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**REVIEW ON *QUERCUS DALECHAMPII* TEN. AND *QUERCUS PETRAEA* (MATTUSCHKA) LIEBL.
IN THE VEGETATION OF BULGARIA**

Eva Filipova¹ & Asen Asenov^{2*}

¹ Department of Ecology and EP, Faculty of Biology, St Kliment Ohridski University of Sofia, 8 Dragan Tzankov Blvd., 1164 Sofia, Bulgaria

² Department of Botany, Faculty of Biology, St Kliment Ohridski University of Sofia, 8 Dragan Tzankov Blvd., 1164 Sofia, Bulgaria

Abstract. *Quercus dalechampii* Ten. and *Quercus petraea* (Mattuschka) Liebl. have close taxonomical features, ecological requirements and phytocenological characteristics. *Quercus dalechampii* is wide spread in Bulgarian mountains up to 1500 m. *Q. petraea* does not make communities, but takes part in the communities of *Q. dalechampii* as single individuals. The aim of this review is to show taxonomical differences and some ecological and phytocenological characteristics of these two similar species.

Key words: *Quercus dalechampii*, *Quercus petraea*, oak forest, Bulgaria

The oak forests are widely presented in the vegetation of Bulgaria. In 1990, they covered 31,4 % of the forest area (RADENSKI 1999). They are distributed on fore balkan and mountain belt from 300 to 1500 m a.s.l. in xerophytous, xeromesophytous and mesophytous habitats. The native oak species in Bulgarian vascular flora are: *Quercus dalechampii* Ten., *Q. cerris* L., *Q. frainetto* Ten., *Q. petraea* (Mattuschka) Liebl., *Q. robur* L., *Q. hartwisiana* Stev., *Q. pedunculiflora* C. Koch, *Q. polycarpa* Schur, *Q. virgiliana* Ten., *Q. pubescens* Willd., *Q.*

* *corresponding author:* Asen Asenov - Department of Botany, Faculty of Biology, St Kliment Ohridski University of Sofia, 8 Dragan Tzankov Blvd., 1164 Sofia, Bulgaria; e-mail: asenasenov71@yahoo.com

mestensis Bond. et Gančev, *Q. thracica* Stef. et Nedjalkov, *Q. trojana* Webb., *Q. cocifera* L. (JORDANOV 1966; ASSYOV & PETROVA 2012). *Q. dalechampii* and *Q. petraea* are often reported in a common group.

The detailed classification of oak forests in Bulgaria was made by PENEV ET AL. (1969) and Popov (2002). *Quercus dalechampii* Mill (Balkan durmast) communities are an element of xeromesophytic microthermic forest vegetation (BONDEV 1991). The wood floor is pure or mixed, often with different participation of *Carpinus betulus*, *Fagus sylvatica*, *Acer platanoides*, *Quercus polycarpa*, *Acer campestre*, *Fraxinus ornus*, *Carpinus orientalis*. The species that often predominate in the undergrowth and lower floors are: *Poa nemoralis*, *Geum urbanum*, *Helleborus odorus*, *Dicranum scoparium*, *Pleurozium schreberi*, *Hypnum cupressiforme* and others. In the biological spectrum the hemicryptophytes (over 50%) have the highest participation, followed by cryptophytes (over 10%). The phanerophytes are also represented by over 10% (e.g. DJANKOVA ET AL. 2003; PACHEDGJIEVA ET AL. 2004; LYUBENOVA ET AL. 2009; GOGUSHEV ET AL. 2009).

A large number of associations with the participation of *Quercus petraea* (sessile oak, durmast) have been described in Bulgaria by applying the dominant method (APOSTOLOVA ET AL. 1997), where the species is dominant, subdominant or only participate. According to the floristic approach of Brown-Blanke sessile oak forests are included in the alliance *Quercion petraeae* Zólyomi et Jakucs in Soó 1963 - thermophilic oak forests on acidic rock underground rock (Rodwell et al. 2002). Comparative analysis on the state of sessile oak forests in Europe is published by LYUBENOVA ET AL. (2015).

The forests of *Quercus dalechampii*, described in Bulgaria or its nearby areas by different authors are assigned to different classification schemes (e.g. HORVAT ET AL. 1974; BERGMEIER & DIMOPOULOS 2008; GOGUSHEV 2009; LYUBENOVA ET AL. 2011; ASSENOV ET AL. 2013). They are classified in the class *Quercio-Fagetea*, order *Fagetalia sylvaticae* and alliances *Fagion* and *Carpinion betuli*. The communities from ass. *Carpino-Fagetum* and *Galio-Carpinetum betuli* are grouped in ass. *Aegopodium podagraria-Carpinus betulus* (DIMITROV 2015). GOGUSHEV (2009) classified *Quercus petraea* communities in the association *Genisto carinalis-Quercetum petraeae* Bergmeier in Bergmeier et Dimopoulos 2008. PACHEDGJIEVA (2011) assigned the sessile oak forests in the reserve "Kamenshtitsa" to the class *Quercetea pubescentis* (Oberd. 1948) Doing Kraft 1955, order *Quercetalia pubescenti-petraeae* Klika, alliance *Quercion petraeae* Zólyomi et Jakucs in Soó 1963 (xeromesophytic forests of durmast) and the association *Genisto carinalis - Quercetum petraeae* Bergmeier in Bergmeier et Dimopoulos 2008.

Although *Q. petraea* and *Q. dalechampii* are widely known as similar species, it is outlined that there are clear diagnostic features, which allow differentiation between the both oaks. They concern the leaves, fruits, flowers and species height.

Quercus dalechampii is smaller than *Q. petraea*. The height is to 30 m. The leaves are smaller (to 15 cm in length and 5 cm in width), widest below the center or in the center. The leaves are situated uniformly on the branches, not only on the ends. The leaves are more chopped, on the upper side is nude and dark green, on the down side - downy with small cluster hairs. The nerves are 5-9, not parallel. The axis of male catkin have hairs. The male flowers have 6 parts perianth. The anthers are large with short stamen handles. The cupola is larger with knots on the flakes.

Quercus petraea is higher than *Q. dalechampii*. The height is more than 30 m. The leaves are bigger (to 16 cm in length and 10 cm in width), widest above the center or in the center. Weakly chopped, situated on the ends of branches, on the upper side are green, on the down side - light with short hairs. The nerves are 6-9 (11) couples. The axis of male catkin are naked or have rare hairs. The male flowers have 6-8 parts perianth. The anthers are smaller than stamen handles. The cupola is smaller without knots on the flakes (JORDANOV 1966).

According to the literature available, the both oak species have similar ecological requirements. *Q. petraea* grows on colluvial, fresh, shallow soils, on limestone or silicate terrains, on dry and rich grey forest and cinnamon soils, or also on degraded soils (KAVRAKOVA ET AL. 2009). *Q. dalechampii* grows on neutral to weakly acid, rarely carbonate soils, which are rich and moist to fresh. These soils acc. to NINOV (2002) are cinnamon forest (*Chromic Cambisols*), grey forest (*Luvisols*) and brown forest (*Cambisols*).

The geographical range of *Quercus petraea* is broad – it covers the areas of Europe, Anatolia, Transcaucasia (TUTIN ET AL. 1964; JORDANOV 1966; EUROPEAN FOREST GENETIC RESOURCES PROGRAMME). The species is an European floristic element (Eur; ASSYOV & PETROVA 2012) – **Fig. 1**. The communities of *Quercus dalechampii* have more limited distribution – they cover the areas of Southeastern Europe, Southeastern Austria,

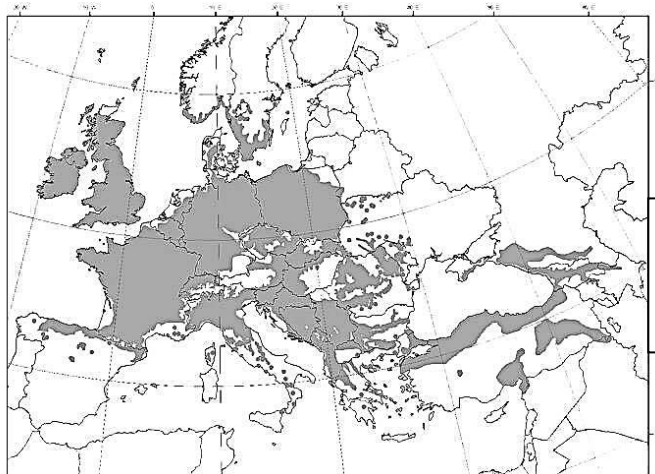


Fig. 1. Distribution of *Quercus petraea*
(retrieved from
<http://www.euforgen.org/distribution-maps>)

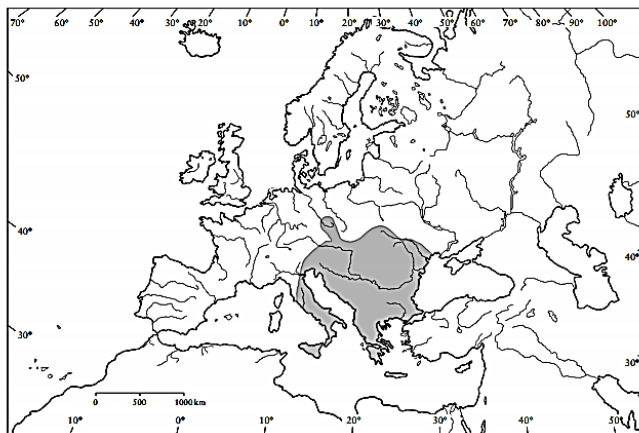


Fig. 2. Distribution of *Quercus dalechampii*
(retrieved from
<http://www.euforgen.org/distribution-maps>)

Italy, Sicily – (TUTIN ET AL. 1964; JORDANOV 1966; EUROPEAN FOREST GENETIC RESOURCES PROGRAMME). The species is a Submediterranean floristic element (subMed; ASSYOV & PETROVA 2012) – **Fig. 2**.

In Bulgaria *Quercus dalechampii* is wide spread in the mountains up to 1500 m a.s.l. (JORDANOV 1966) and covers large areas (450 000 ha) in the following mountains: Rodopi, Stara Planina, Sredna Gora, Osogovska Planina, Vlahina, Maleshevska Planina and Ograzhden. The participation of *Quercus petraeae* in communities increases mainly on northern exposed wetter terrains and with the increase of the altitude and on different inclinations. The forests of *Quercus dalechampii* are a part of mesophytous microthermal broadleaf native forest vegetation in Bulgaria. They form the hornbeam-durmast forest belt that sometimes enters in the beech belt. The monodominant forest with good developed spring sinusia prevail. On the lower mountain regions and in North-eastern Bulgaria *Quercus dalechampii* forms mixed forest with *Carpinus betulus* L., and *Tilia* sp. L.; in Western Bulgaria - with *Q. frainetto* Ten., and in Danube plain - with *Q. cerris* L. The accompanying species in durmast foest are *Carpinus orientalis* Mileer., *Crataegus monogina* Jacq., *Cornus mas* L., *Fraxinus excelsior* L., *Acer campestre* L., *A. platanoides* L. and others (LYUBENOVA 2004).

In Western and Eastern Sredna Gora and Vitosha region on the upper border of the durmast belt *Quercus petraea* appears as single individuals, mixed with *Fagus sylvatica* (JORDANOV 1966). In North Bulgaria it is spread in the Danube Plain (ASSYOV & PETROVA 2012) and in Dobrudzha (KAVRAKOVA ET AL. 2009).

According to BONDEV (1991) *Quercus dalechampii* takes parts in the following native vegetation in Bulgaria:

Mesophytous and xeromesophytous microthermal vegetation in the coniferous forest belt:

20. Mixed silver pine (*Pinus silvestris* L.) and Balcanic durmast (*Quercus dalechampii* Ten.) forests

Mesophytous and xeromesophytous microthermal vegetation in the hornbeam-durmast forest belt:

51. Mixed Mizian beech (*Fagus sylvatica* L. ssp. *moesiaca* (K. Maly) Hyelmq); Balkanic durmast (*Quercus dalechampii* Ten.), mountain ashtree (*Fraxinus excelsior* L.) sycamore (*Acer pseudoplatanus* L.), Hyrcanum maple (*Acer hyrcanum* Fischh et Mey.), etc. forests

56. Hornbeam-Balkanic durmast forests (*Querceto-Carpineta betuli*) (over 600 m. a.s.l.)

57. Mixed ordinary hornbeam (*Carpinus betulus* L.) and cerris oak forests (*Quercus cerris*) partly with Balkanic durmast (*Quercus dalechampii*), maple (*Acer campestre* L.). etc.

58. Balkanic durmast forests (*Quercus dalechampii*)

59. Mixed Balkanic durmast (*Quercus dalechampii*) and aquatic hornbeam forest (*Ostrya carpinifolia* Scop.) partly with mountain ashtree (*Fraxinus excelsior* L.), flowering-ash (*Fr. ornus* L.), Oriental hornbeam (*Carpinus orientalis* L.), etc.

60. Mixed balkanic durmast (*Quercus dalechampii* Ten.) cerris oak (*Quercus ceriis*) and *Quercus frainetto* Ten. forests

61. Mixed Balkanic durmast (*Quercus dalechampii* Ten.) and *Quercus frainetto* Ten. forests

62. Mixed Balkanic durmast (*Quercus dalechampii* Ten.) and Oriental hornbeam (*Carpinus orientalis* Mill.) forests, partly of secondary origin

63. Mountain ash-tree forests (*Fraxinus excelsior* L.) often mixed with Balkanic durmast (*Quercus dalechampii* Ten.), *cerris oak* (*Quercus cerris* L.), flowering-ash (*Fraxinus ornus* L.) etc.

66. Mixed Black pine (*Pinus nigra* Arn.) and Balkanic durmast (*Quercus dalechampii* Ten.) forests

69. Mixed silverleaf lime (*Tilia tomentosa* Moench.), ordinary hornbeam (*Carpinus betulus* L.) or *cerris oak* (*Quercus cerris* L.) forests, partly also with Balkanic durmast (*Quercus dalechampii* Ten.), field maple (*Acer campestre* L.), etc.

According to the EUROPEAN UNIVERSITY INFORMATION SYSTEMS ORGANISATION (EUNIS) *Q. petraea* and *Q. dalechampii* are classified in the following habitats:

G1.7641 Helleno-Moesian *Quercus petraea* forests,

G1.763 Helleno-Moesian *Quercus dalechampii* forests,

G1.76821 Central Moesian oriental hornbeam (*Quercus dalechampii*) forests

According to GOGUSHEV (2009) the diagnostic species for the *Quercus dalechampii* communities are: *Quercus dalechampii* Ten., *Mycelis muralis* (L.) Dumort., *Lapsana communis* L., *Campanula trachelium* L., *Scutellaria columnae* Al., *Silene vulgaris* (Moench) Garcke, *Lathyrus vernus* Bernh., *Genista carinalis* Griseb. and *Galium pseudoaristatum* Schur. The diagnostic species for the communities, in which takes part *Quercus petraea*, are: *Quercus dalechampii* Ten., *Fagus sylvatica* L., *Hypericum perforatum* L., *Euphorbia amygdaloides* L., *Genista carinalis* Griseb., *Fragaria vesca* L., *Poa nemoralis* L. и *Asplenium adianthum-nigrum* L. The constant species for the group of durmast coenoses are: *Quercus dalechampii*, *Poa nemoralis*, *Potentilla micrantha*, *Veronica chamaedrys*, *Fragaria vesca*, *Galium pseudaristatum*, *Fagus sylvatica*, *Cystopteris fragilis*, *Hypericum perforatum* (PACHEDJIEVA 2011).

According to the DIRECTIVE 92/43/EEC *Quercus petraea* agg. (incl. *Q. dalechampii*) are classified into the following habitats:

91G0 Pannonic woods with *Quercus petraea* and *Carpinus betulus*

91I0-Euro-Siberian steppic woods with *Quercus* spp.

91M0-Pannonian-Balkanic turkey oak-sessile oak forests

9170 Galio-Carpinetum oak-hornbeam forests (Kavrakova et al, 2009).

The habitat of *Quercus dalechampii* have a conservation status, protected by the BULGARIAN BIODIVERSITY ACT and COUNCIL DIRECTIVE 92/43 EC and is included in the Red Data Book of Bulgarian Natural Habitats as Mountain forests of *Carpinus betulus* and *Quercus dalechampii* with Code 27G1 and Near Threatened conservation status (DIMITROV 2015a). *Quercus petraea* also takes part in a habitat which has a conservation value: Lowland mesophilic oak and hornbeam forests. The habitat is protected by the BULGARIAN BIODIVERSITY ACT, COUNCIL DIRECTIVE 92/43 EC and BERN CONVENTION and is included in the Red Data Book of Bulgarian Natural Habitats with code 26G1 and Near Threatened conservation status (DIMITROV 2015b).

Two species are well known to have economic significance and are anthropogenically affected. Durmast was used for furniture manufacturing, and a flour for the birds can be made from its acorns. The leaves are used for forage and pasture (in mountains Ograzhden and Maleshevska Planina). Due to the clear felling much of the forests have offshoot origin (as it is well exemplified on the mountain Vlahina). Durmast forests are situated far away from the towns and therefore a part of them has comparatively preserved structure and natural restoration process takes part there (LYUBENOVA 2004).

In conclusion, it could be summarised that: 1) The both discussed oak species differ well by diagnostic features; 2) In Central Europe, the communities are dominated by *Quercus petraea* (Matt.) Liebl. (European floristic element) while in Bulgaria, Greece and Macedonia the communities are dominated by *Quercus dalechampii* Ten. (sub-Mediterranean floristic element); 3) The communities of *Quercus dalechampii* need more syntaxonomical investigations in Bulgaria and therefore a conduction of such targeted research will help to fill the lack of sufficient information on this topic.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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