Craig Goch Report No. 13

Invertebrate Studies: Ystwyth and Rheidol

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Introduction

The Rivers Ystwyth and Rheidol have a history of metal pollution (Carpenter, 1924, 1925; Newton, 1944) and many reaches still receive substantial contamination from heavy metals, principally zinc and lead, although there has been considerable improvement in water quality and biological status in recent years, particularly in the r. Rheidol (Jones and Howells 1975). As a consequence of proposals to divert uncontaminated water from the headstreams of both rivers in order to provide a refill source for the enlarged Craig Goch reservoir, a surveillance programme was instituted to provide base-line data for water quality, fisheries and invertebrates. U.W.I.S.T. has implemented a programme designed to provide information on the variety, distribution and relative abundance of aquatic invertebrates: the study of other aspects has been undertaken by South West Wales River Division (1976).

Methods and Sampling Sites

Samples of invertebrates were collected with a cylinder sampler (net aperture 440 µm), modified after Neill (1938) at 6 sites on the r. Ystwyth and tributaries and 7 sites on the r. Rheidol and tributaries (Fig. 1 & Table 1). At each site 4 cylinder samples (total area $0.2m^2$) were collected across the width of a riffle. Animals were returned to the laboratory, preserved in 5% formaldehyde solution and sorted by hand. Current velocity and water depth were measured at the location of each sample.

Results from four surveys, March and September 1975 and July and September 1976are presented here. Water quality data have been provided by S.W.W.R.D. and are described in more detail elsewhere.

Results

Ystwyth Catchment

Metal concentrations within the Ystwyth catchment indicate two principal sources of contamination (Table 2). Concentrations of zinc and lead as high as 4.5 and 1.3 mg/l respectively were recorded in the tributary Nant Magwr (Y5, Fig 1). At Cwmystwyth (Y2), the most heavily contaminated site on the main river, maximum concentrations of zinc and lead were 2.3 and 0.14 mg/l respectively.

A total of 105 taxa were collected from the Ystwyth catchment over the period of study. The greatest number of taxa were recorded at Y1, where metal concentrations were lowest, and fewest taxa were recorded at Y5, where metal concentrations were highest (Tables 2 and 3). Except at Y5, which was dry in August 1976, most taxa were collected in September 1976 (Table 3).

A comparison of sites based on the similarity between their faunas using the Jaccard Index (UWIST 1976) revealed considerable variability of associated (Fig. 2).

Mean total invertebrate density at each site varied from 435-9190/m^2 over the period of study (Table 4). There was no clear relationship between total invertebrate density and metal concentrations but lowest mean densities over the period of study were recorded at Y2 and Y5.

The fauna was numerically dominated by the Insecta, particularly the Plecoptera (e.g. *Leuctra* spp, *Chloroperla* spp) and Ephemeroptera (e.g. *Baetis* spp) which at times comprised up to 90% of the total macro-invertebrate density (Table 5). Chironomidae and Simuliidae were occasionally abundant, particularly in the lower reaches. In general, Oligochaeta formed a small proportion of the fauna but in July 1976 51% of the invertebrates at Y1 were oligochaetes, principally *Nais alpina* (Appendix I).

Rheidol catchment

Metal concentrations in the Rheidol catchment were generally lower than in the Ystwyth (Table 2). Highest concentrations were recorded at R1 and R5 where mean zinc concentrations were 0.39 and 0.31 mg/l respectively and mean lead concentrations were 0.010 and 0.012 mg/l respectively (Table 2). 115 taxa were collected from the Rheidol catchment over the period of study. The highest number of taxa (68) was recorded at R3 and the lowest number from R1 (Table 6). In general, site R5, downstream of the Rheidol mine treatment works (Fig. 1) had a much richer fauna than site R4, immediately upstream of the workings. A comparison of sites based on the Jaccard Index revealed no clear pattern of association (Fig. 3).

Total invertebrate density recorded at each site over the period of study ranged from 155-4280/m^2 (Table 7). In general R1, where highest metal concentrations were recorded, supported fewer invertebrates than other sites. Site R4, upstream of the Rheidol mine treatment works generally supported lower densities than nearby sites.

In general the fauna of the Rheidol catchment was similar to the Ystwyth and was numerically dominated by Plecoptera (e.g. *Chloroperla* spp., *Leuctra* spp.) and Ephemeroptera (e.g. *Baetis* spp.) which, at times, comprised 92% of the benthic macrofauna (Table 8). Oligochaeta, Trichoptera and Diptera (Chironomidae) were abundant at certain sites and times.

The faunas at R6 and R7, which are subject to irregular and substantial discharges from Nant-y-Moch Reservoir, were not substantially different from site R5, above the discharge point.

Discussion

The faunas of both catchments were dominated by the Insecta, in particular the Plecoptera and Ephemeroptera, and these results are similar to the findings of other workers (Carpenter 1924, Jones 1958, A. Jenkins *pers. comm.*). At most sites the number of invertebrate taxa and total densities were similar to those recorded in the uncontaminated upper reaches of the R. Wye over the same period (Table 9) confirming

the general improvement in biological status of the Ystwyth and Rheidol in the last fifty years (Carpenter 1924, Laurie and Jones 1938, Jones and Howells 1975).

Carpenter attributed the absence of Platyhelminthes, Mollusca, Trichoptera, Crustacea, Oligochaeta and Hirudinea in these streams to lead mine wastes. Jones, (1940, 1958), following later studies, suggested that the absence of molluscs and malacostracans resulted from pollution but that the rarity of triclads, oligochaetes and leaches probably resulted from the scouring action of mine refuse and rubble. The concentrations of metals known to be acutely toxic to molluscs and malacostracans (Wurtz 1962, Brown 1976) were exceeded at many sites, particularly in the Ystwyth catchment, but Edwards *et al* (1977) reported that in the neighbouring Wye catchment molluscs other than *Ancylus* and malacostracans occur only at sites where calcium concentrations exceed a mean value of 10mg/l. The highest concentrations of calcium in the Ystwyth and Rheidol catchments were calculated to be 6 and 4 mg/l respectively (Cremer and Warner 1974) and it seems unlikely that these organisms would be found in these rivers even if unpolluted.

Data linking the invertebrate status of the Ystwyth and Rheidol catchments with metal contamination are inconclusive. Y5, the most heavily contaminated site, had fewer taxa and generally lower densities than nearby sites but such a comparison is confused by differences in the physical size of the sites (e.g. Y5 approx. 2.5m wide, Y4 approx 16m wide); in addition Y5 ran dry in August 1976. Y2 supported fewer taxa than the relatively uncontaminated Y1 upstream but density differences were not statistically significant.

Factors other than measured metal concentrations are clearly of major importance in determining invertebrate status and this is indicated by a comparison of the three most polluted sites Y5, Y2 and R1. Fish have not been recorded from Y5 or Y2 and their absence has been attributed to metal contamination (S.W.W.R.D. 1976). In contrast, R1, a headstream tributary which had a lower concentration of metals and supported fish populations, sustained the poorest invertebrate fauna.

The paucity of invertebrate fauna at R4, upstream of the treatment works at Rheidol mine can probably be attributed to the nature of the substrate and the possible upwelling of mine effluent from the bed of the river (R. Milne, *pers. comm.)*.

Data collected from the lower reaches of the R. Rheidol suggest that releases of generating water from Nant-y-Moch reservoir have no major effect on the invertebrate community.

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Figures

Table 1

Sampling sites on R. Ystwyth and R. Rheidol

Ystwyth Catchment	Rheidol Catchment
Y1. R. Ystwyth at Tymawr (SN 815 748)	R1. Afon Myherin (SN 771 782)
Y2. R. Ystwyth below Cwmystwyth Mine (SN 790 738)	R2. Nant Rhuddnant (SN 774 776)
Y3. R. Ystwyth at Grogwynion (SN 715 720)	R3. R. Mynach (SN 755 770)
Y4. R. Ystwyth at Trawscoed (SN 666 729)	R4. R. Rheidol above mine (SN 731 780)
Y5. Nant Magwr (SN 672 744)	R5. R. Rheidol below mine (SN 725 781)
Y6. R. Ystwyth at Llanilar (SN 618 756)	R6. R. Rheidol at Tycam (SN 681 792)
	R7. R. Rheidol at Capel Bangor (SN 649 798)

Table 2

Metal concentrations (mg/l) in the Ystwyth (April 1975 – January 1977) and Rheidol (January 1976 – January 1977) catchments (Data supplied by S.W.W.R.D.)

Site	Lead		Zinc		Cadmium	
	Mean	Range	Mean	Range	Mean	Range
Y1	0.008	0.0006 – 0.042	0.018	0.004 – 0.060	0.0008	0.0001 – 0.002
Y2	0.071	0.030 – 0.141	0.637	0.137 – i2.250	0.0019	0.0005 – 0.0041
Y3	0.061	0.020 – 0.148	0.507	0.174 – 0.945	0.0007	0.0005 – 0.0040
Y4*	0.037	0.010 – 0.139	0.440	0.267 – 0.690	0.0021	0.0010 – 0.0030
Y5	0.127	0.020 – 1.328	1.912	0.910 – 4.538	0.0042	0.0020 – 0.0086
Y6	0.022	0.002 – 0.100	0.421	0.113 – 0.900	0.0014	0.0004 – 0.0033
R1	0.010	0.002 – 0.086	0.290	0.29 – 0.660	0.0013	0.0008 – 0.0020
R2	0.004	0.001 – 0.042	0.013	0.001 – 0.037	0.0005	0.0001 – 0.0010
R3	0.006	0.001 – 0.029	0.170	0.080 – 0.280	0.0008	0.0005 – 0.0014
R4	0.011	0.001 – 0.074	0.119	0.064 – 0.230	0.0009	0.0004 – 0.0014
R5	0.012	0.001 – 0.073	0.305	0.145 – 0.396	0.0014	0.0008 – 0.0042
R6	0.008	0.002 – 0.042	0.339	0.168 – 0.502	0.0012	0.0007 – 0.0024

* April 1975 – January 1976

Table 3

Total number of taxa at sites in Ystwyth Catchment

	1975		1976		Total
	March	September	July	September	
Y1	15	30	27	39	72
Y2	18	26	15	37	60
Y3	19	30	21	32	58
Y4	22	17	32	43	65
Y5	17	18	24	19	42
Y6	26	22	25	48	65

Table 4

Total densities of macroinvertebrates (No./m^2) at sites in Ystwyth catchment

	1975		1976		Total
	March	September	July	September	
Y1	750	830	2165	1350	1273
Y2	1480	670	435	1245	957
Y3	910	2445	1190	1820	1591
Y4	1355	2180	4590	4115	3060
Y5	1270	1565	1560	1325	1098
Y6	2400	4170	4855	9190	5153

Table 5

Proportional representation (% total numbers of major groups in the Ystwyth catchment)

	Platy.				Oligochaeta				Plecoptera				Ephemeroptera				Trichoptera			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
Y1	-	11	-	2	4	5	51	6	83	36	4	9	3	6	<1	39	1	8	1	13
Y2	-	2	-	-	-	<1	-	-	70	20	36	12	<1	28	1	16	1	10	13	14
Y3	-	2	-	1	2	<1	-	-	70	11	26	20	13	70	55	34	1	5	5	10
Y4	<1	3	-	<1	-	-	<1	-	42	23	14	16	20	56	32	27	3	1	3	14
Y5	1	10	9	8	-	-	-	<1	35	25	4	13	51	42	33	35	3	9	5	8
Y6	-	-	-	<1	-	-	-	<1	69	17	4	12	14	73	44	17	1	2	9	17

	Coleoptera				Chironomidae				Simuliidae				Others			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
Y1	-	21	2	6	5	6	39	11	3	<1	-	14	1	6	2	1
Y2	<1	19	5	9	26	18	43	30	<1	2	3	6	<1	<1	<1	4
Y3	3	6	2	12	7	<1	6	6	-	4	<1	14	4	3	6	3
Y4	1	11	<1	4	3	<1	6	10	30	4	44	28	<1	2	<1	9
Y5	-	1	3	<1	1	<1	37	25	9	3	3	-	-	9	6	1
Y6	1	2	4	4	13	4	5	4	1	1	34	44	1	1	<1	5

M = March 1975
S_1 = September 1975
J = July 1976
S_2 = September 1976

Table 6

Total number of taxa at sites in Rheidol catchment

	1975		1976		Total
	March	September	July	September	
R1	13	14	18	13	34
R2	9	17	40	32	59
R3	19	14	34	51	68
R4	18	18	23	18	46
R5	13	26	27	31	54
R6	20	23	51	42	67
R7	22	22	36	37	65

Table 7

Total densities of macroinvertebrates (No./m^2) at sites in the Rheidol catchment

	1975		1976		Mean 1975-6
	March	September	July	September	
R1	495	570	325	155	386
R2	1045	630	4280	1380	1833
R3	1355	430	2743	3660	2047
R4	720	530	545	435	557
R5	465	760	1405	1065	923
R6	1495	880	3480	2640	2123
R7	1645	895	2215	1445	1550

Table 8

Proportional representation (% total numbers of major groups in the Rheidol catchment)

	Platy.				Oligochaeta				Plecoptera				Ephemeroptera				Trichoptera			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
R1	<1	-	1	-	<1	-	-	-	91	38	35	45	<1	54	42	39	<1	4	3	10
R2	2	8	-	<1	-	<1	22	46	92	12	17	21	-	57	3	21	1	6	5	1
R3	-	-	-	<1	-	-	1	1	83	16	15	13	-	73	24	20	2	3	1	37
R4	2	1	-	1	<1	17	9	23	52	39	28	18	8	27	33	36	24	3	6	6
R5	3	1	3	1	36	4	9	27	44	17	29	18	9	20	7	16	-	27	29	26
R6	2	5	4	7	2	7	13	10	51	22	20	16	18	6	6	4	15	45	13	41
R7	<1	2	2	4	<1	30	4	24	54	42	11	10	33	7	13	8	7	<1	23	30

	Coleoptera				Chironomidae				Simuliidae				Others			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
R1	<1	-	9	-	3	-	3	3	-	2	6	-	2	2	<1	3
R2	-	3	4	2	2	-	46	5	2	2	<1	1	1	11	3	3
R3	1	-	<1	3	3	-	6	23	9	-	49	2	2	8	2	2
R4	10	1	11	6	2	-	7	2	-	2	3	1	1	11	3	7
R5	-	18	8	5	4	1	15	2	-	-	1	1	4	12	<1	3
R6	8	3	4	4	3	3	32	14	<1	-	6	1	1	9	1	5
R7	1	7	1	13	6	2	11	5	-	<1	26	<1	3	8	9	5

M = March 1975
S_1 = September 1975
J = July 1976
S_2 = September 1976

Table 9

Taxa and density (No./m^2) collected at upstream sites, R. Wye

Site	1975				1976			
	March		September		March		September	
	Taxa	Density	Taxa	Density	Taxa	Density	Taxa	Density
W1	23	945	19	635	35	2445	28	1165
W2	22	1285	39	1895	42	3310	32	1195
W3	29	1360	36	1110	50	3030	29	655
W4	33	2730	43	1705	43	2255	46	3570

Invertebrate Studies: Ystwyth & Rheidol - (Appendix to UWIST CGR No. 13)

	Y1				Y2				Y3				Y4				Y5				Y6			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
Coelenterata																								
Hydra sp.	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Platyhelminthes																								
Planaria torva (O.F. Muller)	-	-	-		-	-	-	-	-	5	-	-	-	-	-	-	-	120	105	-	-	-	-	15
Polycelis feline (Dalyell)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycelis tenuis/nigra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phagocatta vitta (Duges)	-	70	-	30	-	10	-	110	-	-	-	15	5	60	-	15	20	35	35	105	-	-	-	10
Annalida (Oligochaeta)																								
Naidae																								
Nais alpine Sperb.	-	-	1095	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nais elinguis Mull.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tubificidae																								
Peloscolex ferox (Eisen)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lumbricilidae																								
Lumbriculu variegates (Mull)	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	10
Stylodrilus herangianus Clap.	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-
Enchytraeidae	30	25	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lumbricidae																								
Eiseniella tetrahedral (Savigny)	-	-	-	10	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Annalida (Hirudinea)																								
Glossosiphoniidae																								
Helobdella stanalis (L.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Erpobdellidae																								
Erpobdella octoculata (L.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arthropoda (Insecta)																								
Leuctridae																								
Leuctra hippopu (Kempny)	15	-	15	-	30	-	-	-	5	-	60	5	-	-	240	40	-	-	20	15	5	-	-	20
Leuctra moselyi (Morton)	-	-	55	-	-	30	120	10	-	5	205	10	-	-	245	5	95	5	40	-	-	40	5	5
Leuctra inermis (Kempny)	50	-	5	-	405	-	25	-	35	-	20	-	10	-	30	-	-	-	-	-	20	-	-	-
Small indet. Leuctra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
Nemouridae																								
Protonemura meyeri (Pictet)	-	10	-	-	20	-	-	40	10	25	-	135	45	-	-	15	-	85	-	50	35	15	-	25

	Y1				Y2				Y3				Y4				Y5				Y6			
	M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
Amphinemura sulcicollis (Stephens)	145	15	-	35	110	20	-	40	125	35	-	-	60	-	-	-	50	55	-	10	185	15	-	-
Nemoura sp. indet.	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chloroperlidae																								
Chloroperla torrentium (Pictet)	80	-	20	10	240	-	10	25	35	-	5	95	45	-	110	95	45	-	5	20	5	-	170	170
Chloroperla tripunctata (Scopoli)	325	70	-	25	220	40	-	30	420	195	20	125	375	510	10	465	65	235	-	75	1375	635	15	855
Perlodidae																								
Isoperla grammatical (Poda)	20	130	-	45	10	40	-	10	5	5	-	-	10	-	-	25	10	-	-	-	10	-	-	20
Perlodes microcephala (Pictet)	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Taeniopterygidae																								
Brachyptera risi (Morton)	5	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-	170	-	-	-	25	-	-	-
Rhabdiopteryx acuminata Klapalek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
Taeniopteryx nebulosa (L.)	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetidae																								
Baetis rhodani (Pict)	15	205	-	415	5	175	-	160	60	845	120	265	75	695	835	295	40	395	385	425	140	2405	710	920
Baetis scambus Etn.	-	-	15	75	-	-	5	35	-	-	480	-	5	-	565	-	-	-	110	5	-	-	1175	50
Baetis muticus (L.)	-	25	-	-	-	5	-	-	-	25	-	-	-	-	35	-	-	-	-	-	-	30	100	40
Baetis vernus (Curt)	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenidae																								
Caenis rivulorum Etn	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ephemerellidae																								
Ephemerella ignita (Poda)	-	-	5	-	-	-	-	-	-	-	40	-	-	-	50	-	-	-	5	-	-	-	120	-
Heptageniidae																								
Ecdyonurus venosus (Fabr.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-	-
Ecdyonurus dispar (Curt)	-	-	-	20	-	-	-	-	10	-	-	5	-	-	-	5	-	-	-	-	-	25	-	-

R1				R2				R3				R4				R5				R6				R7			
M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
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-	-	-	-	-	45	-	-	-	-	-	10	-	5	-	-	-	15	-	5	-	5	-	-	-	-	15	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	80	-	-	15	-
-	-	-	-	-	-		-	-	-	-	-	15	-	-	-	15	-	-	-	-	40	100	85	-	5	5	25
-	-	5	-	20	5	-	10	5	-	-	5	-	-	-	5	-	-	35	10	30	-	5	10	5	10	10	10
-	-	-	-	-	5	955	625	-	-	5	-	-	-	35	90	-	-	-	20	-	-	5	15	-	-	-	10
-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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-	-	-	-	-	-	-	-	-	-	-	-	-	85	10	5	-	15	-	-	-	25	10	10	-	150	-	50
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	65	-	-	25	-	-	25	15	5	-	-	10
-	-	-	-	-	-	-	-	20	-	25	-	-	10	-	-	105	10	55	-	15	15	305	-	-	-	10	-
-	-	-	-	-	-	-	10	-	-	-	10	-	-	5	-	-	-	70	100	-	-	75	65	-	-	80	110
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-
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-	-	45	-	-	-	325	10	20	-	100	25	-	-	135	40	-	-	165	5	-	-	645	160	5	-	45	10
-	10	30	-	-	10	245	170	-	-	5	150	-	140	-	5	-	40	205	5	-	480	5	20	-	260	-	5
135	-	-	5	100	-	120	-	430	-	5	-	15	-	-	-	15	-	15	5	625	5	20	10	700	25	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
20	5	-	5	5	-	-	15	-	10	5	70	-	20	-	5	-	65	-	30	25	-	-	5	20	-	-	-

R1				R2				R3				R4				R5				R6				R7			
M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
120	-	-	-	125	-	5	10	175	-	-	20	15	-	-	-	5	-	-	40	165	-	-	30	105	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
55	145	30	30	710	15	25	30	390	25	190	10	40	40	15	-	-	10	15	85	50	80	30	25	5	110	-	10
50	50	10	30	-	-	20	30	75	25	100	170	320	5	-	30	145	5	5	20	-	45	5	175	30	45	195	115
25	10	-	15	30	55	-	20	155	10	-	-	-	-	-	-	10	5	-	-	45	5	-	-	35	-	-	-
-	-	-	-	-	-	-	10	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	15	-	-	-		-	-	-	5	-	-	-	-	-	-	-	15	-	-	-
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-	290	15	15	-	360	15	165	5	230	170	300	-	130	25	145	-	145	45	115	105	45	5	80	220	70	90	15
-	-	40	5	-	-	80	25	-	-	325	40	-	-	50	-	-	-	45	-	-	5	55	15	20	10	50	40
-	-	5	10	-	-	5	-	-	-	170	5	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-
-	-	65	25	-	-	-	15	-	-	-	10	-	-	-	-	-	-	10	5	-	-	-	-	-	-	-	-
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-	-	5	-	-	-	5	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	135	-	-	-	150	5
-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	25	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	20	-	-	-	65	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-

	Y1				Y2				Y3				Y4				Y5				Y6			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
Heptagenia sulpurea (Mull)	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Rhitrogena semicolorata (Curt.)	-	5	-	15	-	-	-	-	55	840	-	355	185	540	-	825	615	250	10	345	150	625	5	545
Leptophlebiidae																								
Paraleptophlebia cincta (Brauer)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glossosomatidae																								
Glossosoma conformis (Neboiss)	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	125	50
Glossosoma (intermedium?)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydropsychidae																								
Hydropsyche siltalai (Dohler)	-	5	-	130	-	30	-	170	10	85	15	70	25	5	40	445	5	115	45	60	25	50	95	1270
Hydropsyche pellucidula (Curtis)	-	-	-	-	-	-	-	5	-	15	-	85	-	-	80	35	5	-	10	45	-	5	195	180
Cheumatopsyche lepida (Pictet)	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ploycentropidae																								
Polycentropus flavomaculatus (Pictet)	-	30	-	-	-	20	-	-	-	10	-	-	-	10	-	-	-	-	-	-	5	-	-	-
Polycentropus kingi (McLachlan)	-	-	30	5	-	-	50	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	10
Plectrocnemia conspersa (Curtis)	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
'Holocentropus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beraeidae																								
Beraeidae sp. indet.	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	40	-	-	-	5	-	-	-	20
Rhyacophilidae																								
Rhyacophila dorsalis (Curtis)	-	15	-	25	5	15	5	5	-	10	-	15	10	-	15	35	10	5	20	-	5	5	5	70
Sericostomatidae																								
Sericostoma personatum (Spence)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lepidostoma hirtum (F)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae																								
Potamophylax cingulatus?)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drusus annulatus (Stephens)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydroptilidae Larvae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Y1				Y2				Y3				Y4				Y5				Y6			
	M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
Dytiscidae																								
Oreodytes sanmarki	-	5	5	-	-	-	5	-	-	-	-	-	-	-	5	-	-	-	-	-	-	30	-	-
Larvae (indet.)	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gyrinidae																								
Larvae (indet.)	-	-	-	-	-	-	-	5	-	-	-	-	-	30	-	5	-	-	-	10	5	60	-	205
Hydrophilidae																								
Hydraena gracilis (Germer)	-	-	10	-	-	-	5	-	5	15	5	5	5	200	5	15	-	-	15	-	-	-	-	5
Larvae (indet.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elminthidae																								
Elmis aenea (P. Mull)	-	20	-	10	-	30	-	5	-	20	-	10	-	5	10	5	-	-	-	-	-	5	-	-
Esolus parallelopipedus (P. Mull)	-	-	10	20	10	20	-	10	-	15	20	25	5	5	5	10	-	-	-	-	10	-	190	10
Limnius volkmari (Panzer)	-	10	20	20	-	70	5	85	10	90	10	5	5	-	5	5	-	15	-	-	-	5	5	20
Oulimnius tuberculatus (P. Mull)	-	95	-	25	-	-	-	10	15	5	-	-	-	-	-	5	-	-	-	5	10	-	-	-
Coleoptera larvae (indet.)	-	-	-	5	-	-	-	-	-	-	-	170	-	-	-	120	-	-	-	-	-	-	-	150
Rhagionidae																								
Atherix sp.	-	20	10	-	-	-	-	20	15	40	-	45	5	-	10	5	-	170	105	80	5	-	-	15
Tipulidae																								
Dicranota sp.	10	10	-	-	30	10	-	-	10	10	-	-	-	-	-	-	-	5	-	-	-	-	-	-
Indet.	-	5	-	5	-	5	-	15	-	-	-	-	-	-	5	10	-	5	10	5	-	-	-	15
Ephydridae																								
Ephydra sp.	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Empididae																								
Clinocera sp.	-	5	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	5	-	-
Hemerodroma sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tabanidae																								
Indet.	-	-	-	5	-	-	-	5	-	30	10	10	-	5	-	5	-	15	5	40	-	5	15	15
Chironomidae																								
Diamesa (insignipes? = prolongata)	10	-	-	-	105	-	-	5	5	-	-	5	-	-	-	-	-	-	-	-	-	-	-	10
Potthastia longimana?	10	-	-	5	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potthastia gaedii	-	5	425	-	-	-	-	110	-	-	5	-	-	5	-	-	-	-	-	-	-	-	-	-
Procladius sp. 1	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rheopelopia eximia?	-	5	90	10	-	55	50	5	-	-	90	5	-	-	120	-	-	-	25	-	-	-	85	-

R1				R2				R3				R4				R5				R6				R7			
M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
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-	5	-	5	-	-	-	60	-	65	-	300	65	-	-	-	43	-	-	55	180	-	-	-	310	-	-	60
-	-	-	-	-	5	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	10	5	5	-	5	-	-	105	-	-	-	-	-	-	-	65	-	5	-	-	-	90	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	90	-
-	15	-	-	-	5	5	5	-	-	20	1155	10	15	20	10	-	75	280	110	170	215	220	745	80	-	20	220
-	-	-	10	-	-	-	-	-	5	-	125	25	-	15	15	-	105	55	165	-	180	170	285	15	5	295	195
-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	10	45	-	-	5	-	-	-	5	-	-	-	15	-	-	-	5	-	-	5	-	-	-
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-	5	10	-	-	15	60	10	10	-	20	40	10	-	-	-	-	5	35	-	5	-	70	30	-	-	5	5
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R1				R2				R3				R4				R5				R6				R7			
M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
-	-	-	-	-	-	60	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	5	-	5	60	5	-	5	-	10	-	15	5	20	-	30	-	5	-	125
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
-	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
5	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	5	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	10	5	-	5	15	-	-	10	15
-	-	10	-	-	20	15	5	10	-	20	20	15	-	30	20	-	135	105	25	120	15	135	20	15	10	5	10
-	-	20	-	-	-	10	10	-	-	5	45	-	5	-	-	-	-	-	-	-	10	10	30	-	5	-	45
-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	10	-	-	5	-	-	60	30	-
10	5	-	5	40	55	90	35	-	5	40	35	5	5	5	30	-	5	-	5	-	-	-	-	30	10	-	-
-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	10	10	-	-	-	5	10
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35	-	-	-	10	-	-	15	5	-	-	-	-	-	-	5	-	-	-	-	-	-	10	-	-	-	-	-
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-	5	-	-	-	-	135	15	5	-	60	65	5	-	5	-	-	5	45	-	-	10	570	130	-	10	130	10

	Y1				Y2				Y3				Y4				Y5				Y6			
	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
Pentaneurini sp. 2	-	-	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conchapelopia pallidula?	-	-	-	5	-	-	5	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	-
Eukiefferiella clypeata?	-	5	15	-	5	-	-	-	-	5	-	-	-	5	30	-	-	-	-	-	-	120	60	30
Eukiefferiella calvescens?	5	-	-	5	-	-	-	-	5	-	-	-	-	-	15	10	-	-	-	-	-	-	-	30
Eukiefferiella bavarica?	-	-	-	15	-	5	-	-	-	-	-	-	-	-	-	285	-	-	-		10	25	15	65
Eukiefferiella hospital?	-	-	-	-	35	-	-	5	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	5
Eukiefferiella brevicalcar?	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eukiefferiella atrfasciata?	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eukiefferiella ilkleyensis?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brillia modesta (Mg)	-	-	5	-	-	30	-	-	-	-	-	-	-	-	-	5	5	20	-	-	-	-	-	-
Orthocladius sp. 1	-	-	5	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthocladius rubicundus?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthocladius sp. 3	-	-	10	-	-	-	-	15	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Orthocladius sp. indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthocladius sp. 5	-	-	10	-	205	-	-	-	50	-	-	-	40	-	-	-	5	-	-	-	280	-	-	-
Orthocladius sp. 14	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synorthocladius semivirens (K)	-	-	35	25	-	-	-	10	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Microcricotopus Rectinervis (K)	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
Rheocripcotopus sp.	-	-	-		-	-	-		-	-	-		-	-	-		-	-	-		-	-	-	
Cricotopus trifascia	-	-	25	10	-	-	15	35	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-
Cricotopus bicinctus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus sp. 1	-	-	55	40	-	15	45	130	-	-	-	20	-	-	-	10	-	-	-	-	-	-	-	15
Cricotopus sp. 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus albiforceps?	10	-	-	-	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conynoneura sp. 1	-	5	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lymnophy es exiguus?	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichocladius sp. ?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thienemaniella sp. 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum nubeculosum	-	-	25	-	-	-	70	-	-	-	5	65	-	-	70	40	5	-	555	330	-	-	95	145
Polypedilum convictum	-	-	-	-	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Polypedilum scalaenum	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rheotanytarsus sp. 1	-	-	-	5	-	-	-	-	-	-	5	-	-	-	-	5	-	-	5	-	-	-	-	-
Microtendipes chloris?	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Demicryptochironomus vulneratus (Zett)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lauterbornia sp. 1	-	5	90	20	-	10	-	10	-	5	-	5	-	-	15	20	-	-	-	-	-	5	10	20
Zavrelia pentatoma?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratopogenidae																								
Atrichopgon sp.	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	5
Indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	5	-

	Y1				Y2				Y3				Y4				Y5				Y6			
	M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
Simuliidae																								
*Simulium latipes (*Mg)	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium brevicaule (Dorier & Grenier)	-	-	-	-	-	-	-	-	-	-	-	70	5	-	115	-	-	-	-	-	5	-	-	-
Simulium monticola (Fried)	-	-	-	40	-	-	-	35	-	-	-	35	340	-	125	50	80	-	20	-	15	-	-	35
Simulium ornatum (Meig.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Simulium variegatum (Meig.)	-	-	-	5	5	10	-	-	-	80	-	5	55	85	105	100	45	40	5	-	-	60	60	415
Simulium nitidfrons (Edw.)	-	-	-	70	-	-	15	20	-	-	-	40	-	-	-	330	-	-	-	-	5	-	-	2700
Simulium aureum (grp.)	-	5	-	75	-	-	-	20	-	5	-	95	-	-	-	645	-	-	-	-	-	-	-	655
Simulium equinum (grp.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Simulium reptans typ. (L.)	-	-	-	-	-	-	-	-	-	-	5	15	-	-	1775	20	-	-	15	-	-	-	1580	175
Simulium spinosum Dolby & Deblock	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium tuberosum (Lund)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Simulium indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arthropoda (Arachnida)																								
Hydracarina	-	-	15	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	10	5
Mollusca																								
Ancylidae																								
Ancylus fluviatilis (Mull)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	5	30

R1				R2				R3				R4				R5				R6				R7			
M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2	M	S_1	J	S_2
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10	-	-	-	5	-	-	5	10	-	15	5	5	-	-	-	20	-	-	-	-	5	10	-	10	5	5	-
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R1				R2				R3				R4				R5				R6				R7			
M	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**	**M**	**S_1**	**J**	**S_2**
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15	10	-	-	-	5	-	-	-	-	-	-	-	10	-	-	-	15	-	-	5	-	95	-	-	-	-	-
-	10	10	-	-	-	-	-	-	15	980	55	-	20	-	-	-	-	-	5	-	-	55	-	-	-	5	-
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