

# THE INVERTEBRATE SPECIES OF A GRAVEL STREAM

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## ABSTRACT

Based on information obtained from several studies, and some new taxonomical assessment since 1980, a compilation list is given of the invertebrate and vertebrate species inhabiting both the surface and the hyporheos of the experimental reach of the gravel stream Oberer Seebach. A total of 569 invertebrate species belonging to micro-, meio- and macrobenthic assemblages inhabit the bed sediments. The high species richness is explained by different scales of habitat patchiness, heterogeneous grain size distribution with a high porosity, availability of biofilm, variations in water through flow and the dispersal patterns of major meio- and macrobenthic taxa.

## INTRODUCTION

There are a number of environmental and biotic factors to which the species richness of a community can be related. Firstly, it is possible to find geographically related characteristics namely latitude, altitude as well as productivity of the environment, climatic variability, spatial heterogeneity, the "age", and the "harshness" of the environment (Begon et al. 1986). Secondly, biological attributes of a community may comprise the successional state of the community, and the potential interspecific interactions such as predation and competition.

It is obviously clear that without species, ecosystems per definition would not exist. Lawton (1994) in his review of what species do in an ecosystem, stressed that some processes varied significantly with species richness. However, not all mechanisms related to these responses are well understood, and all species are not equal in their impacts on ecosystem processes. Lately, van de Bund, Goedkoop & Johnson (1994) have demonstrated that in sediments macroinvertebrate bioturbation has a profound effect on bacterial densities and production, and can be both taxa- and density-dependent.

On the other hand, streams and rivers are clear centres of high biodiversity (Zwick 1991). The same author has reported that the Breitenbach stream in Germany contains 1000 species ranging from Protozoa to Insecta. Unfortunately, many species lists failed to report small-sized organisms, and there is meanwhile a bulk of listings based only on macrofaunal groups.

The long-term stream project (Ritrodat) was founded in 1976 with the basic purpose to understand the dynamics of a gravel stream. The

research aimed the examination of hydrophysical characteristics, organic matter, and the dynamics and distribution of the biocoenosis. At the same time, a great effort was done on creating, modifying and/or adapting quantitative sampling methods for the general objectives under study.

Throughout nearly two decades, many studies examining the distribution of invertebrates at the streambed surface and the hyporheos have focused on diverse invertebrate taxa.

The present contribution was undertaken in order to make a compilation of all invertebrate and fish species found in the gravel stream Oberer Seebach.

## MATERIAL AND METHODS

The study compiles invertebrate species and fish species which inhabit the stream Oberer Seebach in Lower Austria (47°51' N, 5°04' E, 610 m a.s.l.). Emphasis has been given to invertebrate taxa occurring within the 100 m research area „Ritrodat“ in the stream. In general, the Oberer Seebach is a coldwater gravel stream (mean maximum water temperature 10.2°C.) The stream sediments have a median grain size composition of 23.1 mm, and a distinct oxygen saturation in the upper 60 cm of the streambed (Bretschko 1991). The riparian vegetation is dominated by *Fraxinus excelsior* L., *Acer pseudoplatanus* L., willows (*Salix caprea* L.), beeches (*Fagus sylvatica*), and spruces (*Picea abies*) (Moser 1992). A full description of the study site is given by Bretschko (1983, 1991).

Data was mainly collected from literature sources, and additionally, new listings were made for some macroinvertebrate taxa and fish species (Table 1).

Tab. 1: Summary of invertebrate taxa found in the Oberer Seebach, and sampling methods used by diverse researchers. Sampling methods used: Hess modified sampler (HS), Stand-pipe traps (SP) (Klemens & Bretschko 1986), Cage pipes (CP) (Panek 1991), Freeze-core with electropositioning (FC) (Klemens & Bretschko, 1986; Schmid, 1987), Drift sampler (DR) (Siegl, 1993), Emergence traps (ET). (\*\* denotes a partial taxonomical assessment).

	No. taxa	Sampling method	Author	
I	PROTOZOA	(29)**	HS, SP	Schmid-Araya, this paper
II	CNIDARIA	2	HS, DR	ibid
III	TURBELLARIA	(13)**	HS, SP	ibid
IV	TREMATODA	2**	DR	ibid
V	GASTROTRICHA	7	HS, SP	W. Hummon, pers.comm.
VI	ROTIFERA	101	HS, SP, DR	Schmid-Araya, 1993
VII	NEMATODA	(45)	SP	Loof, 1991
VIII	GASTROPODA	1	CP	Panek, 1991
IX	POLYCHAETA	1	SP	Schmid-Araya, this paper
X	OLIGOCHAETA	21	all	ibid
XI	TARDIGRADA	(3)**	HS, SP	ibid
XII	ACARI	20	all	ibid
XIII	EPHEMEROPTERA	19	HS, DR	Siegl, 1993; Wagner, pers.comm.
XIV	PLECOPTERA	47	HS, ET	Stummer, 1979
XV	TRICHOPTERA	38	SP	Waringer, 1986
XVI	MEGALOPTERA	1	SP	Schmid, this paper
XVII	COLEOPTERA	(7)**	HS	Kowarc, pers. comm.
XVIII	PSYCHODIDAE	(1)**	HS	Schmid, this paper
XIX	CHIRONOMIDAE	103	FC	Schmid, 1987, 1993a, 1993b
XX	CERATOPOGONIDAE	2	HS	Schmid, this paper
XXI	SIMULIIDAE	13	HS	Car, 1981, 1993
XXII	TIPULIDAE	9	HS	Schmid, this paper
XXIII	ATHERICIDAE	1	HS	ibid
XXIV	EMPIDIDAE	4	HS	ibid
XXV	COLLEMBOLA	42	SP	Bretschko & Christian, 1989
XXVI	CLADOCERA	4	all	Schmid-Araya, this paper
XXVII	CYCLOPOIDA	2	all	ibid
XXVIII	HARPACTICOIDA	12	FC	Kowarc, 1990
XXIX	OSTRACODA	16	SP	Marmonier, 1984
XXX	AMPHIPODA	2	SP	Marmonier, 1985
XXXI	ISOPODA	1	SP	Marmonier, 1985
XXXII	PISCES	6		Adamicka, Kummer, pers.comm.

## RESULTS AND DISCUSSION

The taxa recorded from the Oberer Seebach are listed in the Appendix. A total of 569 invertebrate species and 6 fish species have been identified between 1979 and 1995. However, there are still many invertebrate groups which have not been thoroughly taxonomically examined. Among micro- and meiofaunal taxa not completely examined are Protozoa, Microturbellaria, and Tardigrada, while among the macrofauna some species of Diptera and Coleoptera need further investigations.

The number of species found within the 100 m experimental area is extremely high, compared to extensive studies conducted in other stream types such as the Breitenbach in Germany (Zwick 1991), and others in Britain (i.e. Townsend, Hildrew & Francis 1983, Wright et al. 1984). Only the work of

Zwick (1991) has shown that a high diversity can also be found among some meiofaunal taxa. At a high taxonomic order, the present invertebrate list gives a similar number of species as that reported by Zwick (1991) with respect to Gastrotricha, Rotifera, Hydrachnellae, Crustacea, and Ephemeroptera.

Benthic rotifers and larval Chironomidae constitute together 36.0% of all 570 invertebrate species found in the bed sediments of the Oberer Seebach (Fig. 1). Moreover, the number of genera among the most abundant taxa declined logarithmically (Fig. 1). Interestingly, the majority of taxa is characterized by less than 15 genera. Rotifers, nematodes and chironomids are represented by 114 genera, which are 46.5% of all genera in 19 major taxa occurring in the gravel stream Oberer Seebach (Fig. 1). Most rotifer and chironomid species were only represented by one genus (Appendix), but the rotifer and chironomid genera *Cephalodella* and *Eukiefferiella*, comprised 10 and 14 species,

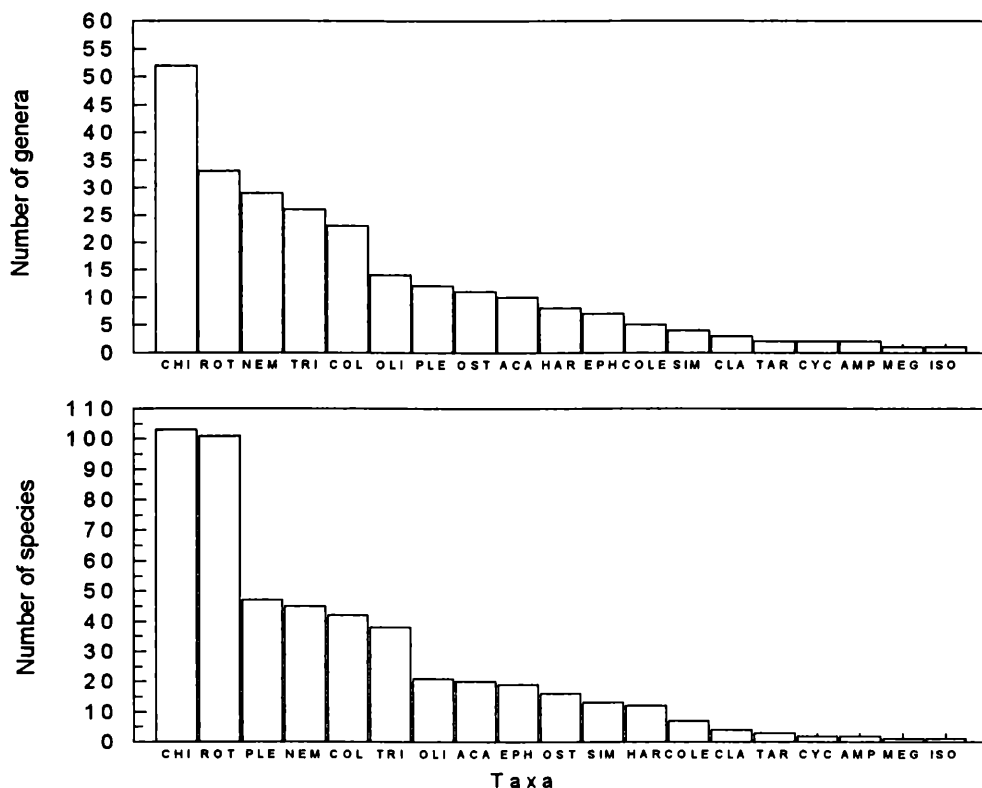


Fig. 1: Number of genera and species of the 19 most abundant benthic taxa found in the bed sediments of the Oberer Seebach from 1980 through 1995.

respectively (Appendix, Fig. 2). Both abundant and species-rich taxa, are mainly represented by highly motile and dispersive species which follow the hydrophysical variations in the stream, and can have consequently fast spatio-temporal turnover rates (Schmid, in press).

A heterogeneous and fractionated habitat such as the bed sediments, combined with variable hydro-physical conditions may increase the probability for congeneric and conspecific coexistence. The hyporheic zone has often been considered as a refuge for many benthic invertebrates with respect to spates (Williams & Hynes 1974). In the Oberer Seebach many authors have found a similar invertebrate depth distribution, in average with a maximal peak between 20 to 40 cm depth (Marmonier 1984, 1985; Kowarc 1990, 1992, Schmid-Araya 1994 and in press). These authors have mostly used the stand-pipe trap method, which can reveal animal activity and abundances if the exposure time is kept constant through all sampling occasions (Waringer 1987). Similar depth distribution patterns using other sampling method such as the *in-situ* freeze core technique with prior electropositioning, have been reported by Schmid (1987, 1992) and Ratulangi (1993).

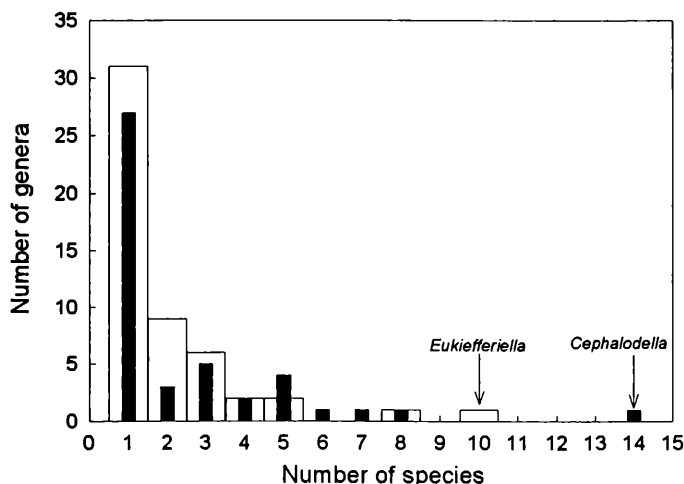


Fig. 2: Number of species in genera of benthic rotifers and chironomids found in the bed sediments of the Oberer Seebach from 1990 through 1995. Solid bars: rotifera, Open bars: chironomidae.

The high species richness shown within this gravel stream may be explained by a variety of abiotic and biotic factors. Generally, the bed sediments are well oxygenated down to depths of 60 cm. A heterogeneous grain-size distribution within this stream-bed indicates that interstitial spaces vary among sediment depth layers and in time. Consequently, the size of colonizable microhabitats may shift continuously both horizontally and vertically in space. Fluctuations in water through-flow within the hyporheos lead to spatio-temporal variations in particle movement and sedimentation, which in turn may change interstitial spaces and the availability of particle-associated food (i.e. biofilm). Particles must be resident for a certain time in order to be fed upon by organisms such as browsers (i.e. gastrotrichs, rotifers). In addition, at the streambed surface small-scale variations in current velocity and hydraulic shear stress may change microhabitat characteristics and alter species' colonization patterns. Within the bed sediments, a high meio- and macrozoobenthic species diversity may be explained by the active movement of species in all major spatial directions reducing the probability of exploitation and interference competition; most species found within this gravel stream are motile and many species-rich taxa such as rotifers and chironomids colonize within hours newly formed habitats. Certain taxa and species even appear to occur most of their developmental periods within the hyporheos such as certain monogonont rotifers, harpacticoid copepods, Orthoclaadiinae (Chironomidae), habroleptid mayfly nymphs and leuctrid stonefly nymphs, all showing spatial speciation patterns due to particle-associated feeding habits. Species occurring both at the uppermost sediment layer and within deeper sediments such as tanypod predators, mirror active prey searching behaviour. Some detritivorous species such as Orthoclaadiinae might generally colonize deeper sediment layers in early developmental stages, using these zones as comparatively 'protected' habitats; other surface dwelling species might actively search for refuge microhabitats at periods of high water discharge. This magnitude of scale-dependent spatio-temporal unpredictability and the extent of both abiotic and biotic factor variations contribute to a high species diversity within the bed sediments of a headwater stream such as the Oberer Seebach.

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Appendix: The invertebrate and vertebrate species composition found in the experimental area Ritrodat since 1979.

## I. PROTOZOA

### CILIATA

S.C. HOLOTRICHIA

O. GYMNOSTOMATIDA

FAM. COLEPIDAE

1. *Coleps* sp.

FAM. ENCHELYIDAE

2. *Prorodon* sp.

3. *Lacrymaria* sp.

FAM. AMPHILEPTIDAE

4. *Litonotus* sp.

FAM. DIDINIIDAE

5. *Didinium* sp.

FAM. TRACHELIIDAE

6. *Trachelius ovum* EHRB.

7. *Dileptus* sp.

O. HYMENOSTOMATIDA

FAM. TETRAHYMENIDAE

8. *Tetrahymena* sp.

9. *Glaucoma* sp.

10. *Colpidium colpoda* (EHRB.)

FAM. PARAMECIIDAE

11. *Paramecium caudatum* EHRB.

12. *Paramecium* sp.

FAM. FRONTONIIDAE

13. *Frontonia* sp.

14. *Lembadion* sp.

15. *Turania vitrea* BRODSKY

FAM. CYCLIDIIDAE

16. *Cyclidium* sp.

S.C. PERITRICHIA

O. PERITRICHIDA

FAM. VORTICELLIDAE

17. *Vorticella campanula* EHRB.

18. *Vorticella* sp.

FAM. EPISTYLIDAE

19. *Opercularia* sp.

S.C. SPIROTRICHIA

O. HETEROTRICHIDA

FAM. BURSARIIDAE

20. *Bursaria* sp.

FAM. STENTORIDAE

21. *Stentor* sp.

FAM. SPIROSTOMIDAE

22. *Spirostomum* sp.

O. OLIGOTRICHIDA

FAM. STROMBILIDAE

23. *Strombilibidium* sp.

O. HYPOTRICHIDA

FAM. ASPIDISCIDAE

24. *Aspidisca* sp.

FAM. EUPLOTIDAE

25. *Euplotes* sp.

FAM. OXYTRICHIDAE

26. *Stylonychia* sp.

27. *Oxytricha* sp.

### TESTACEA

FAM. DIFFLUGIIDAE

28. *Diffugia* sp.

29. *Centropyxis* sp.

## II. CNIDARIA

Class HYDROZOA

O. HYDROIDA

30. *Hydra viridis*

31. *Hydra* sp.

## III. TURBELLARIA

O. CATENULIDA

FAM. CATENULIDAE

32. *Catenula lemnae* ANT. DUGES

FAM. STENOSTOMIDAE

33. *Rhynchoscolex* sp.

34. *Stenostomum leucops* ANT. DUGES

35. *S. unicolor* O. SCHMIDT

O. MACROSTOMIDA

FAM. MACROSTOMIDAE

36. *Macrostomum appendiculatum* (O. FABR.)

37. *M. tuba* GRAFF

38. *M. viride* E. BENED.

39. *Macrostomum* sp. 1

40. *Macrostomum* sp. 2

O. PERILECITHOPHORA

41. *Geocentrophora* sp.

O. NEORHABDOCOELA DALYELLIOIDA

FAM. DALYELLIIDAE

42. *Castrella truncata* ABILDG.

O. NEORHABDOCOELA KALYPTORHYNCHIA

43. *Gyratrix hermaphroditus* EHRB.

O. SERIATA TRICLADIDA

44. *Crenobia alpina* (DANA)

## IV. TREMATODA

O. MONOGENEA

45. *Gyrodactylus* sp.

O. DIGENEA

46. *Opisthorchis sinensis*

## V. GASTROTRICHIA

O. MACRODASYOIDEA

47. *Marinellina flagellata*? RUTTNER-KOLISKO

FAM. CHAETONOTIDAE

48. *Chaetonotus laroides* MARCOLONGO

49. *C. maximus* EHRB.

50. *Chaetonotus* n. sp. A

51. *Chaetonotus* n. sp. B

52. *Chaetonotus* n. sp. C

53. *Chaetonotus* n. sp. D

54. *Chaetonotus* n. sp. E

## VI. ROTIFERA

MONOGONONTA

O. PLOIMIDA

FAM. BRACHIONIDAE

55. *Notholca foliacea* (EHRB.)

56. *N. labis* GOSSE

57. *N. squamula* (O.F.M.)

FAM. EUCHLANIDAE

58. *Euchlanis deflexa* (GOSSE)

FAM. MYTILINIDAE

59. *Mytilina ventralis* (EHRB.)

60. *Lophocharis salpina* (EHRB.)

FAM. COLURELLIDAE

61. *Colurella colurus* (EHRB.)

62. *Colurella* sp.

63. *Lepadella acuminata* (EHRB.)

64. *L. ovalis* (O.F.M.)

65. *L. triptera* EHRB.

FAM. LECANIDAE

66. *Lecane* (s.str.) *flexilis* (GOSSE)

67. *L. luna* (O.F.M.)

68. *L. (Monostyla) lunaris* (EHRB.)

69. *L. (Monostyla) sp.*

## FAM. PROALIDAE

70. *Proalinopsis caudatus* (COLLINS)  
 71. *Proales globulifera* (HAUER)  
 72. *P. fallaciosa* WULF.  
 73. *P. similis* DE BEAUCHAMP  
 74. *Proales theodora* (GOSSE)  
 75. *Proales sp.*

## FAM. LINDIIDAE

76. *Lindia torulosa* DUJARDIN

## FAM. NOTOMMATIDAE

77. *Drilophaga bucephalus* VEJDOVSKY  
 78. *Itura aurita* f. *intermedia* (WULF.)  
 79. *Monommata sp.*  
 80. *Resticula nyssa* H. & M.  
 81. *R. vermisculus* WULF.  
 82. *Resticula sp.*  
 83. *Pleurotrocha petromycon* EHRB.  
 84. *Notommata thopica* H. & M.  
 85. *Cephalodella catellina* (O.F.M.)  
 86. *C. forceps* DONNER  
 87. *C. forficula* (EHRB.)  
 88. *C. gibba* (EHRB.)  
 89. *C. gibba macrodactyla* KOCH-ALTHAUS  
 90. *C. cf. gobio* WULF.  
 91. *C. cf. gracilis* DONNER  
 92. *C. cf. incila* WULF.  
 93. *C. megalocephala* (GLASCOTT)  
 94. *C. oxydactyla* WULF.  
 95. *C. reimanni* DONNER  
 96. *C. cf. rigida* DONNER  
 97. *C. tenuior* (GOSSE)  
 98. *Cephalodella sp.*

## FAM. TRICHOCERCIDAE

99. *Trichocerca (Diurella) porcellus* (GOSSE)  
 100. *T. (Diurella) taurocephala* (HAUER)  
 101. *T. (Diurella) tigris* (O.F.M.)

## FAM. GASTROPODIDAE

102. *Ascomorpha eucadis* (PERTY)

## FAM. SYNCHAETIDAE

103. *Synchaeta tremula* (O.F.M.)

## FAM. DICRANOPHORIDAE

104. *Dicranophorus difflugiarum* (PENARD)  
 105. *Dicranophorus forcipatus* (O.F.M.)  
 106. *D. liepolti* DONNER  
 107. *D. lütkeni-sigmoides* (BERGENDAL)  
 108. *D. uncinatus* MILNE  
 109. *Aspelta sp.*  
 110. *Wierzejskiella velox* (WISZNIEWSKI)  
 111. *Encentrum* (s.str.) *gulo* WULF.  
 112. *E. incisum* WULF.  
 113. *E. cf. lupus* WULF.  
 114. *E. mucronatum* WULF.  
 115. *E. mustela* (MILNE)  
 116. *E. putorius* WULF.  
 117. *Encentrum sp.*  
 118. *Encentrum (Paraencentrum) longipes* (WULF.)  
 119. *Myersinella tetraglena* (WISZNIEWSKI)

## S. O. DIGONONTA

## O. BDELLOIDEA

## FAM. HABROTROCHIDAE

120. *Habrotrocha collaris* (EHRB.)  
 121. *H. proxima* DONNER  
 122. *Habrotrocha cf. pusilla* (BRYCE)  
 123. *Habrotrocha sp. A*  
 124. *Habrotrocha sp. B*

## FAM. PHILODINIDAE

125. *Philodina acuticornis* MILNE  
 126. *P. flaviceps* BRYCE  
 127. *P. nemoralis* BRYCE  
 128. *P. plena* (BRYCE)  
 129. *P. vorax* (JANSON)  
 130. *Embata laticeps* MURRAY  
 131. *E. hamata* (MURRAY)  
 132. *Dissotrocha aculeata* (EHRB.)  
 133. *D. macrostyla* (EHRB.)  
 134. *Rotaria macroceros* (GOSSE)  
 135. *R. rotaria* (PALLAS)  
 136. *R. sordida* (WESTERN)  
 137. *R. socialis* KELLICOTT  
 138. *Rotaria sp. A*  
 139. *Rotaria sp. B*  
 140. *Macrotrachela cf. habita* (BRYCE)  
 141. *Macrotrachela papillosa* (THOMPSON)  
 142. *M. plicata* (BRYCE)  
 143. *M. quadricornifera* MILNE  
 144. *M. timida* MILNE  
 145. *M. vesicularis* (MURRAY)  
 146. *Macrotrachela sp.*  
 147. *Mniobia obtusicornis* MURRAY  
 148. *Mniobia scarlatina* (EHRB.)  
 149. *Mniobia sp.*

## FAM. ADINETIDAE

150. *Adineta barbata* JANSON  
 151. *A. steineri* BARTOŠ  
 152. *Adineta vaga* (DAVIS)  
 153. *Adineta sp.*

## FAM. PHILODINAVIDAE

154. *Philodina paradoxus* (MURRAY)  
 155. *Henoceros falcatus* (MILNE)

## VII. NEMATODA

## TORQUENTIA

## FAM. DESMOSCOLECIDAE

156. *Desmoscolex aquaedulcis* STAM.

## SECERNANTIA

## FAM. ANGUINIDAE

157. *Subanguina sp.*  
 158. *Ditylenchus sp.*

## FAM. NEOTYLENCHIDAE

159. *Hexatylus sp.*

## FAM. HOPLOLAIMIDAE

160. *Helicotylenchus sp.*

## FAM. CRICONEMATIDAE

161. *Hemicycliophora aquatica* (MICOLETZKY)  
 162. *Criconema sphagni* MICOLETZKY

## PENETRANTIA

## FAM. MONONCHIDAE

163. *Mononchus aquaticus* COETZEE  
 164. *M. truncatus* BASTIAN  
 165. *Clarkus papillatus* (BASTIAN)  
 166. *Iotonchus zschokkei* (MENZEL)  
 167. *Prionchulus muscorum* (DUJARDIN)  
 168. *P. punctatus* COBB

## FAM. MYLONCHULIDAE

169. *Mylonchulus cavensis* (W. SCHNEIDER)  
 170. *Mylonchulus sp.*

## FAM. ANATONCHIDAE

171. *Anatonchus tridentatus* (de MAN)

## FAM. NYGOLAIMIDAE

172. *Paravulvulus hartingii* (de MAN)  
 173. *Nyngolaimus(?) asymmetricus* ANDRASSY

## FAM. PRODORYLAIMIDAE

174. *Prodorylaimus longicaudatoides* ALTHERR  
 175. *P. acris* (THORNE)  
 176. *P. mas* LOOF  
 177. *P. uliginosus* LOOF

## FAM. DORYLAIMIDAE

178. *Dorylaimus stagnalis* DUJARDIN  
 179. *Mesodorylaimus aberrans* LOOF  
 180. *Mesodorylaimus sp.*

## FAM. QUDSIANEMATIDAE

181. *Eudorylaimus agilis* (de MAN)  
 182. *Eudorylaimus carteri-grp.*  
 183. *Eudorylaimus sp.*

## FAM. APORCELAIMIDAE

184. *Sectonema macrospiculum* (ALTHERR)  
 185. *Aporcelaimellus obtusicaudatus* (BASTIAN)  
 186. *A. simplex* (THORNE & SWANGER)  
 187. *A. ronnebergi* ALTHERR  
 188. *Aporcelaimellus sp.*

## FAM. NORDIIDAE

189. *Pungentus engadinensis* (ALTHERR)  
 190. *Enchodelus macrorodus* (de MAN)  
 192. *E. vulvostriatus* (STEFANSKI)

193. *Enchodelus sp.*

## FAM. LONGIDORIDAE

194. *Longidorus caespiticola* HOOPER  
 195. *L. picens* ROCA, LAMB. & AGOST.  
 196. *Longidorus sp.*

## FAM. DORYLAIMOIDIDAE

197. *Dorylaimoides limnophilus* (de MAN)

## FAM. CRATERONEMATIDAE

198. *Chrysonemoides holsaticus* (W.SCHNEIDER)

## FAM. BELONDIRIDAE

199. *Axonchium coronatum* (de MAN)

## FAM. TYLENCHOLAIMELLIDAE

200. *Tylencholaimus proximus* THORNE

## FAM. DIPHTHEROPHORIDAE

201. *Diphtherophora communis* (de MAN)

**VIII. MOLLUSCA: GASTROPODA**

## S.C. PROSOBRANCHIA

## O. MESOGASTROPODA

## FAM. HYGROBIIDAE

202. *Bythinella austriaca* FRAUENFELD

**IX. POLYCHAETA**

## FAM. NERILLIDAE

203. *Troglochaetus beranecki* DEL.

**X. OLIGOCHAETA**

## FAM. AELOSOMATIDAE

204. *Aelosoma hemprichi* EHRB.  
 205. *Aelosoma quaternarium* EHRB.

## FAM. NAIDIDAE

206. *Chaetogaster crystallinus* VEJDOVSKY  
 207. *C. langui* BRETSCHER  
 208. *Nais alpina* SPERBER  
 209. *N. elinguis* MÜLLER  
 210. *N. pardalis* PIGUET  
 211. *Naididae gen.sp.*

## FAM. ENCHYTRAEIDIDAE

212. *Achaeta eiseni* VEJDOVSKY  
 213. *Marionina argentea* (MICHAELSEN)  
 214. *Cernovitoviella atrata* (BRETSCHER)  
 215. *Mesenchytraeus armatus* LEVINSEN  
 216. *Enchytraeididae gen. sp.1*  
 217. *Enchytraeididae gen. sp.2*  
 218. *Enchytraeididae gen. sp.3*

## FAM. LUMBRICULIDAE

219. *Lumbriculus variegatus* MÜLLER  
 220. *Stylogdrilus heringianus* CLAP.  
 221. *Rhynchelmis limonella* HOFFMAN.  
 222. *Lumbriculidae gen.sp.*

## FAM. HAPLOTAXIDAE

223. *Haplotaxis gordioides* (HARTMANN)

## FAM. LUMBRICIDAE

224. *Eiseniella tetraedra* (SAVIGNY)

**XI. TARDIGRADA**

## O. EUTARDIGRADA

225. *Macrobotus ampullaceus* THULIN  
 226. *Macrobotus sp.A*  
 227. *Milnesium tardigradus* DOYÈRE

**XII. ACARI**

## HYDRACHNELLAE

## FAM. HYDRYPHANTIDAE

228. *Partnunia angusta* KOENICKE

## FAM. SPERCHONTIDAE

229. *Sperchon brevisrostris* (KOENICKE)  
 230. *S. glandulosus* (KOENICKE)  
 231. *S. denticulatus* (KOENICKE)

## FAM. LEBERTIIDAE

232. *Lebertia (Pseudolebertia) glabra* THOR  
 233. *Lebertia sp.*

## FAM. TORRENTICOLIDAE

234. *Torrenticola elliptica* MAGLIO

## FAM. HYGROBATIDAE

235. *Hygrobatas foreli* LEBERT  
 236. *Atractides gibberipalpis* PIERS.  
 237. *A. lorricatus* PIERSIG  
 238. *A. mitisi* WALTER  
 239. *A. nodipalpis nodipalpis* (THOR)  
 240. *A. nodipalpis var. robustus* SOKOLOV  
 241. *A. vaginalis var. adnatus* LUNDBLAND  
 242. *A. walteri* VIETS

## FAM. FELTRIIDAE

243. *Feltria setigera* (KOENICKE)  
 244. *F. minuta* (KOENICKE)

## FAM. ATURIDAE

245. *Ljanina bipapillata* THOR  
 246. *Aturus fontinalis* LUNDBLAND

## POROHALACARIDA

247. *Walterella weberi*

**INSECTA****XIII. EPHEMEROPTERA**

## FAM. HEPTAGENIIDAE

248. *Epeorus alpicola* EATON  
 249. *E. sylvicola* PICTET  
 250. *Ecdyonurus dispar* CURTIS  
 251. *E. helveticus* EATON  
 252. *E. picteti* MEYER-DÜR  
 253. *E. venosus* FABRICIUS  
 254. *Rhithrogena alpestris* EATON  
 255. *Rhithrogena cf. hybrida* EATON

## FAM. BAETIDAE

256. *Baetis alpinus* PICTET  
 257. *B. melanonyx* PICTET  
 258. *B. muticus* L.  
 259. *B. rhodani* PICTET  
 260. *B. vernus* CURTIS  
 261. *Centroptilum luteolum* MÜLLER

## FAM. EPHEMERELLIDAE

262. *Ephemerella ignita* PODA  
 263. *E. mucronata* BENGTSOON

## FAM. LEPTOPHLEBIIDAE

264. *Habroleptoides confusa* SART. & JAKOB



**XIV. PLECOPTERA**

## FAM. TAENIOPTERYGIDAE

265. *Taeniopteryx hibaulti* AUBERT

## FAM. NEMOURIDAE

266. *Amphinemura sulcicollis* STEPHENS267. *A. standfussi* RIS268. *A. triangularis* RIS269. *Nemoura cinerea* (RETZIUS)270. *N. flexulosa* AUBERT271. *N. marginata* PICTET272. *N. minima* AUBERT273. *N. mortoni* RIS274. *N. sinuata* (RIS)275. *Nemurella* sp.276. *Protonemura auberti* ILLIES277. *P. brevistyla* (RIS)278. *P. intricata* (RIS)279. *P. lateralis* (PICTET)280. *P. nimborella* MOSELY281. *P. nitida* STEPHENS

## FAM. LEUCTRIDAE

282. *Leuctra albida* KEMPNY283. *L. armata* KEMPNY284. *L. aurita* NAVAS285. *L. braueri* KEMPNY286. *L. cingulata* KEMPNY287. *L. fusca* (L.)288. *L. hexacantha* DESPAX289. *L. hippopus* KEMPNY290. *L. inermis* KEMPNY291. *L. maior* BRINCK292. *L. mortoni* KEMPNY293. *L. moselyi* MORTON294. *L. nigra* (OLIVER)295. *L. prima* KEMPNY296. *L. rosinae* KEMPNY

## FAM. CAPNIIDAE

297. *Capnia nigra* PICTET

## FAM. PERLODIDAE

298. *Dictyogenus alpinum* PICTET299. *D. fontium* RIS300. *Isoperla difformis* (KLAPALEK)301. *I. grammatica* (PODA)302. *I. oxylepis* (DESPAX)303. *Perlodes intricata* (PICTET)304. *P. microcephala* (PICTET)

## FAM. PERLIDAE

305. *Dinocras cephalotes* CURTIS306. *Dinocras* sp.307. *Perla bipunctata* (PICTET)308. *P. marginata* (PANZER)309. *P. maxima* SCOPOLI310. *Chloroperla sussemicheli* (ZWICK)311. *C. torrentium* (PICTET)**XV. TRICHOPTERA**

## FAM. RHYACOPHILIDAE

312. *Rhyacophila aurata* BRAUER313. *R. dorsalis* CURTIS314. *R. hirticornis* MC.L.315. *R. tristis* PICTET316. *R. vulgaris* PICTET

## FAM. HYDROPTILIDAE

317. *Ithytrichia lamellaris* EATON318. *Hydroptila ivisa* MAL.319. *H. martini* MARSHALL320. *Hydroptila* sp.

## FAM. PHILOPOTAMIDAE

321. *Philopotamus ludificatus* MC.L.322. *Wormaldia copiosa* MC.L.323. *W. pulla* MC.L.

## FAM. HYDROPSYCHIDAE

324. *Hydropsyche* sp.

## FAM. POLYCENTROPODIDAE

325. *Plectrocnemia geniculata* MC.L.326. *P. conspersa* CURTIS

## FAM. PSYCHOMYIDAE

327. *Tinodes dives* PICTET

## FAM. BRACHYCENTRIDAE

328. *Brachycentrus montanus* KLAP.329. *Micrasema minimum* MC.L.

## FAM. LIMNNEPHILIDAE

330. *Drusus biguttatus* PICTET331. *Ecclisopteryx guttulata* PICTET332. *Metanoea rhaetica* SCHMID333. *Limnephilus germanus* MC.L.334. *L. rhombicus* L.335. *Colpotaulius incisus* CURTIS336. *Potamophylax cingulatus* STEPHENS337. *Halesus digitatus* SCHRANK338. *H. radiatus* CURTIS339. *H. rubricollis* PICTET340. *Melampophylax melampus* MC.L.341. *Allogamus auricollis* PICTET342. *A. uncatus* BRAUER343. *Chaetopteryx fusca* BRAUER344. *Pseudopsilopteryx zimmeri* MC.L.345. *Chaetopterygopsis maclachlani* STEIN346. *Annitella obscurata* MC.L.

## FAM. GOERIDAE

347. *Silo nigricornis* PICTET

## FAM. LEPIDOSTOMATIDAE

348. *Crunoecia kempnyi* MORTON

## FAM. SERICOSTOMATIDAE

349. *Sericostoma flavicorne* SCHNEIDER**XVI. MEGALOPTERA**

## FAM. SIALIDAE

350. *Sialis fuliginosa* PICTET**XVII. COLEOPTERA**

## FAM. DYTISCIDAE

351. *Oreodytes* (?) *borealis*

## FAM. HYDRAENIDAE

352. *Haenydra gracilis* GERM.353. *H. lapidicola* KIESW.354. *H. truncata* REY

## FAM. ELMIDAE

355. *Esolus angustatus* PH. MÜLL.356. *Riolus subviolaceus* PH. MÜLL.357. *Elmis* sp.**DIPTERA**

## S.O. NEMATOCERA

**XVIII. FAM. PSYCHODIDAE**358. *Pericoma* sp.**XIX. FAM. CHIRONOMIDAE**

## S.F. PODONOMIINAE

359. *Paraboreochlus minutissimus* (THIEN.)

## S.F. TANYPODINAE

360. *Conchapelopia pallidula* (MEIGEN)361. *Macropelopia notata* (MEIGEN)362. *Nilotanypus dubius* (MEIGEN)363. *Paramerina divisa* (WALKER)364. *Thienemannimyia geijskesi* (GOET.)365. *T. laeta* (MEIGEN)366. *Trissopelopia longimana* (STAEGER)367. *Zavrelimyia signatipennis* (KIEFFER)

## S.F. DIAMESINAE

368. *Diamesa cinerella* (MEIGEN)  
 369. *D. hamaticornis* (KIEFFER)  
 370. *D. insignipes* (KIEFFER)  
 371. *D. permacer* (WALKER)  
 372. *D. thienemanni* (KIEFFER)  
 373. *Potthastia gaedii* (MEIGEN)  
 374. *P. longimana* (KIEFFER)  
 375. *Pseudodiamesa branickii* (NOWICKI)

## S.F. PRODIAMESINAE

376. *Prodiamesa olivacea* (MEIGEN)

## S.F. ORTHOCLADIINAE

377. *Brillia longifurca* (KIEFFER)  
 378. *B. modesta* (MEIGEN)  
 379. *Bryophaenocladus ictericus* (MEIGEN)  
 380. *B. muscicola* grp.  
 381. *Chaetocladus laminatus* (BRUN.)  
 382. *Chaetocladus* sp. A  
 383. *Corynoneura edwardsi* BRUN.  
 384. *C. lobata* EDWARDS  
 385. *Cricotopus* (*Cricotopus*) *annulator* (GOET.)  
 386. *C. (C.) curtus* HIRVENOJA  
 387. *C. (C.) fuscus* (KIEFFER)  
 388. *Cricotopus (C.) sp.cf similis* GOET.  
 389. *C. (Cricotopus) tremulus* (L.)  
 390. *Eukiefferiella brevicar* (KIEFFER)  
 391. *E. claripennis* LUNDBECK  
 392. *E. clypeata* KIEFFER  
 393. *E. coeruleascens* (KIEFFER)  
 394. *E. devonica* (EDWARDS)  
 395. *E. ilkleyensis* (EDWARDS)  
 396. *E. lobifera* GOET.  
 397. *E. minor* (EDWARDS)  
 398. *E. similis* GOET.  
 399. *E. tirolensis* (GOET.)  
 400. *Heleniella ornatocollis* (EDWARDS)  
 401. *Heterotrissocladius marcidus* (WALKER)  
 402. *Krenosmittia boreoalpina* (GOET.)  
 403. *Limnophyes prolongatus* (KIEFFER)  
 404. *Metriocnemus hygropetricus* (KIEFFER)  
 405. *Nanocladus rectinervis* (KIEFFER)  
 406. *Orthocladus (Euorthocladus) ashei* SOPONIS  
 407. *O. (Orthocladus) excavatus* (BRUNDIN)  
 408. *Orthocladus (Eu.) frigidus* (ZETTERSTEDT)  
 409. *Orthocladus (Eu.) rivulorum* KIEFFER  
 410. *Orthocladus (Eu.) rivicola* KIEFFER  
 411. *Orthocladus (O.) sp.cf.saxicola* KIEFFER  
 412. *Orthocladus (Eu.) luteipes* GOET.  
 413. *Orthocladus (O.) wetterensis* (BRUNDIN)  
 414. *Paracladius alpicola* (ZETTERSTEDT)  
 415. *Parametriocnemus boreoalpinus* GOWIN  
 416. *P. stylatus* (KIEFFER)  
 417. *Paraphaenocladus impensus* (WALKER)  
 418. *P. irritus* (WALKER)  
 419. *P. pseudirritus* STRENZKE  
 420. *Paraphaenocladus* sp. 1  
 421. *Paratrichocladus nivalis* (GOET.)  
 422. *P. rufiventris* (MEIGEN)  
 423. *P. skirwithensis* (EDWARDS)  
 424. *Paratrissocladius excerptus* (WALKER)  
 425. *Parorthocladus nudipennis* (KIEFFER)  
 426. *Pseudosmittia gracilis* (GOET.)  
 427. *P. holsata* (THIEN. & STREN.)  
 428. *P. recta* (EDWARDS)  
 429. *Rheocricotopus effusus* (WALKER)  
 430. *R. fuscipes* (KIEFFER)  
 431. *R. gouini* (GOET.)

432. *Rheosmittia spinicornis* (BRUNDIN)  
 433. *Smittia paranudipennis* (BRUNDIN)  
 434. *Symbiocladius rhithrogenae* KIEFFER  
 435. *Symposiocladius lignicola* (KIEFFER)  
 436. *Synorthocladus semivirens* (KIEFFER)  
 437. *Thienemania gracilis* KIEFFER  
 438. *Thienemanniella clavicornis* KIEFFER  
 439. *T. morosa* (EDWARDS)  
 440. *T. partita* (SCHLEE)  
 441. *T. vittata* EDWARDS  
 442. *Trissocladius* sp. 1  
 443. *Tvetenia bavarica* GOET.  
 444. *T. calvescens* EDWARDS  
 445. *T. discoloripes* (GOET.)

## S.F. CHIRONOMINAE

## TRIBE: CHIRONOMINI

446. *Cryptocladopelma lateralis* (GOET.)  
 447. *Microtendipes pedellus* grp.  
 448. *Paracladopelma camptolabis* (KIEFFER)  
 449. *Phaenopsectra flavipes* MEIGEN  
 450. *Polypedilum albicorne* (MEIGEN)  
 451. *P. apfelbecki* (STROBL)  
 452. *P. laetum* (MEIGEN)

## TRIBE: TANYTARSINI

453. *Micropectra attenuata* (REISS)  
 454. *M. atrofasciata* KIEFFER  
 455. *M. notescens* (WALKER)  
 456. *Neozavrelia bernensis* REISS  
 457. *Rheotanytarsus nigricauda* FITTKAU  
 458. *Stempellina bausei* (KIEFFER)  
 459. *S. brevis* (EDWARDS)  
 460. *Tanytarsus gibbosiceps* (KIEFFER)  
 461. *T. palettaris* (VERNEAUX)

## XX CERATOPOGONIDAE

462. *Bezzia* sp. 1  
 463. *Dasyhelea* sp.

## XXI. SIMULIIDAE

464. *Prosimulium hirtipes* (FRIES)  
 465. *P. latimucro* (ENDERLEIN)  
 466. *P. rufipes* (MEIGEN)  
 467. *Simulium (Eusimulium) aureum* FRIES  
 468. *Nevermannia brevidens* (RUBZOW)  
 469. *N. carthusiensis* (GRENIER & DORIER)  
 470. *N. cryophilum* (RUBZOW)  
 471. *Simulium maximum* (KNOZ)  
 472. *S. monticola* (FRIEDRICH)  
 473. *S. ornatum* MEIGEN  
 474. *S. reptans* (LINNAEUS)  
 475. *S. tuberosum* (LUNDSTRÖM)  
 476. *S. variegatum* MEIGEN

## XXII. TIPULIDAE

## S.F. TIPULINAE

477. *Tipula* sp.

## S.F. LIMONIINAE

478. *Antocha* sp. 1  
 479. *Antocha* sp. 2  
 480. *Dicranota* sp. 1  
 481. *Dicranota* sp. 2  
 482. *Limnophila* sp. 1  
 483. *Hexatoma* sp. 1  
 484. *Ormosia* sp.  
 485. *Rhypholophus* sp.

## S.O. BRACHYCERA

## XXIII. ATHERICIDAE

486. *Atherix cf. marginata* (F.)

**XXIV. EMPIDIDAE**

487. *Hemerodromia* sp.  
 488. *Chelifera* sp.  
 489. *Wiedemannia* sp.1  
 490. *Wiedemannia* sp. 2

**XXV. COLLEMBOLA**

491. *Agrenia bidenticulata* (TULLBERG)  
 492. *Anurida ellipsoides* (STARCH)  
 493. *Anurida* cf. *granulata* (AGRELL)  
 494. *Anurophorus laricis* (NICOLET)  
 495. *Arrhopalites caecus* (TULLBERG)  
 496. *Ceratophysella armata* (NICOLET)  
 497. *Ceratophysella* sp.  
 498. *Deuterosminthurus bicinctus* (KOCH)  
 499. *Dicyrtomina minuta* (FABRICIUS)  
 500. *Dicyrtomidae* Gen. sp.  
 501. *Entomobrya corticalis* (NICOLET)  
 502. *Entomobrya multifasciata* (TULLBERG)  
 503. *Entomobrya nivalis* (L.)  
 504. *Entomobrya* sp.  
 505. *Folsomia candida* WILLEM  
 506. *Folsomia penicula* BAGNALL  
 507. *Folsomia quadrioculata* (TULLBERG)  
 508. *Friesea claviveta* AXELSON  
 509. *Friesea truncata* (CASSAGNAU)  
 510. *Friesea* sp.1  
 511. *Friesea* sp.2  
 512. *Heteromurus nitidus* (TEMPLETON)  
 513. *Isotoma germanica* HÜTHER & WINTER  
 514. *Isotoma notabilis* (SCHÄFFER)  
 515. *Isotoma olivacea* TULLBERG  
 516. *Isotomurus palustris* (MÜLLER)  
 517. *Isotomurus* sp.  
 518. *Lepidocyrtus lignorum* (FABRICIUS)  
 519. *Lepidocyrtus* sp.  
 520. *Onychiurus armatus* (TULLBERG)  
 521. *Onychiurus* cf. *austriacus* (BUTSCHEK)  
 522. *Onychiurus paradoxus* (SCHÄFFER)  
 523. *Onychiurus pseudogranulosus* GISIN  
 524. *Onychiurus* sp. 1  
 525. *Onychiurus* sp. 2  
 526. *Orchesella flavescens* (BOURLET)  
 527. *Pseudodisotoma sensibilis* (TULLBERG)  
 528. *Pseudosinella huetheri* STOMP  
 529. *Proisotoma* sp.  
 530. *Tomocercus* sp.  
 531. *Triacanthella perfecta* DENIS  
 532. *Xynella maritima* TULLBERG

**CRUSTACEA****CLASS BRANCHIOPODA****XXVI. CLADOCERA**

## FAM. CHYDORIDAE

533. *Acroperus* sp.  
 534. *Alona quadrangularis* O.F.M.  
 535. *Chydorus sphaericus* O.F.M.  
 536. *Chydorus* sp.

**CLASS MAXILLOPODA****COPEPODA****XXVII. O. CYCLOPOIDA**

537. *Megacyclops viridis* (JURINE)  
 538. *Paracyclops fimbriatus* (FISCHER)

**XXVIII. O. HARPACTICOIDA**

539. *Canthocamptus staphylinus* (JURINE)  
 540. *Bryocamptus zschokkei* (SCHMEIL)  
 541. *B. minutus* (CLAUS)  
 542. *B. pygmeus* (SARS)  
 543. *B. typhlops* (MRAZEK)  
 544. *Arctiocamptus cuspidatus* (SCHMEIL)  
 545. *Limnocamptus echinatus* (MRAZEK)  
 546. *Paracamptus schmeili* (MRAZEK)  
 547. *Attheyella wierzejskii* (MRAZEK)  
 548. *A. crassa* (SARS)  
 549. *Morararia poppei* (MRAZEK)  
 550. *Parastenocaris* sp.

**XXIX. CLASS OSTRACODA**

551. *Cypridopsis subterranea* (WOLF)  
 552. *Candona candida* (O.F.M.)  
 553. *C. neglecta* SARS  
 554. *Pseudocandona bilobata* (KLIE)  
 555. *P. aff. tyrolensis* LÖFFLER  
 556. *P. rostrata* BRADY & NORMAN  
 557. *P. aff. brisiaca* (KLIE)  
 558. *Pseudocandona* n.sp.  
 559. *Cryptocandona aff. vavrai* KAUFMANN  
 560. *Mixtacandona aff. laisi* (KLIE)  
 561. *Cypria lacustris* SARS  
 562. *Cyclocypris* sp.  
 563. *Eucypris pigra* (FISCHER)  
 564. *Psychrodromus fontinalis* (WOLF)  
 565. *Potamocypris* sp.  
 566. *Limnocythere sancti-patricii* BR. & ROBERT.

**CLASS MALACOSTRACA****S.O. PERACARIDA****XXX. O. AMPHIPODA**

## FAM. GAMMARIDAE

567. *Gammarus fossarum* KOCH  
 568. *Niphargus* sp.

**XXXI. O. ISOPODA**

## FAM. ASELLIDAE

569. *Proasellus slavus* (REMY)

**XXXII. PISCES**

## FAM. SALMONIDAE

570. *Oncorhynchus mykiss* (WB.)  
 571. *Salmo trutta fario* L.  
 572. *Salvelinus fontinalis* MITCHILL  
 573. *S. alpinus* (L.)

## FAM. CYPRINIDAE

574. *Phoxinus phoxinus* (L.)

## FAM. COTTIDAE

575. *Cottus gobio* L.