick class inflorescens. The flowers are small, pale pink to red pink. It is widespread in damp places.

Iridaceae Family

- *Iris pumila* L. - it is a perennial species with rhizome, very short stem, ended with single blooms. The flower is protected by two spathes. Flower color is quite variable: yellow and purple or violet are the most common. The species forms numerous populations on open, sunny places, on limestone.

ENDEMIC SPECIES

BALKAN ENDEMICS

Asteraceae Family

- *Achillea clypeolata* Sm. - it is a perennial species with well- developed rhizome, erected stems, silver hairy pinnate leaves and small flowers, cumulate in flat clusters at the top of the stem. The species is occurs on rocky and stony open sunny places.
- *Jurinea mollis* (L.) Rechb. subsp. *anatolica* (Boiss.) Stoj. et Stef. - it is a perennial herb with 20 - 60 cm in height, with ground-rosette of pinnatifid leaves. Flower heads are solitary, globose, purple or lilac, with cottony-hairy bracts. Taxon is prevalent in rocky places.

Apiaceae Family

- *Bupleurum apiculatum* Friv. - it is an annual herbaceous species up to 60 cm in height. The stem is usually pseudo-dichotomously branched in the upper half, umbels 5-30, some of them usually depauperate. The stem is erect, usually slightly flexuose, striate and ends with umbel, which is often overtopped by branches; umbel rays are very unequal. All leaves are with amplexicaul basis. The species is distributed on sunny, rocky places, forms fewest population.

Boraginaceae Family

- *Alkanna primuliflora* Griseb. - it is a perennial herbaceous species with golden-yellow flowers, collected in cimes at the top of the stem. It is common on rocky, sunny and open places with shallow soils.
- *Nonea atra* Griseb. - it is an annual herbaceous species with dark-violet flowers and stem and leaves, thickly covered with bristly hairs. In grass communities it is presented by single individuals.

Caryophyllaceae Family

- *Dianthus moesiacus* Vis. - it is a perennial species with narrow leaves and pink flowers, growing on rocky meadows and grassy places. It occurs rarely in grasslands.

Fabaceae Family

- *Trifolium dalmaticum* Vis. - it is an annual grass species with numerous trailing or ascending stems, ended with 1-2 small spherical heads. The species grows on dry, sunny and stony places.

Iridaceae Family

- *Iris sintenisii* Jka. - it is a perennial rhizomatous species with flattened stem up to 30 cm in height, and light blue flowers at the top. Species is disseminated in grass and bush communities.

Hypericaceae Family

- *Hypericum rumeliacum* Boiss. - it is a grassy species with creeping rhizomes, erect stem, branched in the upper section and specific translucent dots on the leaves. Leaves and flowers are covered with black and red pointed glandules. The flowers are bright yellow. The species is widespread in region.

Lamiaceae Family

- *Thymus longidentatus* (Deg. et Urum.) Ronn. - it is a perennial species with rhizomes and creeping gray-greenish stems, covered with trichomes. The flowers are small, lilac-blue, collected in head inflorescences on the top. The species forms numerous populations on the sunny open, rocky places.

Linaceae Family

- *Linum thracicum* (Griseb.) Deg. - it is a perennial grass species with numerous, slender and short ascending stems and bright yellow flowers, cumulated in terminal clusters. The species forms fewness populations in grassy communities.

Scrophulariaceae Family

- *Digitalis viridiflora* Lindl. - it is a perennial taxon with well develop rhizomes, stems up to 80 cm in height. The leaves form a rossete and greenish-yellow flowers, which cumulate in spike on the top. It occurs rarely in the area.

BULGARIAN ENDEMICS

Asteraceae Family

- *Centaurea napulifera* Rochel. ssp. *thirkei* (Schultz-Bip.) Dost - it is a perennial plant with puffy tuberous taproot. The species forms solitary pink basket-like cluster on the top of the stem. It is spread in open, sunny places, often on rocks.

Brassicaceae Family

- *Capsella bursa-pastoris* (L.) Medic. ssp. *thracica* (Vel.) Stoj. et Stef. - it is an annual - biannual species with a rossete of lobbed leaves at the base. The stem leaves are simple, pointed and partly grasp the stem. The flowers are white and small, in loose racemes, and produce seed pods which are heart-shaped. The subspecies has typical deeply incised on the top seed pod. The species is pervasive in grasslands, develops even in anthropogenic impact areas.

Ranunculaceae Family

- *Thalictrum aquilegifolium* L. - it is an herbaceous perennial, with leaves composed of frilled leaflets, resembling to those of aquilegia fern. The species reaches up to 120 m in height. The leaves are alternate, bipinnately compound, and commonly glaucous blue-green in colour. The flowers are small and apetalous, with numerous long stamens, brightly white, and form dense inflorescences. The species occurs naturally in shady areas, under shrubs.

Orchidaceae Family

- *Fritillaria pontica* Wahn. - it is a herbaceous perennial with a little bulb and simple, tulip-shaped green perianth with wine purple lip. The species forms numerous populations and is well developed both in undergrowth of oak forests, and on open sunny places. It is sub endemic species for Bulgaria and Turkey.

Conclusion

The hotspots conception as “oases” of biological diversity develops in some targets of Biodiversity Strategy EU 2020 - increasing the number of species under protection, restoring the original green shelter belts infrastructure, and limitation of anthropogenic pressure. This fact enhances the value of any information related to the endemic and relict species and their populations.

Endemism and relictness reveal specifics and genetic characteristics of each flora. Bulgarian regional endemism indicates that the territory of our country is rich in a variety of ecological niches and underwent complex Floro-genetic and phytoclimatic history.

Regardless of the low altitude, the Sarnena Sredna Gora Mt slopes and the low hills of the Stara Zagora Plain represent refugia of a number of relict taxa of Tertiary time.

Genotypically stabilized as a result of continuous evolution, they are perfectly adapted to the local abiotic conditions and play the role of the main species in mixed forests in the area.

Relict taxa of bush and grass biotype also show a constant presence in the grass overgrowth.

Despite the anthropogenic pressure on the floristic sub region Sarnena Sredna Gora Mt a significant presence of endemic species is reported. They belong to the grassy biological type; they are perennial and form stable populations. Data obtained from the survey complement the available floristic information and require regulated attitude to local biota. Registered populations of endemic species should be included in the national network as habitats of the corresponding taxa.

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