A checklist of invertebrates from Norwegian caves and mines

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The invertebrates hitherto registered from Norwegian caves and mines are presented in a checklist. Each species is listed with localities, cavity type with altitude, total length and depth, and also minimum age ka (i.e. in units of 1000 years) if available. The species from each recorded taxa are listed in tables, with reference to the specific cave or mine where it is recorded, and to relevant publications. Taxa are classified according to their hypogean environment as trogloxenes, habitual or accidental, troglofiles and troglobites based on existing information. In total, 244 species were recorded representing 14 higher taxa. Insecta and Collembola together dominate with 85% of the recorded species, while Diptera alone stand for 42% of the species. The invertebrate fauna in Norwegian caves and mines are relatively poor compared to what is found further south in Europe.

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INTRODUCTION

A general introduction to Norwegian speleology is given in Lauritzen & Østbye (1994) and Lauritzen (2010), with a short description of caving history, caves and karst, biospeleology and vertebrate remains in caves. Relatively few surveys have been conducted in order to investigate the invertebrate fauna in Norwegian caves and mines, most of which are of short observation time (Hippa et al.1984a, b, 1985a, b, 1986, 1988a, b; Hippa & Koponen 1988; Dolmen & Arnekleiv 1990; Arnekleiv & Dolmen 1992), only a few encompass studies through several seasons (Østbye et al. 1987; Kjærandsen 1992, 1993; Lien et al. 1996; Lien 1997). This paper presents an up to date checklist of known invertebrate taxa and species in the country according to published reports.

Species that occur in the hypogean (under-ground) environment are categorised after the Schiner-Racovitza system (Jefferson 1976, 1983) in three categories:

1. **Trogloxenes**, defined as species that never spend their whole life cycle in caves. Many species roost there or use the caves seasonally, mostly in winter for hibernation but in some cases for aestivation during the summer, while other only uses the caves as resting places during short periods. Generally they feed outside the cave. This category is further divided in two subcategories, accidental and habitual.
2. **Troglofiles**, defined as species that can live permanent in caves and establish reproducing populations here, but they also occur in the epigean (above-ground/on the surface) environment.
3. **Troglobites**, defined as obligate cave-dwellers; these are the animals which often (but not always) show the characteristic cave-modifications as loss of pigment and reduction of eyes.

As spelean ecosystems, the Norwegian caves may be divided, according to their energy flux (Heaton 1986; Østbye *et al.* 1987;

Werker & Werker 2006) into two main categories:

1. **Open systems**; connected directly to the surface, with rivers or brooks entering through discrete openings.
2. **Infiltration systems**; which are fed by ground water or seepage water from overlying material.

METHODS

The majority of reports come from north-Norwegian caves, which is quite natural as the majority of caves in Norway are situated in this part of the country (Figure 1). The faunal elements found in mines are scarcer; however, they are included here because the knowledge of immigration of animals to artificial cavities provides important information of the ecological history of cave animals. The location (in UTM coordinates), morphology and habitat characteristics of the investigated caves and mines are given in Table 1. The number of taxa (class and order) and species are summarised in Table 5. Detailed list of species recorded are presented in Table 2. The investigations by Kjærandsen (1992, 1993) on Diptera recorded in Norwegian caves and mines are in addition presented in Tables 3 and 4, grouped on the different types of cavities.

Figure 1. Distribution of karst caves in Norway. After Lauritzen (2010). Reproduced with permission from Vigmostad & Bjørke (Tun forlag).

Table 1. Investigated cavities. EN = South East Norway, WN = South West Norway, NN = North Norway, CA = caves, LM = large mines, > 20 m, SM = small mines, < 20 m, BU = bunkers, SF = screes and fissures.

Locality no.	Locality	Municipality	Region	UTM-reference	Cavity type	Altitude m a.s.l.	Total length m	Depth m	Min. age ka	Reference
1	Bevergrotta	Kongsberg	EN	32V NM 365 007	CA	350	190	5	60	15
2	Gammarusgrotta	Kongsberg	EN	32V NM 366 008	CA	370	50	2		12,13,15
3	Midtre Sandågrotte	Kongsberg	EN	32V NM 369 010	CA	380	95	10		12,13,15
4	Finnegurigruven	Kongsberg	EN	32V NM 408 045	CA	290	30	5		15
5	Svartjerngrottene	Nedre Eiker	EN	32V NM 580 266	CA	205-220	100-150	2-10	2.5	9,10,15
6	Båntjerngrotta	Oslo	EN	32V NM 964 486	CA	230	50	5		9,10,15
7	Minnesund	Eidsvoll	EN	32V PN 209 006	LM + SM		100-6			9,10
11	Nonås	Osterøy	WN	32V LN 075 169	LM		~100			9,10
12	Skistad	Osterøy	WN	32V LN 098 122	LM		~25			9,10
13	Skaftå	Osterøy	WN	32V LN 144 073	LM		~1000			9,10
14	Trengereid	Bergen	WN	32V LN 135 042	LM		~100			9,10
15	Langhelle	Vaksdal	WN	32V LN 192 063	CA		19			9,10
16	Bergen	Bergen	WN	32V KM 974 999	LM		~100			9,10

Table 1. Continued.

Locality no.	Locality	Municipality	Region	UTM-reference	Cavity type	Altitude m a.s.l.	Total length m	Depth m	Min. age ka	Reference
17	Trollhaugen	Bergen	WN	32V KM 976 928	LM		25			9,10
18	Haukeland	Bergen	WN	32V LM 046 962-047 963	LM + SM		160-20			9,10
19	Riple	Bergen	WN	32V LM 036 918	LM + SM		155-3			9,10
20	Gymmeland	Bergen	WN	32V LM 040 905	LM		65			9,10
21	Varaldsøy	Kvinnherad	WN	32V LM 040 905-043 909	SF		1-2			9,10
22	Atramadalen	Kvinnherad	WN	32V LM 260 595	LM		~100			9,10
23	Fugleberget	Kvinnherad	WN	32V LM 249 577	CA		5-10			9,10
24	Litlabø	Stord	WN	32V KM 992 337	LM		85			9,10
25	Hidle	Bømlo	WN	32V KM 889 273	SM		19			9,10
26	Lykling	Bømlo	WN	32V KM 846 249-852 268	LM + SM		25 – 15			9,10
27	Nordbø	Sveio	WN	32V KM 906 102	BU		1-10			9,10
28	Førde	Sveio	WN	32V LM 013 139-001 134	SF		3-10			9,10
29	Dreganes	Ølen	WN	32V LM 193 162	SM		5-10			9,10
30	Vikse	Haugesund	WN	32V KL 900 004	SM		3			9,10
31	Kvalsvik	Haugesund	WN	32V KL 870 950	BU		8			9,10
32	Sirijordgrotta	Vefsn	NN	33W VN 149 709	CA	200	1400	90	7.5	15
33	Revhølet (Grønndalsgrotta)	Hemnes	NN	33W VP 552 174	CA	560	2400	70	160	15
34	Pikhågvassgrotta	Rana	NN	33W VP 553 175	CA	549	100	16		15
35	Kalkrastgrotta	Rana	NN	33 VP 501 786	CA	350	600	50		15
36	Fosshølet	Rana	NN	33 VP 515 806	CA	450	490	30		15
37	Hammarnesgrotta	Rana	NN	33 VP 571 641	CA	220	2950	128		14
38	Grønligrotta	Rana	NN	33 VP 671 668	CA	236	4251	115		4-8
39	Setergrotta	Rana	NN	33 VP 667 677	CA	110	3720	124		1,2
40	Jordbrugrotta	Rana	NN	33 VP 877 479	CA	640	3000	110		4-7
41	Krystallgrotta	Rana	NN	33 VP 805 561	CA	410	1160	115		1,2
42	Svarthamarhola	Fauske	NN	33 WQ 224 568	CA	280	1730	160	120	15
43	Okshola	Fauske	NN	33 WQ 216 607	CA	170	11000	300	350	15
44	Nonshauggrotta	Gildeskål	NN	33 VQ 549 265	CA	280	1200	30	10	15
45	Vattenhullet	Grane	NN	33 VN 160 462	CA	300	700	43		1,2
46	Jegerhullet	Grane	NN	33 VN 158 472	CA	400	680	34		1,2
47	Invasjonsgrotta	Grane	NN	33 VN 161 465	CA	320	439	27		1,2
48	Etasjegrotta	Grane	NN	33 VN 158 467	CA	330	1100	42		1,2

Table 2. The recorded species registered in the different caves and mines. The species are characterised as trogloxenes - ○, troglofiles - ◘, and troglobites - ●. (┼ characterization undetermined). The cave/mine number refers to the number in Table 1. Column 7 contains all registrations from localities 7 to 31, because no specific locality information excists for the Diptera species from these localities. Reference number according to the number in the reference list.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
Class Gastropoda, order Stylomatophora.																									
Fam. Endodontida:																									
○ *Discus ruderatus* (Ferussac)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Fam. Zonitidae:																									
○ *Oxychilus alliarius* (Miller)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Fam. Limacidae:																									
○ *Limax cineroniger* Wolf	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Fam. Clausiliidae:																									
○ *Clausilia bidentata* (Strom)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Fam. Helicidae:																									
○ *Arianta arbustorum* (L.)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	15
○ *Cepaea hortensis* (Muller)	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Class Clitellata, order Oligochaeta.																									
Fam. Lumbricidae:																									
○ *Allolobophora caliginosa* (Savigny)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Lumbricus rubellus* Hoffmeister	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Class Arachnidae, order Araneae																									
Fam. Nestidae:																									
┼ *Nesticus cellulanus* (Clerck)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	3
Fam. Metidae (Tetragnathidae):																									
◘ *Metellina merianae* (Scopoli)	-	x	-	x	x	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	3, 15
◘ *Meta menardi* (Latreille)	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	3, 15
┼ *Leptorhoptrum robustum* (Westring)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	3
Fam. Linyphiidae:																									
◘ *Porrhomma convexum* (Westring)	-	-	-	-	-	-	-	-	-	x	-	-	-	x	-	x	-	-	-	-	-	-	-	-	3, 15
○ *Saristoa abnormis* (Blackwall)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
┼ *Leptyphantes pallidus* (O.P. Cambridge)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	3
┼ Linyphiidae spp. (juv.)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	3, 15
Class Arachnidae, order Acari																									

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
Cryptostigmata:																									
◘ *Hypodamaeus brevitibialis* Bulanova-Zachvatkina	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	7, 8
◘ *Belba* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	7, 8
◘ *Chamobates cuspidatus* (Michael)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	7, 8
Prostigmata:																									
◘ *Linopodes motatorius* (Linnaeus)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-		-	-	-	-	-	-	-	-	7, 8
◘ *Thoribdella meridionalis* (Thor)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-		-	-	-	-	-	-	-	-	7, 8
┼ *Leptus* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	7
┼ Prostigmata spp.	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	15
○ O.fam. Hydrachnidia	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	2
Mesostigmata:																									
┼Mesostigmata spp.	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	7, 8, 15
Subphylum Crustacea																									
Cladocera:																									
○ *Bosmina longispina* Leydig, 1860	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	1
○ *Acroperus elongatus* (Sars 1862)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ *Acroperus harpe* (Baird 1835)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ *Alonella nana* (Baird 1843)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ *Chydorus sphaericus/latus* (O. F. Müller 1785)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
Copepoda:																									
○ *Cyclops scutifer* G.O.Sars 1863	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ *Megacyclops gigas* (Claus 1857)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	1
○ *Diacyclops nanus* (Sars 1863)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ Cyclopoidae cop. indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	1
○ Cyclopoidae nauplii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ Harpactoidae cop. indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
○ Calanoidae nauplii indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	1
Amphipoda:																									
● *Gammarus lacustris* G.O.Sars, 1863	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	◘ x	1, 15
Class Collembola																									
Neanuridae:																									

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○*Neanura muscorum* (Templeton)	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	6, 8, 15
Onychiuridae:																									
◘ Oligaphorura *schoetti* (Lie-Pettersen)	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *O. ursi* Fjellberg	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Micraphorura absoloni* (Börner)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Tullbergia arctica* Wahlgren	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ Mesaphorura *tenuisensillata* Rusek	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
◘ *M. sylvatica* (Rusek)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Isotomidae:																									
○ *Folsomia fimetaria* (L.)								x																	15
○ *Agrenia bidenticulata* (Tullberg)	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	6, 8, 15
○ *Desoria olivacea* (Tullberg)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	6, 8, 15
○ *D. hiemalis Schött*	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Isotoma viridis* Bourlet	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Parisotoma notabilis* (Schäffer)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Pogonognathellus flavescens* (Tullberg)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	6, 8
Entomobryidae:																									
◘ *Lepidocyrtus lignorum* (Fabricius)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
◘ *L. violaceus* Lubbock	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6, 8
○ *Entomobrya nivalis* (Linné)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Neelidae:																									
○ *Neelus minimus* (Willem)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Sminthuridae:																									
○ *Sminthurides malmgreni* (Tullberg)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	6, 8
○*Arrhopalites principalis* Stach	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	6, 8
○ *A. secundarius* Gisin	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	6, 8
○ *Sminthurinus concolor* (Lubbock)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	6, 8
◘ *Dicyrtoma fusca* (Lubbock)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	6, 8
○ *Arrhopalites* sp.	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Bourlettiella* sp.	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Order Ephemeroptera																									
○ *Ameletus inopiatus* Eaton, 1887	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	x	x	-	x	2

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○ *Siphlonurus* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	2
○ *Baetis rhodani* Pictet, 1843-1845	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	x	x	-	x	2
○ *B.fuscatus/scambus* (Linnaeus 1761)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	2
○ *B. muticus* (Linnaeus, 1758)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	-	x	x	x	2
○ *B. niger* (Linnaeus, 1761)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	x	x	-	2
○ *Centroptilum luteolum* (Müller, 1776)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-	2
○ *Heptagenia dalecarlia* Bengtsson	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	2, 4
○ *H. sulphurea* (Mûller, 1776)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	-	-	-	2
○ *H. /Nixe joernensis* (Bengtsson, 1909)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	2
○ Leptophlebidae spp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	2
○ *Ephemerella aurivillii* (Bengtsson, 1908)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	-	-	2
Order Plecoptera																									
○ *Diura nanseni* (Kempny, 1900)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	x	x	-	-	1, 2, 4, 8
○ *Isoperla grammatica* (Poda, 1761)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	x	1, 2
○ *I. obscura* (Zetterstedt, 1840)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	4, 8
○ *Siphonoperla burmeisteri* (Pictet, 1841)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	1, 2
○ *Taeniopteryx nebulosa* (Linnaeus, 1758)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	1, 2
○ *Brachyptera risi* (Morton, 1896)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	1, 2
○ *Amphinemura* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	-	-	x	-	1, 2
○ *A. borealis* (Morton, 1894)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	-	-	-	1, 2, 4, 8
○ *A. standfussi* (Ris, 1902)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	1, 2
○ *A. sulcicollis* (Stephens, 1836)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	1, 2
○ *Nemoura* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	x	x	1, 2
○ *N. cinerea* (Retzius, 1783)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	x	x	x	-	1, 2
○ *N. avicularis* Morton, 1894	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	1, 2
○ *Nemurella pictetii* (Klápalek, 1900)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	x	-	1, 2
○ *Protonemura meyeri* (Pictet, 1841)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	1, 2
○ *Capnia* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	-	-	-	-	1, 2
○ *C. atra* Morton, 1896	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	1, 2
○ *Leuctra* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	1, 2
○ *L. fusca* (Linnaeus, 1758)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	x	-	x	-	1, 2
○ *L. digitata* Kempny, 1899	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	1, 2

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○ *L. hippopus* Kempny, 1899	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	x	-	1, 2, 4, 8
Order Trichoptera																									
○ *Rhyacophila nubila* (Zett.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	1, 2
○ *Hydroptila* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	1, 2
○ *Philopotamus montanus* (Donovan, 1813)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	-	-	-	-	x	x	1, 2, 4, 8
○ *Plectrocnemia conspersa* (Curtis, 1834)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	x	-	-	-	x	x	x	x	1, 2
○ *Limnephilus* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	1, 2
○ Trib. Chaetopterygini	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	1, 2
Order Coleoptera																									
Carabidae:																									
○ *Cychrus caraboides* (L.)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	15
○ *Nebria gyllenhali (rufescens)* Schönherr.	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	x	x	-	-	-	-	-	15
○ *Patrobus atrorufus* (Ström)	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8, 15
○ *Trechus rubens* (F.)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8
○ *Pterostichus melanarius* (Illiger)	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *P. oblongopunctatus* (Fabricius)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Calathus micropterus* (Duftschmid)	x	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8, 15
Leiodidae:																									
○ *Agathidium seminulum* (L.)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Silphidae:																									
◘ *Pteroloma forsstroemi* (Gyllenhal)	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8, 15
Catopidae:																									
◘ *Choleva septentrionis* Jeannel	x	-	-	-	x	-	-	x	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	11, 15
◘ *C. fagniezi* Jeannel	x	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11, 15
◘ *Catops longulus* Kellner	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
◘ *C. tristis* (Panzer)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
◘ *C. nigrita* Erichson	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
◘ *C. nigricans* (Spence)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	15
◘ *C. picipes* (Fabricius)	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
┼ *C.* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8
Staphylinidae:																									
○ *Quedius fulvicollis* (Stephens)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○ *Q. xanthopus* Erichson	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
◘ *Q. mesomelinus* (Marsham)	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8, 15
◘ *Olophrum fuscum* (Gravenhorst)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *O. consimile* (Gyllenhal)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8
◘ *Arpedium quadrum* (Gravenhorst)	-	-	-	-	-	-	-	-	x	-	-	-	-	x	-	x	-	-	-	x	-	-	-	-	5, 8, 15
◘ *Lesteva monticola* Kiesw.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8
◘ *L. pubescens* Mannerheim	-	-	-	-	-	-	-	x	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	5, 8, 15
◘ *Psephidonus longipes* (Mannh.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	5, 8
○ *Olisthaerus megacephalus* (Zetterstedt)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Tachinus pallipes* Gravenhorst	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *T. elongatus* Gyllenhal	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Atheta diversa* (Sharp)	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Oxypoda spectabilis* Märkel	-	-	-	-	-	x	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	5, 8, 15
○ *O. soror* Thomson	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Liogluta alpestris* (Heer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	5, 8
Cryptophagidae:																									
○ *Cryptophagus setulosus* Sturm	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Curculionidae:																									
○ *Otiorhynchus* sp.	-	-	-	-	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Dytiscidae:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
○ *Agabus arcticus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	2
○ *Deronectes multilineatus/griseostriatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	2
○ *Hydroporus obscurus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	2
Order Lepidoptera																									
Geometridae:																									
○ *Triphosa dubitata* L.	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Plusiidae:																									
○ *Scoliopteryx libatrix* L.	-	x	-	x	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
Tipulidae:																									
○ *Pedicia immaculata* (Meigen)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Dolichopeza albipes* Strøm	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Trichoceridae:																									

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
◘ *Trichocera maculipennis* Meigen	-	-	-	-	-	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8, 9, 10
○ *T. regulationis* (Linnaeus)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
○ *T. implicata* Dahl	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *T. hiemalis* (De Geer)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Simuliidae:																									
◘ *Helodon ferrugineum* (Wahlberg)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Cnephia fuscipes* (Fries)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Eusimulium bicorne* Dorier & Rubzov	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *E. ?meigeni* Rubzov & Carlsson	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *E.* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Simulium rostratum* (Lundström)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *S. tuberosum* (Lundström)	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
Ceratopogonidae:																									
○ Ceratopogonidae sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	2
Mycetophilidae:																									
○ *Mycetophila strobli* Lastovka	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *M.* cf. *blanda* Winnertz	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. curviseta* Lundström	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. evanida* Lastovka	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. ocellus* Walker	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. ornata* Stephens	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. ruficollis* group	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. signatoides* Dziedzicki	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M.* cf. *sordida* van der Wulp	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M. unipunctata* Meigen	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *M.* sp.	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Macrobrachius* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Phronia fusciventris* Van Duzee	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Phronia* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Anatella ankeli* Plassmann	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Anatella* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Exechia confinis* Winnertz	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○ *E. contaminata* Winnertz	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. cornuta* Lundström	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. dizona* Edwards	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. exigua* Lundström	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. festiva* Winnertz	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. frigida* (Boheman)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. fusca* (Meigen)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. spinigera* group	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
◘ *Speolepta leptogaster* (Winnertz)	x	-	-	-	-	-	x	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8, 15, 9, 10
○ *Rhymosia fasciata* Meigen	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15, 9, 10
○ *R. affinis* Winnertz	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *R. placida* Winnertz	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *R.* cf. *Winnertzi* Barendrecht	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Exechiopsis* sp.?	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Exechiopsis clypeata* (Lundström)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. distendens* (Lackschewitz)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. dryaspagensis* Chandler	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. fimbriata* (Lundström)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. hammi* (Edwards)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. indecisa* (Walker)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. ingrica* (Stackelberg)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. intersecta* (Meigen)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. januarii* (Lundström)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. lackschewitziana* (Stackelberg)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. landrocki* (Lundström)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. ligulata* (Lundström)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. pseudindecisa* Lastovka & Matile	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. pseudopulchella* (Lundström)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. subulata* (Winnertz)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *E. (X.) pollicata* (Edwards)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Pseudexechia aurivernica* Chandler	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *P. trisignata* (Edwards)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○ *Exechia* sp.	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *Tarnania dziedzickii* (Edwards)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,10
○ *T. fenestralis* (Meigen)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,10
Heleomyzidae:																									
○ *Heleomyza serrata* (L.)	x	-	-	-	-	-	x	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	9, 10, 14, 15
○ *H. brachypterna* (Loew.)	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
○ *H. borealis* (Boheman)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Scoliocentra (L.) brachypterna (Loew.)*	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Suillia* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Sciaridae:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
○ *Bradysia* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Lycoriella* cf. *solani* (Winnertz)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Itonidae:																									
○ Itonidae sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
Chironomidae:																									
○ *Macropelopia* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Diamesa* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ Chironomidae sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	-	-	-	-	-	-	x	x	-	2
○ *Zavrelimya nubila* (Meigen)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Diamesa bohemani* Goetghebuer	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Chaetocladius* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Thienemannia gracilis* Kieffer	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Culicidae:																									
○ *Culex pipiens*	-	-	-	-	x	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15, 9, 10
○ *C. territans* Walker	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Culiseta alaskaensis* (Ludlow)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *C. annulata* (Schrank)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Aedes* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
Empididae:																									
○ *Platypalpus cursitans* (Fabricius)	-	-	-	-	-	-	-	-	-	-	-	-	-	x-	-	-	-	-	-	-	-	-	-	-	8
○ *Clinocera appendiculata* (Zetterstedt)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Phoridae:																									

Table 2. Continued.

Cave number:	1	2	3	4	5	6	7	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	Ref. nr.
Species																									
○ Phoridae sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	8
○ *Megaselia* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Limoniidae:																									
○ *Elliptera* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Limonia nubeculosia* Meigen	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ Limoniidae sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Bolitophilidae:																									9, 10
○ *Bolitiphila cinerea* Meigen	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Psychodidae:																									9, 10
○ *Psychoda lobata* Tonnoir	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *P. phalaenoides* (Linnaeus)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Psychoda* sp.	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Dixidae:																									
○ *Dixa nebulosa* Meigen	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Lonchopteridae:																									
○ *Lonchoptera lutea* Panzer	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Syrphidae:																									
○ *Eristalis tenax* (Linnaeus)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Sphaeroceridae:																									
○ *Copromyza (F.) roseri* (Rondani)	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Drosophilidae:																									
○ *Drosophila phalerata* Meigen	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
○ *Leucophenga quinquemaculata* Strobl	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10
Calliphoridae:																									9, 10
○ *Calliphora vicina* Robineau-Desvoidy	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9, 10

Table 3. The number of species of order Diptera other than family Mycetophilidae from Southwest (SWN) and Southeast Norway (SEN), after Kjærandsen (ref. no. 9 & 10). LM = large mines, i.e. > 20 m, SM = small mines, i.e. < 20 m , CA = cave, BU = bunkers, SF = screes and fissures. Symbols as in Table 2.

Family:			SWN				SEN	
Species	LM	SM	CA	BU	SF	LM	SM	CA
Tipulidae:								
○ *Dolichopeza albipes* Strøm	x	-	-	-	-	-	-	-
Limoniidae:								
○ *Elliptera* sp.	x	-	-	-	-	-	-	-
○ *Limonia nubeculosia* Meigen	x	-	-	-	-	-	-	-
○ Limoniidae sp.	x	-	-	-	-	-	-	-
Bolitophilidae:								
○ *Bolitiphila cinerea* Meigen	x	-	-	-	-	-	-	-
Sciaridae:								
○ *Lycoriella* cf. *solani* (Winnertz)	x	-	-	-	-	-	-	-
Psychodidae:								
○ *Psychoda lobata* Tonnoir	-	x	-	-	x	-	-	-
○ *P. phalaenoides* (Linnaeus)	-	x	-	-	-	-	-	-
○ *Psychoda* sp.	-	x	-	-	-	-	-	-
Trichoceridae:								
○ *Trichocera implicata* Dahl	x	-	-	-	-	-	-	-
○ *T. maculipennis* Meigen	x	-	-	x	-	-	-	-
○ *T. hiemalis* (De Geer)	x	-	-	-	-	-	-	-
Dixidae:								
○ *Dixa nebulosa* Meigen	-	-	-	-	-	-	-	x
Culicidae:								
○ *Culex pipiens* Linnaeus	x	x	x	x	x	x	x	x
○ *C. territans* Walker	x	x	x	-	x	-	x	x
○ *Culiseta alaskaensis* (Ludlow)	-	-	-	-	x	x		x
○ *C. annulata* (Schrank)	x	x	x	x	x	-	x	-
Chironomidae:								
○ *Zavrelimya nubila* (Meigen)	x	-	-	-	-	-	-	-
○ *Diamesa bohemani* Goetghebuer	-	x	-	-	-	-	-	-
○ *Chaetocladius* sp.	x	-	-	-	-	-	-	-
○ *Thienemannia gracilis* Kieffer	x	-	-	-	-	-	-	-
Empididae:								
○ *Clinocera appendiculata* (Zetterstedt)	x	-	-	-	-	-	-	-
Lonchopteridae:								
○ *Lonchoptera lutea* Panzer	x	-	-	-	-	-	-	-
Phoridae:								
○ *Megaselia* sp.	x	x	-	-	-	-	-	-
Syrphidae:								
○ *Eristalis tenax* (Linnaeus)	x	x	-	x	-	-	x	-
Heleomyzidae:								
○ *Scoliocentra (L.) brachypterna (Loew.)*	x	-	x	-	-	-	-	x
○ *Heleomyza borealis* (Boheman)	x	-	-	-	-	-	-	-
○ *H. serrata* (Linnaeus)	x	x	x	x	x	x		x
○ *Suillia* sp.	x	-	-	-	-	-	x	-
Sphaeroceridae:								
○ *Copromyza (F.) roseri* (Rondani)	x	-	-	-	-	-	-	-
Drosophilidae:								
○ *Drosophila phalerata* Meigen	x	-	-	-	-	-	-	-
○ *Leucophenga quinquemaculata* Strobl	-	-	-	-	-	-	-	x
Calliphoridae:								
○ *Calliphora vicina* Robineau-Desvoidy	-	-	-	x	-	-	-	-
Number of species	25	9	5	6	6	3	5	7

Table 4. The number of species of the family Mycetophilidae of the order Diptera, from Southwest (SWN) and Southeast Norway (SEN), according to Kjærandsen (ref.no. 9 & 10). LM = large mines > 20 m, SM = small mines, < 20 m, CA = caves, BU = bunkers, SF = screes and fissures. Symbols as in Table 2.

			SWN				SEN	
Species	LM	SM	CA	BU	SF	LM	SM	CA
◘ *Speolepta leptogaster* (Winnertz)	x	x	-	-	-	x	x	x
○ *Macrobrachius* sp.	-	x	-	-	-	-	-	-
○ *Mycetophila* cf. *blanda* Winnertz	-	x	-	-	-	-	-	-
○ *M. curviseta* Lundström	x	-	-	-	-	-	-	-
○ *M. evanida* Lastovka	x	x	-	-	-	x	-	-
○ *M. ocellus* Walker	-	-	-	x	x	-	-	-
○ *M. ornata* Stephens	x	x	-	x	-	x	-	-
○ *M. ruficollis* group	-	-	-	-		x	-	-
○ *M. signatoides* Dziedzicki	x	x	-	-	-	-	-	-
○ *M.* cf. *sordida* van der Wulp	x	-	-	-	-	-	-	-
○ *M. unipunctata* Meigen	x	x	x	-	x	-	-	-
○ *Phronia fusciventris* Van Duzee	x	-	-	-	-	-	-	-
○ *Phronia* sp.	-	-	-	-	-	x	-	-
○ *Anatella ankeli* Plassmann	x	-	-	-	-	-	-	-
○ *Anatella* sp.	x	-	-	-	-	-	-	-
○ *Exechia confinis* Winnertz	x	-	-	-	x	x	x	-
○ *E. contaminata* Winnertz	x	x	-	-	-	-	-	-
○ *E. cornuta* Lundström	x	x	x	-	-	-	-	-
○ *E. dizona* Edwards	x	x	x	-	x	-	x	-
○ *E. exigua* Lundström	x	x	x	-	x	x	-	-
○ *E. festiva* Winnertz	x	x	x	x	x	-	-	-
○ *E. frigida* (Boheman)	x	x	-	-	-	-	-	-
○ *E. fusca* (Meigen)	x	x	-	x	x	-	-	-
○ *E. spinigera* group	-	x	-	-	-	-	-	-
○ *Exechiopsis clypeata* (Lundström)	x	-	-	-	-	x	x	x
○ *E. distendens* (Lackschewitz)	x	x	x	-	-	-	-	-
○ *E. dryaspagensis* Chandler	x	-	-	-	-	-	-	-
○ *E. fimbriata* (Lundström)	x	x	x	-	-	x	-	-
○ *E. hammi* (Edwards)	X	x	x	-	-	x	x	-
○ *E. indecisa* (Walker)	x	-	-	-	x	x	-	-
○ *E. ingrica* (Stackelberg)	-	-	-	-	-	-	-	x
○ *E. intersecta* (Meigen)	x	x	x	-	-	x	-	-
○ *E. januarii* (Lundström)	-	-	-	-	-	x	x	x
○ *E. lackschewitziana* (Stackelberg)	x	-	-	-	-	-	x	x
○ *E. januarii* (Lundström)	x	-	-	-	-	-	-	-
○ *E. ligulata* (Lundström)	x	-	x	-	-	x	-	-
○ *E. pseudindecisa* Lastovka & Matile	-	-	-	-	-	x	-	-
○ *E. pseudopulchella* (Lundström)	x	x	x	-	-	-	-	-
○ *E. subulata* (Winnertz)	x	x	x	-	-	x	-	x
○ *E. (X.) pollicata* (Edwards)	x	-	-	-	-	x	-	-
○ *Pseudexechia aurivernica* Chandler	x	x	x	x	x	-	-	-
○ *P. trisignata* (Edwards)	x	-	x	-	x	-	-	-
○ *Rymosia affinis* Winnertz	x	x	x	x	-	-	-	-
○ *R. fasciata* (Meigen)	x	x	x	x	x	x	x	x
○ *R. placida* Winnertz	x	x	-	-	-	x	x	-
○ *R.* cf. *Winnertzi* Barendrecht	x	-	-	-	-	-	-	-
○ *Tarnania dziedzickii* (Edwards)	x	x	-	-	-	-	-	-
○ *T. fenestralis* (Meigen)	x	-	-	-	-	-	-	-
Number of species	39	26	16	7	12	19	9	7

Table 5. Class, order and number of species recorded in Norwegian caves and mines.

Taxa	Number of species
Class Gastropoda:	
Order Stylomatophora	6
Class Clitellata:	
Order Oligochaeta	2
Class Arachnidae:	
Order Araneae	8
Order Acari	8
Class Cladocera	5
Class Copepoda	7
Class Amphipoda	1
Class Collembola	25
Class Insecta:	
Order Ephemeroptera	12
Order Plecoptera	21
Order Trichoptera	6
Order Coleotera	38
Order Lepidoptera	2
Order Diptera	103
Total	244

RESULTS AND DISCUSSION

In total, 244 species were recorded from 14 taxa. Insecta and Collembola together dominates with 85% of recorded species; Diptera alone stand for 42%. In general, the invertebrate fauna of Norwegian caves are poor in species diversity compared to the fauna in caves further south in Europe due to the more severe and harsh climatic regime at high latitudes (Østbye *et al.* 1987). Multiple glacial-interglacial cycles during the Pleistocene period would expectedly have implications for the faunal history of our caves, with less suitable conditions prevailing during long periods of glaciations. It is likely that many of the caves may have been completely water-filled (subglacial) during stadials and hence unsuitable for terrestrial animals.

In caves of the *Open systems* types all faunal components belonging to the upstream limnic ecosystems, lakes, ponds, rivers or brooks can be found, brought in with running water. The surface or surface-related forms may survive for a period but rarely reproduce underground, even if they are able to run through some stages of their life cycle in underground environments. Most of the water-drifting forms have to be classified as accidental or habitual trogloxenes (Hippa *et al.* 1985; Østbye *et al.* 1987; Dolmen & Arnekleiv 1990; Arnekleiv & Dolmen 1992), even if some species are supposed to be permanent inhabitants, troglophiles. Little attention, however, has been paid to the fauna of this category of caves, as very few cavernicoles (troglobites) have been found. Only in one open-system cave, in south Norway, a stable population of a cavernicolous crustacean, the troglobite population of *Gammarus lacustris* is known (Østbye *et al.* 1987; Lien 1997; Lien, Østbye & Østbye 1996). This species display several of the typical traits for cave adaption. In addition, the phylogeographic history (based on unpublished investigations of mtDNA) of this caveliving population suggests that it has immigrated to the area from refugia most likely situated in southern Europe, the Alps. This immigration appears to have taken place long before the presumed post-glacial immigration of the surface-living populations of *G. lacustris* which are found in adjacent lakes in the area. Furthermore their origin of the latter immigration is likely from the east, the Siberian area in Russia.

In caves of the *Infiltration systems* types, several examples on more complex and stable cave ecosystems are found. Possibly due to the northern location and the glacial history (and the age of the caves) of Norway, no faunal inhabitant in the caves of the Infiltration system type can be classified as a true troglobite. Only a few troglophiles have been found, most of the recorded species must be classified as trogloxenes, accidental or habitual.

All the six recorded species of Gastropoda must be characterised as accidental trogloxenes, as the both recorded species of Clitellata. Three of the eight recorded species of Arachnida, Aranea, could be classified as troglophiles, the other species as trogloxenes, most probably accidental ones, even those marked with ┼. Of the nine recorded species (or taxa) of Arachnida, Acari, five could be characterised as troglophiles, one as trogloxene, while three were uncertain in classification. One of the 13 recorded species of the Crustacea could be classified as a real troglobite, the amphipod *Gammarus lacustris* with a permanent population in cave no. 2. The specimens in cave no. 48 are drift. All the other species were accidental trogloxenes.

Five of the recorded 25 species of the Collembola could be classified as troglophiles, while all the 20 other species were (probably) accidental trogloxenes. All of the 12 recorded species of the order Ephemeroptera has to be classified as accidental trogloxenes, as all the 21 recorded species of the order Plecoptera, together with the six recorded species of the order Trichoptera. Of the recorded 38 species of the order Coleoptera 14 could be classified as troglophiles, while the others were trogloxenes, most probably accidental, but some may be habitual ones. Of the order Lepidoptera both recorded species are habitual trogloxenes, entering caves for hibernation. Three of the recorded species of the order Diptera could be classified as troglophiles, of which *Speolepta leptogaster* is the most typical one. All the other species are trogloxenes.

Kjærandsen (1992, 1993) has the following classification for the registered species of the order Diptera:

A. Troglophiles of which larvae live in underground environments: *Speolepta leptogaster.*

B. Habitual trogloxenes:

1. Hibernators.

a. Species where both sexes hibernate underground and mating takes place in the following spring (Mycetophilidae).

b. Species where mating takes place prior to hibernation and only females are found underground during winter (Culicidae).

2. Aestivators.

a. Species where both sexes seek cave systems during summer (Limoniidae).

b. Species where mating takes place prior to aestivation and only females are found underground in summer (Bolitophilidae).

3. Species which seek cave systems independent of sex and season (Helomyzidae, Trichoceridae).

4. Opportunists (Chironomidae, Phoridae?)

C. Accidental trogloxenes (most other Diptera).

The study Kjærandsen has conducted (1992, 1993) is one of the best carried out on cavedvelling Diptera, and we regard his classification as the best one for the Nordic caves and mines.

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