Pith characteristics for distinguishing *Vaccinium myrtillus* from *Vaccinium vitis-idaea*

Morfologické odlišnosti dřeně u druhů *Vaccinium myrtillus* a *Vaccinium vitis-idaea*

Dana S t r u ž k o v á[1], Fritz Hans S c h w e i n g r u b e r[2] & Yvonne S t e i n e r[2]

[1] Archaeological Institute, Department of Spatial Archaeology, Letenská 4, Praha 1, 110 00, Czech Republic, e-mail: dana.struzkova@seznam.cz; [2] Swiss Federal Institute for Forest, Snow and Landscape Reseach (WSL/FNP), Division Landscape Dynamics and Management Research department Landscape, Zürcherstrasse 111, CH-8903, Birmensdorf, Switzerland, e-mail: fritz.schweingruber@wsl.ch

Stružková D., Schweingruber F. H. & Steiner Y. (2003): Pith characteristics distinguishing *Vaccinium myrtillus* from *Vaccinium vitis-idaea*. – Preslia, Praha, 75: 85–91.

Transverse sections of the stems of *Vaccinium myrtillus* revealed that the pith is oval, round or drop shaped. In contrast, in *V. vitis-idaea* it is usually radially angular (triangular, tetragonal etc.). This difference can be used to distinguish the vegetative remains of these plants in peat sediments.

K e y w o r d s : *Vaccinium myrtillus, V. vitis-idaea,* stem morphology, pith, palaeobotany

Introduction

Vegetative remains of various species of the family *Vacciniaceae* are common in peat sediments (Müller 1927, 1929, Puchmajerová 1942, 1944, 1945, Kotoučková 1963, Dohnal et al. 1965, Grosse-Brauckmann 1986, Dupont 1987, Joosten 1995, Herbichowa 1998, Nováková 2000, Svobodová & Soukupová 2000). Unfortunately the consistency and age of fossil material often makes a precise determination difficult. Greguss (1945), Odell et al. (1989) and Schweingruber (1990) describe the microscopical anatomy of wood but did not mention the pith. The aim of the present paper is to precise the results of Steiner (1999) and demonstrate that the cross-sectional shape of pith differs in *Vaccinium myrtillus* L. and *V. vitis-idaea* L. and the difference is of diagnostic value.

Materials and methods

Stems of both fossil and recent plants were studied (217 stems of *V. myrtillus* and 172 stems of *V. vitis-idaea* – Appendix 1). Fossil material (from early Subatlantic – samples no. 4, 5) came from peat profiles in the sandstone region of the Adršpašsko-teplické skály Protected Nature Reserve near the town of Broumov in the NE part of the Czech Republic (16°10'N, 50°30'E, regional altitude range 480–785 m a.s.l.). Living specimens came from moist sites (peat-bogs – no. 9, 10, 11, 14), hydrologically mesic sites (forests – no. 3, 7, 12, 13, 18) and dry sites (rocks – no. 1, 2, 6, 8, 15, 16, 17). Samples no. 19 and 20 were from the collections of the Swiss Federal Institute for Forest, Snow and Landscape Research WSL. In most cases, three internodal stem sections were analysed per plant. To determine whether the cross-sectional shape of pith is the same throughout a plant, sections were

taken from the green apical, dark green and brown middle region of the stem, and the dark brown underground shoots. In total, 552 stem sections of *V. myrtillus* and 506 of *V. vitis-idaea* were studied (Appendix 1).

The log-linear analysis of the data was done using S-plus 4 software (Data Analysis Products Division, MathSoft, Seattle).

Nomenclature of taxa follows Rothmaler (1995).

Results

In cross-section of stem the pith shape is either: (i) oval, round or drop-like (Fig. 1), (ii) radial (Figs. 2, 3), or (iii) indefinite (Fig. 4). In 87.9% of the stem sections of *V. myrtillus* the pith was oval (Fig. 1), round or drop-shaped. In contrast, in 87.6% of those of *V. vitis-idaea* it was radial, triangular (Fig. 2), tetragonal (Fig. 3), pentagonal or a similar shape. Sometimes both species had indefinitely shaped pith (Fig. 4) or the shape typical of the other species (Table 1). The species differed significantly in the shape of their pith ($df = 80$, $F = 172.49$, $P < 0.001$) but not in the locality from which the plants were collected ($df = 85$, $F = 0.0001$, $P = 0.98$), which indicates that hydrology or phytogeography did not affect this morphological character.

Table 1. – Distribution of the different pith shapes in stem sections of *Vaccinium myrtillus* (n = 552) and *V. vitis-idaea* sections (n = 506). Percentages of samples attributed to a particular pith shape are shown.

Pith form	*V. myrtillus*	*V. vitis-idaea*
Oval, round	87.9	3.1
Radial	3.1	87.6
Indefinite	9.0	9.3

Discussion

The remains of plants of the family *Vacciniaceae* are a frequent compoment of peat sediments. Stem characters of *Vaccinium* species are well described (Greguss 1945, Vander Kloet 1983, Odell et al. 1989, Schweingruber 1990) but not that of the pith. The present paper shows that it is possible to identify stems of *V. myrtillus* and *V. vitis-idaea* using differences in the shape of the pith. The pith in cross-section of *Vaccinium* varies little in shape through the whole shoot. In specimens with thick stems, it is mostly possible to identify *Vaccinium myrtillus* by the presence of multiseriate rays (Greguss 1945, Schweingruber 1990). The samples we analysed came from 6 European countries and the shape of the pith was not influenced by the hydrology of the site or its geographical position. Roots of plants of the family *Vacciniaceae* lack pith so the roots of those plants, which are common in peat cannot be identified in this way (Schweingruber 1978, Steiner 1999).

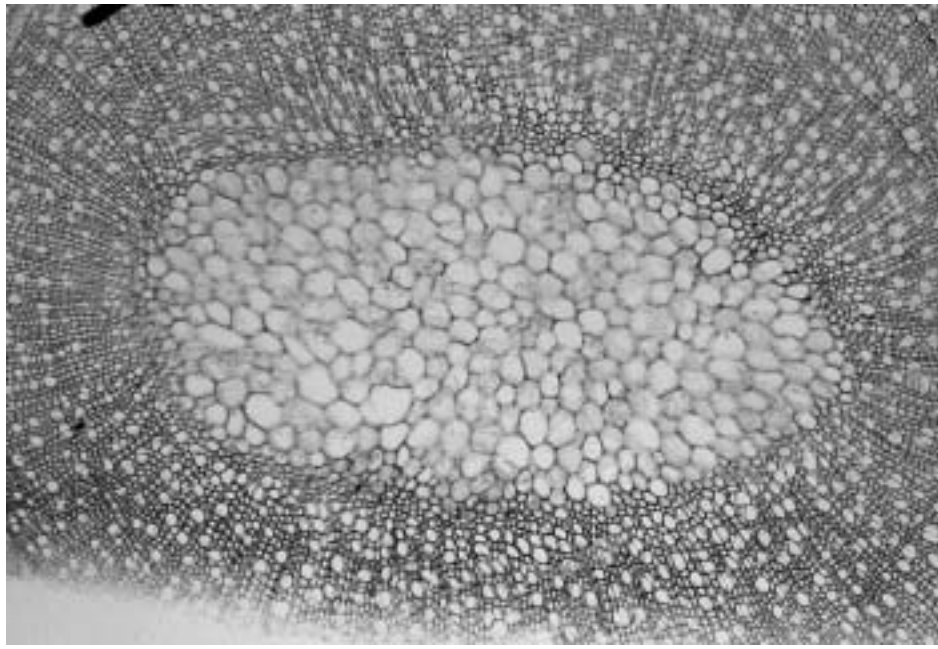

Fig. 1. – Stem section of *Vaccinium myrtillus* with nearly oval shaped pith. Magnification 100 ×.

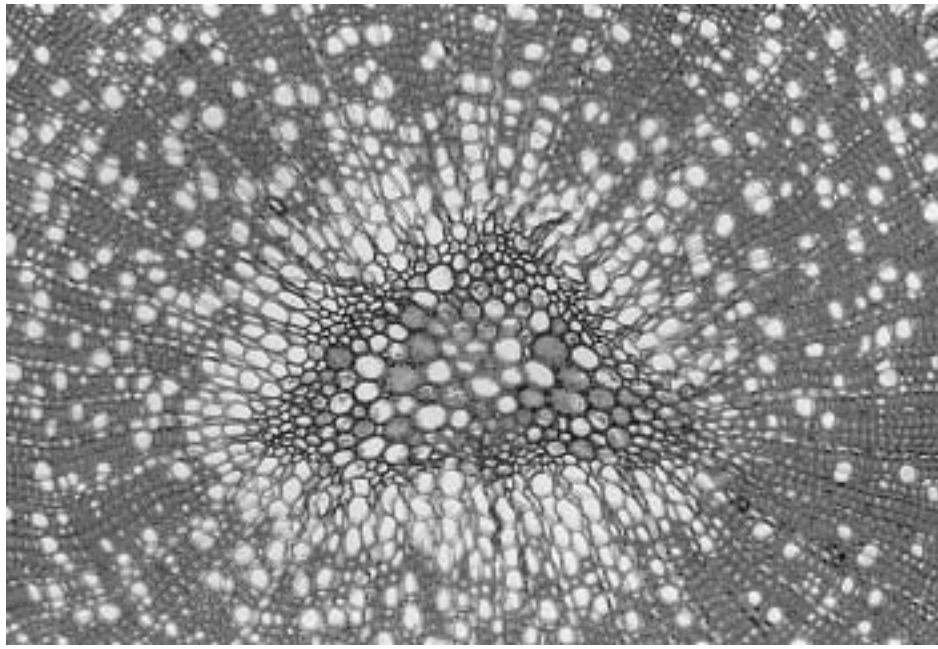

Fig. 2. – Stem section of *Vaccinium vitis-idaea* with triangular shaped pith. Magnification 200 ×.

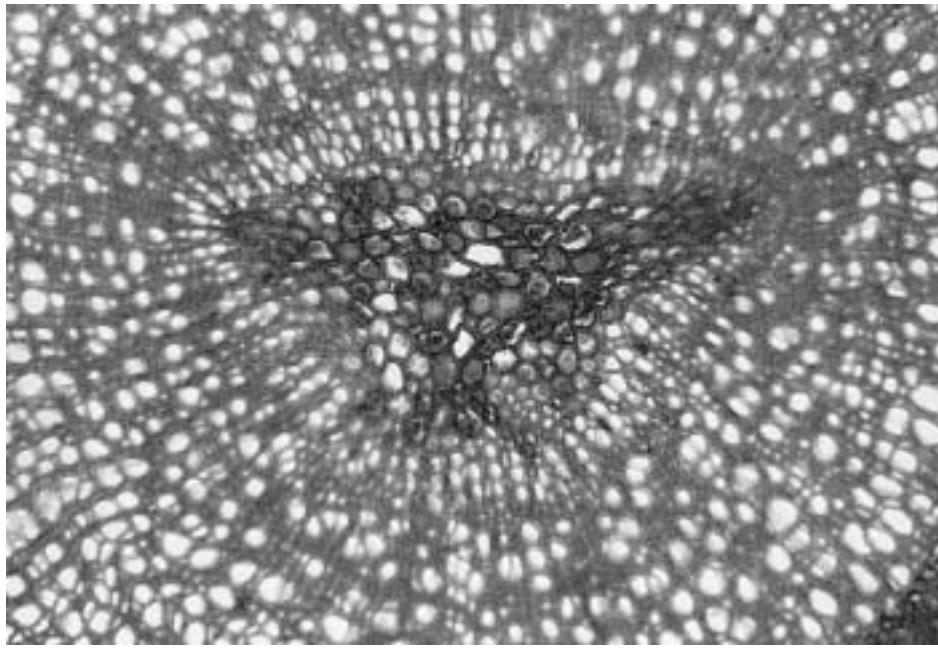

Fig. 3. – Stem section of *Vaccinium vitis-idaea* with tetragonal shape of pith. Magnification 200 ×.

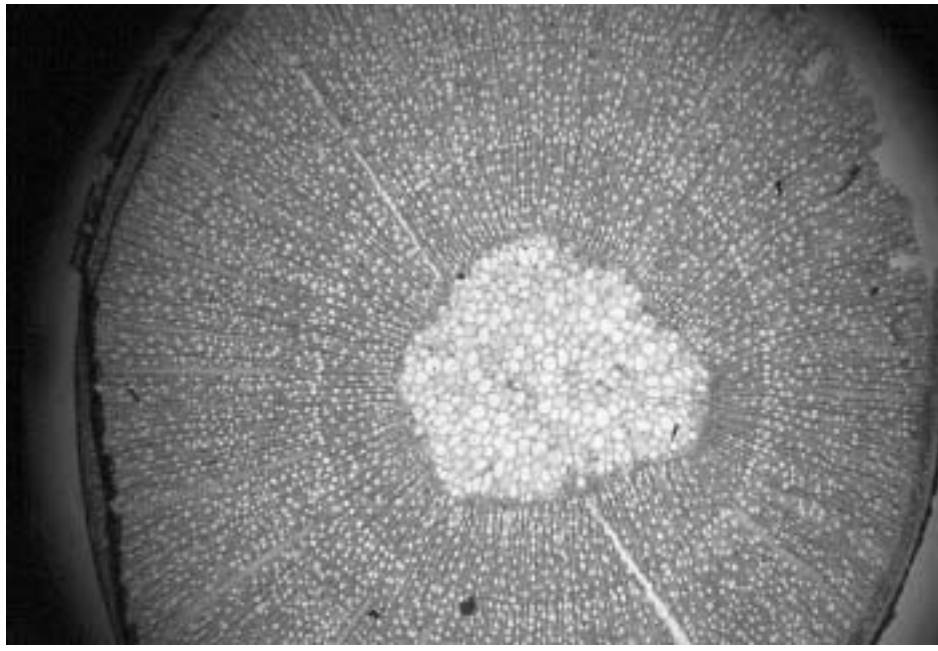

Fig. 4. – Stem section of *Vaccinium myrtillus* with pith of indefinite form. Magnification 40 ×.

Acknowledgements

We thank Zuzana Münzbergová for doing the statistical analysis, Karol Marhold for advice on methodology and Miloš Kaplan for taking the photographs. Tony Dixon kindly improved our English. The study was supported by grant no. A6005904 from the Grant Agency of the Academy of Sciences of the Czech Republic.

Souhrn

Vegetativní zbytky rostlin z čeledi *Vacciniaceae* tvoří významnou součást rašelinných sedimentů. Daný příspěvek demonstruje využití mikroskopického znaku k determinaci fosilních lodyh druhů *V. myrtillus* a *V. vitis-idaea*. Na transversálním řezu stonkem *V. myrtillus* lze sledovat dřeň oválného či kruhového tvaru, příp. tvarem připomínající kapku, *V. vitis-idaea* zde tvoří dřeň paprsčitou (trojúhelníkovitá, čtyřúhelníkovitá apod.). Celkem bylo zkoumáno 217 rostlin druhu *Vaccinium myrtillus*, u nichž bylo sledováno 552 příčných řezů stonkem a dále 172 rostlin *Vaccinium vitis-idaea*, kde bylo zkoumáno celkem 506 řezů. Rostliny pocházejí z 6 evropských států a nebyl u nich prokázán významný vliv zeměpisné polohy či hydrologických poměrů lokality na popsaný morfologický znak.

References

Dohnal Z., Kunst M., Mejstřík V., Raučina Š. & Vydra V. (1965): Československá rašeliniště a slatiniště. – ČSAV, Praha.

Dupont L. M. (1987): Paleoecological reconstruction of the successive stands of vegetation leading to a raised bog in the Meerstalblok area (The Netherlands). – Rev. Palaeobot. Palynol. 51: 271–287.

Greguss P. (1945): Bestimmung der Mitteleuropäischen Laubhölzer und Sträucher auf xylotomischer Grundlage. – Verl. Ungar. Naturwiss. Museums, Budapest.

Grosse-Brauckmann G. (1986): Analysis of vegetative plant macrofossils. – In: Berglund B. E. (ed.), Handbook of Holocene palaeoecology and palaeohydrology, p. 591–617, John Wiley & Sons, Chichester.

Herbichowa M. (1998): Ekologiczne studium rozwoju torfowisk wysokich wlasciwych na przykladzie wybranych obiektów z srodkowej czesci pobrzeza Baltyckiego. – Wydaw. Uniw. Gdańskiego, Gdańsk.

Joosten J. H. J. (1995): Time to regenerate: long-term perspectives of raised bog regeneration with special emphasis on palaeoecological studies. – In: Wheeler B. D., Shaw S. C., Fojt W. J. & Robertson R. A. (eds.), Restoration of temperate wetlands, p. 379–403, John Wiley & Sons, Chichester.

Kotoučková V. (1963): Vývoj vegetace a stratigrafie rašeliniště Červené blato. – Ms., 122 pp. [Dipl. pr.; depon. in: Knih. Kat. Bot. PřF UK Praha].

Müller F. (1927): Paläofloristiche Untersuchungen dreier Hochmoore des Böhmerwaldes. – Lotos, Prag, 75: 53–80.

Müller F. (1929): Paläofloristiche Untersuchung zweier Moore des Adlergebirges. – Lotos, Prag, 77: 188–193.

Nováková D. (2000): Rekonstrukce paleoekologických poměrů rašelinišť NPR Adršpašsko-teplické skály metodou analýzy makrozbytků. – Ms., 158 pp. [Dipl. pr.; depon. in: Knih. Kat. Bot. PřF UK Praha].

Odell A. E., Vander Kloet S. P. and Newell R. E. (1989): Stem anatomy of *Vaccinium* section *Cyanococcus* and related taxa. – Can. J. Bot. 67: 2328–2334.

Puchmajerová M. (1942): Oravské rašeliny. – Studia Bot. Čech., Praha, 5: 80–120.

Puchmajerová M. (1944): Rašeliniště moravsko-slezských Beskyd. – Rozpr. II. třídy Čes. Ak., Praha, 54/18: 1–29.

Puchmajerová M. (1945): Rašeliniště u Velkého Dářska podle rozborů rašeliny. – Sborn. Čes. Akad. Techn., Praha, 18: 1–33.

Rothmaler W. (1995): Exkursionflora von Deutschland. Vol. 3. – G. Fischer Verl., Stuttgart.

Schweingruber F. H. (1978): Microscopic wood anatomy. – Verlag Zürcher AG, Zug.

Schweingruber F. H. (1990): Anatomy of European woods. – Haubt, Stuttgart.

Steiner Y. (1999): Holzanatomie und dendro-ökologische Untersuchungen an Zwergstäuchern im Hochmoor. – Ms., 105 pp. [Dipl. pr.; depon. in: Botanischen Institut Univ. Basel].

Svobodová H. & Soukupová L. (2000): Mires of the Šumava Mountains: 13,000-years of their development and present-day biodiversity. – Geolines 11: 108–111.

Van der Kloet S. P. (1983): The taxonomy of *Vaccinium* s. *Cyanococcus*: a summation. – Can. J. Bot. 61: 256–266.

Appendix 1. – Source and number of samples of *Vaccinium myrtillus* and *V. vitis-idaea*. Samples No. 1–18 were collected by the first author, 19 and 20 by the second and third author at various localities in Switzerland. ? – uncertain data.

No	Species	Locality	Altitude (m)	Habitat	Number of samples	Number of sections analysed
1	*V. myrtillus*	Czech Republic: Labské pískovce sandstone region	500	rock	10	30
2	*V. myrtillus*	Czech Republic: Adršpašsko-teplické skály sandstone region	600	rock	10	30
3	*V. myrtillus*	Czech Republic: near Rakovník	380	forest	10	30
4	*V. myrtillus*	Czech Republic: Kancelářský příkop peat profile in the Adršpašsko-teplické skály region	650	?peat	15	15
5	*V. myrtillus*	Czech Republic: Kraví hora peat profile in the Adršpašsko-teplické skály region	700	?peat	8	8
6	*V. myrtillus*	Poland: Biele Skaly (White Rocks) Nat. Prot. Res. Gory Stolowe	650	rock	10	30
7	*V. myrtillus*	Poland: Biele Skaly (White Rocks) Nat. Prot. Res. Gory Stolowe	650	forest	10	29
8	*V. myrtillus*	Norway: near Vettisvegen	50	rock	10	30
9	*V. myrtillus*	Norway: Halley Jostedalen	450	peat	10	30
10	*V. myrtillus*	Norway: near Nigardsbreen	400	peat	11	32
11	*V. myrtillus*	Norway: near Raubergstolen	1000	peat	10	30
12	*V. myrtillus*	Norway: near Galdhopigveien	900	forest	10	30
13	*V. myrtillus*	Norway: near Pollfossen	550	forest	10	30
14	*V. myrtillus*	Norway: near Trollstigen	700	peat	10	29
15	*V. myrtillus*	Sweden: near Torpasjon, rest stat. Kungsbacka	30	rock	10	30
16	*V. myrtillus*	Sweden: near Stromstad	0	rock	10	30
17	*V. myrtillus*	Sweden: near Dyne Camping	0	rock	11	33
18	*V. myrtillus*	Italy: near Toblach Zee	1000	forest	7	17
19	*V. myrtillus*	Switzerland: Schweingruber's preparation collection	–	–	10	12
20	*V. myrtillus*	Switzerland: Steiner's preparation collection	–	–	25	47
1	*V. vitis-idaea*	Czech Republic: Labské pískovce sandstone region	500	rock	10	30
2	*V. vitis-idaea*	Czech Republic: Adršpašsko-teplické skály sandstone region	600	rock	10	30
3	*V. vitis-idaea*	Czech Republic: near Rakovník	380	forest	10	30
6	*V. vitis-idaea*	Poland: Biele Skaly (White Rocks) Gory Stolowe Nature Reserve	650	rock	10	30
7	*V. vitis-idaea*	Poland: Biele Skaly (White Rocks) Gory Stolowe Nature Reserve	650	forest	10	30
8	*V. vitis-idaea*	Norway: near Vettisvegen	50	rock	10	30
9	*V. vitis-idaea*	Norway: valley Jostedalen	450	peat	10	30
10	*V. vitis-idaea*	Norway: near Nigardsbreen	400	peat	11	33
11	*V. vitis-idaea*	Norway: near Raubergstolen	1000	peat	10	30
12	*V. vitis-idaea*	Norway: near Galdhopigveien	900	forest	10	30
13	*V. vitis-idaea*	Norway: near Pollfossen	550	forest	10	30

14	*V. vitis-idaea*	Norway: near Trollstigen	700	peat	10	30
15	*V. vitis-idaea*	Sweden: near Torpasjon, rest station Kungsbacka	30	rock	10	30
16	*V. vitis-idaea*	Sweden: near Stromstad	0	rock	10	30
17	*V. vitis-idaea*	Sweden: near Dyne Camping	0	rock	11	33
18	*V. vitis-idaea*	Italy: near Toblach Zee	1000	forest	10	30
20	*V. vitis-idaea*	Switzerland: Steiner's preparation collection	–	–	10	20

Received 16 March 2002
Revision received 19 August 2002
Accepted 8 November 2002