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Recent and subrecent diatom flora of the Sudeten mountains: The Jeseníky Mts and The Jizerské hory Mts

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Recent and subrecent diatom flora of the Sudeten mountains: The Jeseníky Mts and The Jizerské hory Mts. – Acta Mus. Siles. Sci. Natur., 63: 39-51, 2014.

Abstract: The present study focuses on the summary of recent and subrecent diatom flora within Sudeten mountain wetlands – the Jizerské Mts and the Jeseníky Mts Recent samples were taken during the years 2003 and 2006 - 2010. Herbarized bryophytes and fixed samples deposited in museums from the period 1898 – 1995 were used as a source of subrecent diatom flora. A total of 163 diatom species occurred at 70 microsites within 26 mires along the Czech-Polish-German border areas. Recent diatom flora of both areas seems to be comparable in terms of species richness and dominant species. Subrecent samples (herbarized bryophytes) contain some less frequent species (representation < 1%), which do not belong to mire flora and can represent a contamination (e.g. planktic genera). *Frustulia saxonica* and *Eunotia paludosa* were the most frequent species. *E. exigua* related in Western Europe to acidification caused by acid rains, was less frequent in both historic and modern samples. Unfortunately, we have few historical herbarium specimens from the 70-ies and 80-ies to trace changes associated with air pollution.

Key words: epibryon, diatoms, peat bogs, sampling

Introduction

The peat bogs in the Jizerské hory (Fig. 1,2) and in the Jeseniky Mts (both in the northern portions of the Czech Republic), represent unique ecosystems within Central Europe, characterized mostly by ombrotrophic conditions, a very low pH, and an unaffected water regime (Hájková et al. 2011). Few minerotroph, transitional mires and one spring fen were also included in our project (see Material and methods).

Both regions differ in their air contamination and deposition loads, especially the one which was supplied to them in the past, particularly at the end of the 1980's (Bragazza et al. 2004, Jiroušek et al. 2011). The westward located Jizerské Mts are characterized by a suboceanic climate with higher mean annual temperatures (5 °C) and slightly higher precipitation (1340 mm); the elevation of bogs is about 900 m a.s.l. Summit bogs in the Jeseníky Mts are at higher altitude (~ 1300 m a.s.l.) and are about 2 °C colder than the Jizerské Mts with slightly lower precipitation (1280 mm) (Hájková et al. 2011a).

Permanent sampling plots were established in both areas in 1991 - 1993 (Rybníček 2000) in order to monitor the environmental changes (Rybníček & Houšková 1994, Rybníček 2000, Hájková et al. 2011a). Although desmids and euglenophytes have occasionally been studied (Ettl & Perman 1958, Perman 1958, Perman & Lhotský 1963, Popovský 1968, Štěpánková et al. 2008, 2012, Mazalová et al. 2013), diatoms were previously overlooked, thus the reference historical data are missing. Fortunately, bryophytes (*Sphagnum*) herbarized and deposited in museums can be used as a source of subrecent diatom samples (Poulíčková et al. 2013a, 2013b, Cocquyt & De Wever 2002, Denys 2009, van Dam and Mertens 1993).

Diatoms are one of the most important indicators of recent and past water quality, climate warming, eutrophication, acidification and water chemistry recovery (Smol & Stoermer 2010). Diatoms, desmids and other microorganisms have specific ecological preferences and their small size and short life spans enable them to respond rapidly to environmental changes (Hájek et al. 2011, 2014, Finlay 2002, Finlay et al. 2002).

The present paper focuses on a description of diatom flora in Sudeten mires with emphasis to publish complete diatom species list from the research conducted in years 2003 and 2006-2013 including historical samples (1898 – 1995).

Material and methods

Floristic results are based on sampling of 59 permanent plots at 13 mires (A-M) in summer-autumn 2006 and 2008. Most of the mires have the characteristics of oligotrophic montane raised bogs (Jóža & Vonička 2004), with *Sphagnum* growths and several shallow pools or puddles. The geographic positions and selected environmental data of these sites were summarized in previous papers (Poulíčková et al. 2013a) and can be found also in diploma theses (Bergová 2011, Hnilica 2010, Rutová 2010, Kubišová 2012) free available on internet (https://theses.cz/). Another 13 mires (N-Z) have been sampled in summer 2003 and 2010 (Vavrušková 2006, Czudková 2012, Boček 2014, Čopjanová 2014). Altogehter 276 samples were examined, 400 specimens were counted in each sample.

Subrecent samples were obtained from herbarized bryophytes deposited in herbariums: Regional Museum in Olomouc; Department of Botany, Charles University in Prague; Regional Museum in Litoměřice, Moravian museum Brno, Department of Botany and Zoology, Masaryk University in Brno, private collection of Doc. K. Rybníček AVČR Brno.

A list of localities, mire types and sampling years *(n = number of samples, details to individual samples can be found in diploma theses cited):*

A Na čihadle, Jizerské Mts, ombrotrophic; 2006 (Rutová 2010), 2008 (Bergová 2011); n = 11
1955 (Novotná 2012); n =1

B Klečová louka, Jizerské Mts, ombrotrophic; 2006 (Rutová 2010), 2008 (Bergová 2011); n = 13

C Tetřeví louka, Jizerské Mts, ombrotrophic; 2006 (Rutová 2010), 2008 (Bergová 2011); n = 9
1978 (Novotná 2012); n = 1

D Malá Jizerská louka South, Jizerské Mts, ombrotrophic; 2006 (Rutová 2010), 2008 (Bergová 2011), 2010 (Boček 2014); n = 19
1954, 1978 (Novotná 2012), 1993 (Czudková 2012); n = 3

E Malá Jizerská louka North, Jizerské Mts, ombrotrophic; 2006 (Rutová 2010), 2008 (Bergová 2011); n = 15

F Sedlo pod Májem, Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 7
1930, 1946 (Baťková 2012), 1993 (Czudková 2012); n = 3

G Sedlo u Barborky, Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 5
1937, 1971(Baťková 2012), 1998 (Czudková 2012); n = 5

H Malý a Velký Jezerník (Slatě), Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 15
1946, 1963 (Baťková 2012), 1955, 1993 (Czudková 2012); n = 12

I Rejvíz, Jeseníky Mts, ombrotrophic + minerotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 9
1904, 1928, 1947, 1959, 1965 (Baťková 2012), 1955, 1989, 1994 (Czudková 2012); n = 12

J Trojmezí A (Šerák, Keprník), Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 18
1911, 1918, 1946, 1653 (Baťková 2012), 1955, 1993 (Czudková 2012); n = 13

K Trojmezí B, Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010);2010 (Boček 2014); n = 15
1966 (Baťková 2012) , 1993 (Czudková 2012); n = 2

L Sedlo pod Vozkou, Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 5

M Vozka, Jeseníky Mts, ombrotrophic; 2006 (Kubišová 2012), 2008 (Hnilica 2010); n = 11
1934, 1947, 1855 (Baťková 2012), 1955 (Czudková 2012); n = 8

N Skřítek, Jeseníky Mts, transitional; 2010 (Čopjanová 2014); n = 4
1905, 1929, 1946 (Baťková 2012); n = 3

O Velká Kotlina, Jeseníky Mts, spring fen; 2010 (Čopjanová 2014); n = 4
1931(Baťková 2012); n = 1

P Praděd, Jeseníky Mts, ombrotrophic; 2010 (Baťková 2012), n = 1
1934, 1949 (Baťková 2012); n = 2

Q Ovčárna, Jeseníky Mts, ombrotrophic;1948 (Baťková 2012), n = 1

R Klikvová louka, Jizerské Mts, minerotrophic ; 2010 (Boček 2014); n = 4
1954 (Novotná 2012); n = 1

S Nová louka, Jizerské Mts, ombrotrophic + minerotrophic; 2010 (Boček 2014); n = 5
1898, 1900,1995 (Novotná 2012); n = 3

T Holubník, Jizerské Mts, ombrotrophic; 2010 (Boček 2014); n = 4
1995 (Novotná 2012); n = 1

U Černá jezírka, Jizerské Mts, ombrotrophic; 2010 (Boček 2014); n = 4
1978 (Novotná 2012); n = 1
V Malá krásná louka, Jizerské Mts, ombrotrophic; 2010 (Boček 2014); n = 3
1978 (Novotná 2012); n = 5
W Velká jizerská louka, Jizerské Mts, ombrotrophic + minerotrophic; 2010 (Boček 2014); n = 4
1900, 1959 (Novotná 2012); n = 3
X Kneipa, Jizerské Mts, ombrotrophic; 2003 (Czudková 2012); n = 3
1956 (Czudková 2012); n = 1
Y Posed, Jizerské Mts, ombrotrophic; 2003 (Czudková 2012); n = 2
Z Vlčí louka, Jizerské Mts, ombrotrophic; 2003 (Czudková 2012); n = 4

Fig. 1: Peat bog Černá jezírka, Jizerské Mts

Fig. 2: Peat bog Holubník, Jizerské Mts demaged by acid rains.

Recent diatom samples collected by the squeezing of *Sphagnum* tufts were concentrated by sedimentation, cleaned with a mixture of concentrated sulphuric and nitric acids and mounted in Naphrax as previously described by Poulíčková et al. (2013a).

Dry *Sphagnum* herbarized biomass (cca. 9 cm^3) was mineralized in Erlenmayer flasks using the same acid mixture as described above. The diatom samples obtained by this method were again mounted in Naphrax. The diatoms were identified according to Krammer & Lange-Bertalot (1986, 1988, 1991a, b) and the nomenclature was updated according to Algaebase (http://www.algaebase.org/).

Results and discussion

Diatom species richness

A total of 163 diatom species occurred at 70 sites from the 26 mountain mires within both mountain regions. Species richness was slightly higher in the Jeseníky Mts (133 taxa) then in the Jizerské Mts (97 taxa). Individual mires (A-Z) were inhabited by 1 – 40 diatom species. The highest species richness was found at Trojmezí (J, 40 species), Rejvíz (I, 37 species) and Skřítek (N, 32 species). Skřítek represents a transitional mire with pH > 4, Rejvíz has both ombrotrophic and minerotrophic parts with wide range of microhabitats and Trojmezí has been affected by aerial liming in its recent history (pH around 5, Poulíčková et al. 2013a,b). On the other hand, strongly acidic ombrotrophic sites can be characterised by low species richness, particularly dry hummocks microsites. Decreasing species richness with decreasing pH and moisture have been recorded previously (Poulíčková et al. 2004, Nováková 2004, Hnilica 2010). The influence of pH and conductivity to species richness is evident also from comparison with other Czech wetlands in Tab. 1.

Tab. 1: Comparison of diatom species richness at different mires in the Czech Republic

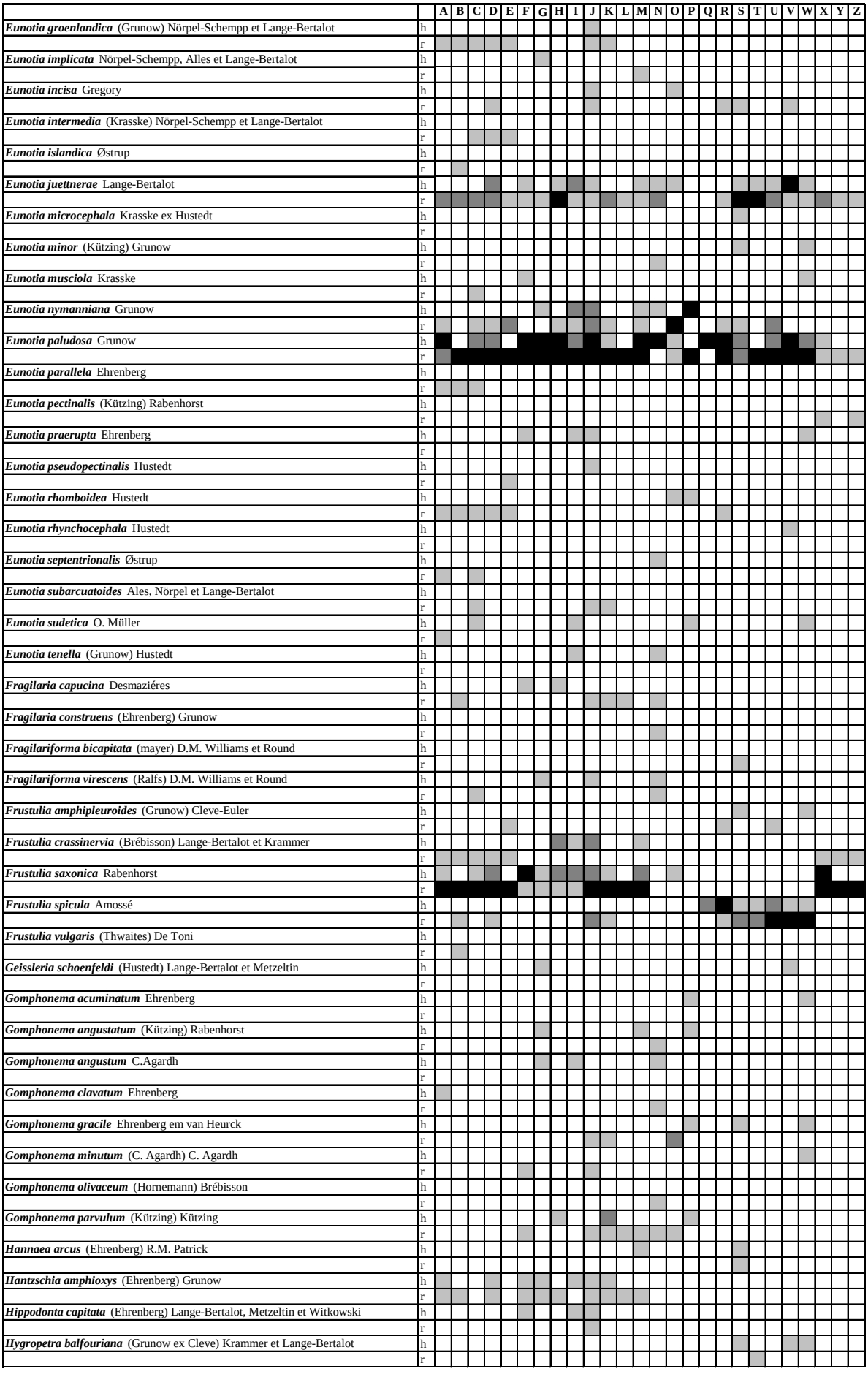
Area	Mire type	Samples n	pH	Conductivity $\mu S.cm^{-1}$	Species richness
Jeseníky Mts[a]	ombrotrophic	30	3.7-5.3	19.6-86.4	30
Jizerské Mts[b]	ombrotrophic	29	3.7-5.1	0.01-33.4	34
Krkonoše Mts[c]	ombrotrophic	21	3.4-6.8	7-116	67
Adršpach [d]	inverse ravines	32	3.3-4.7	47-143	19
West Carpathians[e]	spring fens	14	3.9-7.8	10-770	110
Soos[f]	minerotrophic	16	4.2-7.8	77-2060	60

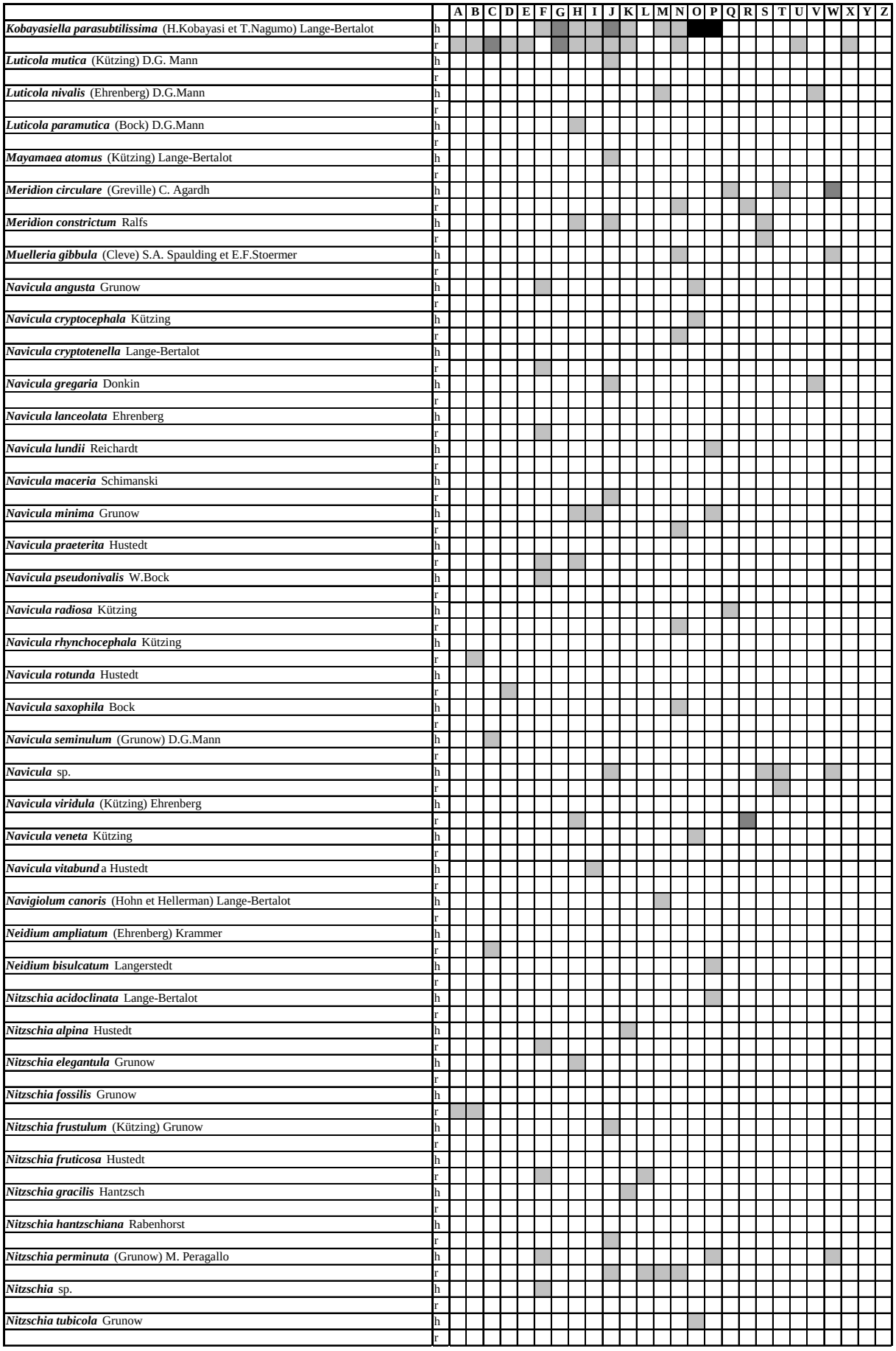
[a] Hnilica 2010, [b] Bergová 2011, [c] Nováková 2000, [d] Nováková 2004, [e] Jarošová 2004, [f] Lederer et al. 1998

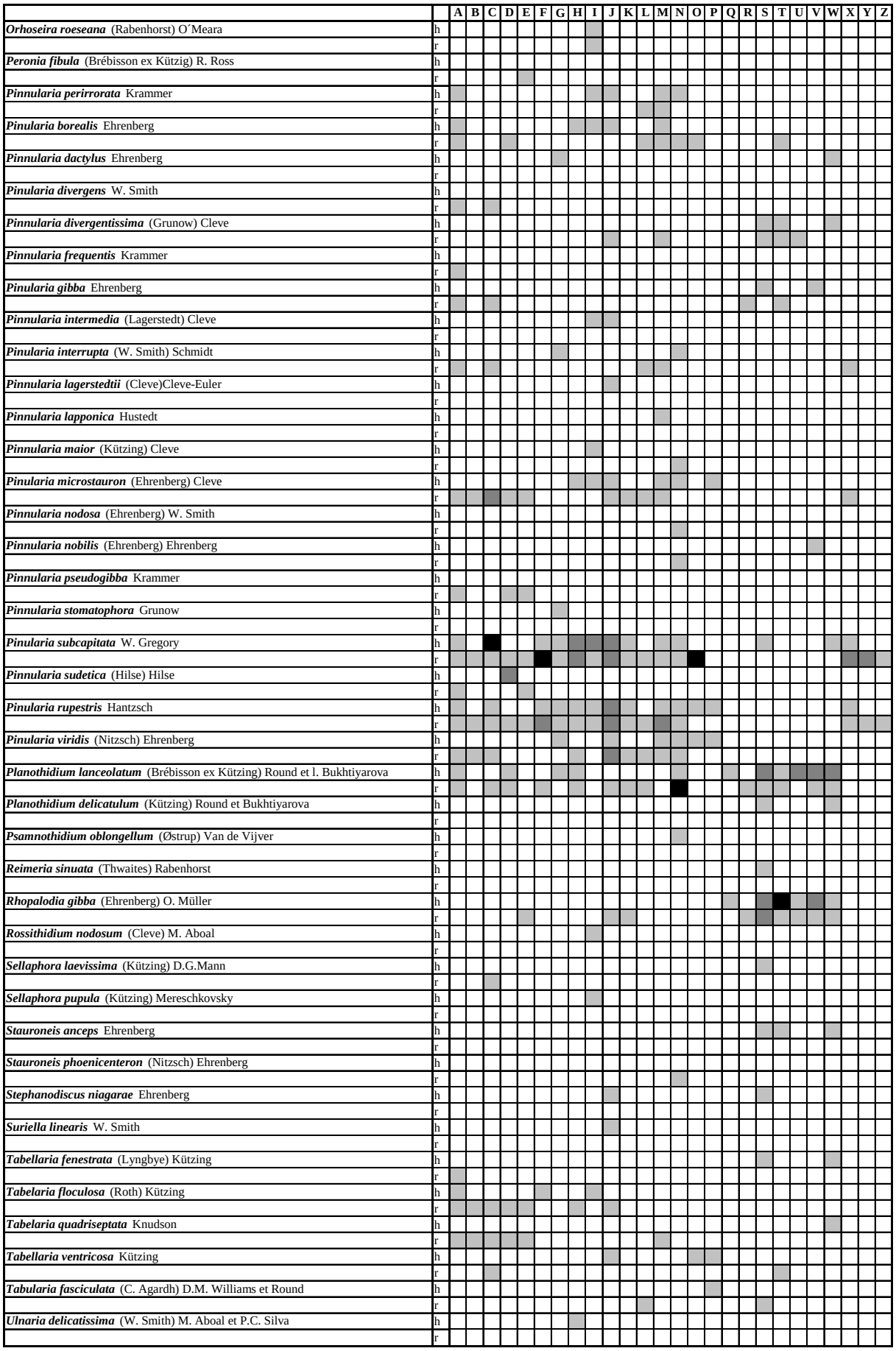
The most frequent and abundant species in both areas were *Eunotia paludosa* Grunow and *Frustulia saxonica* Rabenhorst, representing 40 - 90% of all diatom frustules present (Fig. 3). They were found to be vicariant species on water level gradient (Poulíčková et al. 2004, 2013). Another frequently dominating species were also found in both regions: *E. juetnerae, E. fennica*, *Pinnularia rupestris* and *P. subcapitata* (Figs 3,4). Some species occurred only in the Jizerské Mts e.g. *Pinnularia sudetica, P. divergens, P.gibba* and *Tabellaria fenestrata*. The Jeseniky Mts seem to be characteristic by occurrence of many rare species within genera *Navicula, Nitzschia, Gomphonema, Fragilaria.* Tab. 2 shows a complete species list with relative representation at all 26 mires.

Tab. 2: Diatom species list at mires in the Jeseníky Mts and the Jizerské hory Mts (light gray – occurrence up to 10%, dark gray – occurrence between 11 – 50%, black – dominant species with occurrence > 50%; the list of localities A-Z; h – historical, r – recent samples)

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Achnanthes marginulata Grunow	h																										
	r																										
Achnanthes oestrupii (Cleve-Euler) Hustedt	h																										
	r																										
Achnanthidium bioretii (Germain) Monnier, Lange-Bertalot et Ector	h																										
	r																										
Achnanthidium minutissimum (Kützing) Czarnecki	h																										
	r																										
Achnanthidium rosenstockii (Lange-Bertalot) Lange-Bertalot	h																										
	r																										
Achnanthidium subatomoides (Hustedt) Monnier, Lange-Bertalot et Ector	h																										
	r																										
Adlafia bryophila (J.B.Petersen) Gerdmoser, Lange-Bertalot et D.Metzeltin	h																										
	r																										
Brachysira brebissonii R. Ross	h																										
	r																										
Brachysira serians (Brébisson) Round et D.G. Mann	h																										
	r																										
Brachysira vitrea (Grunow) R. Ross	h																										
	r																										
Caloneis bacillum (Grunow) Cleve	h																										
	r																										
Caloneis tenuis (W.Gregory) Krammer	h																										
	r																										
Cocconeis placentula Ehrenberg	h																										
	r																										
Craticula accomoda (Hustedt) D.G. Mann	h																										
	r																										
Cyclostephanos dubius (Fricke) Round	h																										
	r																										
Cyclotella iris Brun et Héribaud-Joseph	h																										
	r																										
Cyclotella ocellata Pantocsek	h																										
	r																										
Cyclotella striata (Kützing) Grunow	h																										
	r																										
Cymbella naviculiformis (Auerswald) Cleve	h																										
	r																										
Cymbella affinis Kützing	h																										
	r																										
Cymbopleura amphicephala (Nägeli) Krammer	h																										
	r																										
Chamaepinnularia mediocris (Kraske) Lange-Bertalot et Krammer	h																										
	r																										
Chamaepinnularia soehrensis (Krasske) Lange-Bertalot et Krammer	h																										
	r																										
Diadesmis aerophila (Krasske) D.G. Mann	h																										
	r																										
Diadesmis gallica W. Smith	h																										
	r																										
Diatoma anceps (Ehrenberg) Kirchner	h																										
	r																										
Diatoma mesodon (Ehrenberg) Kützing	h																										
	r																										
Encyonema gracile Ehrenberg	h																										
	r																										
Encyonema minutum (Hilse) D.G. Mann	h																										
	r																										
Encyonema silesicum (Bleisch) D.G.Mann	h																										
	r																										
Encyonopsis cesatii (Rabenhorst) Krammer	h																										
	r																										
Encyonopsis microcephala (Grunow) Krammer	h																										
	r																										
Epithemia sp.	h																										
	r																										
Eunotia arculus (Grunow) Lange-Bertalot et Nörpel	h																										
	r																										
Eunotia arcus Ehrenberg	h																										
	r																										
Eunotia exigua (Brébisson ex Kützing) Rabenhorst	h																										
	r																										
Eunotia fennica (Hustedt) Lange-Bertalot	h																										
	r																										
Eunotia glacialis Meister	h																										
	r																										


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Eunotia groenlandica (Grunow) Nörpel-Schempp et Lange-Bertalot h r
Eunotia implicata Nörpel-Schempp, Alles et Lange-Bertalot h r
Eunotia incisa Gregory h r
Eunotia intermedia (Krasske) Nörpel-Schempp et Lange-Bertalot h r
Eunotia islandica Østrup h r
Eunotia juettnerae Lange-Bertalot h r
Eunotia microcephala Krasske ex Hustedt h r
Eunotia minor (Kützing) Grunow h r
Eunotia musciola Krasske h r
Eunotia nymanniana Grunow h r
Eunotia paludosa Grunow h r
Eunotia parallela Ehrenberg h r
Eunotia pectinalis (Kützing) Rabenhorst h r
Eunotia praerupta Ehrenberg h r
Eunotia pseudopectinalis Hustedt h r
Eunotia rhomboidea Hustedt h r
Eunotia rhynchocephala Hustedt h r
Eunotia septentrionalis Østrup h r
Eunotia subarcuatoides Ales, Nörpel et Lange-Bertalot h r
Eunotia sudetica O. Müller h r
Eunotia tenella (Grunow) Hustedt h r
Fragilaria capucina Desmaziéres h r
Fragilaria construens (Ehrenberg) Grunow h r
Fragilariforma bicapitata (mayer) D.M. Williams et Round h r
Fragilariforma virescens (Ralfs) D.M. Williams et Round h r
Frustulia amphipleuroides (Grunow) Cleve-Euler h r
Frustulia crassinervia (Brébisson) Lange-Bertalot et Krammer h r
Frustulia saxonica Rabenhorst h r
Frustulia spicula Amossé h r
Frustulia vulgaris (Thwaites) De Toni h r
Geissleria schoenfeldi (Hustedt) Lange-Bertalot et Metzeltin h r
Gomphonema acuminatum Ehrenberg h r
Gomphonema angustatum (Kützing) Rabenhorst h r
Gomphonema angustum C.Agardh h r
Gomphonema clavatum Ehrenberg h r
Gomphonema gracile Ehrenberg em van Heurck h r
Gomphonema minutum (C. Agardh) C. Agardh h r
Gomphonema olivaceum (Hornemann) Brébisson h r
Gomphonema parvulum (Kützing) Kützing h r
Hannaea arcus (Ehrenberg) R.M. Patrick h r
Hantzschia amphioxys (Ehrenberg) Grunow h r
Hippodonta capitata (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski h r
Hygropetra balfouriana (Grunow ex Cleve) Krammer et Lange-Bertalot h r


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Kobayasiella parasubtilissima (H.Kobayasi et T.Nagumo) Lange-Bertalot h
r
Luticola mutica (Kützing) D.G. Mann h
r
Luticola nivalis (Ehrenberg) D.G.Mann h
r
Luticola paramutica (Bock) D.G.Mann h
r
Mayamaea atomus (Kützing) Lange-Bertalot h
r
Meridion circulare (Greville) C. Agardh h
r
Meridion constrictum Ralfs h
r
Muelleria gibbula (Cleve) S.A. Spaulding et E.F.Stoermer h
r
Navicula angusta Grunow h
r
Navicula cryptocephala Kützing h
r
Navicula cryptotenella Lange-Bertalot h
r
Navicula gregaria Donkin h
r
Navicula lanceolata Ehrenberg h
r
Navicula lundii Reichardt h
r
Navicula maceria Schimanski h
r
Navicula minima Grunow h
r
Navicula praeterita Hustedt h
r
Navicula pseudonivalis W.Bock h
r
Navicula radiosa Kützing h
r
Navicula rhynchocephala Kützing h
r
Navicula rotunda Hustedt h
r
Navicula saxophila Bock h
r
Navicula seminulum (Grunow) D.G.Mann h
r
Navicula sp. h
r
Navicula viridula (Kützing) Ehrenberg h
r
Navicula veneta Kützing h
r
Navicula vitabunda Hustedt h
r
Navigiolum canoris (Hohn et Hellerman) Lange-Bertalot h
r
Neidium ampliatum (Ehrenberg) Krammer h
r
Neidium bisulcatum Langerstedt h
r
Nitzschia acidoclinata Lange-Bertalot h
r
Nitzschia alpina Hustedt h
r
Nitzschia elegantula Grunow h
r
Nitzschia fossilis Grunow h
r
Nitzschia frustulum (Kützing) Grunow h
r
Nitzschia fruticosa Hustedt h
r
Nitzschia gracilis Hantzsch h
r
Nitzschia hantzschiana Rabenhorst h
r
Nitzschia perminuta (Grunow) M. Peragallo h
r
Nitzschia sp. h
r
Nitzschia tubicola Grunow h
r


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Orhoseira roeseana (Rabenhorst) O´Meara h
r
Peronia fibula (Brébisson ex Kützig) R. Ross h
r
Pinnularia perirrorata Krammer h
r
Pinularia borealis Ehrenberg h
r
Pinnularia dactylus Ehrenberg h
r
Pinularia divergens W. Smith h
r
Pinnularia divergentissima (Grunow) Cleve h
r
Pinnularia frequentis Krammer h
r
Pinularia gibba Ehrenberg h
r
Pinnularia intermedia (Lagerstedt) Cleve h
r
Pinularia interrupta (W. Smith) Schmidt h
r
Pinnularia lagerstedtii (Cleve)Cleve-Euler h
r
Pinnularia lapponica Hustedt h
r
Pinnularia maior (Kützing) Cleve h
r
Pinularia microstauron (Ehrenberg) Cleve h
r
Pinnularia nodosa (Ehrenberg) W. Smith h
r
Pinnularia nobilis (Ehrenberg) Ehrenberg h
r
Pinnularia pseudogibba Krammer h
r
Pinnularia stomatophora Grunow h
r
Pinularia subcapitata W. Gregory h
r
Pinnularia sudetica (Hilse) Hilse h
r
Pinularia rupestris Hantzsch h
r
Pinularia viridis (Nitzsch) Ehrenberg h
r
Planothidium lanceolatum (Brébisson ex Kützing) Round et l. Bukhtiyarova h
r
Planothidium delicatulum (Kützing) Round et Bukhtiyarova h
r
Psamnothidium oblongellum (Østrup) Van de Vijver h
r
Reimeria sinuata (Thwaites) Rabenhorst h
r
Rhopalodia gibba (Ehrenberg) O. Müller h
r
Rossithidium nodosum (Cleve) M. Aboal h
r
Sellaphora laevissima (Kützing) D.G.Mann h
r
Sellaphora pupula (Kützing) Mereschkovsky h
r
Stauroneis anceps Ehrenberg h
r
Stauroneis phoenicenteron (Nitzsch) Ehrenberg h
r
Stephanodiscus niagarae Ehrenberg h
r
Suriella linearis W. Smith h
r
Tabellaria fenestrata (Lyngbye) Kützing h
r
Tabelaria floculosa (Roth) Kützing h
r
Tabelaria quadriseptata Knudson h
r
Tabellaria ventricosa Kützing h
r
Tabularia fasciculata (C. Agardh) D.M. Williams et Round h
r
Ulnaria delicatissima (W. Smith) M. Aboal et P.C. Silva h
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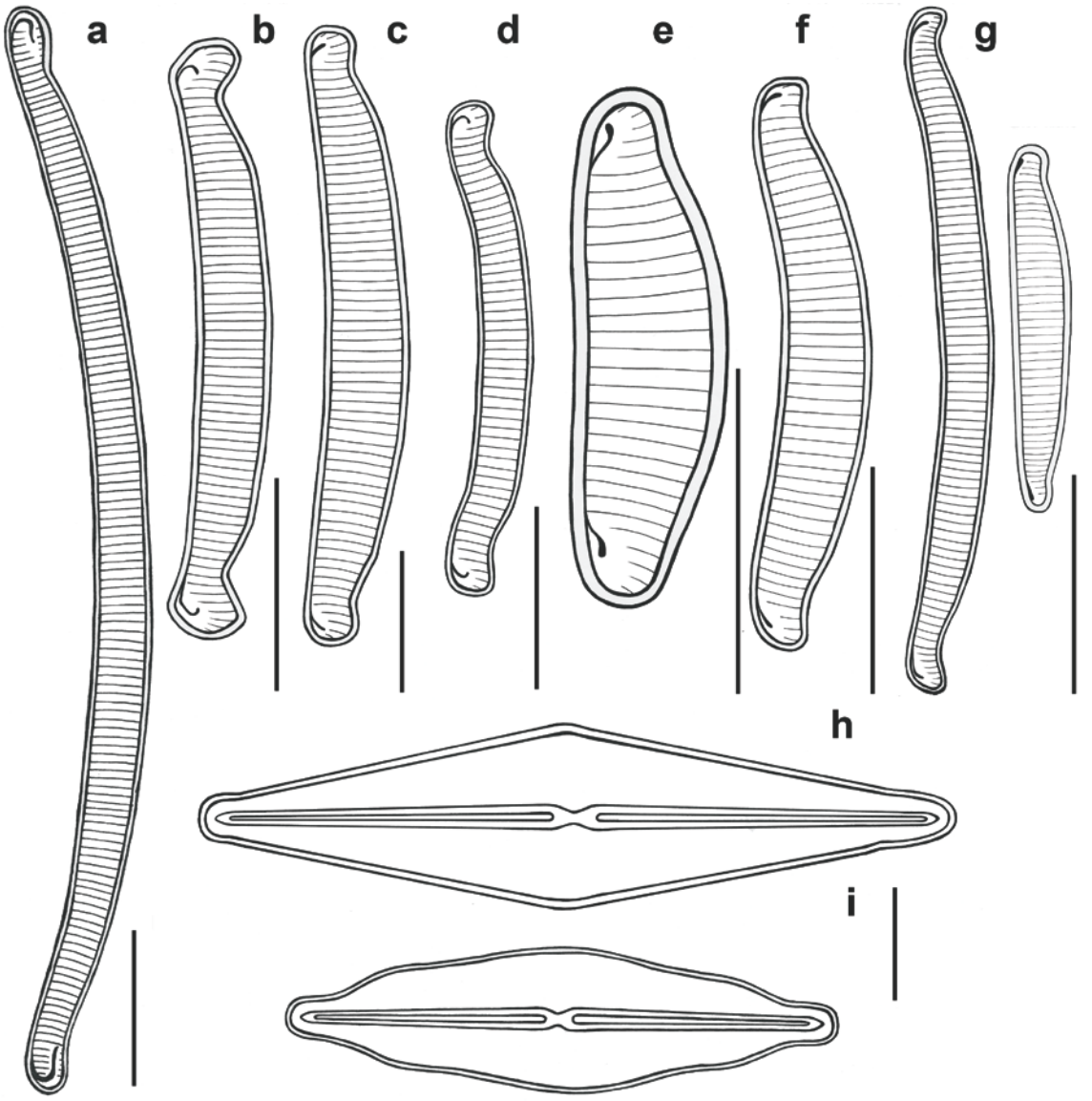

Fig. 3: The most typical peat bog diatoms in Sudeten mountains; orig. drawings Z. Kubišová. a – *Eunotia juettnerae*, b – *E. exigua*, c – *E. fennica*, d – *E. nymanniana*, e – *E. incisa*, f – *E. fallacoides*, g – *E. paludosa*, h – *Frustulia saxonica*, j – *F. crassinervia*

Diatom species composition

Within typical peat bog genera in northern temperate zone (Fránková et al. 2009, Chatová et al. 2014) *Eunotia, Frustulia, Pinnularia* and *Tabellaria* can be included. These genera were represented by 26, 5, 22 and 4 species respectively. They were very frequent, particularly in ombrotrophic mires. The most frequent species *E. paludosa* (Fig. 3) occurred everywhere and its representation was higher in recent samples. *E. paludosa* tolerates very low pH and strong desiccation, thus it is typical for dry hummocks (Poulíčková et al. 2013a,b). The second *Eunotia* species frequent in ombrotrophic mires was *E. juetnerae,* which was found together with *E. fennica* and *Frustulia saxonica* (Fig. 3) as characteristic species of the most pristine period of peat bog evolution in the Jeseniky Mts (Poulíčková et al. 2013b). *E. exigua* (Fig. 3) related in Western Europe to acidification caused by acid rains (van Dam et al. 1981) was less frequent in both historic and modern samples. Unfortunately, we have few historical herbarium specimens from the 70-ies and 80-ies to trace changes associated with air pollution.

We were able to distinguish 5 species in genus *Frustulia* and the most frequent morphotype was *F. saxonica*, particularly in ombrotrophic mires. It is a drying sensitive species occurring in hollows (Poulíčková et al. 2013a,b). Cryptic diversity has been recorded within the *Frustulia* morphotypes (Veselá et al. 2012), thus taxonomic position of our morphotypes should be proved using molecular methods.

The most frequent *Pinnularia* species (Fig. 4) were *rupestris, microstauron, viridis* and *subcapitata*. Quite frequent were also representatives of the genus *Tabellaria,* particularly *T. flocculosa* (Fig. 4).

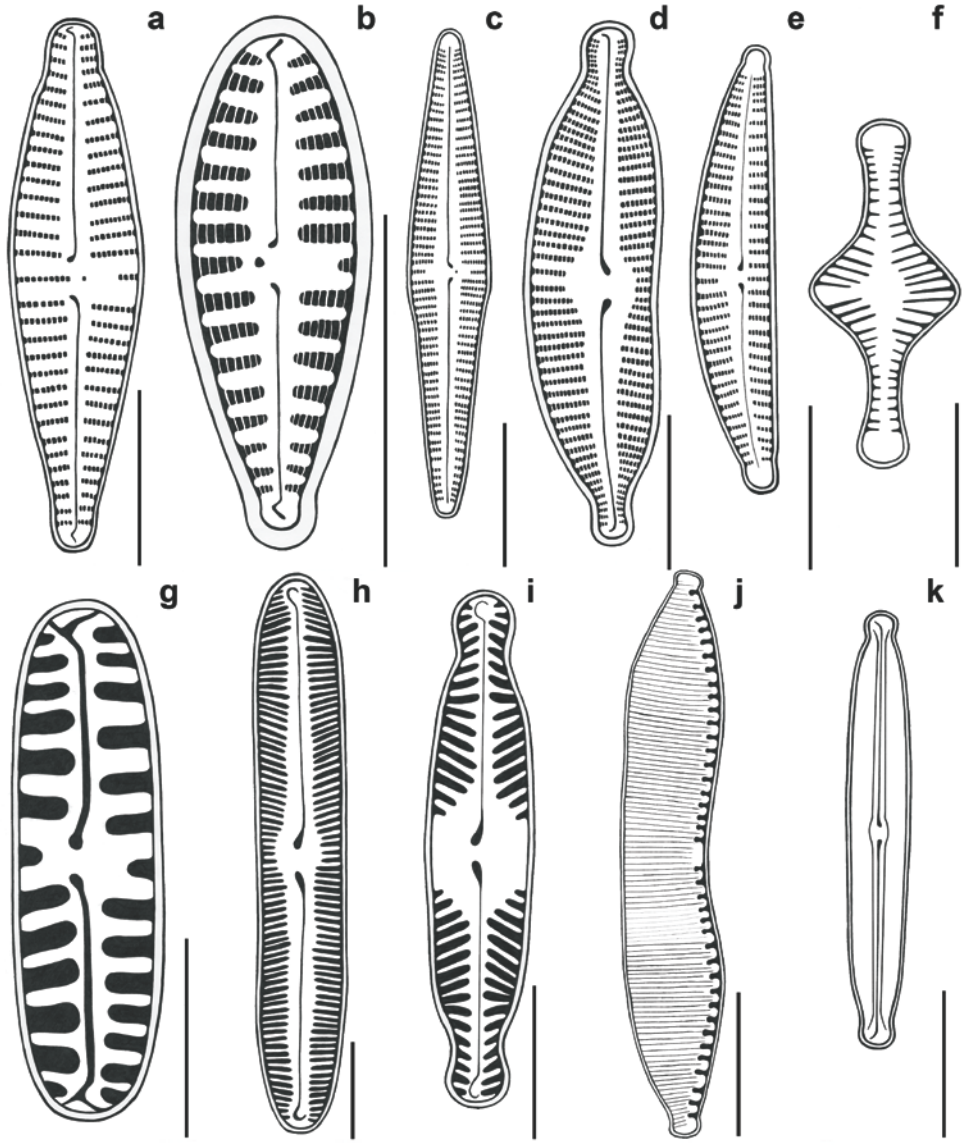

Fig. 4: Diatoms frequently found in Sudeten samples; orig. drawings Z. Kubišová. a – *Gomphonema parvulum*, b – *G. minutum*, c – *G. gracile*, d – *Cymbopleura amphicephala*, e – *Encyonema gracile*, f – *Tabellaria flocculosa*, g – *Pinnularia borealis*, h – *P. rupestris*, i – *P. subcapitata*, j – *Hantzschia amphioxys*, k – *Kobayasiella parasubtilissima*

Moreover, there is a large group of species with rare occurrence in peat bogs, particularly within genera *Achnanthes sensu lato, Navicula, Nitzschia*. New genera (*Achnanthidium, Planothidium*) have been recently separated from *Achnanthes* sensu lato (Algaebase; http://www.algaebase.org/). This group was represented by 10 species in Sudeten, particularly in historic samples. Genera *Navicula* and *Nitzschia* were represented by 34 and 14 species

respectively, but most of them were rare (up to 1% or 5%) and present in historical samples only.

We noticed sporadically the species, whose occurrence is surprising and ecologically does not correspond with conditions in peat bogs and mires.

Centric diatoms represented by genera *Cyclotella* and *Stephanodiscus* are planktic diatoms and do not belong to mire flora. They were present only in historical samples, mostly by one specimen only, and can represent a contamination. As the most peculiar species can be mentioned *Stephanodiscus niagarae* described and known from Great Lakes (USA). The problems with historical samples (the process of herbarium specimen conservation – drying, washing and pressing, unknown microsite origin, additional contamination through centuries) have already been discussed elsewhere (Poulíčková et al. 2013a). *Diatoma* and *Meridion*, typically rheophilous genera occurring in streams, were found sporadically at transitional mires. They were not expected there, except from the spring fen Velká Kotlina with small rheocrens. The most famous aerophytic species (Fig. 4) as *Hantzschia amphioxys*, *Orthoseira roeseana*, *Pinnularia borealis* and several *Luticola* species were also found sporadically, mostly in historical samples. These species, recorded as euryvalent and "cosmopolitan," (Krammer & Lange Bertalot 1986, 1988, 1991a, b) are mostly genetically diverse species complexes (Souffreau et al. 2013).

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