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The wild service tree *Sorbus torminalis* (L.) Crantz in plant communities of Poland

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Abstract: The available phytosociological data and original observations were used for preparing a list of plant communities with *Sorbus torminalis* on its natural sites in Poland. The community context of its sites showed a wide range: from pine-oak forests (alliance *Dicrano-Pinion*) and oak forests (*Quercetalia robori-petraeae*, *Quercetalia pubescenti-petraeae*) to oak-hornbeam forests (*Carpinion*) and beech forests (*Fagion*). Oak-hornbeam forests (*Carpinion*) are the most frequent communities with *S. torminalis* in Poland. Despite this, oak forests (especially the open thermophilous forests of *Quercetalia pubescenti-petraeae*) seem to be the most suitable sites for growth and reproduction of this light-demanding tree species. Some remarks on *S. torminalis* conservation in the community context were also presented as its passive protection in some forest reserves has proved to be ineffective or even harmful.

Additional key words: phytosociology, forest plant communities, niche amplitude, conservation, Rosaceae

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Introduction

The wild service tree *Sorbus torminalis* (L.) Crantz is a typical forest tree. Hermy et al. (1999) listed it among the 132 indicator species of old deciduous forests in Europe. However, Dzwonko and Loster's (2001) list of 155 old-forest species found in Poland unfortunately does not include any woody species. In Polish forests, *S. torminalis* is a typical admixture found in scattered locations, mainly in the western part of the country. The species reaches in Poland its northeastern limit of distribution, so its local populations are generally very small here. Among the 73 surviving natural populations of *S. torminalis*, only eight include more than 100 individuals each (Bednorz 2003, 2004). Although this tree is of no economic importance in Poland, it increases the biodiversity of forests and is a valuable biocoenotic species. Its succulent brown fruit is readily eaten by some mammals

and numerous bird species. In contrast to most of the other native tree species in Poland, it is never the main component of forest stands.

Little is known about the contribution of *S. torminalis* to Polish plant communities, because it has not been studied in detail so far. Due to its scattered distribution and small population size, *S. torminalis* is rarely recorded in phytosociological tables. The aim of this paper is to present and discuss the conditions of occurrence of *S. torminalis* in Poland in relation to its contribution to plant communities.

S. torminalis in plant communities of Poland

The list presented below includes names of all plant associations in which *S. torminalis* was found in Poland, but also locations of this species (Fig. 1), according to the ATPOL grid square system (Bednorz

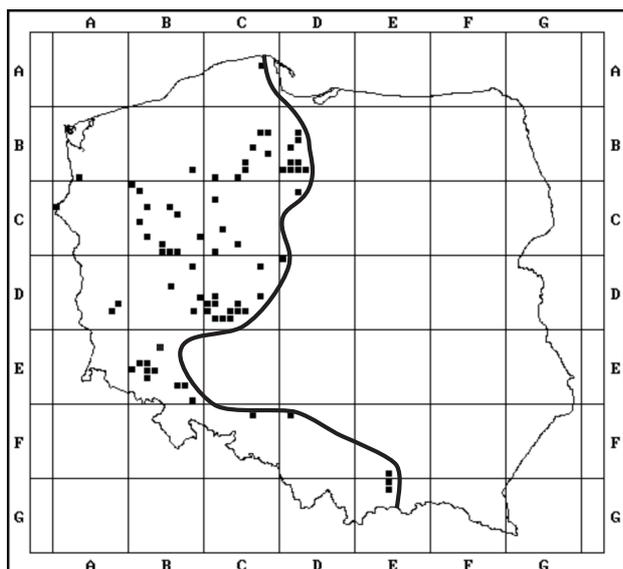


Fig. 1. Distribution of *Sorbus torminalis* in Poland with its range limit (Bednorz 2004)

2004). The list is based on the available publications, documentation of nature reserves, and original data. The classification and names of syntaxonomic units follow those of J.M. Matuszkiewicz (2001), W. Matuszkiewicz (2001), Kwiatkowski (2001, 2003), and Brzeg et al. (1989, 2000, 2001). Numbers of locations representing each association and major higher syntaxonomic unit are given in square brackets.

List of plant communities

Class: *Vaccinio-Piceetea* Br.-Bl. 1939 [5]

Order: *Cladonio-Vaccinietalia* Kiell.-Lund 1967

Alliance: *Dicrano-Pinion* Libb. 1933

Association: *Quercus roboris-Pinetum* (W.Mat. 1981) J.Mat. 1988 (continental pine-oak forest) [5]: BD18 Wielkopolska National Park, CB37 Kaliska Forest District (FD), CB56 Woziwoda FD (reserve "Ustronie"), DB71 Jamy FD, CD81 Chachalnia

Class: *Quercetea robori-petraeae* Br.-Bl. et Tx. 1943 [18]

Order: *Quercetalia robori-petraeae* Tx. 1931

Alliance: *Quercion robori-petraeae* Br.-Bl. 1937

Association: *Fago-Quercetum petraeae* Tx. 1955 (Pomeranian beech-oak forest) [1]: AB93 Beech Forest (Puszczka Bukowa)

Association: *Luzulo luzuloidis-Quercetum* Hartm. 1953 (submontane acid oak forest) [6]

Subassociation: *Luzulo-Quercetum typicum*: BE52 foothills of Kaczawskie Mts. (Pogórze Kaczawskie)

Subassociation: *Luzulo-Quercetum genistetosum tinctoriae*: BE50, BE52, BE53, BE62 foothills of Kaczawskie Mts., BE77 Ślęza Masif

Association: *Calamagrostio arundinaceae-Quercetum* (Hartm. 1934) Scam. 1959 (Central European acid oak forest) [7]: BE52 foothills of Kaczawskie Mts., CD60, 64, 70, 73, 74, 83 Krotoszyn Oak Forests (Dąbrowy Krotoszyńskie)

Subassociation: *Calamagrostio arundinaceae-Quercetum petraeae molinietosum* (Central European acid oak forest, damp subassociation): CD64 Taczanów FD

Association: *Molinio caeruleae-Quercetum roboris* (R. Tx. 1937) Scam. et Pass. 1959, *Anemone* var. (Central European wet oak forest with purple moor-grass, more fertile variant with *Anemone*) [2]: CD73, CD60 Piaski FD

Association: *Aulacomnio androgyni-Quercetum roboris* Brzeg et Kasprowicz in Brzeg et al. 2000 (acid hornbeam-oak forest) [2]: CD73 forest range Stary Las, CD83 Krotoszyn FD, reserve "Dąbrowa koło Biadek Krotoszyńskich"

Class: *Quercus-Fagetea* Br.-Bl. et Vlieg. 1937 [38]

Order: *Quercetalia pubescenti-petraeae* Klika 1933 corr. Moravec in Beguin et Theurillat 1984 [7]

Alliance: *Potentillo albae-Quercion petraeae* Zol. et Jak. 1957 n.nov. Jak. 1967

Association: *Potentillo albae-Quercetum petraeae* Libb. 1933 n.nov. Oberd. 1957 em. Müller 1991 (open sub-continental oak forest) [3]: DB72, DB82 Jamy FD, DD00 reserve "Kawęczyńskie Brzęki"

Alliance: *Quercion petraeae* Zólyomi et Jakucs ex Jakucs 1960 (non. *Quercion pubescenti-petraeae* Br.-Bl. 1932 em. Rivas-Martinez 1972)

Association: *Sorbo torminalis-Quercetum* Svoboda ex Blažková 1962 (= *Cynancho-Quercetum* auct. bohém. non Passarge in Scamoni et Passarge 1959) (submontane thermophilous oak-service forest) [3]

Subassociation: *Sorbo torminalis-Quercetum cephalantheretosum longifoliae*: BE52, 53, 62, foothills of Kaczawskie Mts.

Alliance: *Quercion pubescenti-petraeae* Br.-Bl. 1932 em. Rivas-Martinez 1972

Association: *Quercetum pubescenti-petraeae* Imchenetzky 1929 n.inv. Heinis 1933 (= *Lithospermo-Quercetum subboreale* W.Mat. et A.Mat. 1955) (oak forest with downy oak) [1]: AC30 reserve "Bielinek nad Odrą"

Order: *Fagetalia silvaticae* Pawł. 1928 [31]

Alliance: *Carpinion betuli* Oberd. 1953 [24]

Association: *Tilio-Carpinetum* Tracz. 1962 (sub-continental oak-hornbeam forest) [4]: CB38 Kaliska FD, CB56 reserve “Ustronie” (Woziwoda FD), EG04 reserve “Białowodzka Góra”, EF94 Ostra Góra near Rożnów

Subassociation: *Tilio-Carpinetum calamagrostietosum*: CB68 reserve “Brzęki im. Z. Czubińskiego”, DB71 Jamy FD (forest range Zarosłe),

Subassociation: *Tilio-Carpinetum typicum*: CB68 reserve “Brzęki im. Z. Czubińskiego”, DB72 Jamy FD (forest ranges Orle and Jamy), DB83 Jamy FD, “Las Mędrzycki”

Subassociation: *Tilio-Carpinetum stachyetosum*: CB68 reserve “Brzęki im. Z. Czubińskiego”

Association: *Galio sylvatici-Carpinetum* Oberd. 1957 (Central European oak-hornbeam forest) [19]: locations in Wielkopolska (also called Great Poland), Lower Silesia and Pomerania: BC46, 51, 95, 96, BD18, 78, BE24, 50, 52, CB94, CC21, 62, CD60, 61, 64, 70, 75, CF16, DD00

Subassociation: *Galio sylvatici-Carpinetum polytrichetosum*: CD70 Pępowo

Subassociation: *Galio sylvatici-Carpinetum lathyretosum*: BE52 foothills of Kaczawskie Mts. (Pogórze Kaczawskie) CC21 forest range Zielonagóra, CC91 Promno

Subassociation: *Galio sylvatici-Carpinetum luzuletosum*: BE50 Złotoryja FD, BE52 foothills of Kaczawskie Mts.

Subassociation: *Galio sylvatici-Carpinetum typicum*: BC95 forest range Bytyń, BD18 Wielkopolska National Park

Association: *Stellario holosteeae-Carpinetum betuli* Oberd. 1957 (sub-Atlantic oak-hornbeam forest) [1]: BC35 Trzcianka FD

Alliance: *Tilio platyphyllis-Acerion pseudoplatani* Klika 1955 [1]

Suballiance: *Tilienion platyphylli* (Moor 1975) Müller 1990

Association: *Aceri platanoides-Tiliatum platyphylli* Faber 1936 (submontane linden-maple forest on slopes) [1]: BE52 foothills of Kaczawskie Mts.

Alliance: *Fagion sylvaticae* Luquet 1926 [6]

Suballiance: *Galio odorati-Fagenion* (Tx. 1955) Müller 1989

Association: *Galio odorati-Fagetum* Rübel 1930 ex Sougnes et Thill 1959 em. Dierschke 1989 (= *Melico-Fagetum* Lohm. in Seibert 1954 p.p.), (fertile lowland beech forest) [4]: BC11 Drawieński NP, BC79 Łopuchówko FD, CF16 reserve “Kamień Śląski”, DB82 Jamy FD – valley of the Osa river

Suballiance: *Dentario glandulosae-Fagenion* Oberd. et Müller 1984

Association: *Dentario glandulosae-Fagetum* Klika 1927. em W.Mat. 1964 (fertile Carpathian beech forest) [1]: EG04 reserve “Białowodzka Góra”,

Suballiance: *Cephalanthero-Fagenion* (Tx. 1955) Tx. et Oberd. 1958

Association: *Carici-Fagetum* Moor 1952 (Carpathian orchid beech forest) [1]: EG04 reserve “Białowodzka Góra”.

Overall, *S. torminalis* was recorded in forest phytocoenoses of 16 plant associations (Fig. 2) of three phytosociological classes.

Class: *Vaccinio-Piceetea*

Within this class, *S. torminalis* was observed only in continental pine-oak forest *Quercus roboris-Pinetum* (five locations), which grew on sites suitable for fresh pine-oak forest and for fresh mixed deciduous forest in Pomerania and Wielkopolska. This species has never been recorded in pure pine stands, on the dry, sandy soils that are so common in western Poland.

Class: *Quercetea robori-petraeae*

S. torminalis was found in 18 locations in oak forests of this class (alliance *Quercion robori-petraeae*). In the Beech Forest near Szczecin, it was sporadically recorded in beech-oak forests of the association *Fago-Quercetum petraeae*. On the foothills of the Kaczawskie Mts. and the Ślęza Massif on slopes of Wieżyca, this species is represented by single individuals in submontane acid oak forests *Luzulo luzuloidis-Quercetum*. Those open oak forests (mainly the thermophilous subassociation with *Genista*) usually cover the upper parts of southern slopes. Acid oak forests *Calamagrostio arundinaceae-Quercetum* with *S. torminalis* are found in Wielkopolska (mainly on the Krotoszyn Plateau) and on the foothills of the Kaczawskie Mts. – at lower altitudes on the flat hilltops. On the Krotoszyn Plateau, this species occurs also in patches of a recently distinguished association: the acid horn-

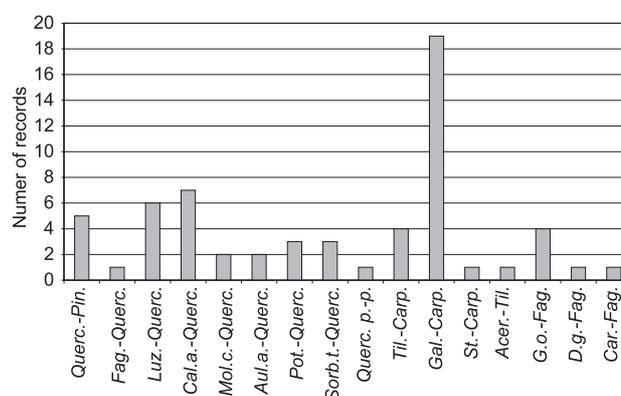


Fig. 2. A participation of *Sorbus torminalis* in plant communities of Poland (an order of associations as in the list given above)

beam-oak forest *Aulacomnio androgyni-Quercetum roboris* (Brzeg et al. 2000). In the same area, *S. torminalis* is recorded sporadically in wet oak forests with purple moor-grass *Molinio caeruleae-Quercetum roboris* and has been regarded as a locally differential species of this association (Lisiewska and Reszel 2000).

Class: *Querco-Fagetea*

S. torminalis is considered as a characteristic species of the order *Quercetalia pubescenti-petraeae* (formerly called *Quercetalia pubescentis*), which includes thermophilous oak forests of sub-Mediterranean and sub-continental oak forests of the steppe-forest type (Szafer and Zarzycki 1972; Matuszkiewicz J. M. 2001; Matuszkiewicz W. 2001). The associations identified in Poland are borderline forms of communities of this order. *S. torminalis* in three locations (Jamy FD and reserve "Kawęczyńskie Brzęki") occurs in phytocoenoses of open oak forest *Potentillo albae-Quercetum petraeae*. In the reserve "Białowodzka Góra" near Nowy Sącz, this species has been recorded in the species-rich thermophilous thickets *Peucedano cervariae-Coryletum*, but after a systematic revision this association is no longer regarded as valid by phytosociologists. In the reserve "Bielinek nad Odrą", *S. torminalis* exists in a single isolated stand of oak forest with downy oak (*Quercetum pubescenti-petraeae*), which used to be distinguished as a regional association *Lithospermo-Quercetum subboreale* W.Mat. et A.Mat. 1955. Celiński and Filipek (1958), who described plant communities of that reserve, regarded *S. torminalis* as a locally differential species of that association, present in phytocoenoses of the variant with *Vicia cassubica*. Kwiatkowski (2001, 2003) has recently identified on the foothills of the Kaczawskie Mts. some phytocoenoses of submontane thermophilous oak-service forest *Sorbo torminalis-Quercetum*, which is a new forest community in the vegetation of Poland. As a result of a comparison with materials concerning this plant association in Europe (the Bohemian Massif, Moravia, northern Austria), Kwiatkowski (2003) described the new subassociation *Sorbo torminalis-Quercetum cephalantheretosum longifoliae*. Oak forest stands of this subassociation have developed on southern, sunny and quite steep rocky slopes of basaltic or greenstone hills (from about 290 m to 365 m in altitude), on shallow soils classified as erosive lithosols. *S. torminalis* is frequent there and sometimes reaches the highest constancy (V). On the foothills of the Kaczawskie Mts., where the largest Polish local population of this species is found (several hundred individuals), it finds optimum conditions in patches of the association *Sorbo torminalis-Quercetum*.

Most frequently, i.e. in 24 locations, *S. torminalis* occurs in oak-hornbeam forests of the alliance *Carpinion betuli* (order *Fagetalia silvaticae*). In the western part of Polish Pomerania, small local populations of

this species are scattered in phytocoenoses of the association *Stellario holosteeae-Carpinetum*. In the Tuchola Forests (Bory Tucholskie), valley of the lower Vistula, and on the mountains Białowodzka Góra and Ostra Góra, it grows in sub-continental oak-hornbeam forests *Tilio-Carpinetum*. However, most of the oak-hornbeam forest stands with *S. torminalis* (19) are phytocoenoses of the association *Galio sylvatici-Carpinetum*. Those forest stands are distributed in the region of the river Noteć (mainly on the moraine hills north of the Noteć), in Wielkopolska (the majority of locations), and in Lower Silesia. It is noteworthy that nearly all the local populations of *S. torminalis* that are protected within reserves are found in oak-hornbeam forest stands. Frequently, it has been listed as a characteristic species of the class *Querco-Fagetea* (e.g. by Krotoska 1953, 1966; Piotrowska 1955; Boinski 1974). Krotoska (1966) as well as Brzeg and Wojterska (2001) regarded *S. torminalis* as a locally differential species of the association *Galio sylvatici-Carpinetum* in Wielkopolska. Also W. Matuszkiewicz (2001) assigned it to the group of slightly heliophilous and thermophilous species that distinguish the association *Galio sylvatici-Carpinetum* from *Tilio-Carpinetum*.

Markedly less frequently, *S. torminalis* occurs in forest communities of other alliances within the order *Fagetalia silvaticae*. On the foothills of the Kaczawskie Mts., this species is found sporadically in phytocoenoses of the association *Aceri platanoides-Tilietum platyphylli* (submontane linden-maple forest on slopes) of the alliance *Tilio platyphyllis-Acerion pseudo-platani*. Communities of beech forests of the alliance *Fagion sylvaticae* with a contribution of *S. torminalis* (six locations) are represented by three associations. The isolated local population of this species in the reserve "Białowodzka Góra", it is a component of fertile Carpathian beech forest *Dentario glandulosae-Fagetum* and orchid Carpathian beech forest *Carici-Fagetum*. Its small local populations scattered from Pomerania to Lower Silesia, are components of phytocoenoses of lowland beech forest *Galio odorati-Fagetum* (= *Melico-Fagetum*).

Phytocoenotic amplitude of the species

As shown in the above review, *S. torminalis* has a broad phytocoenotic spectrum and can be found in forest stands growing in various site conditions. It avoids only wet forests (absent in alder carrs, alluvial forests, and wet coniferous forests) and dry sands (absent in pine forests). Overall, *S. torminalis* was recorded in forest stands of 16 plant associations, representing three classes, four orders and eight alliances. These numbers are surprisingly high, considering that the species has been recorded in Poland on only 73 natural sites. It must be emphasized that the

phytocoenotic spectrum of populations of *S. torminalis* in Poland may be incomplete because no phytosociological observations were made in some locations.

A comprehensive analysis of ecological conditions of *S. torminalis* occurrence, in respect of site characteristics as well as phytocoenotic classification, has recently been conducted by Rasmussen and Kollmann (2004). They compared 994 phytosociological relevés with this species from Switzerland, Germany and Denmark, i.e. over a latitudinal gradient. Results of their study showed clearly that *S. torminalis* has a broad phytocoenotic amplitude, and occurs not only in various forest communities, but also in bush communities of the class *Rhamno-Prunetea* and thermophilous steppe-like grasslands (*Festuco-Brometea*), where it has a bushy habit. In their study area, *S. torminalis* occurs most frequently in phytocoenoses of oak-hornbeam forests of the alliance *Carpinion-betuli* and beech forests of the suballiance *Cephalanthero-Fagenion*.

By comparing the variation of forest stands with *S. torminalis* along the latitudinal gradient, Rasmussen and Kollmann (2004) showed that the variation is the highest close to the latitude of 50°. This zone includes its populations in southern Poland: from Lower Silesia in the west to the Island Beskid Mts. (Beskid Wyspowy) in the east. Although *S. torminalis* is not frequent in that part of Poland, its locations are highly varied there in respect of phytocoenoses (particularly on the foothills of the Kaczawskie Mts.). Thus results of this study confirm the above-mentioned Rasmussen and Kollmann's (2004) observations, which were based on a larger part of Central Europe.

Optimal communities for *S. torminalis* and some remarks on its conservation

Although *S. torminalis* is found in Poland mainly in oak-hornbeam forests, those communities are not optimal for this species. It is a light-demanding tree, while in oak-hornbeam forest it must grow under a usually closed canopy of oaks and additionally some other deciduous species, like maples or lindens. The excessive shade is a barrier mainly for its generative reproduction. The wild service trees growing in shade produce little or no fruit, and the scanty seedlings die usually in the first year. That is why this species often "escapes" from the shade to the forest edge, where it finds better conditions for growth and reproduction. This phenomenon can be observed the most easily in oak-hornbeam forest reserves (with old-growth oak stands) with a contribution of *S. torminalis*, e.g. in the reserve "Brzęki im. Zygmunta Czubińskiego" in the Tuchola Forests and reserve "Kawęczyńskie Brzęki" in eastern Wielkopolska. In those reserves, many unusually beautiful specimens of *S. torminalis* were

found, but those located in the oldest parts of forest stands, were gradually declining. By now only a small number of old trees of this species have survived in the forest interior, while the younger generation of these populations has "moved" to the sunlit edges of the stands. The example of formerly the largest local population of *S. torminalis* in Poland, protected within the forest reserve "Brzęki im. Zygmunta Czubińskiego" proves also that passive protection in the case of this species can be completely ineffective, and in some cases even harmful. *S. torminalis* apparently finds optimal conditions for its growth and development in open thermophilous oak forests and in pine-oak forests, as their canopy is less dense and enables sufficient access to sunlight.

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