

Checklist of benthic macroinvertebrates of high altitude ponds of the Tatra Mountains (Central Europe) with new records of two species for Slovakia

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Abstract: A checklist of benthic macroinvertebrates of ponds of Tatra Mountains is presented. The checklist comprises 122 taxa including the first records of *Derotanypus cf. sibiricus* (Kruglova & Chernovskii, 1940) (Diptera: Chironomidae) and *Arctocorisa carinata* (Sahlberg, 1918) (Heteroptera) from Slovakia. The most diverse pond site supported 28 taxa, the minimum number of recorded taxa was 2. The richest group was Chironomidae (Diptera) constituting almost half of the total diversity (58 taxa), followed by Trichoptera with 15 taxa. The other higher taxonomic groups were represented by considerably lower taxa number. Relatively high number of recorded taxa underlines important contribution of small lentic waterbodies to regional biodiversity of high-altitude ecosystems.

Key words: Tatra Mountains, ponds, benthic invertebrates, *Derotanypus*, *Arctocorisa carinata*, regional diversity

INTRODUCTION

High-altitude ponds are a specific category of aquatic ecosystems. These permanent or temporary water bodies of small area and without a developed profundal zone are excellent models for various ecological studies (De Meester *et al.* 2005) but have often been overlooked or considered as smaller equivalents of large lakes (Kownacki *et al.* 2006). Currently, owing to their specific ecological processes and apparent functional distinction from lakes, research interest in ponds is growing (Oertli *et al.* 2008; Hamerlík *et al.* 2014; Ilg and Oertli 2014). Due to their small area, depth, and small catchment area, high altitude ponds are extremely sensitive to external effects of global, regional, and local scale (Kopáček *et al.* 2002). Compared to lakes, ponds tend to be more abundant within a given area, which in combination with their high environmental heterogeneity (substrate types, depth, etc.) leads to high regional diversity of pond dwelling macroinvertebrates (Hamerlík *et al.* 2014).

Among the stagnant waterbodies of the Tatra Mountains, the majority are ponds with an area up to 1 ha and a maximum depth of less than 2 m (Gregor and Pacl 2005). Due to

their abundance and concentration within a small area, the Tatra ponds represent an ideal system for studying various aspects of benthic invertebrate diversity of high altitude ponds. A high number of both ponds and lakes situated in the same altitudinal belts offer a great possibility of comparison between those aquatic ecosystems. However, for a thorough understanding of the processes governing the diversity of benthic organisms in high altitudes, a good and detailed knowledge of the regional fauna is essential (Fjellheim *et al.* 2000). Because responses of communities to various gradients and environmental factors are different at different latitudes (Astorga *et al.* 2011), sound knowledge of regional species pool is necessary.

In the Tatra Mountains, high altitude lakes have been studied intensively over the last decades both in terms of their biota and physico-chemical patterns (for details see Bitušík *et al.* 2006a). In contrast, pond ecosystems of the region are virtually unknown and the detailed information on taxonomic composition of pond benthic communities is lacking (cf. Hamerlík *et al.* 2014). In this paper, we present the first comprehensive checklist of benthic macroinvertebrates of ponds of the Tatra Mountains. We believe that these data will be useful either for the gradually rising number of studies dedicated to the biodiversity of high altitude ponds or studies dealing with complex description of diversity of high altitude ecosystems.

MATERIAL AND METHODS

Study area and sampling sites

The Tatra Mountains are situated at the border between Slovakia and Poland (the West Carpathians; 49°10' N, 020°10' E; Figure 1). They experience rapid changes in temperature (0.6°C per 100 m; Konček and Orlicz 1974) and precipitation along an altitudinal gradient. Comprehensive general description of the relevant hydrology, soil and vegetation attributes of the Tatra Mountains can be found in Bitušík *et al.* (2006a).

Littoral benthic communities of Tatra lakes and ponds are continuously sampled in order to study their recovery from acidification (Kopáček *et al.* 2002) and their diversity patterns

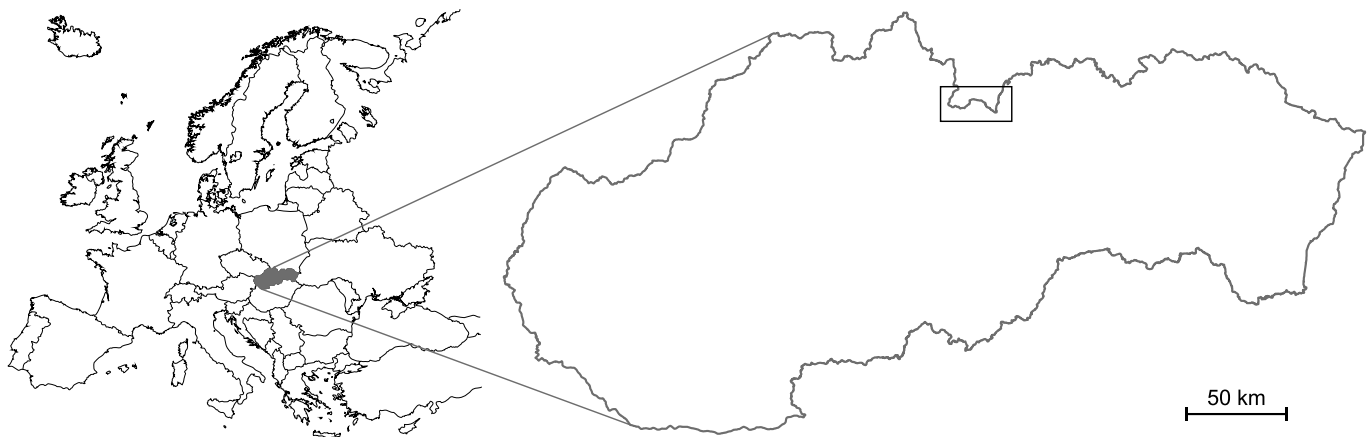


Figure 1. Map showing location of the studied area.

(Hamerlík *et al.* 2014). The dataset presented in this study is based on intensive sampling of lakes and ponds from both Slovak and Polish parts of the Tatra Mountains performed by authors during 2000–2013 (always in September). For purposes of this study, we defined a pond as a water body with an area ≤ 2 ha and maximum depth of 8 m, according to ecological threshold proposed for classification of ponds and lakes (Oertli *et al.* 2000; Hamerlík *et al.* 2014). Based on this criterion, we present data for 66 ponds (Table 1). Some ponds were sampled only in one occasion, but many were more or less regularly sampled in two or three year intervals through the study period. All of the surveyed ponds are of glacial origin, located in altitude range 1,089–2,201 m. Soft-water and oligotrophic ponds as well as dystrophic ponds are represented in the data set.

Data collection

Samples of benthic macroinvertebrate communities were taken by kicking technique using D-shaped hand net (Frost *et al.* 1971) in each sampling occasion. Dominant substrate types were sampled, considering the relative dominance of the different substrate types, and the total amount of sampling effort was equal in all the sites (3 min). Collected material was preserved with 4% formaldehyde and stored in plastic bottles. In the laboratory, organisms were hand sorted and identified (except Oligochaeta, Hirudinea and Hydracarina) to the lowest possible taxonomic level. The identification and nomenclature is based on Rozkošný (1980), Wiederholm (1983), Savage (1999), Bitušík (2000), Hanel and Zelený (2000), Bauernfeind and Humpesch (2001), Kohl (2003), Stur and Ekrem (2006), Tempelman and von Haaren (2009), Waringer and Graf (2011), Krno (2013). Chironomid pupae obtained by kick sampling were determined following the key Langton (1991). All the identified material is deposited in permanent scientific collections open to public of either permanent slide collections (Chironomidae; University of Matej Bel, Banská Bystrica) or alcohol preserved samples (all material excluding Chironomidae; Technical University in Zvolen).

RESULTS AND DISCUSSION

Almost 90,000 individuals of aquatic invertebrates were collected from the studied ponds in period of 2000–2013 and 122 taxa were identified (Table 2). The most diverse pond site supported 28 taxa; the minimum number of recorded taxa

was 2, and the mean diversity was 10.7 taxa per pond. Forty-two taxa (32%) occurred only in a single pond. Oligochaeta (indeterminate) were collected from majority of the ponds (80%). The richest group was Chironomidae (Diptera) with 58 taxa, constituting almost half of the total diversity, followed by Trichoptera with 15 taxa. The remaining taxonomic groups were represented by considerably lower number of taxa.

The predominance of chironomids is a common pattern in European high altitude stagnant water bodies (Fjellheim *et al.* 2009) and has also been found in surveys of the benthic macroinvertebrates of the Tatra Mountains (Kownacki *et al.* 2000; Čiamporová-Zatovičová *et al.* 2010).

The most frequent species of the Tatra ponds is the chironomid *Heterotrissocladius marcidus*, recorded from almost half of the ponds studied. *Heterotrissocladius marcidus* is a eurytopic species with Holarctic distribution pattern that can be found in the littoral to profundal zone of oligotrophic lakes, streams, springs, rivers and ponds (Cranston *et al.* 1983) and belongs to the most common species in the Tatra lakes (Bitušík *et al.* 2006b).

One chironomid species (*Derotanypus cf. sibiricus*; Figure 2) and aquatic bug *Arctocoris carinata* represent new records for Slovakia. The only European species of *Derotanypus* is *D. sibiricus* (Saether and Spies 2013), so the larvae found in a small, permanent pond in Račkova dolina valley (1,717 m a.s.l.



Figure 2. The head capsule (a), mandible (b), mentum (c) and ligula (d) of *Derotanypus* larva. (Photo L. Hamerlík).

Table 1. The list of sampling sites with geographic coordinates.

Number	Pond name	N	E
1.	Tretie Roháčske pleso	49.20889°	19.73667°
2.	Vyšné Jamnické pleso	49.20250°	19.76350°
3.	Prostredné Račkovovo pleso	49.19922°	19.80662°
4.	Nameless pond	49.19863°	19.80907°
5.	Wyżni Siwy Stawek	49.20417°	19.83504°
6.	Niżni Siwy Stawek	49.20452°	19.83548°
7.	Nameless pond	49.20452°	19.83552°
8.	Smreczyński Staw	49.22250°	19.86444°
9.	Vyšné Tomanovo pleso	49.21737°	19.91019°
10.	Jedyniak	49.23972°	19.99917°
11.	Kurtkowiec	49.22944°	20.00389°
12.	Zadni Staw Gąsienicowy	49.22417°	20.01083°
13.	Jamské pleso	49.13306°	20.01250°
14.	Kobylié pleso	49.20029°	20.01417°
15.	Vyšné Terianske pleso	49.16778°	20.02083°
16.	Zmarzły Staw Gąsienicowy	49.22444°	20.02278°
17.	Vyšné Rakytovské pleso	49.12639°	20.02444°
18.	Niżné Rakytovské pleso	49.12500°	20.02583°
19.	Nameless pond	49.15076°	20.02791°
20.	Niżné Furkotské pleso	49.14052°	20.02959°
21.	Vyšné Furkotské pleso	49.14351°	20.03004°
22.	Toporowy Staw Niżny	49.28333°	20.03111°
23.	Niżné Kozie pleso	49.16361°	20.04361°
24.	Vyšné Kozie pleso	49.16833°	20.04528°
25.	Wyżni Mnichowy Stawek II	49.19469°	20.05301°
26.	Wyżni Mnichowy Stawek IX.	49.19416°	20.05358°
27.	Niżné Satanie pleso	49.17251°	20.06088°
28.	Vyšné Satanie pleso	49.17009°	20.06099°
29.	Vyšné Rumanovo pleso	49.17193°	20.10068°
30.	Niżné Rumanovo pleso	49.16991°	20.10182°
31.	Vyšné Žabie pleso	49.18496°	20.10314°
32.	Malé Batizovské pleso	49.15028°	20.12694°
33.	Hrubé pleso	49.18129°	20.13362°
34.	Nameless pond	49.17687°	20.13648°
35.	Horné Velické plesko I	49.17234°	20.13712°
36.	Dlhé Velické	49.16544°	20.14419°
37.	Malé Žabie Javorové pleso	49.20222°	20.14944°
38.	Pusté pleso	49.18222°	20.15389°
39.	Malé Pusté pleso	49.18332°	20.15495°
40.	Nameless pond	49.18344°	20.16204°
41.	Szontághovo pleso	49.16645°	20.16358°
42.	Nameless pond	49.17860°	20.16471°
43.	Nameless pond	49.17822°	20.16471°
44.	Starolesnianske pleso	49.17916°	20.16556°
45.	Vyšné Sesterské pleso	49.17746°	20.16679°
46.	Nameless pond	49.18248°	20.16832°
47.	Nameless pond	49.18481°	20.17468°
48.	Nameless pond	49.18303°	20.17510°
49.	Prostredné Sivé pleso	49.18396°	20.17524°
50.	Niżné Strelecké pleso	49.18389°	20.17528°
51.	Studené pleso I.	49.17979°	20.17605°
52.	Studené pleso II.	49.17901°	20.17779°
53.	Nameless pond	49.18544°	20.17854°
54.	Nameless pond	49.18657°	20.17883°
55.	Nameless pond	49.18414°	20.18138°
56.	Nameless pond	49.18432°	20.18196°
57.	Slavkovské pleso	49.15250°	20.18333°
58.	Modré pleso	49.19219°	20.18562°
59.	Kolové pleso	49.21972°	20.19111°
60.	Pond Vyšné Spišské pleso	49.19449°	20.19700°
61.	Prostredné Spišské pleso	49.18806°	20.19833°
62.	Belasé pleso	49.21495°	20.21131°
63.	Maličké Čierne pleso	49.20780°	20.22315°
64.	Malé Čierne pleso	49.20889°	20.22361°
65.	Čierne pleso	49.20760°	20.22460°
66.	Veľké Biele pleso	49.22183°	20.22987°

[above sea level]) most likely belong to that species; however, species-level determination of larvae is impossible. Larvae of *Derotanypus* are known to inhabit cold lotic and lentic waters and have northern or mountain distribution (Fittkau and Roback 1983). Interestingly, *D. sibiricus* has only been recorded in a few countries, such as Sweden, Estonia, Germany, Austria and Russia (Saether and Spies 2013), and it is not clear whether it is a result of its rare distribution pattern or special habitat preferences. *Arctocorisa carinata* is boreomontane species widespread in some European countries (e.g., Štys 1976; Jansson 1995). According to Jansson (1979) this species occurs in a wide range of habitats from small periodic rocky ponds to permanent, relatively large and deep lakes. Our record comes from Vyšné Tomanovské pleso (1,597 m a.s.l.), dystrophic pond with thick accumulation of plant detritus.

The macroinvertebrate fauna of studied ponds consisted mostly of cold stenothermic taxa typical for high mountain lentic ecosystems of Europe (Kownacki *et al.* 2000; Krno *et al.* 2006). However, great environmental variability of studied ponds is mirrored in occurrence of taxa with various ecological requirements. Lower altitude, dystrophic ponds supported diverse communities with caddisflies (*Oligotricha striata*, *Phryganea bipunctata*, *Limnephilus rhombicus*), aquatic bugs (*Hesperocorixa sahlbergi*), and odonate species (*Aeshna cyanea*, *Aeshna juncea*) with preferences to biotopes rich in aquatic vegetation. Our study set contained also ponds with inflows and outflows, as well as small, shallow ponds with fluctuating water level. This enabled occurrence of lotic taxa inhabiting cold mountain springs and brooks (e.g., *Stilocladius montanus*, *Parorthocladius* sp.), and taxa dwelling in semi-terrestrial and hygropetric habitats (e.g., *Pseudosmittia* sp., *Smittia* sp., *Metriocnemus hygropetricus* group). Due to the strong atmospheric acidification of some waterbodies in the past (Bitušik *et al.* 2006b), pond communities also contained taxa that are able to tolerate low pH (e.g., *Limnephilus coenosus*, *Zalutschia tatica* gr.).

Conservation value of high altitude ponds is often stressed (e.g., Oertli *et al.* 2008). From this point of view, records of rare odonate species listed in the Slovak national red list, *Aeshna juncea* and *Sympetrum danae*, are interesting. These species are tyrphophilous, preferring mountain peat bogs. Though being overall rare, *A. juncea* is assessed as abundant in Tatra area (Šácha *et al.* 2011). Surprisingly, the damselfly *Platycnemis pennipes* was recorded in Wyżni Mnichowy Stawek IX at 1,870 m a.s.l. The reported upper altitudinal threshold for this species is about 700 m in Central Europe with exceptional records above 1,000 m (Dolný and Bárta 2007). Such a dramatic shift in distribution is probably a consequence of accidental oviposition by female transported by wind. However, establishment of viable population is unlikely at this site.

Up to now, the most comprehensive checklist of benthic macroinvertebrates of the Tatra lakes (including several ponds) was presented by Krno *et al.* (2006). Based on intensive sampling in 2000, they listed 93 taxa from 45 lakes, including 17 taxa of Oligochaeta. In our study, the higher number of taxa (even without Oligochaeta) results from considerably greater number of waterbodies studied, but probably also from the heterogeneous community composition mirrored in higher β diversity of ponds, when compared to lakes (cf. Hamerlík *et al.* 2014).

Table 2 (sites 1–33; see p. 7 for sites 34–66). Checklist of benthic macroinvertebrates recorded in ponds of Tatra Mts. in our study. Plus sign indicates presence of taxa at sampling sites. Number of sampling site refers to Table 1.

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33						
TURBELLARIA																																							
<i>Crenobia alpina</i> (Dana, 1766)					+		+				+																									+			
BIVALVIA																																						+	
<i>Pisidium</i> cf. <i>casertanum</i> (Poli, 1791)																																						+	
OLIGOCHAETA																																						+	
<i>Oligochaeta</i> indet.																																						+	
HIRUDINEA																																						+	
<i>Hirudinea</i> indet.																																						+	
ARACHNIDA																																							+
<i>Hydracarina</i> indet.																																							+
MALACOSTRACA																																							+
<i>Gammarus</i> sp.																																						+	
EPHEMEROPTERA																																							+
<i>Ameletus innopinatus</i> Eaton, 1887																																							+
<i>Baetis alpinus</i> (Leach, 1815)																																							+
ODONATA																																							+
<i>Platycnemis pennipes</i> (Pallas, 1771)																																							+
<i>Pyrhosoma nymphula</i> (Sulzer, 1776)																																							+
<i>Coenagrionidae</i> spp. juv.																																							+
<i>Aeshna cyanea</i> (Muller, 1764)																																							+
<i>Aeshna juncea</i> (Linnaeus, 1758)																																							+
<i>Aeshna</i> spp. juv.																																							+
<i>Somatochlora metallica</i> (Vander Linden, 1825)																																							+
<i>Somatochlora</i> sp.																																							+
<i>Sympetrum danae</i> (Sulzer, 1776)																																							+
PLECOPTERA																																							+
<i>Nemoura cinerea</i> (Retzius, 1783)																																							+
<i>Nemurella pictetii</i> (Klapálek, 1900)																																							+
<i>Capnia vidua</i> (Klapálek 1904)																																							+
<i>Leuctra nigra</i> (Olivier, 1811)																																							+
<i>Leuctra</i> cf. <i>rosinae</i> Kempny, 1900																																							+
<i>Arcynopteryx compacta</i> (Mclachlan, 1872)																																							+
<i>Diura bicaudata</i> (Linnaeus, 1758)																																							+
HETEROPTERA																																							+
<i>Arctocoris carinata</i> (C. R. Sahlberg, 1918)																																							+
<i>Hesperocorixa castanea</i> (Thomson, 1869) / <i>moesta</i> (Fieber, 1848)																																							+
<i>Hesperocorixa sahlbergi</i> (Fieber, 1948)																																							+
<i>Corixinae</i> indet.																																							+
<i>Gerris</i> spp.																																							+
MEGALOPTERA																																							+
<i>Sialis lutaria</i> (Linnaeus, 1758)																																							+

Table 2 (sites 1–33). Continued.

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33							
COLEOPTERA																																								
<i>Acliis sulcatus</i> (Linnaeus, 1758)																+																								
<i>Agabus bipustulatus</i> (Linnaeus, 1767)				+																																	+			
<i>Agabus sturmi</i> (Gyllenhal, 1808)																	+																							
<i>Agabus</i> sp.																																								
<i>Hydroporus melanarius</i> Sturm, 1835																																								
<i>Hydroporus palustris</i> (Linnaeus, 1761)																																								
<i>Hydroporus</i> sp.																																								
<i>Hygrotus</i> sp.																																								
<i>Ilybius obscurus</i> (Marsham 1802)																																								
Dytiscidae indet.																																								
<i>Limnius perrisi</i> (Dufour, 1843)																																								
TRICHOPTERA																																								
<i>Rhyacophila</i> sp.																																								
<i>Holocentropus dubius</i> (Rambur, 1842)																																								
<i>Plectrocnemia conspersa</i> (Curtis, 1834)																																								
<i>Agrypnia obsoleta</i> (Hagen, 1864)																																								
<i>Oligotricha striata</i> (Linnaeus, 1758)																																								
<i>Phryganea bipunctata</i> Retzius, 1783																																								
<i>Apatania fimbriata</i> (Pictet 1834)																																								
<i>Drusus</i> cf. <i>annulatus</i> (Stephens, 1837)																																								
<i>Limnephilus rhombicus</i> (Linnaeus, 1758)																																								
<i>Limnephilus coenosus</i> Curtis, 1834																																								
<i>Chaetopteryx</i> sp.																																								
<i>Pseudopsilopteryx zimmeri</i> (McLachlan, 1876)																																								
<i>Acrophylax</i> sp.																																								
<i>Allogamus starmachi</i> Szczęsny, 1967																																								
<i>Limnephilidae</i> indet. juv.																																								
DIPTERA																																								
<i>Pedicia rivosa</i> (Linnaeus, 1758)																																								
<i>Pedicia</i> sp.																																								
<i>Dicranota</i> sp.																																								
<i>Tipula</i> (S.) <i>rufina</i> (Meigen, 1818)																																								
<i>Chaoborus obscuripes</i> (van der Wulp 1804)																																								
<i>Chaoborus crystallinus</i> (De Geer, 1776)																																								
<i>Limoniidae</i> indet.																																								
Ceratopogonidae indet.																																								
<i>Ablatesmyia monilis</i> agg. (Linnaeus, 1758)																																								
<i>Derotanyus</i> cf. <i>sibiricus</i> (Kruglova & Chernovskii 1940)																																								
<i>Macropelopia</i> cf. <i>nebulosa</i> (Meigen, 1804)																																								
<i>Procladius</i> (<i>Holotanyus</i>) spp.																																								
<i>Zavrelimyia</i> sp.																																								

Table 2 (sites 1–33). Continued.

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33			
<i>Micropectra apposita</i> (Walker, 1856)																																				
<i>Micropectra atrofasciata</i> (Kieffer, 1911)	+																																			
<i>Micropectra junci</i> (Meigen, 1818)	+																																			
<i>Micropectra lindrothi</i> Goetghebuer, 1931		+			+	+																														
<i>Micropectra notescens</i> (Walker, 1856)																																				
<i>Micropectra radialis</i> Goetghebuer, 1939																																				
<i>Micropectra</i> spp.																																				
<i>Paratanytarsus austriacus</i> (Kieffer, 1924)																																				
<i>Tanytarsus gregarius</i> group cf. <i>gregarius</i> Kieffer, 1909																																				
<i>Tanytarsus lugens</i> group cf. <i>bathophilus</i> Kieffer, 1911																																				
<i>Tanytarsus</i> spp.																																				

Table 2 (continued; sites 34–66).

Taxa	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66			
TURBELLARIA																																				
<i>Crenobia alpina</i> (Dana, 1766)														+																						
BIVALVIA																																				
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<i>Aeshna</i> spp. juv.																																				
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<i>Somatochlora</i> sp.																																				
<i>Sympetrum danae</i> (Sulzer, 1776)																																				

Table 2 (continued; sites 34–66).

Taxa	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66					
PLECOPTERA																																						
<i>Nemoura cinerea</i> (Retzius, 1783)				+																						+								+				
<i>Nemurella pictetii</i> (Klapálek, 1900)				+																						+									+			
<i>Capnia vidua</i> (Klapálek 1904)			+																																			
<i>Leuctra nigra</i> (Olivier, 1811)																																						
<i>Leuctra cf. rosinae</i> Kempny, 1900						+																																
<i>Arcynopteryx compacta</i> (McLachlan, 1872)						+																																
<i>Diura bicaudata</i> (Linnaeus, 1758)						+																																
HETEROPTERA																																						
<i>Arctocoris carinata</i> (C. R. Sahlberg, 1918)																																						
<i>Hesperocorixa castanea</i> (Thomson, 1869) / <i>moesta</i> (Fieber, 1848)																																						
<i>Hesperocorixa sahlbergi</i> (Fieber, 1948)																																						
<i>Corixinae</i> indet.																																						
<i>Gerris</i> spp.	+																																					
MEGALOPTERA																																						
<i>Stialis lutaria</i> (Linnaeus, 1758)																																						
COLEOPTERA																																						
<i>Acilius sulcatus</i> (Linnaeus, 1758)																																						
<i>Agabus bipustulatus</i> (Linnaeus, 1767)																																						
<i>Agabus sturmi</i> (Gyllenhal, 1808)																																						
<i>Agabus</i> sp.																																						
<i>Hydroporus melanarius</i> Sturm, 1835																																						
<i>Hydroporus palustris</i> (Linnaeus, 1761)																																						
<i>Hydroporus</i> sp.																																						
<i>Hygrotes</i> sp.																																						
<i>Ilybius obscurus</i> (Marsham 1802)																																						
Dytiscidae indet.																																						
<i>Limnius perrisi</i> (Dufour, 1843)																																						
TRICHOPTERA																																						
<i>Rhyacophila</i> sp.																																						
<i>Holocentropus dubius</i> (Rambur, 1842)																																						
<i>Plectrocnemia conspersa</i> (Curtis, 1834)																																						
<i>Agrypnia obsoleta</i> (Hagen, 1864)																																						
<i>Oligotricha striata</i> (Linnaeus, 1758)																																						
<i>Phygadeuon bipunctata</i> Retzius, 1783																																						
<i>Apatania fimbriata</i> (Pictet 1834)																																						
<i>Drusus cf. annulatus</i> (Stephens, 1837)																																						
<i>Limnephilus rhombicus</i> (Linnaeus, 1758)																																						
<i>Limnephilus coenosus</i> Curtis, 1834																																						
<i>Chaetopteryx</i> sp.																																						
<i>Pseudopsilopteryx zimmeri</i> (McLachlan, 1876)																																						
<i>Acrophylax</i> sp.																																						
<i>Allogamus starmachi</i> Szczygły, 1967																																						

Table 2 (continued; sites 34–66).

Taxa	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66				
<i>Psectrocladius</i> (<i>Allopsectrocladius</i>) sp.																																					
<i>Pseudosmittia</i> sp.																																					
<i>Smittia</i> sp.						+								+									+														
<i>Stilodrilus montanus</i> (Rossaro, 1979)																																					
<i>Tokunagaia rectangularis</i> group				+																																	
<i>Tvetenia bavarica</i> (Goetghebuer, 1934)																																					
<i>Zalutschia tatrica</i> (Pagast, 1935)																																					
<i>Zalutschia tornetraeskenis</i> group																																					
<i>Chironomus</i> spp.																																					
<i>Cladopelma laccophila</i> group																																					
<i>Microtenidipes pedellus</i> group																																					
<i>Omisus caledonicus</i> (Edwards, 1932)																																					
<i>Phaenopsectra</i> sp.																																					
<i>Polypedium</i> (s. str.) spp.																																					
<i>Synendotendipes</i> sp.																																					
<i>Micropectra apposita</i> (Walker, 1856)																																					
<i>Micropectra atrofasciata</i> (Kieffer, 1911)																																					
<i>Micropectra junci</i> (Meigen, 1818)																																					
<i>Micropectra lindrothi</i> Goetghebuer, 1931																																					
<i>Micropectra notescens</i> (Walker, 1856)																																					
<i>Micropectra radialis</i> Goetghebuer, 1939																																					
<i>Micropectra</i> spp.																																					
<i>Paratanytarsus austriacus</i> (Kieffer, 1924)																																					
<i>Tanytarsus gregarius</i> group cf. <i>gregarius</i> Kieffer, 1909																																					
<i>Tanytarsus lugens</i> group cf. <i>bathophilus</i> Kieffer, 1911																																					
<i>Tanytarsus</i> spp.																																					

In this study, we have shown that high altitude ponds of the Tatra Mountains harbour relatively rich taxa pool of benthic macroinvertebrates. Considering the extensive sampling scheme (66 ponds over many years), the results provided here can be useful as a good baseline data for estimation of pond macroinvertebrate diversity of the Central European high-altitude ponds. We believe that the checklist presented here underlines the role of ponds in maintaining regional biodiversity of high-altitude ecosystems.

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