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Research Article

DIATOMS (*BACILLARIOPHYCEAE*) IN RIVERS AND STREAMS AND ON CULTIVATED SOILS OF THE PODKARPACIE REGION IN THE YEARS 2007–2011

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ABSTRACT

Diatoms *Bacillariophyceae* are a specialized, systematic group of algae, living in different types of ecosystems, and they are very good indicators of water quality. Recently, detailed studies have been carried out in the territory of the Podkarpacie Province on the diversity of diatoms in running waters. The area of study covers mostly the catchment of the biggest rivers of the province (mainly the Wisłok River) and cultivated soils. Running waters in the Podkarpacie Province are characterized by a huge species richness of diatoms, 738 different taxa have been found so far. The highest number of taxa was noted in the Wisłok River (400), while the Żołynianka and Różanka streams and the Mleczka were also characterized by huge diversity (from 200 to over 350 taxa). In the majority of studied sites diatoms of alkaline (pH>7) and nutrient rich (eutrophic) waters dominated: *Navicula lanceolata*, *N. gregaria*, *N. capitatoradiata*, *Nitzschia palea*, *N. dissipata* ssp. *dissipata*, *Achnanthidium minutissimum* var. *minutissimum*, *A. pyrenaicum*, *Amphora pediculus*, *Diatoma vulgaris*, *Rhoicosphenia abbreviata*, *Planothidium lanceolatum*, *Cocconeis pediculus* and *C. placentula* var. *lineata*. About 150 taxa were indentified on cultivated soils, among which the largest populations were formed by *Hantzschia amphioxys*, *Mayamaea atomus*, *Nitzschia palea*, *N. pusilla*, *Pinnularia obscura* and *Stauroneis thermicola*.

Keywords: diatoms *Bacillariophyceae*, diversity, taxonomy, Podkarpacie Region.

INTRODUCTION

Diatoms are a specialized, systematic group of algae occurring in almost all water ecosystems and other wet habitats, such as: soils, rocks, caves, sea ice, springs (cold, hot and salty). It includes above 10 000 species, from which above 3000 taxa (sea and freshwater) have been recorded on the territory of contemporary Poland. They are a systematic group used in assessment of water quality. Their huge richness and diversity causes the degree of recognition of diatoms to be unequal [Siemińska 1977, Rakowska 2001, Wołowski 2003, Siemińska et al. 2006]. Rivers and streams in southern Poland are the best recognized due to the studies of Siemińska, Kawecka and Kwandrans [Siemińska 1990, Siemińska, Pająk 1992, Kwandrans 1989, Kawecka 2012].

Until recently the Podkarpacie Province had not been studied in algological terms. Only fragmentary studies have been conducted in the upper course of the San River in connection with

the appearance of the *Didymosphenia geminata* diatom, which developed massively below reservoirs in Solina and Myczkowce [Kawecka, Sanecki 2003].

Since 2007, studies have been conducted on the diversity of diatoms in running waters of the Podkarpacie Province [Mucha et al. 2009, Noga, Siry 2010, Tambor, Noga 2011, Noga 2012, Pajączek et al. 2012], and since 2009, studies have also been carried out on cultivated soils [Stanek-Tarkowska, Noga 2011, 2012].

The aim of studies on running waters and soils of the Podkarpacie Province is, first of all, to recognize the species diversity of diatoms, while pointing out both endangered and rare species. The present work is a summary of current studies and their results, gathered over 5 years (2007–2011).

STUDY AREA

Three separate physiographic regions can be singled out on the territory of the Podkarpacie Province: the Sandomierska Valley (in the north), the Carpathian Foothills (the middle part), the Low Beskid and the Bieszczady mountains in the south [Kondracki 2001]. Just a small south-eastern part of the Province (about 1.3%) belongs to the catchment area of the Diestr River, and it is drained by Strwiąż, Mszaniec and Lechnawa rivers. The Wisła River makes the primary drainage system, with two big inflows: the San and the Wisłok River, which belongs to the Baltic Sea Basin. The San River, about 443.4 km long, is the richest water of the Carpathian Region, with its sources located on the territory of the Ukraine. The longest inflow of the San River is the Wisłok River, about 228.5 km, which, similarly to the Wisłoka River (163.6), begins in the Low Beskids. All the biggest rivers of the voivodeship have a mountainous character in their upper courses, and their catchment areas are extremely valuable in natural terms.

Generally conducted studies on the territory of the Podkarpacie Province include rivers and streams in the valley of the Wisłok River (the Carpathian Foothills). However, single study sites are located in valleys of the Wisłoka and the San rivers, and also on the afore-mentioned rivers themselves (Figure 1).

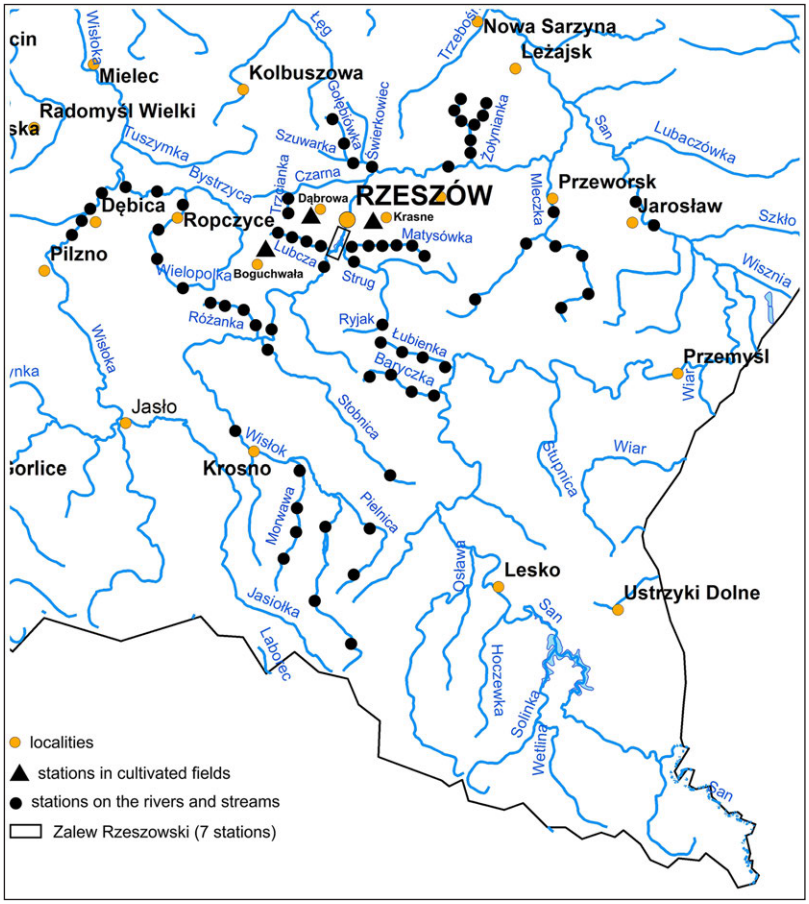

Figure 1. Distribution of studies stations in Podkarpacie Region

MATERIALS AND METHODS

Materials for study were taken, over a period of 5 years (2007–2011), from the territory of the Podkarpacie Province. The majority of study sites were located in the catchment area of the Wisłok River. The number of study sites on rivers and streams were: Wisłok – 8 sites, and in the Rzeszów Reservoir – 7 sites, Morwawa – 4 sites, Pielnica – 2 sites, Stobnica – 2 sites, Mleczka – 7 sites, Lubcza – 4 sites, Strug – 1 site and streams: Różanka – 4 sites, Ryjak – 1 site, Szuwarka – 1 site, Gołębiówka – 2 sites, Świerkowiec – 1 site, Żołynianka – 8 sites, Trzcianka – 2 sites, and Matysówka – 6 sites. Studies were also conducted on the Wisłoka River (4 study sites) and its inflow: Wielopolka (6 sites), and also on the San River (2 sites) and its two inflow streams: Łubienka (4 sites) and Baryczka (4 sites). Also, since 2009, soil diatoms have been studied, mainly on cultivated soils in Krasne (2 study sites), Boguchwała (3 study sites) and Dąbrowa (2 study sites) (Figure 1).

Material for studies in rivers and streams was taken from rocks, silt and water plants, in seasons from spring to autumn within a year in every studied current, and it was then prepared and processed according to the methods applied in this type of research [Kawecka 2012]. At the same time pH values and conductivity were measured. Collected material was preserved in a 4% formalin solution. Soil samples were taken once during the autumn season on study sites in Dąbrowa and Boguchwała and on the study site in Krasne once a month (from spring to autumn). In order to obtain pure valves of diatoms, part of the obtained material was subjected to maceration in a mixture of sulphuric acid and potassium dichromate at a proportion of 3:1, and rinsed in a centrifuge (at 2500 rev×min^{-1}). Cleaned diatoms were embedded in Pleurax synthetic resin (refractive index 1.75).

Soil samples were taken from stratum 0–3 cm to Petri dishes (3 samples from each study site), and next the material was subjected to maceration in acids (similarly as in the case of samples taken from water).

Diatoms were identified using a light microscope, "Nikon ECLIPSE 80i" at a magnification of 1000x, according to the keys: Krammer and Lange-Bertalot [1986–1991], Lange-Bertalot [2001], Krammer [2000] and Hofmann et al. [2011].

The number of noted species was obtained through calculating valves in randomly chosen fields of view of the microscope, until a total number of 400 cells was obtained. The most numerous species were those, whose participation in a given community was above 5%.

Based on the Red List of Algae, created for Poland [Siemińska et al. 2006], species, which were rare and endangered to different degrees, were singled out and assigned to the following categories: E – endangered, V – vulnerable, R – rare, I – indeterminate.

RESULTS

Measurements of pH and conductivity conducted in the open field indicated that all studied currents were characterized by alkaline or close to neutral water reactions (pH: 7–9), whereas conductivity was between above 100 to above 700 μS/cm.

The existence of 738 taxa of diatoms was identified during studies in 2007–2011 on the territory of the Podkarpacie Province. The largest diversity was encountered in the Wisłok River, in which 400 taxa were found on 8 sites. Huge species richness was noted also on many inflows of the Wisłok River, in which the Żołynianka stream was characterized by the largest number (365 taxa on 8 studying sites). Over 200 taxa were also identified in the Mleczka, Stobnica, Pielnica, Morwawa and Ryjak streams and on the San River (253), on two study sites near Jarosław city (Table 1).

Diatoms characteristic for alkaline (pH>7) and fertile, i.e. eutrophic waters, dominated on the majority of studied rivers and streams in the Podkarpacie Province. The most frequent were: *Navicula lanceolata*, *N. gregaria*, *N. capitatoradiata*, *Nitzschia palea*, *N. dissipata* ssp. *dissipata*, *Achnanthidium minutissimum* var. *minutissimum*, *A. pyrenaicum*, *Amphora pediculus*, *Diatoma vulgaris*, *Rhoicosphenia abbreviata*, *Planothidium lanceolatum*, *Cocconeis pediculus* and *C. placentula* var. *lineate* (Plate 1: 1–30).

Achnanthidium minutissimum var. *minutissimum* and *A. pyrenaicum* formed the most numerous populations in the upper sections of rivers and streams (30–50%), whereas in the middle and lower sections the most numerous were *Navicula lanceolata* and *N. gregaria* (above 30%).

Among 738 diatom taxa, 80 were endangered and rare, appearing in the Polish Red List

Table 1. The list of diatom taxa found at studies sites in the Podkarpacie Region

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Achnanthes coarctata (Bréb.) Grun.		+								+	+	+		+	+		+		+			+	R
Achnanthes expressa Carter		+											+	+									
Achnanthes exigua var. e*xigua* Grun.		+																			+		V
Achnanthes rupestoides Hohn		+																					
Achnanthes cf. *expressa* Carter										+													
Achnanthes sp.					+																		
Achnanthidium affine (Grun.) Czarn.																					+		
A. eutrophilum (Lange-Bert.) Lange-Bert.																					+		
Achnanthidium minutissimum var. *jackii* (Rabenh.) Lange-Bert.		+																				+	
Achnanthidium minutissimum (Kütz.) Czarn. var. *minutissimum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Achnanthidium pyrenaicum (Hust.) Kobayasi	+	+	+		+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Achnanthidium saprophilum (Kobayasi & Mayama) Round & Bukht.					+				+			+	+	+		+	+				+		
Achnanthidium subatomus (Hust.) Lange-Bert.		+							+														
Adlafia brockmannii (Hust.) Bruder & Hinz		+										+	+		+						+	+	
Adlafia bryophila (Petersen) Moser, Lange-Bert. & Metzeltin																						+	
Adlafia minuscula (Grun.) Lange-Bert. var. *minuscula*	+	+		+																			
Adlafia minuscula var. *muralis* (Grun.) Lange-Bert.																	+						
Amphipleura pellucida (Kütz.) Kütz.		+								+	+	+	+	+	+	+	+						R
Amphipleura sp.						+																	
Amphora alpestris Levkov																					+		
Amphora cimbrica Østrup		+	+		+						+	+	+	+		+	+			+			R
Amphora copulata Ehrenb.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Amphora hemicycla Stoermenr & Yang																					+		R
Amphora inariensis Krammer		+	+	+	+						+	+	+	+	+	+	+			+	+	+	
Amphora indistincta Levkov																						+	
Amphora micra Levkov												+									+		
Amphora minutissima? W. Smith												+											
Amphora ovalis (Kütz.) Kütz.		+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Amphora pediculus (Kütz.) Grun.	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Amphora sp. 1		+											+										
Amphora sp. 2		+																					
Amphora sp. 3		+																					
Amphora sp. 4	+																						
Anomoeoneis sphaerophora (Ehrenb.) Pfitzer		+			+				+	+			+		+						+		
Asterionella formosa Hassal	+	+	+		+					+	+		+	+	+	+	+		+	+	+	+	
Aulacoseira ambigua (Grun.) Simonsen	+	+			+									+		+	+			+	+		
Aulacoseira distans (Ehrenb.) Simonsen	+	+			+						+		+			+	+				+		
Aulacoseira granulata (Ehrenb.) Simonsen	+	+	+		+					+	+		+	+	+	+	+	+		+	+		
Aulacoseira muzzanensis (Meister) Krammer																					+		
Aulacoseira cf. *muzzanesis* (Meister) Krammer		+																					
Aulacoseira sp. 1		+														+	+					+	
Aulacoseira sp. 2		+																					
Brachysira brebissonii Ross																						+	
Brachysira vitrea (Grun.) Ross		+				+						+											E
Caloneis aerophila Bock													+				+					+	R
Caloneis amphisbaena (Bory) Cleve		+	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Caloneis amphisbaena var. *subsalina* (Donkin) Huls				+																			
Caloneis bacillum (Grun.) Cleve		+	+	+	+	+				+	+	+	+	+	+	+	+		+	+	+		R
Caloneis fontinalis (Grun.) Lange-Bert. & Reichardt												+									+	+	
Caloneis hyalina Hust.				+																			R
Caloneis lancettula (Schulz) Lange-Bert. & Witkowski		+			+						+	+								+	+	+	
Caloneis leptosoma (Grun.) Krammer																					+		
Caloneis macedonica (?) Hust.															+								
Caloneis molaris (Grun.) Krammer		+							+	+	+	+	+	+	+		+	+			+	+	R
Caloneis pulchra Messikommer			+																				
Caloneis schumanniana (Grun.) Cleve		+			+						+		+		+		+						R
Caloneis silicula (Grun.) Cleve	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Caloneis tenuis (Greg.) Krammer																					+	+	
Caloneis vasileyavae Lange-Bert., Genkal & Vekhov																						+	
Caloneis cf. *lancettula* (Schulz) Lange-Bert. & Witkowski	+										+												
Caloneis cf. *tenuis* (Greg.) Krammer													+										
Caloneis sp.												+										+	
Campylodiscus hibernicus Ehrenb.																	+						
Cavinula cocconeiformis (Gregory) D.G.Mann & Stickle												+											
Cavinula lapidosa (Krasske) Lange-Bert.												+											
Cavinula sp.													+										
Chamaepinnularia krookii (Grun.) Lange-Bert. & Krammer		+																			+		R
Chamaepinnularia soechrensis (Krasske) Lange-Bert. & Krammer												+											
Chamaepinnularia submuscicola (Krasske) Lange-Bert.																					+	+	
Chamaepinnularia cf. *krookii*			+																				
Cocconeis disculus (Schum.) Cleve		+																					R
Cocconeis neodiminuta Krammer		+											+										
Cocconeis pediculus Ehrenb.	+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Cocconeis placentula var. *euglypta* (Ehrenb.) Grun.	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Cocconeis placentula var. *lineata* (Ehrenb.) Van Heurck	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Cocconeis placentula Ehrenb. var. *placentula*		+	+	+	+						+		+	+	+		+		+		+		
Cocconeis pseudolineata (Geitler) Lange-Bert.		+			+					+	+	+	+	+	+		+				+		
Cocconeis sp.		+									+		+		+		+						
Craticula accomoda (Hust.) D.G. Mann		+	+	+	+						+		+	+	+	+	+		+	+	+		
Craticula ambigua (Ehrenb.) D.G. Mann		+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Craticula cuspidata (Kütz.) D.G. Mann		+	+	+	+	+		+		+	+		+	+	+	+	+	+	+		+		
Craticula halophilla (Grun.) D.G. Mann		+				+			+						+								
Craticula molestiformis (Hust.) D.G. Mann		+	+	+	+				+	+	+	+	+	+	+	+	+			+	+	+	
Craticula sp. cf. *molestiformis* (Hust.) D.G. Mann	+																						
Craticula sp.		+													+								
Cyclostephanos dubius (Fricke) Round	+	+			+							+	+		+				+	+	+		
Cyclostephanos invistatus (Hohn, Hellerman) Stroermer, Theriot & Håkansson	+				+																+		
Cyclotella atomus Hust.		+	+	+	+	+			+	+	+		+	+	+	+	+	+	+		+		
Cyclotella bodanica var. *affinis* Grun.		+																					
Cyclotella distinguenda Hust.																							
Cyclotella distinguenda Hust. var. *distinguenda*		+										+											
Cyclotella iris Brun		+																					
Cyclotella meneghiniana Kütz.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Cyclotella ocellata Pantocsek		+			+				+	+	+			+	+	+	+						
Cyclotella planktonica Brunnthaler																					+		
Cyclotella cf. *cyclopuncta* Håkansson & Carter	+											+									+		
Cyclotella sp. cf. *distinguenda* Hust.	+																						
Cyclotella sp. cf. *glabriuscula* (Grun.) Håkansson																					+		
Cyclotella sp. cf. *ocellata* Pantocsek		+																					
Cyclotella sp. 1		+																					
Cyclotella sp. 2		+																					
Cyclotella sp. 3											+				+								
Cylindrotheca gracilis (Bréb.) Grun.												+			+	+	+			+		+	
Cymatopleura elliptica (Bréb.) W. Smith		+	+		+					+	+	+	+	+	+	+	+		+		+		
Cymatopleura solea var. *apiculata* (W. Smith) Ralfs	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+		+		+	+	
Cymatopleura solea (Bréb.) W. Smith var. *solea*		+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Cymbella affinis Kütz.	+	+	+		+				+	+	+		+	+	+	+	+	+		+			
Cymbella aspera (Ehrenb.) Cleve		+			+	+				+	+		+	+	+	+					+	+	V
Cymbella cistula (Ehrenb.) Kirchner		+	+	+	+	+				+	+	+	+	+	+	+	+	+				+	I
Cymbella cistuliformis Krammer																					+		
Cymbella compacta Østrup					+																	+	
Cymbella cymbiformis Ag.																					+		
Cymbella cymbiformis var. *nonpunctata* Fontell									+														
Cymbella excisa Kütz.												+									+	+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Cymbella helvetica Kütz.		+	+		+					+	+		+	+	+			+				+	R
Cymbella hustedtii Krasske																					+		
Cymbella laevis Naegeli																					+		
Cymbella lanceolata (Ehrenb.) Van Heurck			+		+				+										+		+		R
Cymbella neocistula Krammer																					+		
Cymbella neocistula var. *lunata* Krammer																					+		
Cymbella parva (W. Smith) Kirchner												+									+	+	
Cymbella proxima Reimer																					+		V
Cymbella subcistula Krammer												+									+	+	
Cymbella tumida (Bréb.) Van Heurck		+	+	+	+			+		+	+	+	+	+	+	+		+			+		
Cymbella tumidula var. *lancetula* Krammer		+																					
Cymbella sp. 1		+																					
Cymbella sp. 2		+																					
Cymbopleura amphicephala Naegali		+	+		+						+	+	+	+	+		+		+			+	
Cymbopleura anglica (Lagerstedtt) Krammer																					+		
Cymbopleura cuspidata Kütz.		+																			+		
Cymbopleura inaequaliformis Krammer																					+		
Cymbopleura inaequalis (Ehrenb.) Krammer													+								+		V
Cymbopleura lata (Grun.) Krammer																					+		
Cymbopleura naviculiformis (Auerswald) Krammer		+			+	+	+	+	+			+	+	+			+	+			+		
Cymbopleura subaequalis Grun.		+													+						+		
Denticula subtilis Grun.																						+	
Denticula tenuis Ag.		+	+		+					+	+	+	+	+	+			+				+	
Diadesmis contenta (Grun.) D.G. Mann		+	+							+	+	+	+	+	+	+	+			+	+	+	
Diadesmis paracontenta Lange-Bert. & Werum var. *paracontenta*												+											
Diadesmis perpusilla (Grun.) D.G. Mann	+	+										+	+	+			+				+	+	
Diadesmis sp. cf. *brekkaensis* (Petersen) D.G. Mann												+									+		
Diadesmis sp. 1														+								+	
Diadesmis sp. 2			+																				
Diadesmis sp. 3	+											+											
Diatoma ehrenbergii Kütz					+													+				+	
Diatoma mesodon (Ehrenb.) Kütz.		+	+	+	+					+													
Diatoma moniliformis Kütz.	+	+			+					+	+	+	+	+	+	+	+	+		+	+		
Diatoma tenuis Kütz.	+	+	+		+						+		+		+						+		
Diatoma vulgaris Bory	+	+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Diatoma sp. cf. *moniliformis* Kütz.		+	+		+						+				+								
Didymosphenia geminata (Lyngbe) M. Schmidt		+			+																		
Diploneis elliptica (Kütz.) Cleve	+	+			+							+					+			+	+		
Diploneis fontanella Lange-Bert.												+									+		
Diploneis fontium Reichardt																						+	
Diploneis krammeri Lange-Bert. & Reichardt												+								+	+	+	
Diploneis minuta Petersen		+								+	+				+							+	
Diploneis modica Hust.		+																					
Diploneis oblongella (Naegeli) Cleve-Euler		+	+	+	+				+	+	+	+	+	+	+	+	+		+	+		+	R
Diploneis ovalis (Hilse) Cleve		+								+		+			+					+	+	+	R
Diploneis oculata (Bréb.) Cleve		+	+		+						+		+	+	+	+	+				+		
Diploneis parma Cleve		+																			+		E
Diploneis petersenii Hust.		+																				+	
Diploneis pseudoovalis Hust.		+											+										R
Diploneis puella (Schum.) Cleve		+											+								+	+	
Diploneis separanda Lange-Bert.												+									+	+	
Diploneis subovialis Cleve				+																			
Diploneis sp.																+							
Discostella pseudostelligera (Hust.) Houk & Klee		+			+					+	+	+	+	+	+	+	+		+	+	+	+	
Discostella stelligera (Cleve & Grun.) Houk & Klee		+			+							+		+									
Discostella woltereckii (Hust.) Houk & Klee																					+		
Discostella cf. *woltereckii* (Hust.) Houk & Klee	+																						
Encyonema caespitosum (Kütz.) D.G. Mann		+	+		+				+	+	+		+		+	+	+		+		+	+	
Encyonema minutum (Hilse) D.G. Mann	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+		+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Encyonema perpusillum (Cleve) D.G. Mann		+											+	+							+		
Encyonema prostratum (Berk.) Kütz.		+	+		+				+	+	+	+	+	+	+	+	+		+		+	+	
Encyonema reichardtii (Krammer) D.G. Mann		+		+										+							+		
Encyonema silesiacum (Bleisch.) D.G. Mann		+			+	+					+	+	+	+	+		+		+		+	+	
Encyonema ventricosum (Ag.) Grun.												+									+	+	
Encyonema cf. *perpusillum* (Cleve) D.G. Mann					+																		
Encyonopsis cesatii (Rabenh.) Krammer																						+	
Encyonopsis microcephala (Grun.) Krammer		+			+						+	+	+	+	+	+	+	+				+	
Encyonopsis subminuta Krammer & Reichardt		+																					
Eolimna minima Lange-Bert.	+	+	+		+					+	+	+	+	+	+	+	+			+	+	+	
Eolimna subminuscula (Manguin) Moser, Lange-Bert. & Metzeltin	+	+	+	+	+					+	+	+	+	+	+	+	+			+	+	+	
Epithemia adnata (Kütz.) Bréb.	+	+			+					+	+	+	+	+	+						+		
Epithemia sorex Kütz.													+								+		
Epithemia turgida (Ehrenb.) Kütz.																					+		
Eucocconeis austriaca (Hust.) Lange-Bert.																						+	
Eucocconeis flexella (Kütz.) Meister		+																					
Eucocconeis laevis (Østrup) Lange-Bert.		+	+								+		+	+	+								
Eunotia bilunaris (Ehrenb.) Scharschmidt	+	+	+		+	+	+			+	+	+		+	+	+	+					+	
Eunotia botuliformis Wild, Nörpel & Lange-Bert.												+											
Eunotia curtagrunowii Nörpel-Schempp & Lange-Bert.					+						+												
Eunotia diodon Ehrenb.												+											
Eunotia exigua (Bréb.) Rabenh.											+	+		+								+	
Eunotia flexuosa (Bréb.) Kütz.												+											
Eunotia formica Ehrenb.																					+		V
Eunotia implicata Nörpel-Schempp, Lange-Bert. & Alles						+	+																
Eunotia incisa Greg.																					+		
Eunotia islandica Østrup												+											
Eunotia meisteri Hust.										+											+	+	I
Eunotia minor (Kütz.) Grun.		+	+							+		+									+		
Eunotia muscicola v. *tridentula* (Grun.) Nörpel-Schempp & Lange-Bert.		+										+											
Eunotia mucophilla (Lange-Bert. & Nörpel) Lange-Bert.						+	+		+			+		+	+							+	
Eunotia praerupta Ehrenb.												+											
Eunotia septentrionalis Østrup		+								+													E
Eunotia soleirolii (Kütz.) Rabenh.																					+		
Eunotia sp. cf. *crista-galli* Cleve												+											
Eunotia sp. cf. *groenlandica* (Grun.) Nörpel & Lange-Bert.												+											
Eunotia sp. 1		+										+							+				
Eunotia sp. 2		+																					
Eunotia sp. 3																	+						
Eunotis sp. 4										+													
Fallacia egregia (Hust.) D.G. Mann																					+		
Fallacia insociabilis (Krasske) D.G. Mann		+										+		+	+	+	+			+		+	
Fallacia lenzii (Hust.) Lange-Bert		+	+						+	+	+		+	+	+	+	+					+	E
Fallacia monoculata (Hust.) D.G. Mann	+	+	+	+						+	+	+	+	+	+	+	+		+	+	+	+	
Fallacia omissa (Hust.) D.G. Mann		+													+								
Fallacia pygmaea (Kütz.) Stricke & D.G. Mann	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+		+	+	+		
Fallacia subhamulata (Grun.) D.G. Mann		+	+	+	+			+	+	+	+	+	+	+	+	+	+		+	+	+	+	R
Fallacia sublucidula (Hust.) D.G. Mann					+						+		+	+		+							
Fistulifera pelliculosa (Bréb.) Lange-Bert.																						+	
Fistulifera saprophila (Lange-Bert.& Bonik) Lange-Bert.	+				+																+		
Fragilaria acus (Kütz.) Lange-Bert.	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+	
Frafilaria austriaca (Grun.) Lange-Bert.					+																	+	
Frafilaria biceps (Kütz.) Lange-Bert.		+			+							+	+								+		
Frafilaria bicapitata A. Mayer		+					+														+		
Frafilaria bidens Heiberg		+																					R
Frafilaria brevistriata Grun.					+																+		R
Frafilaria capucina Desmazieres var. *capucina*	+	+	+		+						+	+	+	+	+	+	+			+	+	+	
Frafilaria constrruens f. *binodis* (Ehrenb.) Hust.		+			+																+		

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Frafilaria construens f. *construens* (Ehrenb.) Grun.	+	+	+		+	+	+	+													+		
Frafilaria construens f. *subsalina* (Hust.) Hust.																					+		R
Frafilaria construens f. *venter* (Ehrenb.) Hust.					+																+		
Frafilaria crotonensis Kitton	+	+	+		+																+		
Frafilaria dilatata (Bréb.) Lange-Bert.					+																+		V
Frafilaria distans (Grun.) Bukht.																					+		
Frafilaria elliptica Schumann		+																			+		
Frafilaria exigua Grun.																					+		I
Frafilaria famelica (Kütz.) Lange-Bert. var. famelica		+																			+		
Frafilaria fasciculata (Ag.) Lange-Bert.	+	+	+		+	+	+		+														
Frafilaria gracilis Østrup	+	+	+	+	+	+					+	+	+	+		+	+			+	+	+	
Frafilaria lapponica Grun.																					+		E
Frafilaria leptostauron (Ehrenb.) Hust. var. *leptostauron*											+								+		+		
Frafilaria mesolepta Rabenh.		+	+		+							+	+								+		
Frafilaria nanana Lange-Bert.	+																				+		V
Frafilaria oldenburgiana Hust.																					+		R
Frafilaria pararumpens Lange-Baert., Hofmann, Mann & Werum												+									+		
Frafilaria parasitica (W. Smith) Grun. var. *parasitica*	+	+	+		+						+	+	+	+	+	+	+				+	+	
Frafilaria parasitica var. *subconstricta* Grun.		+	+	+	+	+		+	+	+	+	+	+	+	+	+	+		+		+		
Frafilaria perminuta (Grun.) Lange-Bert.		+			+																		
Frafilaria pinnata Ehrenb.	+	+			+	+					+		+	+	+				+		+	+	
Frafilaria pinnata var. *intercedens* (Grun.)Hust.		+																			+		
Frafilaria pulchella (Ralfs) Lange-Bert.		+																			+		
Frafilaria pseudoconstruens Marciniak																					+		
Frafilaria radians (Kütz.) Lange-Bert.		+											+			+	+				+		
Frafilaria robusta (Fusey) Manguin																					+		R
Frafilaria tenera (W. Smith) Lange-Bert.																					+		V
Frafilaria ulna var. *oxyrhynchus* (Kütz.) Lange-Bert.		+																					I
Frafilaria ulna var. *ulna* (Nitzch.) Lange-Bert.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Frafilaria vaucheriae (Kütz.) Petersen	+	+			+					+	+	+	+	+	+	+	+		+	+	+	+	
Frafilaria virescens Ralfs		+										+		+									E
Frafilaria cf. *capensis* Grun.		+																					
Fragilaria sp. 1		+																					
Fragilaria sp. 2		+	+													+							
Fragilaria sp. 3		+																					
Fragilaria sp. 4										+													
Frustulia crassinerva (Bréb.) Ross										+												+	
Frustulia rhomboides (Ehrenb.) De Toni						+	+		+										+				
Frustulia saxonica Rabenh.		+																					
Frustulia vulgaris (Thwait.) De Toni	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Geissleria decussis (Østrup) Lange-Bert. & Metzeltin		+			+	+	+														+		R
Geissleria ignota var. *palustris* (Krasske) Lange-Bert. & Metzeltin														+									
Gomphonema acuminatum Ehrenb.	+	+	+	+	+	+	+	+		+	+		+	+	+	+	+			+	+	+	
Gomphonema affine Kütz.		+													+						+		R
Gomphonema augur Ehrenb.		+	+						+	+	+	+	+	+	+	+			+		+		
Gomphonema angustatum (Kütz.) Rabenh.																						+	
Gomphonema angustum Ag.									+											+			
Gomphonema bohemicum Reichelt & Fricke		+																					E
Gomphonema clavatum Ehrenb.																						+	
Gomphonema clevei Fricke																					+		
Gomphonema cymbeliclinum Reichard & Lange-Bert.												+			+						+		
Gomphonema elegantissimum Reichardt & Lange-Bert.																						+	
Gomphonema exilissimum (Grun.) Lange-Bert. & Reichardt												+									+	+	
Gomphonema gracile Ehrenb.		+	+		+						+		+	+	+		+				+	+	
Gomphonema hebridense Gregory																						+	
Gomphonema insigne Greg.		+									+				+				+				
Gomphonema micropus Kütz.	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+		+	+	+	+	
Gomphonema minutum (Ag.) Ag.	+	+	+	+	+				+				+	+	+	+			+	+	+	+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Gomphonema minutum f. *pachypus* Lange-Bert. & Reichardt		+																					
Gomphonema olivaceum var. *minutissimum* Hust.		+												+									
Gomphonema olivaceum var. *olivaceoides* (Hust.) Lange-Bert.		+		+										+	+						+		
Gomphonema olivaceum (Horn.) Bréb. var. *olivaceum*	+	+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Gomphonema olivaceolacuum (Lange-Bert. & Reich.) Lange-Bert. & Reichardt					+							+											
Gomphonema parvulum (Kütz.) Rabenh. var. *parvulum*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Gomphonema parvulum (Kütz.) Rabenh. var. *parvulum* f. *saprophilum*												+											
Gomphonema parvulius (Lange-Bert & Reichardt) Lange-Bert & Reichardt																					+	+	
Gomphonema procerum ? Reichardt & Lange-Bert.		+																					
Gomphonema productum (Grun.) Lange-Bert. & Reichardt		+							+			+	+	+	+	+				+	+	+	
Gomphonema pseudoaugur Lange-Bert.			+																				
Gomphonema pumilum (Grun.) Reichardt & Lange-Bert.	+					+						+								+	+	+	
Gomphonema reichardtii Lange-Bert.		+																					
Gomphonema sarcophagus Greg.		+	+		+					+	+	+	+	+	+	+	+		+	+	+	+	V
Gomphonema subclavatum (Grun) Grun.	+	+	+	+	+				+	+	+	+	+	+	+	+	+			+	+	+	
Gomphonema tergestinum (Grun.) Fricke	+	+	+	+	+					+	+	+	+	+	+	+	+		+	+	+	+	I
Gomphonema truncatum Ehrenb.		+	+		+	+	+	+	+	+	+		+	+	+	+					+	+	
Gomphonema utae Lange-Bert. & Reichardt		+										+		+	+							+	
Gomphonema cf. *angustum* (Kütz.) Rabenh.	+	+	+							+	+		+	+	+	+	+				+	+	
Gomphonema cf. *bavaricum* Reichardt & Lange-Bert.											+												
Gomphonema cf. *bohemicum* Reicheld & Fricke											+												
Gomphonema cf. *hebridense* Gregory							+																
Gomphonema cf. *minutum* (Ag.) Ag.																	+						
Gomphonema cf. *pumilum* (Grun.) Reichardt & Lange-Bert.		+	+		+					+	+		+	+	+	+	+		+			+	
Gomphonema sp. cf. *clevei* Fricke		+																					
Gomphonema sp. cf. *dichotomum* Kütz.		+																					
Gomphonema sp. 1		+										+	+	+			+					+	
Gomphonema sp. 2		+																				+	
Gomphonema sp. 3		+																				+	
Gomphonema sp. 4													+										
Gomphonema sp. 5		+																					
Gomphonema sp. 6		+																					
Gomphonema sp. 7		+									+		+		+		+						
Gomphonema sp. 8		+																					
Gomphonema sp. 9													+										
Gomphonema sp. 10													+										
Gomphonema sp. 11																					+		
Gyrosigma acuminatum (Kütz.) Rabenh.	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Gyrosigma attenuatum (Kütz.) Rabenh.		+	+	+	+		+		+	+	+	+	+	+	+	+	+		+		+	+	
Gyrosigma elongatum (W. Smith) Griffith & Henfrey									+														
Gyrosigma obtusatum (Sulivant & Wormley) Boyer	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+		+	+		+	
Gyrosigma sciotonense (Sulivant) Cleve		+	+	+	+				+	+	+	+	+	+	+	+	+		+			+	
Gyrosigma spencerii (W. Smith) Cleve										+													
Gyrosigma sp.												+											
Halamphora montana (Krasske) Levkov	+	+	+	+	+					+	+	+	+	+	+	+	+		+	+	+	+	
Halamphora normannii (Rabenh.) Levkov		+		+						+		+	+	+	+	+	+			+	+	+	
Halamphora veneta (Kütz.) Levkov	+	+											+		+			+		+	+	+	
Halamphora cf. *veneta* (Kütz.) Levkov				+																			
Hannaea arcus (Ehrenb.) Patrick					+																		
Hantzschia abundans Lange-Bert.	+		+							+	+	+			+						+	+	
Hantzschia amphioxys (Ehrenb.) Grun.	+	+	+	+	+					+	+	+	+	+	+	+	+		+	+	+	+	
Hippodonta capitata (Ehrenb.) Lange-Bert., Metzeltin & Witkowski	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Hippodonta costulata (Grun.) Lange-Bert., Metzeltin & Witkowski												+			+								

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Hippodonta cf. *lueneburgensis* (Grun.) Lange-Bert., Metzeltin & Witkowski															+								
Karayevia clevei (Grun.) Round & Bukht.		+																					
Karayevia laterostrata (Hust.) Round & Bukht.						+		+						+									
Kobayasiella subtilissima (Cleve) Lange-Bert.											+				+								
Kolbesia ploenensis (Hust.) Round & Bukht.		+																			+		
Lemnicola hungarica (Grun.) Round & Bassed	+	+	+		+	+	+	+			+	+	+	+	+	+	+				+		
Luticola acidoclinata Lange-Bert.		+								+	+	+		+		+	+				+	+	R
Luticola cohnii (Hilse) D.G. Mann	+										+												
Luticola dismutica (Hust.) D.G. Mann																+						+	
Luticola goeppertiana (Bleisch.) D.G. Mann		+	+		+					+	+		+	+	+	+	+		+		+	+	
Luticola kotschyi (Grun.) D.G. Mann		+			+					+	+	+	+	+	+	+	+			+	+	+	
Luticola mutica (Kütz.) D.G. Mann	+	+	+	+	+	+				+	+	+	+	+	+	+	+		+	+	+	+	
Luticola nivalis (Ehrenb.) D.G. Mann	+	+	+			+				+	+	+	+	+	+	+	+		+	+		+	
Luticola paramutica var. *binodis* Bock (Van de Vijver)		+			+								+	+	+		+						
Luticola paramutica Bock (Van de Vijver)	+	+										+			+							+	
Luticola sueoconum var. *dismutica* (Hust.) D.G. Mann		+																					
Luticola ventriconfusa Lange-Bert.												+											
Luticola ventricosa (Kütz.) D.G. Mann	+	+		+	+		+			+	+	+	+	+	+	+	+		+	+	+	+	
Luticola cf. *cohnii* (Hilse) D.G. Mann															+								
Luticola ?		+																					
Mayamaea agrestis (Hust.) Lange-Bert.	+	+	+		+								+		+		+		+				
Mayamaea asellus (Weinhold) Lange-Bert.		+																		+			
Mayamaea atomus var. *alcimonica* (Reichardt) Reichardt					+							+									+	+	
Mayamaea atomus (Kütz.) Lange-Bert. var. *atomus*	+	+	+	+						+	+	+	+	+	+	+	+			+	+	+	
Mayamaea atomus var. *permitis* (Hust.) Lange-Bert.		+	+		+					+	+	+	+	+	+	+	+			+	+	+	
Mayamaea excelsa (Krasske) Lange-Bert.	+																						
Mayamaea fossalis (Krasske) Lange-Bert. var. *fossalis*		+												+		+	+				+		
Mayamaea fossalis (Hust.) Lange-Bert. var. *obsidialis*																						+	
Mayamaea fossalloides (Hust.) Lange-Bert.					+																		
Mayamaea cf. *atomus* var. *permitis* (Hust.) Lange-Bert.	+																						
Mayamaea cf. *agrestis* (Hust.) Lange-Bert.										+		+			+								
Mayamaea cf. *recondita* (Hust.) Lange-Bert.	+																						
Mayamaea sp. 1		+												+	+							+	
Mayamaea sp. 2	+																						
Melosira lineata (Dilwyn) Ag.											+												
Melosira varians Ag.	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+		+	+	+	+	
Meridion circulare Ag. var. *circulare*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Meridion circulare var. *constrictum* (Ralfs) Van Heurck		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Muelleria gibbula Spaulding & Stoermer		+																				+	
Muelleria sp. cf. *gibbula* Spaulding & Stoermer	+																						
Navicula amphiceropsis Lange-Bert. & Rumrich																						+	
Navicula antonii Lange-Bert.	+	+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula arvensis var. *major* Lange-Bert.		+												+								+	
Navicula associata Lange-Bert.	+	+	+		+								+	+	+	+	+						
Navicula aquaedurae Lange-Bert.											+	+											
Navicula bacilloides Hust.	+									+		+			+	+	+				+	+	
Navicula capiata Ehrenb.																			+				
Navicula capitatoradiata Germain	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+		+		+		
Navicula cari Ehrenb.		+			+				+	+	+	+		+	+	+	+			+	+	+	
Navicula cariocincta Lange-Bert.															+								R
Navicula caterva Hohn & Hellerman		+																					
Navicula cincta (Ehrenb.) Ralfs		+	+		+					+		+	+	+	+	+	+		+	+	+	+	
Navicula cryptocephala Kütz.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula cryptotenella Lange-Bert.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula cryptotenelloides Lange-Bert.	+	+	+		+					+	+	+	+	+	+	+	+		+	+	+	+	
Navicula digitoradiata (Gregory) Ralfs									+														R
Navicula digitoconvergens Lange-Bert.																					+		
Navicula erifuga Lange-Bert.		+	+		+					+	+		+	+	+	+	+			+		+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Navicila exigua Gregory																						+	
Navicula germainii Wallace		+			+																		
Navicula gregaria Donkin	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula harderii Hust.														+		+	+					+	
Navicula integra (W. Smith) Ralfs	+	+			+	+	+	+											+		+		
Navicula lanceolata (Ag.) Kütz.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula libonensis Schoeman					+								+		+	+	+				+	+	
Navicula longicephala Hust.		+													+						+		
Navicula medioconvexa ? Hust.															+								R
Navicula microcari Lange-Bert.															+								
Navicula moskalii Metzeltin, Witkowski & Lange-Bert.	+																				+		
Navicula novaesiberica Lange-Bert.		+		+	+				+		+	+	+	+	+								
Navicula oblonga (Kütz.) Kütz.		+												+	+						+		R
Navicula oppugnata Hust.		+			+																+		R
Navicula phyllepta Kütz.				+																			
Navicula radiosa Kütz.		+	+	+	+	+	+	+		+	+	+	+	+	+	+	+		+		+	+	
Navicula radiosafallax Lange-Bert.		+																					
Navicula recens (Lange-Bert.) Lange-Bert.		+							+		+	+	+	+	+					+	+	+	
Navicula reichardtiana Lange-Bert.	+	+	+	+	+					+	+	+	+	+	+	+	+	+	+	+	+	+	
Navicula reinhardtii (Grun.) Grun.		+	+		+																+		
Navicula rhynchotella Lange-Bert.		+			+																+		R
Navicula rhynchocephala Kütz.		+				+	+	+	+					+		+					+		
Navicula rostellata (Kütz.) Cleve		+	+		+	+				+	+			+	+	+					+	+	
Navicula salinarium Grun. var. *salinarium*		+	+		+				+														
Navicula salinarium var. *rostrata* Hust.					+																		
Navicula simulata Manguin																						+	
Navicula sinuata Schumann																						+	
Navicula slesvicensis Grun.	+	+	+		+				+	+	+		+	+	+	+	+		+	+	+	+	
Navicula splendicula Land		+																					V
Navicula tenelloides Hust.		+				+				+	+	+	+	+	+	+	+		+	+	+	+	
Navicula tripunctata (O.F. Müller) Bory	+	+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula trivialis Lange-Bert.	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+		+	+	+	+	
Navicula trophicatrix Lange-Bert.																					+		
Navicula upsaliensis (Grun.) Peragallo	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	R
Navicula vandamii Schoeman & Archbald var. *vandamii*		+			+								+	+	+		+		+		+		
Navicula veneta Kütz.	+	+	+		+					+	+	+	+	+	+	+	+		+	+	+	+	
Navicula ventralis Krasske		+																					
Navicula vilaplanii (Lange-Bert. & Sabather) Lange-Bert. & Sabather		+								+		+	+	+	+	+	+		+	+	+	+	
Navicula viridula (Kütz.) Ehrenb.	+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+		+	+	
Navicula viridulacalcis Lange-Bert.		+																					
Navicula vulpina Kütz.		+																					
Navicula wiesneri Lange-Bert.		+												+	+	+	+					+	
Navicula sp. cf. *microdigitoradiata* Lange-Bert.																		+					
Navicula sp. cf. *moskali* (?) Metzeltin, Witkowski & Lange-Bert.		+																					
Navicula cf. *parsura* Hust.															+								
Navicula sp. cf. *symmetrica* Patrick		+																					
Navicula sp. cf. *streckerae* Lange-Bert. & Witkowski					+																		
Navicula sp. cf. *suchlandtii* Hust.												+											
Navicula cf. var. *vilaplanii* Lange-Bert. & Sabather				+																			
Navicula sp. 1		+																				+	
Navicula sp. 2		+											+	+	+							+	
Navicula sp. 3		+																					
Navicula sp. 4			+																				
Naviculadicta stauroneioides? Lange-Bert.		+																					
Navicymbula pusilla (Grun.) Krammer					+																		
Neidium affine (Ehrenb.) Pfitzer		+			+					+	+	+	+	+	+	+					+		
Neidium affine var. *longiceps* (Greg.) Cleve															+								
Neidium ampliatum (Ehrenb.) Krammer		+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+		+	+	V

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Neidium apiculatum Reimer				+																			
Neidium binodis (Ehrenb.) Pfitzer													+										
Neidium binodeforme Krammer		+	+				+			+	+	+	+	+	+	+	+		+		+	+	
Neidium bisulcatum var. *subampliatum* Krammer					+								+		+							+	
Neidium dubium (Ehrenb.) Cl.	+	+			+			+		+	+	+	+	+	+	+	+		+		+		I
Neidium hercynicum ? A. Mayer															+								
Neidium productum (W. Smith) Cleve						+	+								+						+	+	
Nitzschia abbreviata Hust.																					+		
Nitzschia acicularis (Kütz.) W. Smith	+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia acicularoides Hust.					+																		
Nitzschia acidoclinata Lange-Bert.	+	+									+	+		+	+				+	+	+	+	
Nitzschia acula (Kütz.) Hantzsch																					+	+	
Nitzschia alpina Grun.												+											
Nitzschia amphibia Grun.	+	+	+	+	+	+				+	+		+	+	+	+	+		+	+	+	+	
Nitzschia angustata Lange-Bert.		+			+								+	+	+	+		+	+		+		
Nitzschia angustatula Lange-Bert.		+	+		+					+	+	+	+		+		+						
Nitzschia archibaldii Lange-Bert.	+	+	+		+						+	+	+	+	+	+	+			+	+		
Nitzschia bacillum Hust.		+	+		+								+	+		+							
Nitzschia brevissima Grun.				+					+			+											
Nitzschia brunoi Lange-Bert.												+											
Nitzschia bulheimana (Rabenh.) Smith		+	+							+		+		+		+	+						R
Nitzschia calida Grun.		+		+	+				+	+	+	+	+	+	+	+	+		+	+		+	
Nitzschia capitellata Hust.	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+		+	+	+	+	
Nitzschia clausii Hantzsch																+	+						
Nitzschia communis Rabenh.	+	+										+	+	+	+	+	+				+	+	
Nitzschia constricta (Kütz.) Ralfs		+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia debilis (Arnott) Grun.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia delognei Grun.					+																		
Nitzschia denticula Grun.		+											+					+					
Nitzschia desertorum Hust.		+								+					+								
Nitzschia dissipata (Kütz.) Grun. ssp. *dissipata*	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia dissipata var. *media* (Hantzsch) Grun.		+	+		+				+	+	+	+	+	+	+		+		+		+	+	
Nitzschia dravelliensis Coste & Ricard		+				+																	
Nitzschia dubia W. Smith		+	+	+	+			+	+	+	+	+	+	+	+	+	+		+	+		+	
Nitzschia filiformis (Smith) Van Heurck				+																			
Nitzschia fonticola Grun.	+	+	+		+	+	+		+	+	+		+	+	+	+	+	+		+	+		
Nitzschia frequens Hust.												+											
Nitzschia frustulum (Kütz.) Grun. var. *frustulum*	+	+	+	+	+	+		+		+	+	+	+	+	+	+	+	+	+	+		+	
Nitzschia frustulum var. *inconspicua* (Grun.) Grun.		+	+		+					+	+		+	+	+	+	+		+	+	+	+	
Nitzschia graciliformis Lange-Bert. & Simonsen		+	+									+			+								
Nitzschia gracilis Hantzsch	+	+	+		+	+				+	+	+			+		+				+	+	
Nitzschia hantzschiana Rabenh.																						+	
Nitzschia heufleriana Grun.		+	+		+					+	+	+	+	+	+	+	+		+	+	+	+	
Nitzschia homburgiensis Lange-Bert.	+	+										+		+		+	+				+		
Nitzschia hungarica Grun.	+	+	+	+	+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Nitzschia intermedia Hantzsch		+	+		+				+			+	+	+	+	+		+					
Nitzschia lacuum Lange-Bert.																						+	
Nitzschia levidensis (W. Smith) Grun.		+	+	+	+	+	+	+	+	+	+		+	+	+	+	+		+	+			
Nitzschia linearis (Ag.) Smith	+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia microcephala Grun.		+	+								+												
Nitzschia ovalis Arnott																+	+						
Nitzschia palea (Kütz.) W. Smith	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Nitzschia palea var. *debilis* (Kütz.) Grun.																						+	
Nitzschia paleacea (Grun.) Grun.		+	+		+						+							+			+		
Nitzschia perminuta Grun.	+	+	+	+					+	+	+	+	+	+	+	+	+				+	+	
Nitzschia pura Hust.					+							+											
Nitzschia pusilla Grun.	+	+	+		+					+	+	+	+	+	+	+	+		+	+	+	+	
Nitzschia pumila Hust.		+																					
Nitzschia recta Hantzsch	+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Nitzschia sigma (Kütz.) W. Smith		+	+		+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia sigmoidea (Nitzsch) W. Smith		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Nitzschia salinarum Grun.		+			+							+	+	+		+	+				+	+	
Nitzschia solgensis Cleve-Euler		+	+									+	+	+	+	+	+				+	+	
Nitzschia sociabilis Hust.		+	+		+				+	+	+	+	+	+	+	+	+		+			+	
Nitzschia solita Hust.			+												+								
Nitzschia subacicularis Hust.		+	+		+				+	+	+	+									+		
Nitzschia sublinearis Hust.																					+		
Nitzschia subtilis Grun.		+			+					+	+	+	+	+	+	+	+		+	+		+	
Nitzschia supralitorea Lange-Bert.		+			+						+	+							+		+	+	
Nitzschia tabellaria Grun.	+		+		+						+			+	+			+			+		
Nitzschia tenuis W. Smith	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia terrestris (Perersen) Hust.														+									
Nitzschia tubicola Grun.															+				+			+	
Nitzschia trybionella Hantzsch		+	+		+					+			+		+						+		
Nitzschia umbonata (Ehrenb.) Lange-Bert.		+		+					+			+			+	+						+	
Nitzschia vermicularis (Kütz.) Hantzsch		+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Nitzschia vermicularoides Lange-Bert.																						+	
Nitzschia sp. cf. *agnita* Hust.											+												
Nitzschia sp. cf. *bergii* Cleve-Euler																							
Nitzschia sp. cf. *commutata* Grun.		+																					
Nitzschia sp. cf. *fasciculata* (Grun.) Grun.										+													
Nitzschia sp. cf. *ovalis* Arnott												+											
Nitzschia sp. cf. *paleacea* (Grun.) Grun.				+	+																		
Nitzschia cf. *supralitorea* Lange-Bert.													+										
Nitzschia sp. 1																							
Nitzschia sp. 2						+																	
Nitzschia sp. 3	+																						
Nitzschia sp. 4	+																						
Parlibellus crucicula (Smith) Witkowski, Lange-Bert. & Metzeltin		+			+																+		R
Parlibellus protracta (Grun.) Witkowski, Lange-Bert. & Metzeltin		+		+					+			+	+	+							+		
Parlibellus protractoides (Hust.) Witkowski, Lange-Bert. & Metzeltin		+	+	+		+	+	+	+		+	+	+	+	+	+	+	+	+		+		R
Pinnularia acuminata W. Smith																					+		
Pinnularia appendiculata (Ag.) Cleve		+								+		+	+	+	+	+				+	+		
Pinnularia borealis Ehrenb. var. *borealis*	+	+										+		+			+		+	+	+	+	
Pinnularia borealis var. *sublinearis* Krammer		+									+					+	+						
Pinnularia borealis var. *scalaris* (Ehrenb.) Rabenh.										+													
Pinnularia borealis var. *rectangularis* Carlson		+													+								
Pinnularia brebissonii (Kütz.) Rabenh.		+	+	+	+		+		+	+		+	+	+	+	+	+		+	+	+	+	
Pinnularia clevei var. *minor* (Hust.) Krammer																					+		
Pinnularia divergentissima var. *triundulata* Krammer																						+	
Pinnularia dubitabis var. *minor* Krammer														+									
Pinnularia esoxiformis Fusey																					+		
Pinnularia flexuosa Cleve																					+		
Pinnularia frauenbergiana Reichardt														+						+			
Pinnularia gentilis (Donkin) Cleve																					+		
Pinnularia gibba Ehrenb.						+	+					+									+		
Pinnularia globiceps Greg.			+	+					+			+		+						+		+	
Pinnularia grunowii Krammer		+	+			+					+	+	+	+	+		+			+	+		
Pinnularia iselana Krammer												+	+	+	+		+				+	+	
Pinnularia islandica ? Østrup		+													+								
Pinnularia legunem Ehrenb.													+										
Pinnularia lundii Hust.		+	+	+	+				+	+		+	+	+	+	+	+		+	+	+		
Pinnularia major (Kütz.) Cleve		+																					
Pinnularia marchica Schönfelder												+										+	
Pinnularia microstauron (Ehrenb.) Cleve	+	+	+	+	+							+	+					+			+		V
Pinnularia neomajor Krammer											+												
Pinnularia nodosa (Ehrenb.) W. Smith												+											

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Pinnularia nodosa var. *robusta* (Foged) Krammer																					+		
Pinnularia obscura Krasske	+	+		+	+					+	+	+	+	+	+	+	+			+	+	+	
Pinnularia obscuriformis Krammer					+								+	+			+				+		
Pinnularia oriunda Krammer		+	+		+							+	+	+	+		+			+	+	+	
Pinnularia parvulissima Krammer																					+		
Pinnularia perirrorata Krammer												+									+	+	
Pinnularia renata Krammer																							
Pinnularia rhenohassiaca Krammer & Lange-Bert.																					+		
Pinnularia rhombarea var. *udulata* Krammer										+													
Pinnularia rhombarea var. *variarea* Krammer																					+		
Pinnularia rupestris Hantzsch		+	+	+					+	+	+		+	+	+		+				+		E
Pinnularia schonfelderi Krammer												+			+	+	+				+	+	E
Pinnularia schroederii (Hust.) Krammer												+											
Pinnularia silvatica Petersen												+										+	
Pinnularia similis Hust.										+			+		+								
Pinnularia sinistra Krammer	+	+										+	+	+			+			+	+		
Pinnularia septentrionalis Krammer												+											
Pinnularia subcapitata Greg.												+		+	+						+		
Pinnularia subcapitata var. *subrostrata* Krammer																				+			
Pinnularia subcapitata var. *elongata* Krammer		+				+	+					+											
Pinnularia subcommutata Krammer														+			+				+	+	
Pinnularia subcommutata var. *nonfasciata* Krammer		+									+	+			+					+	+	+	
Pinnularia subgibba Krammer																					+	+	E
Pinnularia subgibba var. *undulata* Krammer																					+		
Pinnularia subrupertris Krammer					+							+	+	+	+	+	+			+	+	+	E
Pinnularia subundulata Østrup																					+		
Pinnularia undula (Schumann) Krammer													+								+		
Pinnularia viridiformis Krammer		+	+	+	+	+	+			+	+	+	+	+	+	+	+			+	+	+	E
Pinnularia viridiformis var. *minor* Krammer																					+		
Pinnularia viridis (Nitzsch) Ehrenb.		+			+	+			+	+		+	+	+	+		+		+	+	+	+	
Pinnularia cf. *appendiculata* (Ag.) Cleve														+									
Pinnularia cf. *cherryfieldiana* Krammer																					+		
Pinnularia cf. *frauenburgiana* Reichardt															+								
Pinnularia cf. *kuetzingii* Krammer														+								+	
Pinnularia cf. *oriundiformis* Krammer																					+		
Pinnularia cf. *schoenfelderii* Krammer		+																					
Pinnularia cf. *silvatica* Petersen																							
Pinnularia cf. *subrombica* Krammer																						+	
Pinnularia cf. *viridiformis* Krammer												+											
Pinnularia sp. 1		+										+											
Pinnularia sp. 2		+																					
Pinnularia sp. 3													+										
Pinnularia sp. 4																					+		
Placoneis abiscoensis (Hust.) Lange-Bert. & Metzeltin																					+		
Placoneis anglica (Ralfs) Cox																					+		
Placoneis clementis (Grun.) Cox		+		+	+	+	+	+	+		+	+	+	+	+	+	+		+		+		
Placoneis constans (Hust.) Cox												+									+		
Placoneis dicephala (Ehrenb.) Mereschkowsky									+										+		+		
Placoneis elginensis (Greg.) Cox		+	+	+	+	+						+			+				+		+	+	
Placoneis exigua var. *signata* (Hust.) Hawarth & Kelly																					+		
Placoneis gastrum (Ehrenb.) Mereschkowsky	+				+																+		
Placoneis paraelginensis Lange-Bert.		+			+						+	+		+	+					+	+	+	
Placoneis placentula (Ehrenb.) Cox					+						+				+	+					+		
Placoneis pseudoanglica Lange-Bert.						+								+							+		
Placoneis subplacentula (Hust.) Cox																							
Placoneis undulata (Østrup) Lange-Bert.																					+		
Placoneis cf. *abiskoensis* (Hust.) Lange-Bert. & Metzeltin																			+				
Placoneis sp.														+		+						+	
Platessa conspicua (Mayer) Lange-Bert.		+			+					+			+	+	+						+		

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Planothidium delicatulum (Kütz.) Round & Bukht.		+											+										
Planothidium ellipticum (Cleve) Round & Bukht.		+							+	+	+		+	+	+	+	+		+			+	
Planothidium frequentissimum (Lange-Bert.) Round & Bukht.	+	+			+	+	+	+	+		+	+	+	+	+	+	+			+	+	+	
Planothidium lanceolatum (Bréb.) Round & Bukht.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	
Planothidium rostratum (Østrup) Lange-Bert.		+			+	+	+	+						+							+		
Psammothidium biorettii (Germain) Bukht. & Round		+				+	+	+	+					+							+		
Psammothidium grischunum (Wuthrich) Bukht. & Round		+									+	+		+	+								
Psammothidium helveticum (Hust.) Bukht. & Round		+																					
Psammothidium laueunburgianum (Hust.) Bukht. & Round		+									+	+	+	+		+	+				+		V
Psammothidium subatomoides (Hust.) Bukht. & Round		+				+	+				+	+			+						+		V
Psammothidium cf. *grischunum* (Wuthrich) Bukht. & Round				+																			
Puncticulata radiosa (Lemmermann) Håkansson		+	+		+					+						+							
Reimeria sinuata (Greg.) Kociolek & Stoermer	+	+	+		+					+	+	+	+	+	+		+				+	+	
Reimeria uniseriata Sala, Guerrero & Ferrario		+	+		+					+	+	+	+	+	+	+	+		+			+	
Rhoicosphenia abbreviata (Ag.) Lange-Bert.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Rhopalodia brebissonii Krammer																+							
Rhopalodia gibba (Ehrenb.) Müller		+									+					+	+	+			+	+	
Rhopalodia gibberula (Ehrenb.) Müller		+	+								+		+	+	+	+	+					+	
Rhopalodia rupestris (W. Smith) Krammer															+								R
Rhopalodia cf. *rupestris* (W. Smith) Krammer										+													
Rossithidium petersenii (Hust.) Round & Bukht.						+																	
Scoliopleura peisonis Grun.												+											
Sellaphora americana (Ehrenb.) D.G. Mann																					+		R
Sellaphora bacillum (Ehrenb.) D.G. Mann		+	+		+					+	+	+	+		+	+				+	+		V
Sellaphora hustedtii (Krasske) Lange-Bert. & Werum															+							+	V
Sellaphora joubaudii (Germain) Aboal	+	+	+								+	+	+	+	+	+	+			+	+	+	
Sellaphora levissima (Kütz.) D.G. Mann.						+															+		
Sellaphora mutata (Krasske) Lange-Bert.					+										+								
Sellaphora nana (Hust.) Lange-Bert.	+																			+			
Sellaphora pseudopupula (Krag.) Lange-Bert.												+							+		+	+	E
Sellaphora pupula (Kütz.) Mereschk.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Sellaphora seminulum (Grun.) D.G. Mann		+	+		+						+	+	+	+	+	+	+			+	+	+	
Sellaphora stroemii (Hust.) D.G. Mann		+											+									+	
Sellaphora cf. *stroemii* (Hust.) D.G. Mann												+											
Simonsenia delognei (Grun.) Lange-Bert.		+									+	+	+	+	+	+	+			+	+	+	
Stauroneis acidoclinata Lange-Bert. & Werum												+										+	
Stauroneis acuta W. Smith																					+		
Stauroneis amphicephala Kütz.																						+	
Stauroneis anceps Ehrenb.	+	+	+		+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Stauroneis borrichii (Petersen) Lund	+																				+	+	
Stauroneis gracilior (Ehrenb.) Reichard															+						+		
Stauroneis gracilis Ehrenb.												+									+		V
Stauroneis kriegerii Patrick		+	+			+				+	+	+	+	+	+						+		
Stauroneis laterostrata Hust.		+																					
Stauroneis lauenburgiana Hust.																					+		
Stauroneis legumen (Ehrenb.) Kütz.						+														+	+	+	
Stauroneis leguminopsis Lange-Bert. & Krammer												+										+	
Stauroneis optusa Lagerstedt											+										+		
Stauroneis parathermicola Lange-Bert.	+											+									+	+	
Stauroneis phoenicenteron (Nitzsch) Ehrenb.		+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+	+	+	V
Stauroneis producta Grun.																						+	
Stauroneis reichardtii Lange-Bert.												+										+	
Stauroneis separanda Lange-Bert. & Werum		+	+		+					+	+		+	+	+	+	+		+	+	+	+	
Stauroneis smithii Grun.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Stauroneis subgracilis Lange-Bert. & Krammer												+									+		
Stauroneis tackei (Hust.) Krammer, Lange-Bert., Kuesber & Metzeltin		+									+	+	+	+	+					+	+	+	

Table 1 contin.

Taxa / Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	0
Stauroneis thermicola (Petersen) Lund	+	+			+					+		+		+	+	+	+			+	+	+	R
Stauroneis undata Hust.		+														+							
Stauroneis cf. *agrestis* Petersen	+																						
Stauroneis cf. *borrichii* (Petersen) Lund	+	+													+	+	+						
Stauroneis sp. 1		+																					
Stauroneis sp. 2		+																					
Stauroneis sp. 3											+				+								
Stenopterobia sp.													+	+	+	+	+						
Stephanodiscus hantzschii Grun.	+	+	+		+				+	+	+	+	+	+	+	+	+	+	+	+	+	+	
S. minutulus (Kütz.) Cleve & Moller		+			+						+	+	+	+	+	+	+				+		
Surirella angusta Kütz.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Surirella bifrons Ehrenb.																					+		V
Surirella biseriata Bréb.		+	+		+						+	+	+	+	+	+	+		+		+		
Surirella brebissonii Krammer & Lange-Bert. var. *brebissonii*		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	R
Surirella brebissonii var. *kuetzingii* Krammer & Lange-Bert.	+	+	+		+			+		+	+	+	+	+	+		+		+	+	+	+	
Surirella brebissonii var. *punctata* Krammer									+													+	
Surirella crumena Bréb.		+			+						+		+	+	+	+							R
Surirella elegans Ehrenb.		+							+						+						+		V
Surirella helvetica Brun												+									+		
Surirella linearis W. Smith			+		+					+			+	+	+	+	+		+	+	+	+	
Surirella minuta (Bréb.) Kütz.	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Surirella ovalis Bréb.		+		+	+				+	+	+	+	+	+	+	+	+			+	+	+	
Surirella robusta Ehrenb.			+																				V
Surirella spirallis Kütz.																						+	
Surirella splendida (Ehrenb.) Kütz.		+	+	+	+					+	+	+	+		+						+		
Surirella tenera Greg.		+	+		+			+	+				+	+	+	+	+						
Surirella tericola Lange-Bert. & Alles		+	+		+				+	+	+	+	+	+	+	+	+		+	+	+	+	
Surirella visurgis Hust.	+																				+		
Surirella cf. *terricola* Lange-Bert.	+											+											
Surirella sp. 1		+			+									+	+								
Surirella sp. 2	+																					+	
Tabellaria fenestrata (Lyngbe) Kütz.		+				+	+																V
Tabellaria flocculosa (Roth) Kütz.		+				+	+			+		+									+	+	
Thalassiosira duostra Pienaar					+																+		
Thalassiosira pseudonana Halse & Heimal	+	+			+							+	+	+	+	+					+		
Thalassiosira weissflogii (Roth) Kütz.		+	+		+						+			+	+		+						
Thalassiosira cf. *weissflogii* (Roth) Kütz.																							
Thalassiosira cf. *aestiwalis* Grun.		+													+								
Thalassiosira cf. *duostra* Pienaar		+																					
Thalassiosira sp.																					+		
The sum of diatom taxa	147	400	197	121	253	100	71	61	126	192	227	279	255	261	286	213	226	53	147	155	365	271	–

Explanations: Column 0: E = endangered; V = vulnerable; R = rare; I = indeterminate (according to Siemińska et al. 2006). Column 1 – soil. Columns 2–22 are a names of rivers and streams: 2 – Wisłok, 3 – Zalew Rzeszowski, 4 – Łubienka, 5 – San (near Jarosław), 6 – Gołębiówka, 7 – Szuwarka, 8 – Świerkowiec, 9 – Lubcza, 10 – Różanka, 11 – Morwawa, 12 – Baryczka, 13 – Pielnica, 14 – Stobnica, 15 – Mleczka, 16 – Strug, 17 – Ryjak, 18 – Wisłoka (near Dębica), 19 – Wielopolka, 20 – Trzcianka, 21 – Żołynianka, 22 – Matysówka.

of Algae (11.5% micro-flora). In this group of 80 taxa there were: 40 of the most rare taxa (R), of which 23 were vulnerable (V), 11 endangered (E) and 6 indeterminate (I) – Table 1, Plate 1: 31–40.

Studies conducted on cultivated soils in Boguchwała, Dąbrowa and Krasne in 2009–2011 indicated the presence of 147 diatom taxa, of which the most numerous were – *Hantzschia amphioxys*, *Mayamaea atomus*, *Nitzschia palea*, *N. pusilla*, *Pinnularia obscura* and *Stauroneis thermicola*. Along with the noted diatoms there were 6 taxa from the Red List, including: *Stauroneis thermicola*, which occurs numerously and is a dominant species, frequently reaching above 20% of the total number.

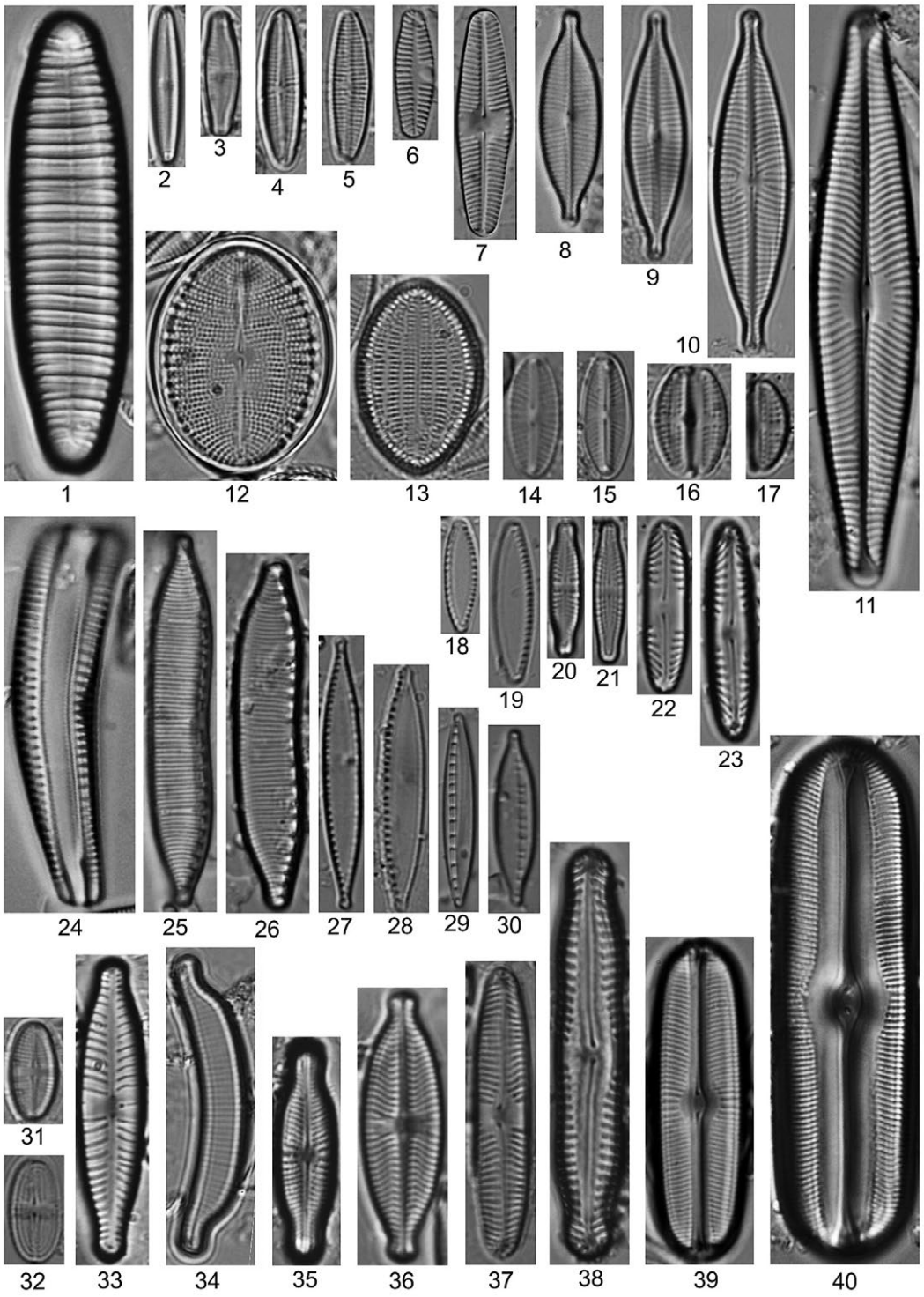

Plate 1. Selected aquatic and soil diatoms taxa: 1 – *Diatoma vulgaris* Bory, 2-3 – *Achnanthidium minutissimum* (Kütz.) Czarn. var. *minutissimum*, 4-5 – *Achnanthidium pyrenaicum* (Hust.) Kobayasi, 6-7 – *Planothidium lanceolatum* (Bréb.) Round & Bukht., 8-9 – *Navicula gregaria* Donkin, 10 – *N. capitatoradiata* Germain, 11 – *N. lanceolata* (Ag.) Kütz., 12 – *Cocconeis pediculus* Ehrenb., 13 – *C. placentula* var. *lineata* (Ehrenb.) Van Heurck, 14-15 – *Mayamaea atomus* (Kütz.) Lange-Bert. var. *atomus*, 16-17 – *Amphora pediculus* (Kütz.) Grun., 18-19 – *Nitzschia pusilla* Grun., 20-21 – *Stauroneis thermicola* (Petersen) Lund, 22-23 – *Pinnularia obscura* Krasske, 24 – *Rhoicosphenia abbreviata* (Ag.) Lange-Bert., 25-26 – *Hantzschia amphioxys* (Ehrenb.) Grun., 27-28 – *Nitzschia palea* (Kütz.) W. Smith, 29-30 – *N. dissipata* (Kütz.) Grun. ssp. *dissipata*, 31 – *Psammothidium lauerburgianum* (Hust.) Bukht. & Round, 32 – *P. subatomoides* (Hust.) Bukht. & Round, 33 – *Gomphonema sarcophagus* Greg., 34 – *Eunotia septentrionalis* Østrup, 35 – *Parliberllus protractoides* (Hust.) Witkowski, Lange-Bert. & Metzeltin, 36 – *Geissleria decussis* (Østrup) Lange-Bert. & Metzeltin, 37 – *Pinnularia schoenfelderi* Krammer, 38 – *P. nodosa* (Ehrenb.) W. Smith, 39 – *Sellaphora bacillum* (Ehrenb.) D.G. Mann, 40 – *S. americana* (Ehrenb.) D.G. Mann (magnification1000×)

DISCUSSION

Running waters and cultivated soils on the territory of the Podkarpacie Province are characterized by a huge richness of diatom species (Table 1). The amounts of taxa found (738 taxa in waters and 147 taxa in soils) during 5 years of studies are prooved.

Most of the studies were conducted on inflows of the Wisłok River [Mucha et al. 2009, Tambor, Noga 2011, Pajączek et al. 2012] and on the Wisłok itself [Noga 2012], in which there were 400 taxa diatom identified. In 1970–1995 Rakowska [2001] recorded a similar number of diatoms in the rivers of central Poland (the highest number was identified in the Rawka River – 444 taxa). During studies conducted in 1993–2007 in the valley of the Kobylanka stream, on the Krakowsko–Częstochowska Upland, the existence of 307 diatom taxa was noted [Wojtal 2009]. In both cases these were studies over periods of many years and they involved a huge amount of studied samples. Hence the species richness of diatoms in rivers and streams of the Podkarpacie Province presented is very impressive.

The studied rivers and streams of the territory of the Podkarpacie Province were characterized by a similar domination structure of diatoms, especially in the middle and lower courses, where there are anthropogenical transformations of the environment. On the majority of study sites the following diatoms dominated: *Navicula lanceolata*, *N. gregaria*, *N. capitatoradiata*, *Nitzschia palea*, *N. dissipata* ssp. *dissipata*, *Achnanthidium minutissimum* var. *minutissimum*, *A. pyrenaicum*, *Amphora pediculus*, *Diatoma vulgaris*, *Rhoicosphenia abbreviata*, *Planothidium lanceolatum*, *Cocconeis pediculus*, and *C. placentula* var. *lineata*. These diatoms prefer alkaline waters (pH>7) and eutrophic, that is fertile, waters, of the second and third classes of quality [Van Dam et al. 1994, Hofmann et al. 2011].

The most often recorded dominants on the majority of study sites were: *Navicula lanceolata* and *N. gregaria*, the latter being a halophytic species. *N. lanceolata* growth the best in waters, which are more mesotrophic and eutrophic [Krammer, Lange-Bertalot 1986–1991, Lange-Bertalot, Steindorf 1996, Hofmann et al. 2011].

The upper sections of the majority of studied rivers and streams were characterized by the dominance of: *Achnanthidium minutissimum* var. *minutissimum* and *A. pyrenaicum*. *Achnanthidium minutissimum* var. *minutissimum* has a wide ecological amplitude and develops from oligo- to eutrophic conditions, whereas *A. pyrenaicum* is determined as an alkaliphilic species [Van Dam et al. 1994, Lange-Bertalot, Steindorf 1996]. According to Hofmann [1994] it is known as an indifferent species, with respect to pH values. Both taxa have a wide range of tolerance in relation to the trophy [Hofmann 1994], whereas, according to Van Dam et al. [1994], *A. pyrenaicum* is determined as a mesotrophic species. These taxa were also registered numerously in the streams of the Tatra Mountains [Kawecka 2012].

According to different authors of studies of benthic diatoms in slightly or highly polluted rivers there are similar dominant species, from which the most frequent are: *Planothidium lanceolatum*, *Cocconeis placentula*, *Navicula lanceolata*, *N. gregaria*, *N. tripunctata*, *Nitzschia palea*, etc. [Wasylik 1985, Kawecka 1986, Ligowski 1988, Rakowska 2001].

In the diatom flora of the Podkarpacie Province, 11.5% taxa are endangered and rare, located on the Polish Red List of Algae [Siemińska et al. 2006]. The places of occurrence of these diatoms are, among others, the upper sections of rivers and streams, where the endangered species of *Pinnularia*: *P. rupestris*, *P. schoenfelderii*, *P. subrupestris*, *P. subgibba* and *P. undula* occur. These are mainly species, which prefer waters from oligo- to mesosaprobous, with low and moderate values of conductivity [Krammer 2000, Hofmann et al. 2011]. Some species occur in the majority of rivers and streams in the Podkarpacie Province, others only in the form of individual specimens [Noga 2012, Pajączek et al. 2012].

The area of the Podkarpacie Province is still weakly known with respect to algological studies. The whole valley of the San River has hardly been studied, with the exception of the section of the river around Jarosław city and two inflows in the Dynowski Foothills – the Łubienka and Baryczka streams [Noga, Siry 2010]. At the moment studies have begun on diatoms in the valley of the upper San, which promise to be unusually interesting [Noga, unpublished data]. Similar studies on soil diatoms have been conducted for two years, so far on a small amount of study sites. The introductory results presented indicate a huge species richness of diatoms, which in the future, as a result of other studies conducted, will surely increase in number.

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