Table S1. Ecology and distribution of 14 new *Nupela* species additional to the list of Wojtal (2009).

Species	Basionym	Ecology	Distribution	Reference
Nupela acaciensis Vouilloud et S. Sala		Samples with dissolved oxygen 7.4 mg.l^{-1}, conductivity 10.3 µS.cm^{-1}, pH 5, temperature 21.3 ºC and altitude 370 m a.s.l.	Colombia (Blanca Stream, Acacias, Llanos Orientales)	Sala et al. 2014
Nupela americana Kociolek in Kociolek et al.		Recorded in lake	Oregon (Van Pritten Lake and Waldo Lake)	Kociolek et al. 2014
Nupela catatumbensis Vouilloud et Plata–Díaz in Sala et al.		Samples with dissolved oxygen 5.1–7.6 mg.l^{-1}, conductivity 3.6–748 µS.cm^{-1}, pH 5.2–7.9, temperature 21.1–29.1 ºC and altitude 97–575 m a.s.l.	Colombia (Catatumbo, Meta River, Caquetá River, Magdalena Alto and Medio River and Tomo River basins)	Sala et al. 2014
Nupela decipiens (Reimer) Potapova	*Achnanthes decipiens* Reimer	Low conductivity (19 µS.cm^{-1}) and slightly acid soft water (pH = 6.5)	USA (North–Central Pennsylvania, Georgia, South Carolina)	Potapova 2013
Nupela elegantula Potapova		Aerial species (moss associated) collected from the wet walls with low conductivity (72–84 µS.cm^{-1}) and slightly acid to circumneutral pH (6.4–6.8)	Only known from two localities in Sullivan County, Pennsylvania	Potapova 2011
Nupela exigua E. Thomas et Kociolek in Kociolek et al.		Recorded in lake	Oregon (Big Lake). Known only from the type locality	Kociolek et al. 2014
Nupela frezelii Potapova		Its type locality is an urban, at least moderately polluted river	Several locations across the USA	Potapova 2011
Nupela monoraphia Kociolek in Kociolek et al.		Recorded in lake	Oregon (Van Pritten Lake). Known only from the type locality	Kociolek et al. 2014
Nupela pardinhoensis Bes, Torgan et Ector in Bes et al.		Rivers with elevated dissolved oxygen (>7.1 mg L^{-1}), low biochemical oxygen demand (BOD5<3.1 mg L^{-1}) and elevated total phosphate concentration (0.1 mg L^{-1})	Brazil (Rio Grande do Sul)	Bes et al. 2012

Table S1 Cont.

Nupela pennsylvanica (R.M. Patrick) Potapova	*Navicula pennsylvanica* R.M. Patrick in Patrick & Reimer	Recorded in swamp, springs and lakes	USA (Pennsylvania). This species was usually recorded as *A. imperfecta* in Europe and USA	Potapova 2011
Nupela poconoensis (R.M. Patrick) Potapova	*Navicula poconoensis* R.M. Patrick	Aerophytic; found on wet walls and swamps	In North America it is not yet recorded outside the Appalachian region. But it seems not to be restricted to North America	Potapova 2011
Nupela pocsii Buczkó et Wojtal in Buczkó et al.			Romania Retezat Mountains (S. Carpathians), Holocene deposits	Buczkó et al. 2013
Nupela potapovae Bahls		pH 7.34–8.19; conductivity 12–31 $\mu S.cm^{-1}$; temperature 8.6–12.0 ºC	USA (Rocky Mountains, North America, Glacier National Park, Montana)	Bahls 2011
Nupela subrostrata (Hustedt) Potapova	*Achnanthes subrostrata* Hustedt	Data from Hustedt (1942): pH 6.7; temperature 8.5 ºC	Sweden Lapland, USA	Hustedt 1942, Potapova 2011

Table S2. Environmental parameters and corresponding relative abundance of *Nupela troglophila* (normal and teratological cells) in the analyzed communities.

Sampling site code	**Distance from the entrance (m)**	**Distance from light (m)**	**PAR (µmol. $m^{-2}.s^{-1}$)**	**LUX (lux)**	**chl–*a* Green algae (µg. cm^{-2})**	**chl–*a* Cyanobacteria (µg. cm^{-2})**	**chl–*a* Diatoms (µg.cm^{-2})**	**Temperature (°C) mean and range of variation**	**Moisture (%) mean and range of variation**	**Substrate**	***Nupela troglophila* relative abundance (%)**	***Nupela troglophila* teratological forms relative abundance (%)**	**Total teratological forms relative abundance (%)**
2X	128	0.5	24.8	1548	0.00	2.47	1.06	8.2 (8.1–8.5)	51.5 (49.8–53.0)	epilithic	0.00	0.00	9.90
4X	124	0.4	13.3	940	0.00	0.43	1.19	8.5 (8.4–9.1)	56.4 (54.1–58.5)	epilithic	0.97	0.00	0.00
9X	158	0.5	15.3	1208	2.88	1.40	1.71	9.4 (9.3–10.0)	59.2 (56.9–62.3)	epilithic	0.00	0.00	3.18
9Y	158	1.4	3.3	167	0.00	0.37	0.72	9.3 (9.2–9.3)	60.7 (58.6–63.9)	epilithic	1.91	0.00	0.48
10X	184	0.4	78.6	871	0.21	0.07	0.65	9.3 (9.2–10.1)	54.2 (52.6–55.7)	epilithic	0.50	0.00	6.93
11Y	204	5.7	1.3	69	0.00	2.5	0.72	9.0 (8.9–9.0)	74.9 (74.0–77.1)	epilithic	44.76	0.00	0.95
12X	202	0.9	23.4	1225	4.13	1.68	1.72	8.8 (8.8–8.9)	77.6 (74.6–81.2)	epilithic	0.00	0.92	2.30
19Y	334	3.0	1.0	61	0.00	1.53	1.79	8.8 (8.8–9.0)	84.7 (73.7–100.0)	epilithic	20.80	0.44	1.77
20X	334	1.4	5.6	324	0.00	1.31	1.29	9.1 (9.0–9.1)	56.3 (55.6–57.3)	epilithic	0.00	0.00	0.48
28X	424	1.7	9.4	437	0.00	2.92	1.73	8.5 (8.4–9.1)	55.9 (54.6–56.8)	epilithic	0.45	0.00	2.25
28Y	424	3.3	0.3	15.9	0.00	0.26	0.64	8.4 (8.4–8.5)	77.9 (72.3–83.1)	epilithic	4.20	0.00	1.68
29X	428	3.0	0.4	22	0.15	0.22	1.19	8.8 (8.7–8.9)	70.3 (68.0–72.2)	epilithic	1.44	0.00	3.37
29Y	428	4.9	0.4	1	0.00	0.13	1.63	8.8 (8.8–8.8)	66.1 (62.5–69.1)	epilithic	6.73	0.00	2.88
32X	378	6.1	0.7	38	0.00	8.92	27.93	8.8 (8.8–8.9)	72.7 (70.1–75.0)	epilithic	72.5	0.42	0.42

Table S2 Cont.

32Y	378	6.5	0.7	42	0.00	15.21	322.74	8.8 (8.8–8.9)	72.7 (70.5–75.0)	epilithic	81.89	0.79	0.79
32Z	378	5.4	0.4	27	0.00	4.70	16.91	8.8 (8.8–8.9)	72.7 (70.5–75.0)	epilithic	48.04	0.98	2.94
F4	10	9.0	0.2	131	1.32	0.60	0.56	6.5 (4.7–7.6)	97.8 (92.5–101.2)	epilithic	20.31	1.56	4.17
F5	16	2.57	2.8	136	0.00	1.82	13.62	9.3 (9.1–9.6)	93.1 (85.6–100.6)	epilithic	87.92	1.45	1.45
F6	15	0.29	6.5	841	2.12	1.25	1.56	8.5 (7.6–9.0)	77.5 (75.5–87.0)	epiphytic	1.96	0.00	0.98
F12	30	2.0	6.1	390	0.00	0.26	0.94	10.2 (10.1–10.7)	75.8 (72.0–79.6)	epilithic	4.04	0.00	0.00
F13	33	1.5	1.3	84	0.00	0.18	1	10.1 (10.0–10.4)	90.6 (87.0–100.7)	epilithic	9.09	0.00	0.00
F14	33	0.1	11.9	1423	7.30	1.48	0.98	10.1 (10.0–10.6)	80.1 (71.6–87.3)	epilithic	1.48	0.00	1.47
F15c1	35	1.5	5.5	311	4.00	2.00	2.00	10.2 (10.1–10.4)	61.6 (58.7–64.7)	epilithic	67.94	0.96	0.96
F15c2	35	1.5	5.5	311	0.00	0.80	9.00	10.2 (10.1–10.4)	61.6 (58.7–64.7)	epilithic	25.98	0.98	1.96
F17	39	0.2	5.8	377	0.00	2.06	3.12	–	–	epiphytic	0.00	0.00	0.00
F22	68	2.0	2.0	109	0.00	5.24	7.68	10.2 (10.1–10.6)	98.5 (85.1–102.0)	epilithic	75.93	0.93	0.93
F23	75	0.2	12.5	471	3.79	3.05	2.00	9.3 (9.2–9.5)	76.6 (68.5–82.7)	epiphytic	65.40	0.95	0.95
F24	87	0.5	4.0	251	4.75	4.7	3.36	–	–	epilithic	0.00	0.00	0.00
F25	93	0.5	2.4	175	0.00	2.71	4.00	8.8 (8.7–9.2)	94.1 (89.5–98.1)	epilithic	4.23	0.00	0.47
F26 (b)	100	0.3	19.0	788	0.00	0.49	1.65	8.4 (8.3–9.4)	91.5 (84.9–96.6)	epilithic	0.00	0.00	0.96
F26 (d)	100	0.3	19.0	788	0.00	0.49	1.65	8.4 (8.3–9.4)	91.5 (84.9–96.6)	epilithic	0.95	0.00	1.90

Table S3. Checklist of the diatom species and corresponding distribution on cave walls in the Bossea cave.

	2X	**4X**	**9X**	**9Y**	**10X**	**11Y**	**12X**	**19Y**	**20X**
Achnanthidium minutissimum (Kützing) Czarnecki	+				+		+		
Achnanthidium sp.	+								
Achnanthidium sp. abnormal form	+								
Amphora pediculus (Kützing) Grunow		+		+					
Cocconeis lineata Ehrenberg	+								
Diadesmis gallica W. Smith		+	+	+	+		+		
Diadesmis gallica W. Smith abnormal form			+	+	+	+	+		
Eolimna minima (Grunow) Lange–Bertalot	+	+					+		
Eucocconeis laevis (Østrup) Lange–Bertalot	+								
Eunotia sp.									
Fallacia insociabilis (Krasske) D.G. Mann		+					+		
Fragilaria arcus (Ehrenberg) Cleve	+								
Halamphora normanii (Rabenhorst) Levkov									
Hantzschia sp.									
Humidophila contenta (Grunow) R.L. Lowe et al.	+	+	+	+	+	+	+	+	+
Humidophila contenta (Grunow) R.L. Lowe et al. abnormal form			+		+				+
Humidophila perpusilla (Grunow) R.L. Lowe et al.									
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al.	+	+	+	+	+	+	+	+	+
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al. abnormal form	+				+		+	+	
Microcostatus sp.		+		+			+	+	+
Navicula crassulexigua E. Reichardt	+								
Nitzschia debilis (Arnott) Grunow									
Nitzschia solgensis Cleve–Euler		+							
Nitzschia sp.	+								
Nupela troglophila sp. nov.		+		+	+	+	+	+	
Nupela troglophila sp. nov. abnormal form							+	+	
Sellaphora sp.		+		+			+	+	+
Stauroneis parathermicola Lange–Bertalot									

Table S3 Cont.

	28X	**28Y**	**29X**	**29Y**	**32X**	**32Y**	**32Z**	**F4c**	**F5d**
Achnanthidium minutissimum (Kützing) Czarnecki			+						
Achnanthidium sp.									
Achnanthidium sp. abnormal form									
Amphora pediculus (Kützing) Grunow									
Cocconeis lineata Ehrenberg									
Diadesmis gallica W. Smith			+						+
Diadesmis gallica W. Smith abnormal form			+						
Eolimna minima (Grunow) Lange–Bertalot	+								
Eucocconeis laevis (Østrup) Lange–Bertalot									
Eunotia sp.									
Fallacia insociabilis (Krasske) D.G. Mann								+	
Fragilaria arcus (Ehrenberg) Cleve									
Halamphora normanii (Rabenhorst) Levkov									
Hantzschia sp.									
Humidophila contenta (Grunow) R.L. Lowe et al.	+	+	+	+		+	+	+	
Humidophila contenta (Grunow) R.L. Lowe et al. abnormal form		+	+	+				+	
Humidophila perpusilla (Grunow) R.L. Lowe et al.	+			+					
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al.	+	+	+	+	+	+	+	+	+
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al. abnormal form	+	+						+	
Microcostatus sp.	+	+							
Navicula crassulexigua E. Reichardt									
Nitzschia debilis (Arnott) Grunow									
Nitzschia solgensis Cleve–Euler									
Nitzschia sp.									
Nupela troglophila sp. nov.	+	+	+	+	+	+	+	+	+
Nupela troglophila sp. nov. abnormal form					+	+	+		+
Sellaphora sp.								+	
Stauroneis parathermicola Lange–Bertalot									

Table S3 Cont.

	F6b	F12a	F13a	F14ab	F15c1	F15c2	F17a	F22b	F23e
Achnanthidium minutissimum (Kützing) Czarnecki									
Achnanthidium sp.									
Achnanthidium sp. abnormal form									
Amphora pediculus (Kützing) Grunow	+								
Cocconeis lineata Ehrenberg									
Diadesmis gallica W. Smith	+	+	+	+	+	+	+		+
Diadesmis gallica W. Smith abnormal form	+			+			+		
Eolimna minima (Grunow) Lange–Bertalot	+		+						
Eucocconeis laevis (Østrup) Lange–Bertalot									
Eunotia sp.	+								
Fallacia insociabilis (Krasske) D.G. Mann	+			+		+			+
Fragilaria arcus (Ehrenberg) Cleve									
Halamphora normanii (Rabenhorst) Levkov									
Hantzschia sp.	+								
Humidophila contenta (Grunow) R.L. Lowe et al.	+	+	+	+	+	+	+		+
Humidophila contenta (Grunow) R.L. Lowe et al. abnormal form									
Humidophila perpusilla (Grunow) R.L. Lowe et al.	+								
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al.	+	+	+		+	+	+	+	+
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al. abnormal form						+			
Microcostatus sp.	+	+		+	+	+	+		+
Navicula crassulexigua E. Reichardt									
Nitzschia debilis (Arnott) Grunow									
Nitzschia solgensis Cleve–Euler	+			+					
Nitzschia sp.									
Nupela troglophila sp. nov.	+	+	+	+	+	+		+	+
Nupela troglophila sp. nov. abnormal form					+	+		+	+
Sellaphora sp.	+	+		+	+	+	+	+	+
Stauroneis parathermicola Lange–Bertalot	+								

Table S3 Cont.

	F24	F25d	F26d	F26b
Achnanthidium minutissimum (Kützing) Czarnecki			+	
Achnanthidium sp.				
Achnanthidium sp. abnormal form				
Amphora pediculus (Kützing) Grunow				
Cocconeis lineata Ehrenberg				
Diadesmis gallica W. Smith	+	+	+	+
Diadesmis gallica W. Smith abnormal form		+		+
Eolimna minima (Grunow) Lange–Bertalot	+			
Eucocconeis laevis (Østrup) Lange–Bertalot				
Eunotia sp.				
Fallacia insociabilis (Krasske) D.G. Mann			+	+
Fragilaria arcus (Ehrenberg) Cleve				
Halamphora normanii (Rabenhorst) Levkov				
Hantzschia sp.				
Humidophila contenta (Grunow) R.L. Lowe et al.	+		+	+
Humidophila contenta (Grunow) R.L. Lowe et al. abnormal form			+	+
Humidophila perpusilla (Grunow) R.L. Lowe et al.				
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al.	+	+	+	+
Humidophila pyrenaica (Lange–Bertalot et Werum) R.L. Lowe et al. abnormal form				
Microcostatus sp.	+	+		+
Navicula crassulexigua E. Reichardt				
Nitzschia debilis (Arnott) Grunow			+	
Nitzschia solgensis Cleve–Euler				
Nitzschia sp.				
Nupela troglophila sp. nov.		+	+	
Nupela troglophila sp. nov. abnormal form				
Sellaphora sp.	+	+	+	+
Stauroneis parathermicola Lange–Bertalot				

Table S4. Comparison of the small–celled *Nupela* species. Data on *Nupela troglophila* are from the present study. Data on *Nupela astartiella*, *N. carolina*, *N. exotica*, *N. frezelii*, *N. matrioschka*, *N. neglecta*, *N. pardinhoensis*, *N. thurstonensis* and *N. vyvermanii* are taken from the original description.

		Nupela troglophila **Falasco, C.E. Wetzel et Ector sp. nov.**	***Nupela astartiella*** **Metzeltin et Lange–Bertalot**	***Nupela carolina*** **Potapova et Clason in Potapova et al.**	***Nupela exotica*** **O. Monnier, Lange–Bertalot et J. Bertrand**	***Nupela frezelii*** **Potapova**	***Nupela matrioschka*** **Kulikovskiy, Lange–Bertalot et Witkowski**	***Nupela neglecta*** **Ponader, R.L. Lowe et Potapova in Potapova et al.**	***Nupela pardinhoensis*** **Bes, Torgan et Ector in Bes et al.**	***Nupela thurstonensis*** **(Kaczmarska) Kulikovskiy, Lange–Bertalot et Witkowski**	***Nupela vyvermanii*** **Gerd Moser, Lange–Bertalot et Metzeltin**
LM	Valve shape	isovalvar; lanceolate to elliptical–lanceolate, up to oval in the smallest individuals; apices rounded or slightly protracted	heterovalvar; elliptical to elliptical–lanceolate; apices cuneate to rounded	slightly heterovalvar; elliptical–lanceolate	isovalvar; elliptical–lanceolate; apices acutely rounded and often slightly short–protracted	heterovalvar; lanceolate to linear–elliptical	isovalvar; broad elliptical; apices never protracted	strongly heterovalvar; lanceolate to elliptical–lanceolate; slightly protracted apices	heterovalvar; lanceolate with subrostrate apices	elliptical to elliptical–lanceolate; apices often slightly protracted	heterovalvar; elliptical to elliptical–lanceolate; apices cuneate or rounded
	Length (µm)	5–13.1	10.0–17.0	5.0(9.3)–15.0	8.6–13.3	10.0–29.0	9.7–12.0	9.0–14.0	10.0–15.0	7.0–13.0	12.0–15.0
	Width (µm)	3.1–4.6	4.5–5.4	2.4(3.4)–4.4	3.0–4.1	3.8–6.3	4.3–6.3	3.0–4.0	5.0–6.0	3.2–4.2	4.5–5.0
	Central area shape	wide and unregular	small	squared; lyre–shaped	barely developed or missing	asymmetrical; reaching the valve margin on one side of the valve	small and round, sometimes missing	small, round or elliptical	small and round or missing	small, round to rectangular	big on the epivalve (but not reaching the margin); small on the hypovalve
	Striae in 10 µm	42–50	31–33	42–54	40–45	29–33	42–48	40–48	40	(30)35–45	32

Table S4 Cont.

SEM	Terminal raphe fissures	strongly deflected on the same side and terminating on the valve surface, never reaching the mantle	bent on the same side at both poles and extending down onto the apical mantle								
	Reference	this paper	Metzelzin & Lange–Bertalot (1998) [Pag. 378 Figs 46–55]	Potapova et al. (2003) [Pag. 299 Figs 45–62; Pag. 301 Figs 63–69]	Monnier et al. (2003) [Pag. 279 Figs 1–11; Pag. 280 Figs 12–17; Pag. 282 Figs 18–24]	Potapova (2011) [Pag. 76 Figs 40–54; Pag. 85 Figs 83–90]	Kulikovskiy et al. (2009) [Pag. 15 Fig. 1; Pag. 16 Fig. 2]	Potapova et al. (2003) [Pags 295–298 Figs 1–44]	Bes et al. (2012) [Pag. 121 Figs 179–201]	Kulikovskiy et al. (2009) [Pag. 155 Figs 81–83; Pag. 156 Figs 107–110; Pag. 157 Fig. 125]	Moser et al. (1998) [Pag. 267 Figs 7–10]
	Type locality and ecology	so far, collected only in the type locality (Bossea show cave). Wet walls characterized by warm air temperature and low light intensities. Found both on naturally and artificially illuminated sites.	Santos (São Paulo), Brazil. Effluent from spring.	Contentnea Creek, Wilson Country, North Carolina (USA). Submerged woody debris. Small rivers with slow flow characterized by high dissolved oxygen and nitrogen concentrations.	tropical fish aquarium, Mardié, Loiret, France. Relatively acid water, with low ion content and carbonates, high nitrate levels.	Rhode Island. Benthos. Moderately polluted river.	Polisto–Lovatsky *Sphagnum* bog, Novgorod, Russia. Subaerial habitats with low pH (*Sphagnum*), oligotrophic.	Coles Brook, Bergen Country, New Jersey (USA). Epilithon. Low total phosphorous and nitrogen concentrations; low DOC.	Pardinho River, Brazil. Epilithon; slow moving flow, high dissolved oxygen and total phosphorous concentrations.	Thurston Lava Tube, Hawaii. Wet walls near cave entrance (naturally illuminated); moist wall near artificial light within the cave.	Thio, New Caledonia.