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A BIOLOGICAL INVESTIGATION OF THE AFFECTS OF DISCHARGES FROM MELDON QUARRY
ON THE WEST OKEMENT RIVER - 8/09/89 AND 20/09/89

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## **SUMMARY**

5 sites on the West Okement and Okement rivers were sampled before and after drought of 1989 broke. The discharge of Meldon Quarry stream was found to cause a severe reduction in both numbers and diversity of the aquatic fauna before and after the drought broke. There is no evidence that severe acid conditions occured at any of the other sites investigated.

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## INTRODUCTION

A biological investigation of the effects of acidic flushes in the West Okement and Okement rivers was requested by the Water Quality Planner (B.Milford). These rivers had previously been subject to acidic metal-rich flushes following rainfall at the end of long drought periods.

## **METHODS**

Samples were taken using a 3 minute kick method with a 1.0 mm mesh pond net. Samples were taken in a riffle area at each site and preserved on site with formaldehyde. The initial samples were taken on the 8/9/89 while the river was still experiencing drought conditions. The drought broke on the 13/9/89 and further survey was carried out on the 20/9/89. The samples were sent up to Queen Mary College, London where they were sorted and identified by the Centre for Research in Aquatic Biology (CRAB).

## RESULTS

Macroinvertebrate sampling sites are shown in figure 1. A more detailed map of the West Okement sites is given in figure 2. Species of macroinvertebrates obtained during both surveys is shown in tables 1 (8/9/89) and 2 (20/9/89).

## DISCUSSION

## Site 1 - West Okement downstream of Meldon Viaduct

This site was located just below Meldon Viaduct (NGR SX56439240) above any of the main quarry discharges. The substrate was found to be clear of any iron deposits and consisted mainly of cobbles/pebbles with some gravel and silt. The river was shallow, fast flowing and clear. Sampling on the 8/9/89, while the river was still in drought conditions, produced a typical moorland macroinvertebrate fauna with moderate numbers of Baetis rhodani, Ecdyonurus sp., Perlodes microcephala, Dinocras cephalotes, Rhyacophila dorsalis and Lumbriculidae. None of the taxa indicated severe acid conditions. Sampling on the 20/9/89, 7 days after spate conditions, found no great changes in numbers or diversity.

Site 2 - West Okement upstream of Meldon Quarry pipe

This site was located about 100 metres above the Quarry pipe (NGR SX56489383). Substrate and flow conditions were as for site 1. Sampling on the 8/9/89 revealed a broadly similar macroinvertebrate fauna to site 1. Leuctra fusca and Hydropsyche siltalai were the only common taxa found which were absent from site 1. Sampling on the 20/9/89 found a reduction in species but no great effect on numbers. However as many of the taxa found are known to be sensitive to very acid conditions it would be more probable that the spate rather than acidity was responsible for the observed changes.

Site 3 - West Okement downstream of Meldon Quarry pipe

This site was located about 30 metres downstream of the Quarry pipe and about 30 metres above the road drain which carries the Meldon Quarry stream discharge (NGR SX56489399). Substrate was similar to site 1 except for a heavy deposition of iron together with some algae. Sampling on the

8/9/89 revealed a similar fauna to site 1. Several acid sensitive taxa such as <u>Baetis rhodani</u> and <u>Ecdyonurus</u> sp. were found in moderate numbers. Resampling on the 20/9/89 revealed a slight drop in numbers of species although <u>Baetis rhodani</u> was still present. There is no significant indication that severe acid problems occured here. Slight effects are indicated but this is more likely to be due to the substrate conditions.

Site 4 - West Okement downstream of Meldon Quarry stream

This site was located 200 metres below the A30 road bridge (NGR SX56599321) approximately 800 metres below site 1. Between these two sites both the Quarry effluent pipe and drainage from the A30 road bridge enter the river. The substrate and flow conditions were similar to site 1 except large deposits of iron from the Quarry effluent pipe were infilling the substrate. Some algae was present found amongst the deposits. Sampling on the 8/9/89 found low numbers of Lumbriculidae only. Resampling on the 20/9/89 found single examples of Leuctra fusca, Lumbriculidae and Glossoscolecidae. On this occasion most of the iron deposition had been flushed from the site by the higher flows. The entry of the two effluents had a marked effect on the macroinvertebrate fauna before and after the breaking of the drought. As a consequence little change occured immediately below the inputs as an impoverished invertebrate fauna already existed.

Site 5 - Okement upstream of Brightley stream

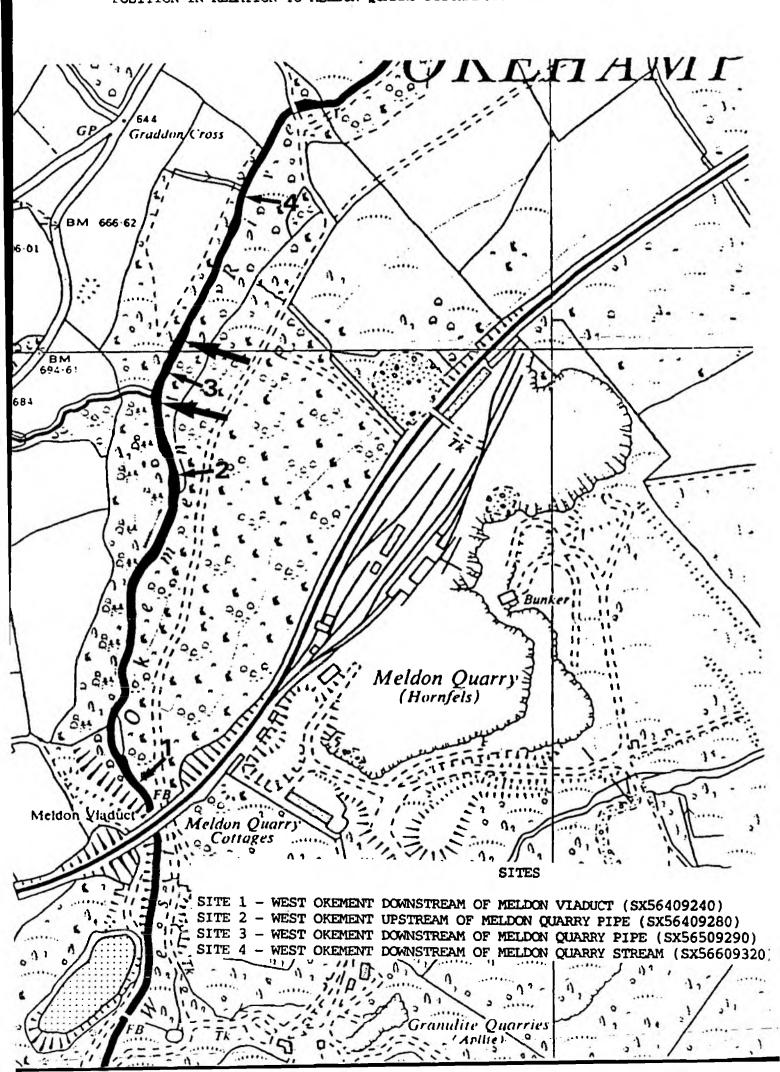
This site is located 100 metres upstream of the entry point of the Brightley stream into the Okement river. The substrate was found to be similar to site 1 with the addition of some areas of bedrock. No deposits of iron were apparent on the substrate but thick growths of algae were found in the pools and slack areas. The macroinvertebrate fauna on the 8/09/89 was similar to that found at sites 1 and 2. Resampling on the 20/09/89 found little change except several of the taxa were present in lower numbers. There was no significant indication of severe acid conditions at this site.

# CONCLUSIONS

- 1. The entry of the Meldon Quarry pipe between sites 2 and 3 had no major impact on the macroinvertebrate fauna. Although a large amount of iron had been deposited on the stream bed downstream of the tunnel there was no evidence that severe acid conditions had occured downstream of the discharge pipe.
- 2. The entry of the Meldon Quarry stream between sites 3 and 4 was found to cause a severe reduction in both numbers and the diversity of the macroinvertebrate fauna. This effect was present before the drought broke. No effect of the breaking of the drought could be detected at this site as a very poor fauna already existed.
- 3. The river Okement prior to the Brightley stream produced a similar fauna to that recorded above the discharges from Meldon Quarry. There was no evidence to suggest severe acid conditions had occured at this site either before or after the drought broke.

FIGURE 1. MACROINVERTEBRATE SAMPLING SITES ON THE WEST OKEMENT AND OKEMENT LAT 50" 46" 98 FORD CT 96 Sticklepath 2) Miles SITES SITE 1 - WEST OKEMENT DOWNSTREAM OF MELDON VIADUCT (SX56409240) SITE 2 - WEST OKEMENT UPSTREAM OF MELDON QUARRY PIPE (\$X56409280) SITE 3 - WEST OKEMENT DOWNSTREAM OF MELDON QUARRY PIPE (SX56509290) SITE 4 - WEST OKEMENT DOWNSTREAM OF MELDON QUARRY STREAM (SX5660932-SITE 5 - OKEMENT UPSTREAM-OF BRIGHTLEY STREAM (SX59609710)

FIGURE 2. MACROINVERTEBRATE SAMPLING SITES ON THE WEST OKEMENT SHOWING POSITION IN RELATION TO MELDON QUARRY DISCHARGES



| IDENTIFYING OFFICER  1 = 1, 2 = 2-10  HEMEROPTERA BAETIDAE Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE Paraleptophlebia cincta ECOPTERA | CRAB | 2<br>TRG<br>8/9/89<br>CRAB<br>11-100, | CRAB 4 = 101- | 4<br>TRG<br>8/9/89<br>CRAB | CRAB |
|---|------|---------------------------------------|---------------|----------------------------|------|
| HEMEROPTERA BAETIDAE Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE Paraleptophlebia cincta  | 2    | 3<br>1                                | 3             | 1000, 5                    |      |
| HEMEROPTERA BAETIDAE Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE Paraleptophlebia cincta ECOPTERA                                       | 2    | 3<br>1                                | 3             |                            |      |
| Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE Paraleptophlebia cincta LECOPTERA   | 2    | 1                                     |               |                            | 2    |
| EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE Paraleptophlebia cincta ECOPTERA   | 2    | 1                                     |               |                            | -    |
| Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE Paraleptophlebia cincta ECOPTERA  | 2    |                                       | A.            |                            |      |
| Ecdyonurus sp.  LEPTOPHLEBIIDAE  Paraleptophlebia cincta ECOPTERA   | 2    | 3                                     |               |                            |      |
| DEPTOPHLEBIIDAE Paraleptophlebia cincta ECOPTERA  | 2    | 3                                     | •             |                            | -    |
| Paraleptophlebia cincta<br>ECOPTERA   |      |                                       | 1             |                            | 3    |
| ECOPTERA  |      |                                       |               |                            | 2    |
| T.EUCMD TO A D  |      |                                       |               |                            |      |
| LEUCTRIDAE  |      |                                       | 100           |                            | 2    |
| Leuctra fusca<br>PERLIDAE   |      | 3                                     | 3             |                            | 3    |
| Dinocras cephalotes   | 2    | 1                                     |               |                            |      |
| PERLODIDAE  | 75   |                                       |               |                            |      |
| Perlodes microcephala   | 2    | 2                                     | 2             |                            | 1    |
| RICHOPTERA  |      |                                       |               |                            |      |
| GLOSSOSOMATIDAE<br>Glossosoma sp.   |      |                                       |               |                            | 1    |
| HYDROPSYCHIDAE  |      |                                       |               |                            |      |
| Hydropsyche pellucidula   |      |                                       |               | £                          | 2.0  |
| Hydropsyche siltalai  |      | 2                                     |               |                            | 3    |
| LIMNEPHILIDAE<br>POLYCENTROPIDAE  |      |                                       |               |                            |      |
| Plectrocnemia geniculata  |      |                                       |               |                            |      |
| Polycentropus flavomaculatus  | 1    | 2                                     | 2             |                            |      |
| RHYACOPHILIDAE  |      |                                       |               |                            | 2    |
| Rhyacophila dorsalis  | 3    | 2                                     | 2             |                            | 1    |
| OLEOPTERA<br>ELMIDAE  |      |                                       |               |                            |      |
| Limnius volckmari   |      |                                       |               |                            | 2    |
| GYRINIDAE   |      |                                       |               |                            |      |
| Orectochilus villosus   |      | 1                                     | 2             |                            |      |
| IPTERA<br>ATHERICIDAE   |      |                                       |               |                            |      |
| Atherix sp.   |      | 2                                     |               |                            |      |
| CERATOPOGONIDAE   |      | -                                     |               |                            |      |
| Forcipomyia sp.   |      | 12                                    |               |                            | 2 2  |
| CHIRONOMIDAE  | 2    | 2                                     | 2             |                            | 2    |
| SIMULIIDAE<br>TIPULIDAE   |      | 3                                     |               |                            | - 4  |
| Dicranota sp.   |      |                                       |               |                            |      |
| CARI  |      |                                       |               |                            |      |
| LIMNOCARIDAE  |      |                                       |               |                            |      |
| RUSTACEA  |      |                                       |               |                            |      |
| ASELLIDAE<br>Asellus aquaticus  |      |                                       |               |                            |      |
| GAMMARIDAE  |      |                                       |               |                            |      |
| Gammarus pulex  |      |                                       |               |                            | 2    |
| LIGOCHEATA  | 1.2  |                                       |               |                            |      |
| GLOSSOSCOLECIDAE<br>LUMBRICULIDAE   | 1 2  | 2 3                                   | 2             | 2                          | 3    |
| OLLUSCA   | 2    | 3                                     | 2             | 2                          | J    |
| ANCYLIDAE   |      |                                       |               |                            |      |
| Ancylus fluviatilis   |      |                                       |               |                            |      |
| LYMNAEIDAE  |      |                                       |               |                            | 2    |
| Lymnaea peregra<br>LATYHELMINTHES   |      |                                       |               |                            | 2    |
| PLANARIIDAE   |      |                                       |               |                            |      |
|   |      |                                       |               |                            |      |
| OTAL NUMBER OF TAXA   | 9    | 15                                    | 9             | 1                          | 15   |

| SITE NUMBER (SEE MAP) SAMPLING OFFICER DATE SAMPLED DATE SAMPLED DIDENTIFYING OFFICER  20/9/99 20/9/9/20 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/96 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/99 20/9/9/20 20/9/20 20/9/20 20 20 20 20 20 20 20 20 20 20 20 20 2   | SAMPLING OFFICER  DATE SAMPLED  IDENTIFYING OFFICER  1 = 1, 2 = 2-1  HEMEROPTERA  BAETIDAE  Baetis rhodani  EPHEMERELLIDAE  Ephemerella ignita  HEPTAGENIIDAE  Ecdyonurus sp.  LEPTOPHLEBIIDAE | TRG<br>20/9/89<br>CRAB<br>.0, 3 = 1 | TRG<br>20/9/89<br>CRAB<br> | TRG<br>20/9/89<br>CRAB<br>4 = 101-3 | TRG<br>20/9/89<br>CRAB | TRG<br>20/9/89<br>CRAB<br> |
|--|--|-------------------------------------|----------------------------|-------------------------------------|------------------------|----------------------------|
| IDENTIFYING OFFICER  | IDENTIFYING OFFICER  1 = 1, 2 = 2-1  HEMEROPTERA  BAETIDAE  Baetis rhodani  EPHEMERELLIDAE  Ephemerella ignita  HEPTAGENIIDAE  Ecdyonurus sp.  LEPTOPHLEBIIDAE                                 | CRAB<br>.0, 3 = 1                   | CRAB<br>                   | CRAB<br>                            | CRAB                   | CRAB<br><br>= 1000+        |
| EMEROPTERA   | 1 = 1, 2 = 2-1 HEMEROPTERA BAETIDAE Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE  | 2                                   | 11-100,                    | 4 = 101-3                           |                        | -3                         |
| EMERGOTERA   Baetis chodani   2   2   2   1  | HEMEROPTERA BAETIDAE Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE   | 2                                   |                            |                                     | 1000, 3                | -2                         |
| Bastis rhodani 2 2 2 1 EPHEMBRELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. 2 2 2 2 2 LIFTOTHLEBIIDAE BCGYOTERA LEUCTRIDAE Leuctra fusca 2 2 2 2 1 2 EPHENDREL BDE Dinocras cephalotes 2 PERLIDAE Perlodes microcephala 2 2 2 1 1 CHOPTERA GLOSSOSOMATIDAE Glossosoma sp. HYDROPSYCHIDAE Hydropsyche pellucidula Hydropsyche siltalai 1 1 1 LIMNEPHILIDAE POLYCENTROPIDAE PECTOCOMEMIA 2 2 2 ENTROPICAE Hydropsyche siltalai 1 1 1 LIMNEPHILIDAE POLYCENTROPIDAE Limius volckmari GYRINIDAE Limius volckmari GYRINIDAE ATHERICIDAE Atherix sp. 1 2 2 ECOPTERA ATHERICIDAE Atherix sp. 2 2 1 1 ELMIDAE Dicranota sp. 1 2 2 ECRATOPOGONIDAE FOCCIDOMIDAE Dicranota sp. 2 2 1 1 ELMIDAE LIMIOCARIDAE Dicranota sp. 2 2 1 1 ELMIDAE Dicranota sp. 1 2 2 ENAMARIDAE Dicranota sp. 2 1 1 ELMIDAE Dicranota sp. 2 2 1 1 ELMIDAE Dicranota sp. 1 2 2 1 3 ELMIDAE DICRANOMIDAE 1 1 1 1 ELMIDATORICAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ANGULIDAE ANGULI | Baetis rhodani EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE  |                                     | 2                          | 2                                   |                        | 4                          |
| EPHEMERELLIDAE   | EPHEMERELLIDAE Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE   |                                     | 2                          | 2                                   |                        |                            |
| Ephemerella ignita HEPTAGENIJABE Ecdyonurus sp. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  | Ephemerella ignita HEPTAGENIIDAE Ecdyonurus sp. LEPTOPHLEBIIDAE  | 2                                   |                            |                                     |                        |                            |
| ECDYONUTUS SP. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2   | Ecdyonurus sp.<br>LEPTOPHLEBIIDAE  | 2                                   |                            |                                     |                        |                            |
| LEPTOPHLEBITDAE  | LEPTOPHLEBIIDAE  | 2                                   | 2                          |                                     |                        | 2                          |
| Paraleptophlebia cincta    COPTERA   Leuctra fusca   2   2   2   1   2   |  |                                     | 2                          |                                     |                        | -                          |
| LEUCTRIDAE  Leuctra fusca 2 2 2 2 1 2  PERLIDAE  Dinocras cephalotes 2  PERLOIDAE  Perlodes microcephala 2 2 2 1  CHOPTERA  GLOSSOSOMATIDAE  Glossosoma sp.  Hydropsyche pellucidula  Hydropsyche siltalai 1 1 1  LIMMEPHILIDAE  POLVCENTROPIDAE  Plectrocnemia geniculata 1 2 2 2  RHYACOPSHILIDAE  Rhyacophila dorsalis 2 2 2  LEOPTERA  ATHERICIDAE  ATHERICIDAE  ATHERICIDAE  ATHERICIDAE  ATHERICIDAE  Dicranota sp. 1 2 2 1  CERATOPOGONIDAE  POCICOMPINIAE  LIMNOCARIDAE  ANILLIDAE  LIMNOCARIDAE  ASELLIDAE  ANCYLIDAE  LUMBRICULIDAE  1 1  LUMBRICULIDAE  ANCYLIDAE      |  |                                     |                            |                                     |                        |                            |
| Leuctra fusca 2 2 2 2 1 2 PERLIDAE     Dinocras cephalotes 2 PERLODIAE     Perlodes microcephala 2 2 2   |  |                                     |                            |                                     |                        |                            |
| PERLIDAE   |  | ז                                   | 2                          | 2                                   | 1                      | 2                          |
| Dinocras cephalotes  PERLODIDAE  Perlodes microcephala  CLONSOSOMATIDAE  GLOSSOSOMA Sp.  Hydropsyche pellucidula  Hydropsyche pellucidula  Hydropsyche pellucidula  Hydropsyche siltalai  LIMMEPHILIDAE  POLYCENTROPIDAE  Plectrocnemia geniculata  Polycentropus flavomaculatus  Polycentropus flavomaculatus  Polycentropus flavomaculatus  Polycentropus flavomaculatus  Polycentropus flavomaculatus  Rhyacophila dorsalis  2  LEOPTERA  ELMIDAE  Limnius volckmari  GYRINIDAE  Orectochilus villosus  1  PETERA  ATHERICIDAE  ATHERICIDAE  ATHERICIDAE  Orectochilus villosus  1  CERATOPOGONIDAE  Forcipomyia sp.  CHIRONOMIDAE  SIMULIIDAE  Dicranota sp.  Dicranota sp.  Dicranota sp.  ASELLIDAE  ASELLIDAE  ASELLIDAE  ASELLIDAE  ASELLIDAE  GAMMARIDAE  ANCYLIDAE  ANC |  | 4                                   | 2                          | 4                                   | •                      |                            |
| Perlodes microcephala  ICHOPTERA GLOSSOSOMATIDAE GLOSSOSOMATIDAE GLOSSOSOMA Sp.  HYDROPSYCHIDAE HYDROPSYCHIDAE HYdropsyche pellucidula Hydropsyche sittalai  LINNEPHILIDAE POLYCENTROPIDAE Plectrocnemia geniculata Polycentropus flavomaculatus Rhyacophila dorsalis  ELMIDAE Limnius volckmari GYRINIDAE Limnius volckmari GYRINIDAE Orectochilus villosus TETERA Atherix sp. 1 CERATOPOGONIDAE FOrcipomyia sp. CHIRONOMIDAE TIPULIDAE TIPULIDAE TIPULIDAE TIPULIDAE TIPULIDAE TIPULIDAE TIPULIDAE TIPULIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE ANCYLIDAE  |  |                                     | 2                          |                                     |                        |                            |
| CCHOPTERA   CLOSSOSOMATIDAE   CLOSSOSOMATICAL   CLOSMATICAL   CLOS   |  | •                                   |                            |                                     |                        | 1                          |
| GLOSSOSOMATIDAE  |  | 2 .                                 | 2                          |                                     |                        | •                          |
| HYDROPSYCHIDAE  Hydropsyche pellucidula Hydropsyche siltalai 1 1 1  LIMNEPHILIDAE POLYCENTROPIDAE Plectrocnemia geniculata 1 Polycentropus flavomaculatus 1 2 2 RHYACOPHILIDAE Rhyacophila dorsalis 2 2 LEOPTERA ELMIDAE Limnius volckmari GYRINIDAE Orectochilus villosus PTERA ATHERICIDAE Atherix sp. 1 2 2  CERATOPOGONIDAE Forcipomyia sp. CHIRONOMIDAE JDICTANOMIDAE DICTANOMIDAE DICTANOMIDAE  LIMINOCARIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE GGMMARIDAE GGMMARIDAE GLOSSOSCOLECIDAE LUMBRICULIDAE ANCYLIDAE ANCYLIDA |  |                                     |                            |                                     |                        |                            |
| Hydropsyche pellucidula Hydropsyche sitalai 1 1  LIMNEPHILIDAE POLYCENTROPIDAE Plectrocnemia geniculata 1 Polycentropus flavomaculatus 1 2 2 RHYACOPHILIDAE Rhyacophila dorsalis 2 2 LEOPTERA ELMIDAE Limnius volckmari GYRINIDAE Orectochilus villosus PTERA ATHERICIDAE Atherix sp. 1 2 2 CERATOPGONIDAE Forcipomyia sp. CHIRONOMIDAE 2 2 1 1 SIMULIIDAE TIPULIDAE Dicranota sp. ANI LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE GGAMMARIDAE GGAMMARIDAE GGAMMARIDAE GGAMBARIDAE GGAMBARIDAE GAMMARIDAE ANCYLIDAE ANCYL |  |                                     |                            |                                     |                        | 2                          |
| Hydropsyche siltalai 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   |  |                                     |                            |                                     |                        |                            |
| LIMNÉPHILIDAE POLYCENTROPIDAE Plectrocnemia geniculata 1 Polycentropus flavomaculatus 1 2 2 RHYACOPHILIDAE Rhyacophila dorsalis 2 2 LEOPTERA ELMIDAE Limnius volckmari GYRINIDAE Orectochilus villosus 1 PTERA ATHERICIDAE Atherix sp. 1 2 2 CERATOPOGONIDAE FOCCIPOMYIA sp. CHIRONOMIDAE 2 2 1 1 SIMULIIDAE TIPULIDAE Dicranota sp. 2 1 ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE GGAMMARIDAE GGAMMARIDAE GGOSSOSCOLECIDAE LUMBRICULIDAE 1 1 1 LUMBRICULIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE LYMNAEID |  |                                     | 1                          |                                     |                        | 1                          |
| Plectrocnemia geniculata 1 Polycentropus flavomaculatus 1 RHYACOPHILIDAE Rhyacophila dorsalis 2 REMIDAE LEOPTERA LIMIUS VOLCKMARI GYRINIDAE LOTERA ATHERICIDAE Atherix sp. 1 CERATOPOGONIDAE Forcipomyia sp. CHIRONOMIDAE Dicranota sp. 2 SIMULIIDAE Dicranota sp. 1 LIMINOCARIDAE ASELLIDAE ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE GAMMARIDAE GLOSSOSCOLECIDAE LUMBRICULIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LLYMNAEIDAE LLYMNAEIDA |  |                                     | -                          |                                     | 171                    |                            |
| Polycentropus flavomaculatus 1 2 2 RHYACOPHILIDAE Rhyacophila dorsalis 2 2 LEOPTERA ELMIDAE Limnius volckmari GYRINIDAE Orectochilus villosus PTERA ATHERICIDAE Atherix sp. 1 2 CERATOPOGONIDAE Forcipomyia sp. CHIRONOMIDAE 2 2 2 1 SIMULIIDAE TIPULIDAE Dicranota sp. 2 1 ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE Asellus aquaticus GAMMARIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE ANCYLIDAE LYMNAEIDAE ATYHELMINTHES  |  | _                                   |                            |                                     |                        |                            |
| RHYACOPHILIDAE Rhyacophila dorsalis Rlyacophila dorsalis ELEOPTERA ELMIDAE Limnius volckmari GYRINIDAE Orectochilus villosus PTERA ATHERICIDAE Atherix sp. 1 2 CERATOPOGONIDAE Forcipomyia sp. CHIRONOMIDAE 2 2 1 1 SIMULIDAE Dicranota sp. 2 1 LIMNOCARIDAE 1 LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 1 2 1 3 LLUSCA ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE L |  |                                     | 2                          | 2                                   |                        |                            |
| Rhyacophila dorsalis 2 2 LEOPTERA  LIMIDAE Limius volckmari GYRINIDAE Orectochilus villosus PTERA ATHERICIDAE Atherix sp. 1 2 CERATOPOGONIDAE Forcipomyia sp. CHIRONOMIDAE 2 2 2 1 SIMULIIDAE TIPULIDAE Dicranota sp. 2 1 LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 1 2 1 3 LLUSCA ANCYLIDAE Ancylus fluviatilis 1 LYMNAEIDAE Lymnaea peregra ATYHELMINTHES   |  | 1                                   | 2                          | 2                                   |                        |                            |
| EMIDAE   |  | 2                                   | 2                          | 2                                   |                        |                            |
| Limnius volckmari  GYRINIDAE  Orectochilus villosus  PTERA  ATHERICIDAE  Atherix sp. 1 2  CERATOPOGONIDAE  FOrcipomyia sp.  CHIRONOMIDAE 2 2 2 1 1  SIMULIIDAE  TIPULIDAE  Dicranota sp. 2 1  LIMNOCARIDAE 1  USTACEA  ASELLIDAE  ASELLIDAE  Gammarus pulex  IGOCHEATA  GLOSSOSCOLECIDAE 1 1 1  LUMBRICULIDAE  ANCYLIDAE  ANCYLIDAE  ANCYLIDAE  ANCYLIDAE  LYMNAEIDAE  LYMNAEI |  |                                     |                            |                                     | 1.7                    |                            |
| GYRINIDAE Orectochilus villosus PTERA ATHERICIDAE Atherix sp. 1 2 CERATOPOGONIDAE FORCIPOMYIA sp. CHIRONOMIDAE 2 2 2 1 SIMULIDAE TIPULIDAE Dicranota sp. 2 1 LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 LUMBRICULIDAE 1 1 2 1 3 LLUSCA ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE |  |                                     |                            |                                     |                        |                            |
| ATHERICIDAE ATHERICIDAE ATHERICIDAE ATHERIX Sp. 1 2 CERATOPOGONIDAE FORCIPOMYIA Sp. CHIRONOMIDAE 2 2 1 1 SIMULIDAE TIPULIDAE Dicranota sp. 2 1 ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE ASELLIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE LY |  |                                     |                            |                                     |                        |                            |
| ATHERICIDAE Atherix sp. 1 2 CERATOPOGONIDAE Forcipomyia sp. CHIRONOMIDAE 2 2 1 1 SIMULIIDAE TIPULIDAE Dicranota sp. 2 1 ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE Ancylus fluviatilis LYMNAEIDAE LYMNAEIDAE LYMNaea peregra ATYHELMINTHES  |  |                                     |                            | 1                                   |                        |                            |
| Atherix sp. 1 2 CERATOPOGONIDAE     Forcipomyia sp. CHIRONOMIDAE 2 2 1 1 SIMULIIDAE     TIPULIDAE     Dicranota sp. 2 1  ARI LIMNOCARIDAE 1 USTACEA     ASELLIDAE     ASEllus aquaticus 1 GAMMARIDAE     Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE     Ancylus fluviatilis 1 LYMNAEIDAE     Lymnaea peregra 2 ATYHELMINTHES   |  |                                     |                            |                                     |                        |                            |
| CERATOPOGONIDAE FORCIPOMYIA SP. CHIRONOMIDAE 2 2 1 SIMULIIDAE TIPULIDAE Dicranota sp.  ARI LIMNOCARIDAE ASELLIDAE ASELLIDAE ASELLIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE LUMBRICULIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE   |  | 1                                   |                            |                                     |                        | 2                          |
| CHIRONOMIDAE 2 2 1 SIMULIIDAE TIPULIDAE Dicranota sp. 2 1 ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE Asellus aquaticus 1 GAMMARIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE LYMNAEIDAE LYMNAEIDAE LYMNAEIDAE LYMNAEA peregra ATYHELMINTHES   |  | <del>-</del>                        |                            |                                     |                        |                            |
| SIMULIIDAE TIPULIDAE Dicranota sp. 2 1  ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE 1 GAMMARIDAE 1 GOMMARIDAE 1 GOCHEATA GLOSSOSCOLECIDAE 1 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE 1 2 1 3 LLUSCA ANCYLIDAE 1 2 1 3 LYMNAEIDAE 1 LYMNAEIDAE 1 LYMNAEIDAE 2 LYMNAEA peregra 2  |  |                                     |                            |                                     |                        | 4                          |
| TIPULIDAE Dicranota sp. 2 1  ARI LIMNOCARIDAE 1 USTACEA ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE GAMMARIDAE GAMMARUS pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  |  | 2                                   | 2                          |                                     |                        | 1                          |
| ARI LIMNOCARIDAE USTACEA ASELLIDAE ASELLIDAE ASELLIDAE GAMMARIDAE GAMMARIDAE GOCHEATA GLOSSOSCOLECIDAE LUMBRICULIDAE ANCYLIDAE ANCYLIDAE ANCYLIDAE LYMNAEIDAE Lymnaea peregra ATYHELMINTHES  |  |                                     |                            |                                     |                        |                            |
| LIMNOCARIDAE  USTACEA  ASELLIDAE  Asellus aquaticus  GAMMARIDAE  Gammarus pulex  IGOCHEATA  GLOSSOSCOLECIDAE  LUMBRICULIDAE  ANCYLIDAE  Ancylus fluviatilis  LYMNAEIDAE  Lymnaea peregra  ATYHELMINTHES  |  |                                     |                            | 2                                   |                        | 1                          |
| USTACEA  ASELLIDAE  Asellus aquaticus  GAMMARIDAE  Gammarus pulex  IGOCHEATA  GLOSSOSCOLECIDAE  LUMBRICULIDAE  ANCYLIDAE  ANCYLIDAE  Ancylus fluviatilis  LYMNAEIDAE  Lymnaea peregra  ATYHELMINTHES   |  | •                                   |                            |                                     |                        |                            |
| ASELLIDAE    Asellus aquaticus  GAMMARIDAE    Gammarus pulex  IGOCHEATA    GLOSSOSCOLECIDAE  |  | 1                                   |                            |                                     |                        |                            |
| GAMMARIDAE Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE LUMBRICULIDAE ANCYLIDAE Ancylus fluviatilis LYMNAEIDAE Lymnaea peregra ATYHELMINTHES  |  |                                     |                            |                                     |                        |                            |
| Gammarus pulex IGOCHEATA GLOSSOSCOLECIDAE 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE 2 1 1 Ancylus fluviatilis 1 LYMNAEIDAE 1 Lymnaea peregra 2 ATYHELMINTHES  | Asellus aquaticus  |                                     |                            |                                     |                        | 1                          |
| IGOCHEATA GLOSSOSCOLECIDAE 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE Ancylus fluviatilis 1 LYMNAEIDAE Lymnaea peregra 2 ATYHELMINTHES   |  |                                     |                            |                                     |                        |                            |
| GLOSSOSCOLECIDAE 1 1 LUMBRICULIDAE 1 2 1 3 LLUSCA ANCYLIDAE 2 1 3 Ancylus fluviatilis 1 LYMNAEIDAE 1 Lymnaea peregra 2 ATYHELMINTHES   |  |                                     |                            |                                     |                        |                            |
| LLUSCA ANCYLIDAE Ancylus fluviatilis LYMNAEIDAE Lymnaea peregra ATYHELMINTHES  |  |                                     | 1                          |                                     | 1                      |                            |
| ANCYLIDAE Ancylus fluviatilis LYMNAEIDAE Lymnaea peregra ATYHELMINTHES   | LUMBRICULIDAE  | 1                                   |                            | 2                                   | 1                      | 3                          |
| Ancylus fluviatilis  LYMNAEIDAE  Lymnaea peregra  ATYHELMINTHES  |  |                                     |                            |                                     |                        |                            |
| LYMNAEIDAE Lymnaea peregra 2 ATYHELMINTHES   |  |                                     |                            |                                     |                        | 1                          |
| ATYHELMINTHES  |  |                                     |                            |                                     |                        |                            |
|  |  |                                     |                            |                                     |                        | 2                          |
|  |  |                                     |                            |                                     |                        | 2                          |
| TAL NUMBER OF TAXA 11 10 6 3 14  |  |                                     |                            |                                     |                        |                            |