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Limno-terrestrial diatom flora in two stream valleys near *Arctowski* Station, King George Island, Antarctica

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Abstract: Diatom communities sampled in the vicinity of the Polish Antarctic *Arctowski* Station (King George Island, South Shetland Islands) have been investigated. Soil and sediment samples were collected from Petrified Forest Creek and Ornithologist Creek valleys. A total of 98 diatom taxa belonging to 30 different genera were recorded in the counts. Nine taxa have a marine origin but all together constitute only 0.14% of all counted valves. Three species: *Staurosira pottiezii*, *Psammothidium germainioides* and *Sellaphora jamesrossensis* dominated the flora. Some differences in the diatom assemblages were observed between soil samples from two stream valleys and between soil and sediments from the same catchment area. The highest species diversity was recorded in samples from the dried-up bed of the Ornithologist Creek, where both freshwater and terrestrial species were found. The soil samples from both investigated valleys showed a comparable number of species, but a different species composition. Based on the PCA analysis a clear separation of the assemblages from both creeks could be observed.

Keywords: Antarctic, South Shetland Islands, soil diatoms, sediments, diversity, Ornithologist Creek, Petrified Forest Creek.

Introduction

The Antarctic Realm is subdivided into three distinct regions: the Antarctic Continent, the Maritime Antarctic Region (generally comprising the Antarctic Peninsula and several archipelagos such as the South Shetland Islands and the South Orkney Islands), and the sub-Antarctic islands in the southern Indian, Atlantic and Pacific Oceans (Chown and Convey 2007). Soil diatom assemblages have been reported from several localities in the Antarctic Realm (Van de Vijver and Beyens 1998; Cavacini 2001; Mataloni and Tell 2002; Van de Vijver *et al.* 2002, 2004, 2014a; Fermani *et al.* 2007; Van de Vijver and Mataloni 2008; Zidarova 2008; Kopalová *et al.* 2009, 2012; Moravcová *et al.* 2010; González Garraza *et al.* 2011; Zidarova *et al.* 2012). All studies report the presence of rather species-rich Antarctic diatom communities controlled by several environmental parameters such as salinity, pH and nutrients. While most of these studies deal with communities on the sub-Antarctic islands in the southern Indian Ocean (such as Iles Crozet or Iles Kerguelen), only a few papers dealing with limno-terrestrial diatoms in the Maritime Antarctic Region were published, concentrated on the South Shetland Islands (Deception Island: Fermani *et al.* 2007; Van de Vijver and Mataloni 2008 and Livingston Island: Zidarova 2008) as well as on the Antarctic Peninsula Region (Mataloni and Tell 2002; Kopalová *et al.* 2014, 2019). On the King George Island, the largest island of the South Shetland Islands, diatom surveys have been carried out for years but were usually restricted to freshwater habitats such as streams and small ponds (Kawecka and Olech 1993, 2003, 2004; Luścińska and Kyć 1993; Kawecka *et al.* 1996, 1998; Noga and Olech 2004; Mrozińska *et al.* 2007). However, these papers all date from before the intensive taxonomic revision that started around 2010 (see Zidarova *et al.* 2016 and references therein) and therefore are usually still based on older taxonomic insights, mainly driven by the Ubiquity hypothesis (Finlay and Clarke 1999) stating that most diatom taxa present a cosmopolitan distribution (Jones 1996). The absence of detailed iconographic diatom voucher floras of the region led very often to an incorrect identification of most species, force-fitting the typical Antarctic taxa into European and North-America relatives based on books and keys available at that time (Tyler 1996). More recently, a first ecological study based on the refined taxonomy as proposed in Zidarova *et al.* (2016) was published on the diatom assemblages from small pools and creeks on the Ecology Glacier Forefield (Kochman-Kędziora *et al.* 2018a). In the framework of that study, several new species were described from that area (Kochman-Kędziora *et al.* 2016, 2017, 2018b).

The present study is the first to discuss the soil diatom assemblages in stream valleys near the Polish *Arctowski* Research Station on King George Island. The aim of this study is to investigate the diversity and composition of diatom assemblages developing in soils in the Petrified Forest Creek valley and in soils and dried sediments of Ornithologist Creek following the results of a detailed taxonomic revision of Maritime Antarctic diatom flora. An additional attempt was made to compare soil diatom assemblages from two stream valleys and between soil and dried sediments of the Ornithologist Creek.

Study area

King George Island (61°54'–62°16'S/57°35'–59°02'W) is the largest (1150 km^2) island of the South Shetland Archipelago. More than 90% of its volcanic bedrock is covered by ice. The climate of the island is typically Maritime Antarctic, transitional between the Antarctic Continent and the sub-Antarctic islands (Marsz and Rakusa-Suszczewski 1987) and is characterized by small annual variations in air temperature, constant cloud cover and relative high humidity (Wen *et al.* 1994; Rakusa-Suszczewski 2002). The aquatic habitats of the island are mostly represented by small meltwater streams and episodic glacial rivulets, running continuously during the summer season (Elster and Komarek 2003).

Petrified Forest Creek (PFC) and Ornithologist Creek (OC) are situated near Admiralty Bay, in the northern part of Antarctic Specially Protected Area (ASPA) No. 128, in close vicinity of the Polish *Arctowski* Research Station. Ornithologist Creek (length c. 1100 m) flows out from a large snow patch, through a number of pools, and ends into a small lake situated close to the shore of Admiralty Bay. It is a mesotrophic meltwater stream flowing most of its length through relict ornithogenic soils. Its mesotrophic state is the result of the vicinity of the gentoo penguin (*Pygoscelis papua*) rookeries (Nędzarek 2010). Several skua couples (*Catharacta* spp.) nest on soils along the stream (Luścińska and Kyć 1993; Kawecka *et al.* 1996; Elster and Komarek 2003; Kvíderová and Elster 2013). Petrified Forest Creek (length c. 1300 m) is an oligotrophic watercourse with a catchment (about 0.7 km^2) on initial soils characterized by the total absence of penguin colonies (Nędzarek 2010). Water originates from seasonal snow cover. In the catchment area three main substrates can be distinguished: loose and bare rock surfaces, slopes covered with coarse-clastic weathering and riverbeds filled with coarse-clastic material (Kozik 1982; Nędzarek 2010). The higher part of Petrified Forest Creek valley constitutes of non-vegetated slopes. Only in some parts of the lower section of the catchment area moss patches can be observed. Only a few skua couples nest in the stream catchment area (Elster and Komarek 2003). Ornithologist Creek has a more open valley, a wider stream body and a lower stream slope, situated at a lower elevation whereas Petrified Forest Creek has a more granulated stream bottom and is oriented more to the north (Elster and Komarek 2003).

Material and methods

Thirteen samples were collected from the soil surface of exposed areas, close to the creeks in the valleys of two meltwater streams, Petrified Forest Creek (PFC, sites 1–5) and Ornithologist Creek (OC, sites 6–8). Part of them were still covered by snow. An additional 5 samples (sites 9–13) were collected from sediments from the dried-up bed of Ornithologist Creek (Fig. 1). Sample 9 was collected in January 2009, whereas the rest of the samples were taken on March 5, 2010 due to a long-remaining snow cover.

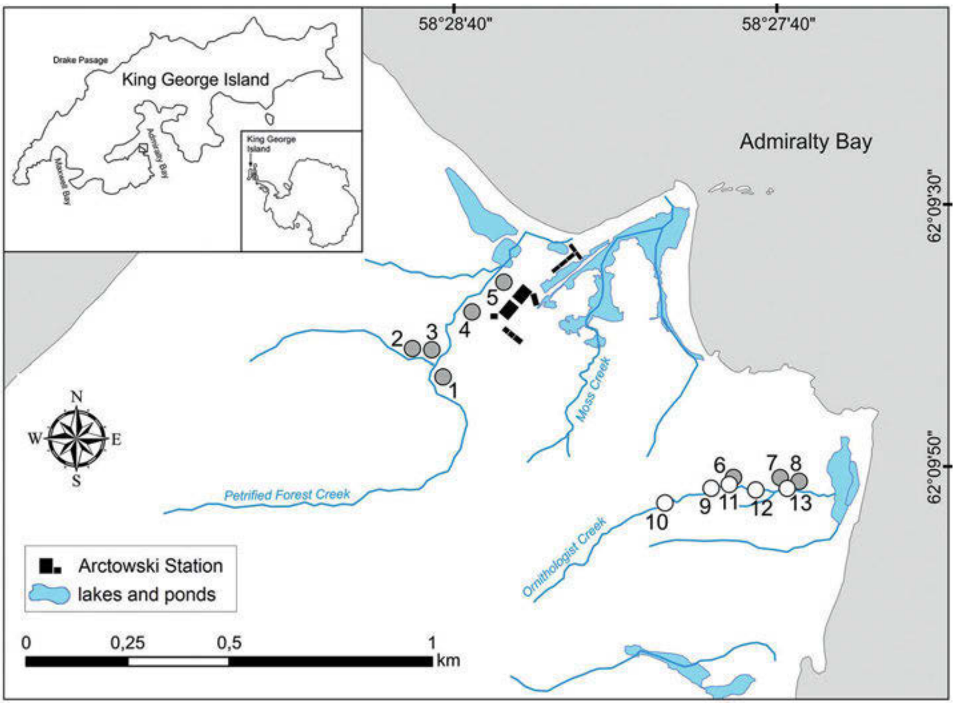

Fig. 1. Location of study area. Gray dots represent sites on soil (1–5: Petrified Forest Creek valley, 6–8: Ornithologist Creek valley), white dots represent sites on dried-up bed of the Ornithologist creek (9–13).

Samples for diatom analysis were prepared according to the method used by Kawecka *et al.* (1998) and Kawecka (2012). Part of each soil sample was digested using a mixture of concentrated sulfuric and chromic acid. Following digestion and centrifugation (5 times 5 minutes at 2500 rpm), the resulting cleaned material was mounted in Pleurax (refractive index 1.75) in order to obtain permanent diatom slides. Light microscopy (LM) observations were performed using a Nikon ECLIPSE 80i and a Carl Zeiss Axio Imager A2 equipped with Differential Interference Contrast (Nomarski) optics. Diatom images were captured using the Zeiss ICC 5 camera. For scanning electron microscopy (SEM), part of the cleaned material was filtered through a 3 μm Isopore™ polycarbonate membrane filter (Merck Millipore), air–dried and attached to aluminium stubs. The stub was subsequently sputter-coated with a 20 nm layer of Au using the Turbo-Pumped Sputter Coater Quorum Q 150OT ES and studied in a Hitachi SU8010 microscope at 5 kV at Podkarpackie Innovative Research Center of Environment (PIRCE), University of Rzeszow (Poland).

Due to the small volume of some soil samples (samples 1–8) it was impossible to conduct a full physicochemical analysis. Therefore, only single measurements of pH, organic matter content (Tjurin 1965) and following elements: Zn, P, Mn, Ca, Mg, K, Na, Fe and Cu (Atomic Absorption Spectrophotometer method–FAAS, using HITACHI Z–2000 device) were determined. To investigate statistical differences between the soil chemical parameters between the two studied valleys, a t-test was conducted using STATISTICA 13.3. The diatom composition in each sample was determined by identification and enumeration. Valves were counted up to 300 on randomly selected transects. Species with a share of 5% or more in the diatom assemblage were defined as dominants. After the count, the rest of the slide was scanned for rare species that were not observed during the counting. Diatom identification was based on Zidarova *et al.* (2016 and references therein). Marine taxa were identified using Witkowski *et al.* (2000) and Al-Handal and Wulff (2008).

The Shannon-Wiener diversity index (log_{10}-based) and Hill's evenness index were calculated using the statistical package MVSP 3.2 (Kovach Computing Services 2002). To elucidate patterns in the species composition, ordination techniques were applied. Detrended correspondence analysis (DCA) was used to estimate gradient length. The resulting DCA showed gradient lengths for the first four axes of 0.2900, 0.0907, 0.0273 and 0.0071 suggesting that methods based on linear models (PCA: Principal Components Analysis) should be applied for all subsequent ordinations of the total dataset (ter Braak and Prentice 1988). All ordinations were performed using CANOCO version 5.03 and CanoDraw (ter Braak and Šmilauer 1998) and are described in full detail in Jongman *et al.* (1995).

Results

The physicochemical analyses have shown that the soil samples taken from the Petrified Forest Creek have a circumneutral to slightly alkaline pH (7.3–7.8), whereas in the samples from the Ornithologist Creek valley the pH was clearly much lower (5.1–5.5). Among all measured elements Zn, K and Cu did not show any differences between soils of two valleys. The soil samples from the PFC valley were characterized by higher content of Mn, Ca, Mg, Na and Fe. On the other hand soils from the Ornithologist Creek Valley contained more organic carbon and phosphorus (Table 1). Statistically significant differences ($p<0.05$)

Table 1.

Chemical analysis of soil samples collected from the Petrified Forest Creek (1–5) and Ornithologist Creek valleys (6–8) (OC – organic carbon).

Parameter	Petrified Forest Creek					Ornithologist Creek		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
pH H_20	7.8	7.5	7.5	7.3	7.4	5.2	5.5	5.1
OC [%]	0.026	0.018	0.023	0.029	0.023	0.260	0.350	0.320
Zn [%]	0.002	0.002	0.003	0.003	0.003	0.002	0.002	0.002
Mn [%]	0.245	0.232	0.343	0.332	0.329	0.147	0.121	0.108
Ca [%]	0.720	0.623	0.740	0.734	0.682	0.214	0.209	0.210
Mg [%]	1.098	0.838	1.085	1.019	0.942	0.257	0.224	0.237
K [%]	0.031	0.039	0.179	0.190	0.181	0.051	0.039	0.043
Na [%]	0.560	0.445	0.420	0.334	0.409	0.071	0.062	0.068
Fe [%]	1.786	1.588	2.572	2.766	2.661	1.090	1.233	1.083
Cu [%]	0.004	0.004	0.005	0.006	0.005	0.004	0.003	0.004
P [%]	0.060	0.045	0.074	0.080	0.079	0.213	0.249	0.248

were observed for organic matter content and the following elements: Mn, Ca, Mg, Na, and P.

A total of 98 diatom taxa (including species, varieties and forms) belonging to 30 different genera were identified in the soil samples. Nine taxa have a marine origin and consisted of less than 0.14% of all counted valves. From 98 identified taxa 65 were found during counting, whereas another 33 (including all marine species) were identified after counting, while checking the entire slide. Thirteen of all recorded taxa were represented by only a single valve. On the other hand, the abundance of the four most numerous species in the study material exceeded 200 valves. A full list of all taxa is provided in Table 2.

Generally, the most species-rich genus was *Pinnularia* (15 taxa), followed by *Luticola* (10 taxa), *Muelleria* (10 taxa) and *Psammothidium* (7 taxa). The most abundant taxa were *Staurosira pottiezii* Van de Vijver (13.2% of all counted valves), *Psammothidium germainioides* Van de Vijver, Kopalová *et* Zidarova (10.4%), *Sellaphora jamesrossensis* (Kopalová *et* Van de Vijver) Van de Vijver *et* C.E. Wetzel (8.0%) and *Planothidium rostrolanceolatum* Van de Vijver *et al.* (7.1%). The most abundant taxa are illustrated, among others in Figures 2–4. The highest species diversity was recorded in samples taken from the top layer of the sediments from the dried-up bed of Ornithologist Creek (81 taxa), whereas soil samples taken from the valleys of both streams had an almost similar number of species (65 taxa from PFC and 68 from OC).

Table 2.

List of all species recorded in Petrified Forest Creek and Ornithologist Creek valleys together with information about number of taxa noted in each sample.

	Petrified Forest Creek valley					Ornithologist Creek							
	valley					valley			dried-up river bed				
sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Achnanthes coarctata (Brébisson) Grunow			+	+	+								
Achnanthes muelleri Carlson				+	+	+	+	+		+	+	+	+
Achnanthidium cf. ***maritimo-antarcticum*** Van de Vijver *et* Kopalová						+		+					
Brachysira minor (Krasske) Lange-Bertalot	+	+	+	+	+	+	+	+	+	+	+	+	+
Caloneis australis Zidarova, Kopalová *et* Van de Vijver				+	+								
Chamaepinnularia australomediocris (Lange-Bertalot *et* Schmidt) Van de Vijver		+	+	+	+	+	+	+		+	+	+	+
Chamaepinnularia elliptica Zidarova, Kopalová *et* Van de Vijver				+									
Chamaepinnularia gerlachei Van de Vijver *et* Sterken				+	+	+		+		+	+	+	+
Chamaepinnularia krookiformis (Krammer) Lange-Bertalot *et* Krammer		+	+	+	+	+	+	+		+	+	+	+
Chamaepinnularia krookii (Grunow) Lange-Bertalot *et* Krammer						+				+	+	+	
Eunotia pseudopaludosa Van de Vijver, de Haan *et* Lange-Bertalot						+	+	+	+	+	+	+	
Eunotia ralitsae Van de Vijver, de Haan *et* Lange-Bertalot						+	+	+	+	+	+	+	+
Fragilaria cf. ***parva*** Tuji et Williams			+	+	+	+	+	+		+	+	+	+
Gomphonema maritimo-antarcticum Van de Vijver *et al.*		+	+	+	+	+	+	+		+	+	+	+
Halamphora cf. ***ausloosiana*** Van de Vijver *et* Kopalová						+					+		
Hantzschia abundans Lange-Bertalot				+	+					+	+		
Hantzschia amphioxys (Ehrenberg) Grunow		+	+			+	+	+		+	+	+	+
Hantzschia hyperaustralis Van de Vijver *et* Zidarova	+	+	+	+	+	+	+	+	+	+	+	+	+
Humidophila australoshetlandica Kopalová, Zidarova *et* Van de Vijver											+		+

Table 2.

List of all species recorded in Petrified Forest Creek and Ornithologist Creek valleys together with information about number of taxa noted in each sample.

	Petrified Forest Creek valley					Ornithologist Creek							
	valley					valley			dried-up river bed				
sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Achnanthes coarctata (Brébisson) Grunow			+	+	+								
Achnanthes muelleri Carlson				+	+	+	+	+		+	+	+	+
Achnanthidium cf. ***maritimo-antarcticum*** Van de Vijver *et* Kopalová						+		+					
Brachysira minor (Krasske) Lange-Bertalot	+	+	+	+	+	+	+	+	+	+	+	+	+
Caloneis australis Zidarova, Kopalová *et* Van de Vijver				+	+								
Chamaepinnularia australomediocris (Lange-Bertalot *et* Schmidt) Van de Vijver		+	+	+	+	+	+	+		+	+	+	+
Chamaepinnularia elliptica Zidarova, Kopalová *et* Van de Vijver				+									
Chamaepinnularia gerlachei Van de Vijver *et* Sterken				+	+	+		+		+	+	+	+
Chamaepinnularia krookiformis (Krammer) Lange-Bertalot *et* Krammer		+	+	+	+	+	+	+		+	+	+	+
Chamaepinnularia krookii (Grunow) Lange-Bertalot *et* Krammer						+				+	+	+	
Eunotia pseudopaludosa Van de Vijver, de Haan *et* Lange-Bertalot						+	+	+	+	+	+	+	
Eunotia ralitsae Van de Vijver, de Haan *et* Lange-Bertalot						+	+	+	+	+	+	+	+
Fragilaria cf. ***parva*** Tuji et Williams			+	+	+	+	+	+		+	+	+	+
Gomphonema maritimo-antarcticum Van de Vijver *et al.*		+	+	+	+	+	+	+		+	+	+	+
Halamphora cf. ***ausloosiana*** Van de Vijver *et* Kopalová						+					+		
Hantzschia abundans Lange-Bertalot				+	+					+	+		
Hantzschia amphioxys (Ehrenberg) Grunow		+	+			+	+	+		+	+	+	+
Hantzschia hyperaustralis Van de Vijver *et* Zidarova	+	+	+	+	+	+	+	+	+	+	+	+	+
Humidophila australoshetlandica Kopalová, Zidarova *et* Van de Vijver											+		+

Table 2 continued

	Petrified Forest Creek valley					Ornithologist Creek							
	valley					valley			dried-up river bed				
Humidophila sceppacuerciae Kopalová			+	+	+								+
Humidophila tabellariaeformis (Krasske) R.L.Lowe *et al.*			+	+		+	+	+	+	+	+	+	+
Luticola australomutica Van de Vijver	+		+	+	+		+	+	+	+			+
Luticola austroatlantica Van de Vijver *et al.*		+	+	+	+					+	+		+
Luticola contii Zidarova, Levkov *et* Van de Vijver						+							
Luticola gigamuticopsis Van de Vijver		+				+							
Luticola higleri Van de Vijver, Van Dam *et* Beyens													+
Luticola muticopsis (Van Heurck) D.G. Mann	+	+	+	+	+	+	+	+	+	+	+	+	+
Luticola olegsakharovii Zidarova, Levkov *et* Van de Vijver						+	+	+	+	+	+	+	
Luticola quadriscrobiculata Van de Vijver		+	+	+									
Luticola truncata Kopalová *et* Van de Vijver	+	+	+	+		+	+	+	+	+	+	+	+
Luticola vandevijveri Kopalová, Zidarova *et* Levkov										+		+	
Mayamaea sweetloveana Zidarova, Kopalová *et* Van de Vijver	+	+	+	+	+	+	+	+		+	+	+	+
Microcostatus australoshetlandicus Van de Vijver *et al.*								+					+
Microcostatus naumannii (Hustedt) Lange-Bertalot													+
Muelleria aequistriata Van de Vijver *et* S.A.Spaulding												+	+
Muelleria algida S.A. Spaulding *et* Kociolek								+		+			
Muelleria australoatlantica Van de Vijver *et* S.A.Spaulding											+	+	
Muelleria kristinae Van de Vijver		+		+	+	+	+	+		+	+	+	+
Muelleria nogae Van de Vijver, Zidarova *et* Kopalová								+		+	+	+	
Muelleria olechiae Kochman-Kędziora *et al.*		+											+
Muelleria pimpireviana Zidarova, Kopalová *et* Van de Vijver	+	+		+	+			+		+		+	

	Petrified Forest Creek valley					Ornithologist Creek							
	valley					valley			dried-up river bed				
Muelleria rostrata Van de Vijver *et* S.A. Spaulding				+									
Muelleria sabbei Van de Vijver *et* S.A.Spaulding		+		+		+		+		+	+		
Muelleria tumida Van de Vijver *et* S.A. Spaulding								+					
Navicula australoshetlandica Van de Vijver				+	+	+	+	+		+	+	+	+
Navicula gregaria Donkin				+	+	+	+	+		+	+	+	+
Navicula sp.											+		
Nitzschia gracilis Hantzsch		+	+	+	+	+	+	+		+	+	+	+
Nitzschia homburgiensis Lange-Bertalot		+	+	+	+	+	+	+		+	+	+	+
Nitzschia kleinteichiana Hamsher *et al.*			+	+	+	+	+	+		+	+	+	+
Nitzschia soratensis E. Morales *et* Vis				+		+	+	+		+	+	+	+
Nitzschia sp.	+				+			+		+	+	+	
Orthoseira roeseana (Rabenhorst) O'Meara				+	+	+	+	+		+	+	+	
Pinnularia australoglobiceps Zidarova, Kopalová *et* Van de Vijver			+	+	+	+	+	+		+	+	+	+
Pinnularia australomicrostauron Zidarova, Kopalová *et* Van de Vijver		+	+	+	+	+	+	+	+	+	+	+	+
Pinnularia australoschoenfelderi Zidarova, Kopalová *et* Van de Vijver					+	+	+	+	+	+	+	+	+
Pinnularia austroshetlandica (Carlson) Cleve-Euler						+	+	+	+	+	+	+	+
Pinnularia borealis Ehrenberg		+	+	+	+	+	+	+	+	+	+	+	+
Pinnularia borealis var. ***pseudolanceolata*** Van de Vijver *et* Zidarova	+	+	+	+		+	+	+		+		+	+
Pinnularia intermedia (Lagerstedt) Cleve		+		+									
Pinnularia magnifica Zidarova, Kopalová *et* Van de Vijver			+	+		+	+	+		+	+	+	
Pinnularia microstauroides Zidarova, Kopalová *et* Van de Vijver								+	+	+	+	+	+
Pinnularia perlanceolata Van de Vijver *et* Zidarova		+	+	+									
Pinnularia sp.									+				
Pinnularia strictissima Manguin													+
Pinnularia subaltiplanensis Zidarova, Kopalová *et* Van de Vijver				+									

Table 2 continued

	Petrified Forest Creek valley					Ornithologist Creek							
	valley					valley			dried-up river bed				
Pinnularia subantarctica var. ***elongata*** (Manguin) Van de Vijver *et* Le Cohu	+	+	+	+	+	+	+	+	+	+	+	+	+
Pinnularia subcarteri Zidarova, Kopalová *et* Van de Vijver				+									
Placoneis australis Van de Vijver *et* Zidarova			+	+	+	+	+	+	+	+	+	+	+
Planothidium australe (Manguin) Le Cohu				+	+	+	+	+	+	+	+	+	+
Planothidium lanceolatum (Brébisson) Lange-Bertalot							+			+	+	+	+
Planothidium rostrolanceolatum Van de Vijver, Kopalová *et* Zidarova		+	+	+	+	+	+	+			+	+	+
Psammothidium antarcticum Van de Vijver				+	+			+		+		+	+
Psammothidium germainii (Manguin) Sabbe				+	+	+	+	+	+	+	+	+	+
Psammothidium germainioides Van de Vijver, Kopalová *et* Zidarova						+	+	+	+	+	+	+	+
Psammothidium incognitum (Krasske) Van de Vijver			+	+		+		+	+	+	+	+	
Psammothidium papilio (D.E.Kellogg *et al.*) Kopalová *et* Van de Vijver			+	+	+	+	+	+		+	+	+	+
Psammothidium rostrogermainii Van de Vijver, Kopalová *et* Zidarova		+	+	+	+	+	+		+	+	+	+	+
Psammothidium subatomoides (Husted) Bukhtiyarova *et* Round				+	+								
Sellaphora jamesrossensis (Kopalová *et* Van de Vijver) Van de Vijver *et* C.E.Wetzel		+	+	+	+	+	+	+		+	+	+	+
Sellaphora nana (Hustedt) Lange-Bertalot, Cavacini, Tagliaventi *et* Alfinito				+			+				+		+
Stauroneis delicata Zidarova, Kopalová *et* Van de Vijver						+					+		+
Stauroneis huskvikensis Van de Vijver *et* Lange-Bertalot					+			+			+	+	
Stauroneis latistauros Van de Vijver *et* Lange-Bertalot			+	+	+	+	+	+		+	+	+	+
Stauroneis minutula Hustedt		+		+	+								
Stauroneis pseudomuriella Van de Vijver *et* Lange-Bertalot				+	+								

	Petrified Forest Creek valley					Ornithologist Creek							
	valley					valley			dried-up river bed				
Staurosira pottiezii Van de Vijver				+	+	+	+	+		+	+	+	+
Surirella australovisurgis Van de Vijver, Cocquyt, Kopalová *et* Zidarova				+									
Tryblionella debilis Arnott				+		+				+	+	+	
MARINE SPECIES													
Actinocyclus sp.										+		+	
Cocconeis costata W. Gregory group					+	+			+	+	+	+	+
Fragilariopsis kergulensis (O'Meara) Hustedt										+	+	+	+
Fragilariopsis rhombica (O'Meara) Hustedt										+	+		
Fragilariopsis sp. (cf. ***curta***) (Van Heurck) Hustedt			+				+	+		+	+		
Licmophora sp.							+			+			+
Navicula perminuta Grunow complex							+				+		+
Thalassiosira gracilis (Karsten) Hustedt				+	+	+	+	+		+	+	+	+
Thalassiosira sp.									+		+	+	
Total number of taxa	**10**	**28**	**34**	**59**	**46**	**53**	**48**	**57**	**24**	**63**	**65**	**60**	**58**

In addition to the number of recorded species, there are several significant differences both between the soils of two stream valleys and between diatom assemblages of two different habitats in the Ornithologist Creek catchment area.

Petrified Forest Creek valley. — In the samples from PFC valley the number of taxa observed per sample ranged from 10 to 59. The sample 1 collected from the higher section of PFC valley contained less diatoms than other samples, making it impossible to count 300 valves, even after counting additional slides. Due to an insufficient number of recorded diatom valves this sample have been removed from all further analysis of diversity and evenness. Three sites (3–5) located closer to the seashore were more diverse and abundant. Both samples were dominated by *Sellaphora jamesrossensis* (about 24%) followed by *Fragilaria* cf. *parva* Tuji *et* Williams (up to 19% in sample 5) and *Planothidium rostrolanceolatum* (up to 15.2% in sample 5). None of these three taxa, however, dominated in the samples from the valley of the neighboring Ornithologist Creek. Moreover, *S. jamesrossensis* and *Fragilaria* cf. *parva* were only present with a few valves per sample (Table 3). Five taxa among all presented in the Table 3 were observed only in the PFC valley. Diversity analysis revealed a mean Shannon-Wiener diversity index for PFC valley (1.1 ± 0.07), slightly lower than the diversity value for soil samples from OC basin (1.25 ± 0.03).

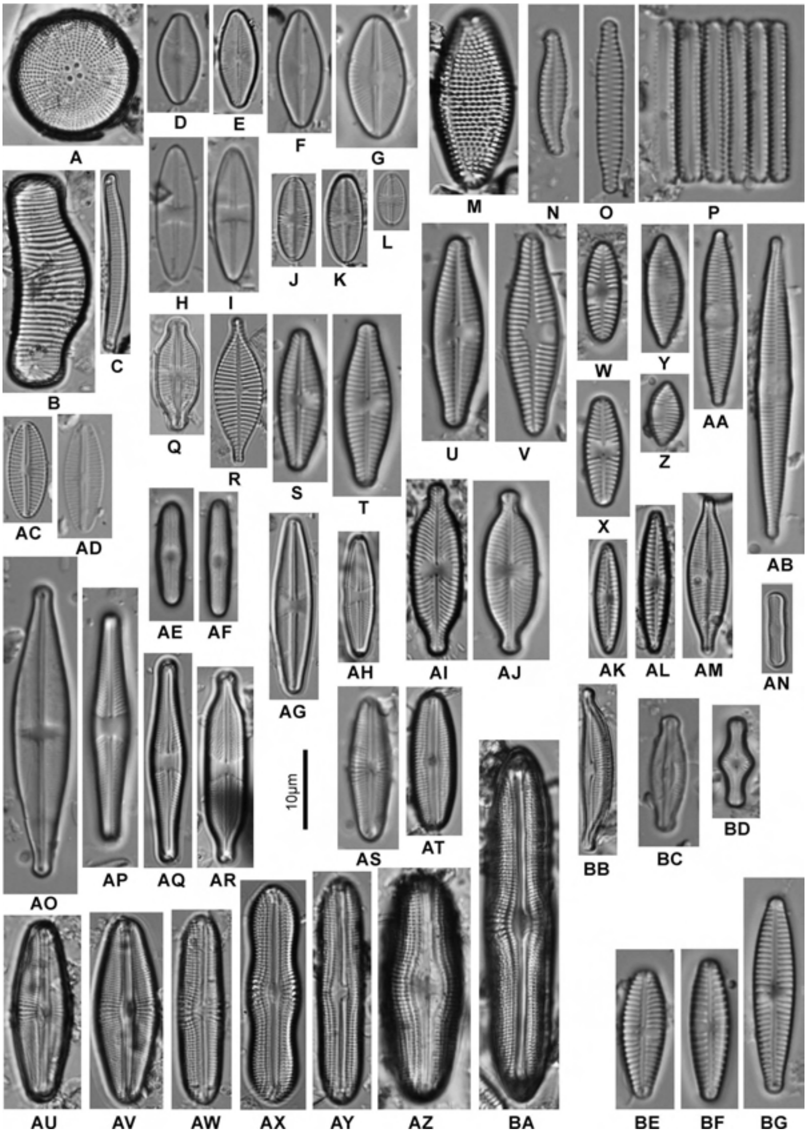

Fig. 2. Light micrographs of selected taxa: **A**, *Orthoseira roeseana*; **B**, *Eunotia ralitsae*; **C**, *E. pseudopaludosa*; **D–F**, *Psammothidium germainioides*; **G**, *P. germainii*; **H–I**, *P. incognitum;* **J–K**, *P. papilio*; **L**, *P. subatomoides*; **M**, *Achnanthes muelleri*; **N–P**, *Staurosira pottiezii*; **Q**, *Psammothidium antarcticum*; **R**, *Planothidium australe*; **S–V**, *P. rostrolanceolatum*; **W–X**, *P. lanceolatum*; **Y–AB**, *Fragilaria* cf. *parva*; **AC–AD**, *Sellaphora jamesrossensis*; **AE–AF**, *Brachysira minor*; **AG**, *Sellaphora nana*; **AH**, *Stauroneis minutula;* **AI–AJ**, *Placoneis australis*; **AK–AL**, *Navicula australoshetlandica;* **AM**, *N. gregaria*; **AN**, *Humidophila sceppacuerciae*; **AO**, *Stauroneis delicata*; **AP–AQ**, *S. pseudomuriella*; **AR**, *S. huskvikensis*; **AS**, *Muelleria olechiae*; **AT**, *M. kristinae*; **AU–AV**, *M. sabbei*; **AW**, *M. australoatlantica*; **AX**, *M. pimpireviana*; **AY**, *M. aequistriata*; **AZ**, *M. nogae*; **BA**, *M. algida*; **BB**, *Halamphora* cf. *ausloosiana*; **BC**, *Microcostatus naumannii*; **BD**, *Humidophila tabellariaeformis*; **BE–BG**, *Gomphonema maritimo-antarcticum*.

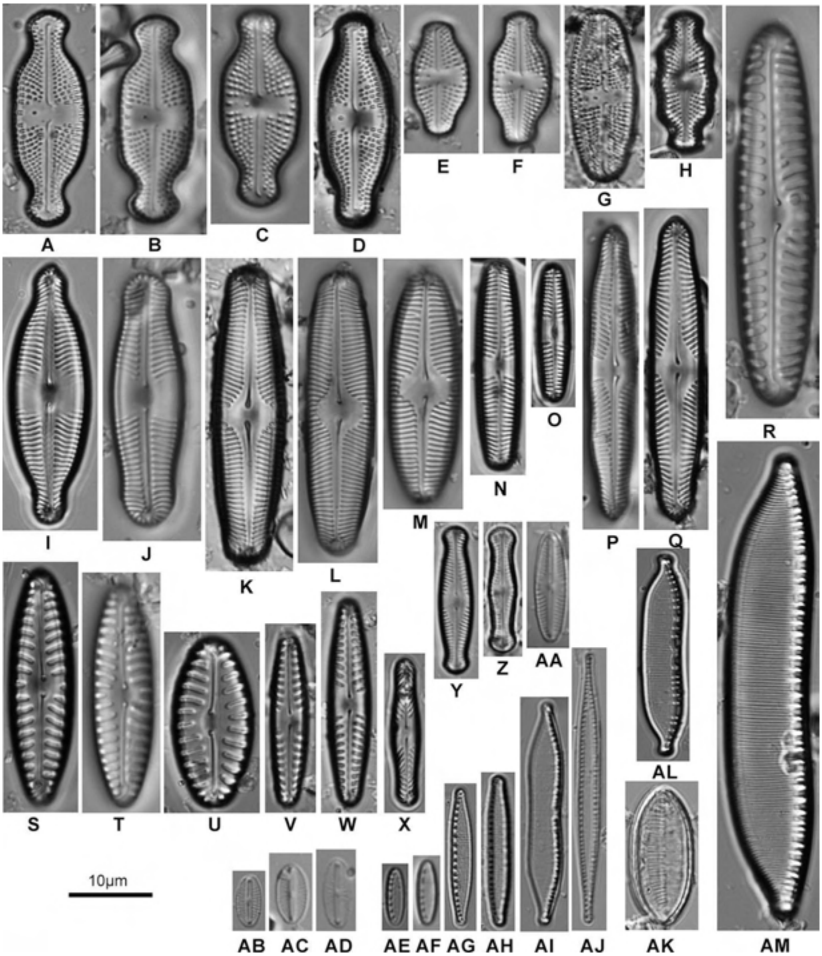

Fig. 3. Light micrographs of selected taxa: **A–C**, *Luticola muticopsis*; **D–F**, *L. truncata*; **G**, *L. vandevijveri*; **H**, *L. contii*; **I**, *Pinnularia austroshetlandica*; **J**, *P. australoglobiceps*; **K–M**, *P. australomicrostauron*; **N**, *Pinnularia subantarctica* var. *elongata*; **O**, *P. subaltiplanensis*; **P–Q**, *P. microstauroides*; **R**, *P. borealis*; **S–T**, *P. borealis* var. *pseudolanceolata*; **U**, *P. perlanceolata*; **V–W**, *P. magnifica*; **X**, *P. subcarteri*; **Y**, *Chamaepinnularia krookiformis*; **Z**, *Ch. krookii*; **AA**, *Ch. elliptica*; **AB–AD**, *Mayamaea sweetloveana*; **AE–AF**, *Nitzschia soratensis*; **AG–AH**, *N. kleinteichiana*; **AI**, *N. homburgiensis*; **AJ**, *N. gracilis*; **AK**, *Tryblionella debilis*; **AL**, *Hantzschia amphioxys*; **AM**, *H. hyperaustralis*.

Ornithologist Creek valley. — A relatively high number of recorded taxa (ranging from 48 to 57 taxa) was observed in the soil samples collected from OC valley with *Staurosira pottiezii*, *Psammothidium germainioides*, *P. germainii* (Manguin) Sabbe and *P. rostrolanceolatum* as most characterizing taxa. The most interesting assemblage was observed at a site located close to the seashore (sample 8), where *Humidophila tabellariaeformis* (Krasske) R.L.Lowe *et al.* was one of the subdominant species (ca. 17%).

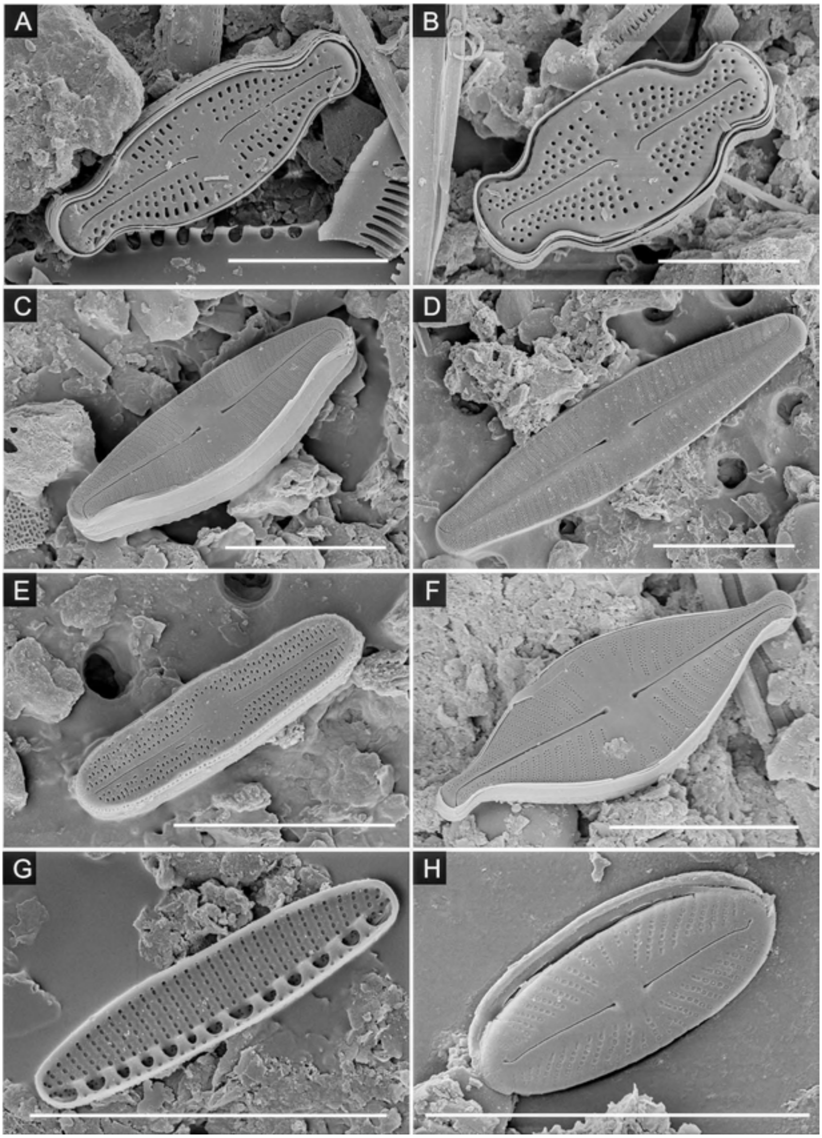

Fig. 4. SEM micrographs of selected taxa: **A**, *Luticola austroatlantica*; **B**, *L. muticopsis*; **C**, *Planothidium rostrolanceolatum*; **D**, *P. lanceolatum*; **E**, *Brachysira minor*; **F**, *Planothidium australe*; **G**, *Nitzschia soratensis*; **H**, *Mayamaea sweetloveana* (scale bars represent 10 μm).

The sediment samples collected from the dried-up river bed were characterized by the highest species diversity (81 taxa), however the number of taxa recorded per sample varied significantly from 24 to 65. Sample 9 was rather species-poor with only 24 observed taxa. The sample was dominated by *P. germainioides* (55.4%) with *Pinnularia borealis* Ehrenberg s.l. (18.6%) and *Pinnularia subantarctica* var. *elongata* (Manguin) Van de Vijver *et* Le Cohu

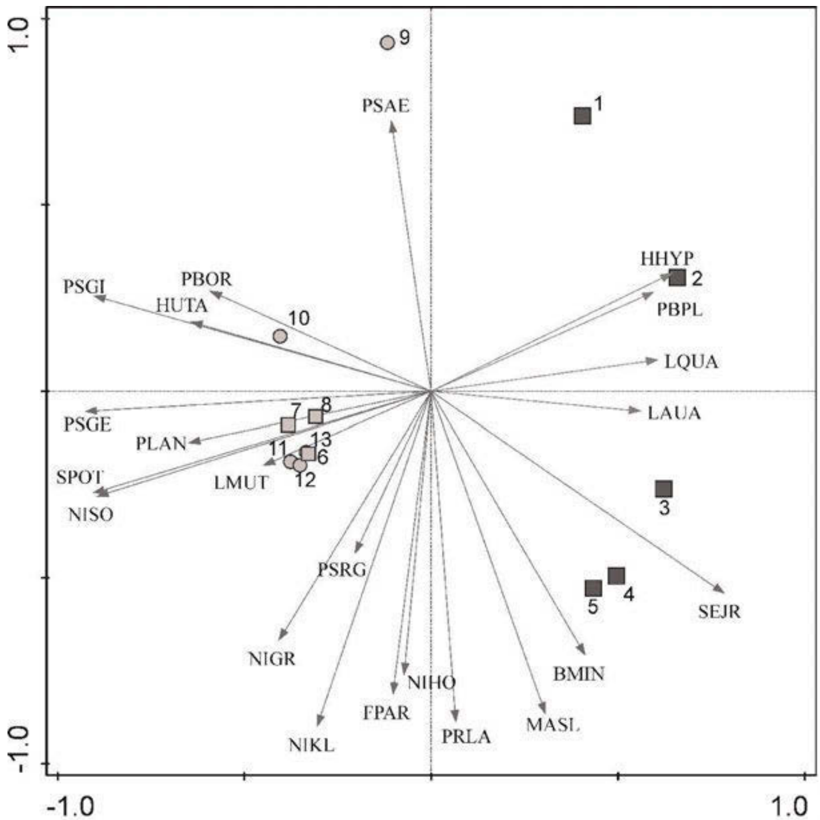

Fig. 5. Principal Component Analysis (PCA) of the studied samples. 1–5: sampling sites in the Petrified Forest Creek valley (dark gray rectangles); 6–8: sampling sites in the Ornithologist Creek valley (light gray rectangles) and from the dried-up river bed (light gray dots). Species acronyms: **BMIN** – *Brachysira minor*; **FPAR** – *Fragilaria* cf. *parva;* **HUTA** – *Humidophila tabellariaeformis*; **HHYP** – *Hantzschia hyperaustralis*; **LAUA** – *Luticola austroatlantica;* **LAUM** – *Luticola australomutica*; **LMUT** – *Luticola muticopsis*; **LQUA** – *Luticola quadriscrobiculata;* **LTRU** – *Luticola truncata*; **MATO** – *Mayamaea atomus* var. *atomus*; **NIGR** – *Nitzschia gracilis*; **NIHO** – *Nitzschia homburgiensis*; **NIKL** – *Nitzschia kleinteichiana*; **NISO** – *Nitzschia soratensis;* **PBOR** – *Pinnularia borealis;* **PBPL** – *Pinnularia borealis* var. *pseudolanceolata;* **PLAN** – *Planothidium lanceolatum*; **PRLA** – *Planothidium rostrolanceolatum;* **PSAE** – *Pinnularia subantarctica* var. *elongata*; **PSGE** – *Psammothidium germainii*; **PSGI** – *Psammothidium germainioides*; **PSRG** – *Psammothidium rostrogermainii*; **SEJR** – *Sellaphora jamesrossensis*; **SPOT** – *Staurosira pottiezii.*

(9.3%) as subdominant taxa. On the contrary, the remaining four samples from this river bed taken in March 2010 proved to be the most species-rich and were characterized by both freshwater and terrestrial species. The dominant species was *S.pottiezii* (19.3–28.3%) followed by *Planothidium lanceolatum*, *P. rostrolanceolatum* and *P. germainioides*, the abundance of the latter however never exceeding 12% (Table 3). *S. pottiezii* was not observed in sample 9 and was noted only occasionally in the samples from PFC valley.

Table 3.

Relative abundances (%) of all counted taxa in all samples (overall) and in each sample together with Shannon-Wiener diversity index and Hill's evenness index.

	Overall	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Brachysira minor	**3.8**	1.7	10.3	6.8	4.6	5.5	2.9	2.0	1.3	+	0.7	2.7	1.6	5.6
Chamaepinnularia australomediocris	**0.9**		0.7	1.6	0.3	0.3	2.6	0.3	+		+	1.0	2.2	1.6
Ch. elliptica	**0.1**				1.0									
Ch. gerlachei	**0.1**				0.3	+	+		+		0.3	+	+	+
Ch. krookiformis	**1.1**		<0.1	<0.1	+	0.3	2.6	0.7	1.6		0.7	2.0	2.5	1.6
Eunotia pseudopaludosa	**0.3**						+	+	+	2.9	+	+	+	
E. ralitsae	**0.1**						+	+	+	+	0.3	0.3	+	+
Fragilaria cf. *parva*	**3.9**			0.3	11.5	19.1	2.9	1.0	1.6		1.9	1.3	1.9	3.0
Gomphonema maritimo-antarcticum	**1.8**		0.3	1.9	2.0	+	1.9	2.0	2.3		2.3	1.7	3.4	3.0
Hantzschia abundans	**0.1**				0.3	0.7					+	+		
H. amphioxys	**0.7**		4.7	1.9			0.6	+	+		+	+	+	0.7
H. hyperaustralis	**1.3**	36.7	3.0	1.3	1.3	+	+	+	+	+	0.6	+	0.3	0.7
Humidophila australoshetlandica	**<0.1**											+		0.3
H. sceppacuerciae	**0.6**			3.2	2.0	1.0								0.7
H. tabellariaeformis	**2.2**			<0.1	+		0.3	0.7	17.0	2.9	1.0	1.0	0.3	1.6
Luticola australomutica	**0.6**	6.7		1.9	0.3	1.9		0.3	0.3	0.3	0.3			+
L. austroatlantica	**1.1**		9.0	1.9	+	0.6					0.3	0.3		0.6

	Overall	1	2	3	4	5	6	7	8	9	10	11	12	13
L. contii	**<0.1**						0.32							
L. gigamuticopsis	**<0.1**		0.3				+							
L. muticopsis	**3.2**	26.7	0.7	0.3	2.0	2.6	4.5	8.3	3.3	0.3	3.6	3.0	2.2	1.3
L. olegsakharovii	**<0.1**						0.3	+	+	+	+	+	+	
L. quadriscrobiculata	**1.2**		13.7	0.3	0.7									
L. truncata	**1.2**	6.7	0.3	0.3	1.0		2.6	0.3	0.3	0.6	1.3	0.7	2.8	2.3
L. vandevijveri	**<0.1**										+		0.3	
Mayamaea sweetloveana	**3.9**	1.7	1.3	15.2	6.9	5.8	1.3	1.0	2.0		1.3	3.7	3.4	3.0
Microcostatus australoshetlandicus	**<0.1**								+					0.3
M. naumannii	**<0.1**													0.3
M. kristinae	**<0.1**		<0.1		+	+	+	+	+		+	+	+	+
M. pimpireviana	**0.1**	1.7	0.7		+	+			+		+		+	
M. sabbei	**0.1**		0.7		+		+		+		+	+		
Navicula australoshetlandica	**0.1**				+	0.3	+	+	+		+	+	+	+
N. gregaria	**0.2**				1.3	0.7	+	0.3	+		+	+	+	+
Nitzschia gracilis	**3.7**		1.7	4.5	1.3	1.0	3.0	7.0	9.1		1.6	5.0	4.0	4.0
N. homburgiensis	**2.9**		4.0	1.3	4.3	3.9	3.5	4.0	5.6		2.3	1.7	1.9	1.3
N. kleinteichiana	**5.3**			3.2	12.1	9.4	5.1	6.6	2.3		4.9	4.3	5.6	6.9
N. soratensis	**2.5**				+		3.9	2.6	2.3		3.9	5.6	4.3	6.2
Nitzschia sp.	**0.3**	1.7				2.6			+		+	+	0.3	
Pinnularia australoglobiceps	**0.1**			<0.1	0.7	+	+	+	+		0.3	+	0.3	+
P. australomicrostauron	**1.7**		0.3	0.3	0.3	0.7	2.6	3.0	+	0.3	4.9	2.7	2.8	1.6

Table 3 continued

	Overall	1	2	3	4	5	6	7	8	9	10	11	12	13
P. australoschoenfelderi	**0.3**					+	0.3	1.0	0.3	0.3	+	0.7	0.3	0.3
P. austroshetlandica	**0.4**						1.3	1.3	1.0	+	0.7	0.3	+	0.3
P. borealis	**4.0**		2.3	0.3	0.7	1.0	2.9	5.0	0.7	18.6	5.2	3.3	3.0	3.0
P. borealis var. *pseudolanceolata*	**1.7**	5.0	16.0	2.6	+		+	+	+		0.7		+	0.3
P. intermedia	**0.1**		1.7		+									
P. magnifica	**<0.1**			<0.1	+		+	+	+		+	+	+	
P. microstauroides	**0.6**								+	4.5	0.7	0.7	0.6	0.3
P. perlanceolata	**<0.1**		0.7	0.3	0.3									
P. subantarctica var. *elongata*	**3.6**	11.7	15.3	0.6	+	+	1.3	2.3	6.5	9.3	1.0	0.7	1.6	1.0
Placoneis australis	**0.3**			<0.1	0.7	+	1.0	0.3	+	+	0.3	0.3	+	0.3
Planothidium australe	**0.7**				+	0.3	1.3	2.3	+	+	1.6	1.3	0.9	0.3
P. lanceolatum	**2.3**							1.3			12.1	2.3	3.4	7.6
P. rostrolanceolatum	**7.1**		2.0	9.4	12.8	15.2	10.0	5.0	8.8			6.3	7.1	4.6
Psammothidium antarcticum	**<0.1**				+	+			+		+		0.3	+
P. germainii	**3.2**				+	0.7	6.8	3.3	9.5	3.2	2.3	5.0	3.4	2.6
P. germainioides	**10.4**						8.7	9.3	7.2	55.4	11.7	10.3	6.8	9.8
P. incognitum	**0.1**			<0.1	0.7		+		0.7	+	+	+	+	
P. papilio	**0.5**			<0.1	1.0	0.3	1.6	0.3	0.7		+	+	0.3	1.0
P. rostrogermainii	**3.1**		5.3	2.3	2.3	1.3	2.3	6.0	5.6	1.0	1.3	4.0	3.7	0.7
Sellaphora jamesrossensis	**8.0**		4.3	37.2	25.5	23.6	+	+	0.3		+	0.3	0.3	0.3

	Overall	1	2	3	4	5	6	7	8	9	10	11	12	13
S. nana	**0.1**				+			0.3				0.3		1.0
Stauroneis delicata	**<0.1**						0.3					+		+
S. latistauros	**0.2**			0.3	0.3	+	+	0.7	+		0.7	+	0.7	+
S. minutula	**0.1**		0.3		0.3	0.3								
S. pseudomuriella	**0.1**				0.3	0.3								
Staurosira pottiezii	**13.1**				+	+	20.9	20.6	8.8		28.3	25.9	27.0	19.3
Shannon		-	1.14	1.0	1.14	1.05	1.28	1.26	1.22	0.65	1.25	1.25	1.26	1.33
Evenness		-	0.78	0.65	0.64	0.63	0.74	0.75	0.70	0.47	0.69	0.69	0.71	0.75

Thirteen of all enumerated taxa (Table 3) were recorded only in the samples from OC catchment area (both from dried bottom and soil collected along the creek). These taxa include: *Luticola contii*, *L. olegsakharovii*, *P. lanceolatum*, *Pinnularia microstauroides*, *P. austroshetlandica*, *Eunotia* spp. and *Microcostatus* spp. Also, most of the rare taxa, noted after counting were observed in the samples from the OC catchment area. The mean diversity for the sediment samples from the dried-up river bed (1.13 ± 0.28) was lower than from soils (1.25 ± 0.03) from the OC valley (Table 3).

The Principal Components Analysis (PCA) based on all retained samples explained 44.1% and 26.2% of species variation on the first and second axis respectively ($\lambda_1 = 0.441$, $\lambda_2 = 0.217$) with an additional 18.51% on the next two axes. Samples on the right side of the PCA diagram (dark gray squares) were collected from the Petrified Forest Creek valley, whereas samples from the Ornithologist Creek (light grey) are concentrated close to each other on the left side (Fig. 5). Sample 9, collected from the dried bottom in 2009, is located entirely on top in the middle of the diagram. Other samples taken from dried sediments (light gray circles) and from the soil in the OC valley (light gray squares) were very similar in the diatom composition. Only species with a cumulative fit of >5% are shown. The dominating taxon in the group of samples focused on left side of the diagram was *S. pottiezii*, accounting for 22% of all valves counted in these samples. The diatom assemblages of soil samples collected from OC valley were composed mainly by terrestrial taxa such as several *Luticola* species, *Hantzschia hyperaustralis* Van de Vijver *et* Zidarova and *Pinnularia subantarctica* var. *elongata* (Fig. 5).

Discussion

Usually, poorly developed soils in the Admiralty Bay region, very often directly formed from the bedrock, show high pH values and very low levels of organic C and total N. The characteristic ornithogenic soils on the contrary, also present in this region, are quite different, as they are characterized by acid pH, high content of phosphorus and nitrogen and are the main source of organic C in terrestrial ecosystems (Simas *et al.* 2007). Also the enhanced concentration of the trace elements (F, Sr, Zn and Cu) is observed in the mineralized guano (Tatur 1989). The occurrence of the ornithogenic soils in the Admiralty Bay region is, however, restricted to the west coast, at Rakusa Point (near the estuary of Ornithologist Creek) and Llano Point. (Simas *et al.* 2008). The elevated level of phosphorus is observed also in the tundra soils adjacent to penguin colonies (Zhu *et al.* 2014). These differences were also observed between two stream valleys. Soils in the PFC are poor Antarctic soils with a slightly alkaline pH. In turn, the soils in the OC valley were characterized by lower pH, as well as an increased content of organic carbon and phosphorus, which is the effect of the penguin's activity in this catchment area. As some studies show that various metals (including measured elements) affect the metabolism, cell physiology and cell morphology of diatoms. The intensity of this influence depends on the species (taxon) and on the metal amount. For example, diatoms can use Cd for catalysis in carbonic anhydrases, Zn has a key role for enzymatic catalysis, Cu is a broker of redox transformation, while Na and Fe condition the cell division of some species (Morrissey and Bowler 2012; Masmoundi *et al.* 2013). The influence of some metals on diatoms is discussed in detail by Masmoundi *et al.* (2013).

The number of taxa recorded in the soil samples of the two investigated valleys in the vicinity of the Polish *Arctowski* Station is quite high compared with other studies on soil diatoms in the Maritime Antarctic Region. The highest species diversity observed in Ornithologist Creek (both in the dried bottom samples and in the samples taken along the stream) can be the result of the nutrient input. In general, the productivity of Antarctic ecosystems is strongly limited by low levels of nitrogen and phosphorus (Zhu *et al.* 2014). The presence of animals in the OC valley is most likely one of the determining factors influencing this higher species diversity, due to higher soil fertilization with biogenic substances from the guano. No strong influence of animals was observed in the adjacent PFC valley, where only few skuas nest (Elster and Komarek 2003). Almost all previous studies of diatoms in this area reported the similar number of species (Kawecka and Olech 1993, 2004; Luścińska and Kyć 1993; Kawecka *et al.* 1996, 1998; Noga and Olech 2004). Unfortunately, all cited studies are of course based on older literature data making any comparison with the present-day situation not possible. Moreover, based on the thorough taxonomic revision (Zidarova *et al.* 2016 and references listed therein) the number of freshwater diatom species in this area should be much higher. In a recent report on freshwater habitats (21 samples collected from small pools and temporary brooks) on the Ecology Glacier Forefield, situated south from the Polish *Arctowski* Station (Kochman-Kędziora *et al.* 2018a), 122 diatom taxa (21 of them from marine origin) were recorded using the latest taxonomic insights. During similar research conducted on other islands of the South Shetland Archipelago, Kopalová *et al.* (2014) recorded 123 taxa in 68 moss samples (Livingston Island) whereas Fermani *et al.* (2007) identified 77 taxa in 18 soil samples (Deception Island).

One of the larger differences in the diatom species composition between the two valleys was the dominance of *P. germainioides* and *S. pottiezii* in the OC catchment area (both from dried bottom and soil collected along the creek). Both species were not observed or found only occasionally in the PFC valley. The obtained results confirm the previous data of the ecology of *P. germainioides*. In the Maritime Antarctic Region, it is a rather uncommon species that usually doesn't form large populations and seems to be restricted to moist soil samples, moist mosses near bird colonies and soils covered by *Prasiola crispa*, having a neutral pH (7.00) and a conductivity of 117 µS/cm (Van de Vijver *et al.* 2016, Zidarova *et al.* 2016). *S. pottiezii* was recorded only in 2010. It dominated the soil samples from OC valley and in samples from the dried-up bottom. It is a common species in the entire Maritime Antarctic Region. They seem to prefer small, shallow, usually temporary pools, most likely originating from meltwater streams or seepage areas. On average, these pools have an alkaline pH (7.5–9.0) and low to moderate conductivity (80–302 µS/cm) (Van de Vijver *et al.* 2014b; Zidarova *et al.* 2016). It was reported from Ornithologist Creek as *Fragilaria alpestris* Krasske by Kawecka and Olech (1993). It was also a dominant species in one small pool on the Ecology Glacier Forefield (Kochman-Kędziora *et al.* 2018a). Most likely, both species not only are able to develop large populations in alkaline or circumneutral habitats, but also in acid ornithogenic soils with high moisture content. On the other hand, the occurrence of these species on the soil in the OC valley can be connected with the higher water level in the Ornithologist Creek during summer season.

S. jamesrossensis, often dominating the assemblages in the soil samples from Petrified Forest Creek valley, was described from seepage areas on the more southern James Ross Island (Kopalová *et al.* 2009), where it was present in a large number of seepage samples. The species is less common on the other islands of the Maritime Antarctic Region such as Livingston Island (Kopalová *et al.* 2012) or King George Island (Kochman-Kędziora *et al.* 2018a) never forming large populations. Recently, the species was also recorded in a moss sample on Heard Island, the most southern island in the southern Indian Ocean (Van de Vijver, pers. obs.). The present study shows that *S. jamesrossensis* can also develop fairly large populations in soils.

A second dominant species in the lower part of Petrified Forest Creek, *P. rostrolanceolatum*, was described from the Maritime Antarctic Region, observed in the epilithon of small rivers and brooks whereas smaller populations were also observed in lakes (Zidarova *et al.* 2016) or pools continuously fed by inflowing (melt)water (Kochman-Kędziora *et al.* 2018a). Large populations were previously recorded on Livingston Island, Deception Island and King George Island, usually reported under the name *P. lanceolatum* or using older name *Achnanthes lanceolata* (Brébisson) Grunow (Kawecka and Olech 1993; Van de Vijver *et al.* 2013). There is only one study reporting this species from the soils (Zidarova 2008), probably pointing to the fact that this species is typical for Antarctic lotic environments. The higher amount of this species in soil samples might be the result of higher water levels during the austral summer period, when snow and ice are melting in the catchment and evacuated via the stream, especially in the lower section of PFC.

Marine valves, constituting only 0.14 % of all counted valves, were probably transported on the feathers of birds or were blown in by seaspray or wind (Kopalová *et al.* 2014).

Despite the extensive taxonomic revision, which contributed to a better understanding of the composition and ecology of the Antarctic diatom flora, undersampling and underreporting are two major factors explaining our gap in knowledge on Maritime Antarctic diatoms. The obtained results showed a large diversity of diatom species adding valuable data to our knowledge on the ecology and composition of the Maritime Antarctic diatom flora. Many of the recorded taxa are reported from other localities in the Maritime Antarctic Region, but usually in a very low number. Therefore, there is a need to continue research on soil diatoms, especially from those habitats which are still unexplored.

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