

## NEW DATA ON THE VERTICAL DISTRIBUTION OF SOME ARBOREAL SPECIES OF THE FLORA IN BULGARIA

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### Abstract

During floristic studies in different floristic regions of Bulgaria in the period 2006–2012, we found habitats of *Juniperus deltoides*, *J. sibirica*, *J. pygmaea*, *Pinus nigra* ssp. *pallasiana*, *Quercus coccifera*, *Q. dalechampii*, *Alnus incana*, *Rhamnus saxatilis*, *R. rhodopaeus*, *Astracantha thracica*, *Ilex aquifolium* that expand our knowledge of the vertical distribution of these species in Bulgaria, and hence their ecological niche in the country. The work also specifies the vertical distribution of *Pseudotsuga menziesii*, an adventitious species of the flora in Bulgaria, whose vertical distribution has not been noted in any literary source.

**Key words:** arboreal plant species, vertical distribution, new chorological information, Bulgaria.

### Introduction

The vertical distribution of each plant species provides valuable information about its ecological requirements and it is cited in all “Handbooks for identification”, “Synopsis of the flora”, “Checklists” and “Floras”. Until 1967 vertical distribution of species of the flora of Bulgaria was marked with approximate digits from 1 to 3 (Stoyanov and Stefanov 1948, Stoyanov et al. 1966–1967). Digit 1 means that the species is spread in the lower or oak belt, which lies approximately between 0 and 1000 m altitude. The

digit 2 indicates that the species is spread in the mountain belt, roughly between 1000 and 2000 m altitude, and digit 3 indicates species distribution in highland (alpine) zone, i.e. higher than 2000 m above sea level. When the species is found in more than one zone, combinations of digits are used. A dash before the digits 2 (–2) and 3 (–3) means that this species can be seen down and below 1000, respectively below 2000 m altitude, and a dash after the digits 1 (1–) and 2 (2–) indicates that the species is up and above 1000, or 2000 m altitude, respectively. These markings give very ap-

proximate notion about the species' vertical distribution and for many species it had never been mentioned. In the multivolume edition of the Flora of Bulgaria (Yordanov ed. 1963–1979, Velchev ed. 1982–1989, Kozhuharov ed. 1995, Kozhuharov and Anchev eds. 2012), the vertical distribution was indicated with real altitudes, but most often only the upper limit of species distribution was specified. "Identification Guide to higher plants in Bulgaria" (Kozhuharov ed. 1992) and "Identification Guide to the plants in Bulgaria" (Delipavlov and Cheshmedzhiev eds. 2003, 2011) indicated altitude distribution of the species represented by specific numbers, as a result of dividing the altitude by 1000. Dashes were also used before or after the altitudes, like in the older literature sources; for some species the range of altitudes was listed as well.

Since 2000, a major and most accurate reference source for the vertical distribution of plant species has become the "Conspectus of the Bulgarian vascular flora", compiled by a group of Bulgarian botanists. The Conspectus had already four editions, which is due to the rapid accumulation of information about the floristic richness and distribution of plant species in Bulgaria (Dimitrov ed. 2001, 2002; Assyov and Petrova eds. 2006, 2012). It is evident, for example, that the first edition included 3807 species of higher plants, while the fourth edition has 4102 species, i.e. 295 plant species have been added to the flora of Bulgaria just for 11 year period. With a few exceptions, the "Conspectus" provides information about the range of altitudes (m) of distribution of each species. There are species, such as *Pseudotsuga menziesii* with no information about the vertical distribution, because this species has only recently been recognized as part of the adventitious flora of Bulgaria (Tashev et al. 2012).

The purpose of the present work is to provide new data on the vertical distribution of some arboreal plants in Bulgaria, which could be considered in the next edition of the "Conspectus of the Bulgarian vascular flora" and in the publications elsewhere.

## Materials and Method

The data presented have been obtained during various floristic studies in the period 2006–2012. During our work we paid special attention to the altitude where plant species have been found, and if different from the well-known one, herbarium specimens were collected. The exact coordinates of localities and altitudes were determined by means of GPS. The plant names follow The Euro + Med PlantBase – the information resource for Euro-Mediterranean plant diversity (2011) and Assyov and Petrova (2012).

## Results

Below we present descriptions of the new localities of arboreal species, found at altitudes not reported previously for the habitats of these species, thus representing new ecological niches. The following information is provided for each locality: floristic region and sub-region; geographic distribution, habitat, orography, exposition, slope, altitude, coordinates, date of collection and numbers of herbarium specimens in the Herbarium of the Institute of Biodiversity and ecosystem research – BAS (SOM), in the Herbarium of the Sofia University (SO) and in the Herbarium of the Agricultural University

in Plovdiv (SOA). In some cases, floristic characteristic of the localities is provided. At the end we cite the references with altitudinal ranges of distribution different from these reported by us.

### **Cupressaceae**

#### ***Juniperus communis* L.**

Rhodopi Mts (Central): Mursalski Rid, Chaeva chuka locality, within a grass community dominated by *Nardus stricta*. Above the treeline, on a northwest facing roof and inclination 2 °, 1900 m a.s.l. (+200 m a.s.l.), N 41°38'48.0", EO24°29'56.8", 9.09.2006, coll. Al. Tashev, A. Vitkova (SOM 163615).

Rhodopi Mts (Central): Mursalski Rid, Mt Karmilyata. Above the treeline, on a roof, 1900 m a.s.l. (+200 m a.s.l.), 18.11.2006, coll. S. Bechev (SOM 163603).

This species was reported to date within the range 200–1700 m a.s.l. (Delipavlov 2011: 37, Assyov and Petrova 2012: 243).

#### ***Juniperus pygmaea* C. Koch**

Balkan Range (Central): in the area of Kalofer, locality called "Kamenlivitsa", near the trail to the hut "Ray", in the only known habitat of *Alchemilla mollis* (Buser) Rothm. in Bulgaria, on a rocky glade, SW exposition, slope of 25 °, 1150 m a.s.l. (–350 m a.s.l.), N 42°41'33.1", EO 24°57'13.6", 21.07.2007, coll. Al. Tashev, A. Vitkova (SOM 164045, SO 104853).

The species was reported till now within the range 1500–1700–1800 m (Delipavlov 2011: 37, Assyov and Petrova 2012: 243).

#### ***Juniperus deltoides* R.P. Adams**

Rhodopi Mts (Central): above the village of Trigrad, locality Kraevo. On a rocky slope, SW exposition, 15 °. On limestone, 1320 m a.s.l., (+220 m a.s.l.) 41°36'24.0"N, 24°23'18.7"E, 26.02.2007, coll. Al. Tashev (SOM 163795).

Rhodopi Mts (Western): close to Devin, Arsaz Tepe locality. In bush community with *Juniperus communis* on a rocky southern slope, inclination 40 °. On rhyolite, 1430 m a.s.l. (+330 m a.s.l.), KG-82, 41°47'33.4"N, 24°23'48.0"E, 08.09.2006, coll. Al. Tashev (SOM 164043, 164044).

The species (sub *J. oxycedrus* L.) has been reported from sea level to 1100 m altitude (Delipavlov 2011: 37, Assyov and Petrova 2012: 243).

#### ***Juniperus sibirica* Burgsd.**

West Frontier Mts: Osogovo, under Mt Choveka, locality Gramadite. In the upper part of a SW slope, inclination 15 °, 1635 m a.s.l. (–265 m a.s.l.), 42°11'17.3"N, 22°37'07.3"E, 18.09.2006, coll. Al. Tashev, A. Vitkova (SOM 163605).

West Frontier Mts: Osogovo, locality Oborite. In the upper part of a SW slope, inclination 12 °, 1560 m a.s.l. (+200 m a.s.l.), 42°10'46.5"N, 22°36'35.5"E, 19.09.2006, coll. Al. Tashev, A. Vitkova (SOM 163606).

The species has been reported from 1900 to 2400 m a.s.l. (Delipavlov 2011: 37, Assyov and Petrova 2012: 243).

### **Fagaceae**

#### ***Quercus coccifera* L. var. *coccifera***

Balkan Range (Eastern): "Sinite kamani" Nature park, locality Karakyutyuk, on a highly eroded slope, 25–30 ° inclination, south-eastern exposition, 850 m a.s.l. (+500 m a.s.l.), N 42°44'07.3", EO 26°17'27.9", MH-43, 8.06.2010, coll. Al. Tashev (SOM 165939, 165940, 165941).

The habitat is located in a narrow vertical strip between 849 and 851 m altitude and its geographical coordinates at the center of the field are 42°44'07.3" N and 26°17'27.9" E, at an average altitude 850 m. Eleven individuals of *Quercus coccifera* L. var. *coccifera* with shrubby habitus were found on an area of about

100 m<sup>2</sup>. Distance between the two most distant individual was 30 m. The height of the specimens found varied from 11 to 77 cm. They had typical globular crowns with diameters between 15 and 90 cm. This shape and sizes are result of livestock grazing in the area. Some parts of the branches and leaves in several individuals were dry. Leaves of the individuals were smaller than normal and had length of 7 to 30 mm and width of 4 to 17 mm. The plant community, where the individuals were found is mostly shrub with single individuals of tree species with height up to 3–4 m. The soil cover undergoes erosion. Tree vegetation was represented by *Carpinus betulus* L., *Quercus pubescens* Willd., *Fraxinus ornus* L., *Acer hyrcanum* Fisch. & C. A. Mey., *Acer platanoides* L., *Prunus avium* L., *Malus sylvestris* Mill., *Pyrus pyraeaster* Burgsd. and *Pinus sylvestris* L. Shrubs were represented by *Rosa canina* L., *Ligustrum vulgare* L., *Cornus sanguinea* L., *Crataegus monogyna* Jacq., *Chamaecytisus supinus* (L.) Link, *Thymus* spp., *Prunus spinosa* L., *Rubus canescens* DC., *Clematis vitalba* L., etc. In the grassy floor we found wheat grasses: *Dactylis glomerata* L., *Festuca rubra* L., *Festuca valesiaca* Schleich. ex Gaudin, *Phleum phleoides* (L.) Karst., *Koeleria nitidula* Velen., *Brachypodium sylvaticum* (Huds.) P. Beauv. Singly and in larger spots there are *Pteridium aquilinum* (L.) Kuhn. Singly or in small groups there are: *Digitalis lanata* Ehrh., *Pulsatilla montana* (Hoppe) Rchb., *Hieracium* spp., *Campanula lingulata* Waldst. et Kit., *Viscaria vulgaris* Röhl., *Teucrium chamaedrys* L., *Fragaria vesca* L., *Filipendula vulgaris* Moench, *Primula veris* L., *Trifolium montanum* L., *T. ochroleucon* Huds., *Euphorbia cyparissias* L., *Sanguisorba minor* Scop., *Dorycnium herbaceum* Vill.,

*Leontodon* sp., *Carex* sp., *Rumex acetosella* L. and some others. The total coverage of vegetation cover in the field was about 50 %. There were typical damages resulting from grazing on all trees and shrubs.

The habitat is at altitude more than 400 m above the highest known habitat in Bulgaria. Furthermore, the habitat represents the northernmost locality of the species in Bulgaria, and hence, in Europe – i.e. this is the most northern point of the species' distribution. Till now, the known habitats of this rare for the Bulgarian flora species are in the valley of the Mesta River, Eastern Rhodopes and South Struma Valley, up to 350 m altitude. (Delipavlov ed. 2011: 62, Assyov and Petrova 2012: 338).

#### ***Quercus dalechampii* Ten.**

Rhodopi Mts (Western): in the territory of the State Forestry "Alabak", locality called Kladova, below the hut "Kladova", in the periphery of a forest of *Picea abies*, *Pinus sylvestris* and *Abies alba*. The locality is situated at the summit part of a south-eastern 5 ° slope at 1600 m a.s.l. (+100 m a.s.l.), N 42°04'42.7", EO 23°56'47.9", 30.08.2012, coll. Al. Tashev (SOM 168943, SOA 059746).

The vertical distribution reported for this species is from sea level to 1500 m a.s.l. (Delipavlov ed. 2011: 62, Assyov and Petrova 2012: 338).

#### **Betulaceae**

##### ***Alnus incana* (L.) Moench**

Rhodopi Mts (Central): in the territory of the State Forestry "Smolyan", near the village of Mugla, close to Kasaka, on the banks of the Little River together with *Picea abies* in the natural habitat "White alder woods" (EUNIS: G1.B24 Rhodopide grey alder woods; PAL. CLASS.: 41.S24 Rhodopide grey alder

woods) – a habitat included in the Red Data Book of Bulgaria with the category “Endangered” (Peev ed. 2011). 1463 m a.s.l. (+63 m a.s.l.), 41°36'08.4"N, 24°31'10.9"E, 2.08.2010, coll. Al. Tashev (SOM 168941).

Rhodopi Mts (Western): in the territory of the Training and experimental forestry “Yundola”, locality Mochura, along with undergrowth of *Pinus sylvestris* and *Picea abies* in the natural habitat “Mochurna gora” (91D0) – a priority habitat under Directive 92/43 / EEC, on a northeastern slope and tilt 2 °, 1516 m a.s.l. (+116 m a.s.l.), N 42°03'44.6”, EO 23°53'02.1”, 29.08.2012, coll. Al. Tashev (SOM 168941, SOA 059748).

The vertical distribution reported for this species is from 600 to 1400 m a.s.l (Delipavlov ed. 2011: 63, Assyov and Petrova 2012: 61).

#### Rhamnaceae

***Rhamnus saxatilis* Jacq. ssp. *tinctorius* (Waldst. et Kit.) Nyman**

Rhodopi Mts (Central): in the territory of the State Forestry “Hvoyna”, below the hut “Persenk”, near a dirt road to the village Orehovo and old-growth *Picea abies* forest with *Abies alba* and *Pinus sylvestris*. In the upper part of the southern slope with 6 ° inclination, 1640 m a.s.l. (+440 m a.s.l.), N 41°50'51.2”, EO 24°33'52.6”, 8.09.2012, coll. Al. Tashev (SOM 168949).

The vertical distribution reported for this species is from the sea level to 1200 m a.s.l (Delipavlov ed. 2011: 279, Assyov and Petrova 2012: 345).

#### ***Rhamnus rhodopaeus* Velen.**

Rhodopi Mts (Central): within the biosphere reserve “Chervenata stena”, on the peak “Popa”, 1300 m a.s.l. (+800 m a.s.l.), 30.08.1992, coll. P. Zhelev (SOM 154059).

The vertical distribution reported for this species is from 200 to 500 m a.s.l (Delipavlov ed. 2011: 279, Assyov and Petrova 2012: 345).

#### Fabaceae

***Astracantha thracica* (Griseb.) Podl. ssp. *jankae* (Degen et Bornm.) Greuter**

Balkan Range (Eastern): in the territory of the natural park “Sinite kamani”, the locality Natural landmark “Trite peshteri”. At a small glade near the road to the locality Karandila near the town of Sliven. Near a forest of *Fagus sylvatica* L. ssp. *moesiaca* with *Carpinus betulus* and *Ostrya carpinifolia* Scop. In the middle part of the slope, southeastern exposition and 3 ° inclination, on shallow rocky soil on sandstone, with flowers, 1021 m a.s.l. (+221 m a.s.l.), N 42°44'23.6”, EO 26°22'36.4”, 20.10.2012, coll. Al. Tashev (SOM 168947, SOA 059744).

The vertical distribution reported for this species is from the sea level to 800 m a.s.l (Assyov and Petrova 2012: 86).

#### Aquifoliaceae

***Ilex aquifolium* L.**

Rhodopi Mts (Western): in the territory of the state forestry “Borino”, locality Kremakliev Dol, in the middle part of an eastern slope with inclination 30 °, near a moist, shady vale at 1348 m a.s.l. (+148 m a.s.l.), N 41°42'08.1”, EO 24°17'00.2”, KG-69 28.11.2009, coll. Al. Tashev (SOM 165562, 165563).

One individual was found in a 70-year old natural forest of *Picea abies*. It is a bush with 14 stems, the highest one reaching 0.85 m, and some of the peripheral stalks are lying on the soil surface. There is an old dead stem with diameter at the base of 32 mm. The projective cover of *Picea abies* in the first floor is up to 90 %, and the undergrowth covered up to 20 %. In the ground floor, representa-

tives of Bryophyta (70–80 %) dominate. The low shrubs found include *Vaccinium myrtillus* L., *V. vitis-idaea* L., *Bruckenthalia spiculifolia* (Salisb.) Rchb., and the herbaceous species occurred singly or in small groups: *Dryopteris filix-mas* (L.) Schott, *Calamagrostis arundinaceae* (L.) Roth, *Melica uniflora* Retz., *Carex sylvatica* Huds., *Aegopodium podagraria* L., *Anthriscus sylvestris* (L.) Hoffm., *Aeromonium agrimonoides* (L.) DC, *Asarum europaeum* L., *Cirsium appendiculatum* Griseb., *Cruciata glabra* (L.) Ehrend., *Euphorbia amygdaloides* L., *Fragaria vesca* L., *Geranium robertianum* L., *Hieracium murorum* L., *Hypericum perforatum* L., *Mycelis muralis* (L.) Dumort., *Oxalis acetosella* L., *Potentilla micrantha* Ramond ex DC., *Primula veris* L., *Salvia glutinosa* L., *Sanicula europaea* L.

The vertical distribution reported for this species is from 400 to 1200 m a.s.l (Delipavlov ed. 2011: 277, Assyov and Petrova 2012: 236).

### Pinaceae

#### *Pinus nigra* Arnold ssp. *pallasiana* (D. Don) Holmboe

Rhodopi Mts (Central): Mursalo-Pereklik part of the Central Rhodopi, locality Chaeva chuka (Eminvoto). In the upper treeline, in the upper part of a slope, south-facing and angle 30 °, 1850 m a.s.l. (+250 m a.s.l.), N 41°38'24.8", EO 24°29'30.5", 2.08.2010, coll. Al. Tashev (SOM 166162, 166163, 166164).

Single trees of *Pinus nigra* ssp. *pallasiana* in sparse forest together with *Picea abies* (L.) Karst., *Abies alba* Mill., *Pinus sylvestris* L., *Betula pendula* Roth and *Sorbus aria* (L.) Crantz. Shrub vegetation was represented by *Juniperus communis*, *J. pygmaeus* C. Koch and *Helianthemum nummularium* (L.) Mill. The plants in herbaceous floor included *Briza*

*media* L., *Festuca rubra* L., *Sesleria latifolia* (Adamović) Degen, *Brachypodium sylvaticum* (Huds.) P. Beauv., *Luzula sylvatica* (Hudson) Gaudin, *Achillea clypeolata* Sm., *Trifolium alpestre* L., *Sideritis scardica* Griseb., *Carlina acanthifolia* All., *Dianthus petraeus* Waldst. & Kit., *Potentilla cinerea* Chaix ex Vill., *Campanula persicifolia* L., *Fragaria vesca* L., *Sedum* spp., *Euphorbia amygdaloides* L., *E. seguerrana* Nick., *Scabiosa ochroleuca* L., *Acinos alpinus* (L.) Moench, *Primula veris* L., *Thymus* sp., *Hieracium alpestre* Jacq., *Nepeta nuda* L., *Leontodon autumnalis* L. etc.

The vertical distribution reported for this species is from sea level to 1600 m a.s.l. (Assyov and Petrova 2012: 316).

#### *Pseudotsuga menziesii* (Mirb.) Franco ssp. *menziesii*

Rhodopi Mts (Eastern): in the territory of the State Forestry "Kirkovo", in the lands of village Tihomir, around the frontier post "Tihomir", in a glade near a forest road in the locality Proletnika. In the upper part of a western slope, with 6 ° inclination, 582 m a.s.l., N 41°17'02.8", EO 25°31'32.5", 08.08.2012, coll. Al. Tashev, N. Tashev (SOM 168935).

Rhodopi Mts (Western): in the territory of the State Forestry "Dospat", in the lands of village Barutin, the locality Lambova livada, mass regeneration under culture of *Pinus sylvestris*, together with undergrowth of *Picea abies* and *Juniperus communis*. On a northwest slope 5 °, 1197 m a.s.l., N 41°36'29.8", EO 24°12'04.9", KG-59, 24.07.2009, coll. Al. Tashev (SOM 165568, 165569).

In the Conspectus of the Bulgarian vascular flora of this species, adventitious for the flora of Bulgaria is not reported. (Assyov and Petrova 2012: 333). Therefore, basing on field data, we offer that

range to be specified – from 500 to 1200 m a.s.l.

## Conclusion

This work presents new data on the distribution of 12 species of the Bulgarian den-droflora expanding our knowledge of their ecological niche. For the first time data are reported about the vertical distribution of the adventitious species *Pseudotsuga menziesii*, which begins to show signs of the invasiveness in the Rhodopes. The data presented can be used in the preparation of new editions concerning the distribution of species in Bulgaria.

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