

**Euro-limpacs**



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**Habitat preferences of selected indicators**

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**Integrated Project to evaluate the Impacts of Global Change  
on  
European Freshwater Ecosystems**

WP2: Climate-hydromorphology interactions

Task 2: Hydromorphological changes and aquatic and riparian  
biota

Subtask 2.3: Autecological and laboratory experiments

**Deliverable No. 92**

**Habitat preferences of selected indicators**

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## Contents

## **1. Analysis of macroinvertebrate habitat preferences in Dutch lowland streams.**

Task 2 of Workpackage 2, in combination with task 3 and 5, deals with the major question: 'What is the relation between discharge dynamics, hydromorphology in terms of habitat stability and diversity and the occurrence of indicator species in other words how tolerant are indicator species to habitat (in)stability?'

The first step was the selection of indicator species. Indicator species should be representative of the important stream habitats (proposed sand and detritus patches) under study. Furthermore, indicator species should be indicative for direct effects of habitat change, thus become more (indicator of disturbance) or less (indicator of reference) abundant if the habitat is disrupted.

This report compiles the selection of indicators and the analysis of their habitat preferences. This was necessary before testing the tolerance for habitat instability and to examine the causes of habitat binding of selected indicators. the report also adds to Deliverable 94.

## 2. Material and methods

A total of 604 habitat-specific macroinvertebrate community samples were taken from 16 different Dutch lowland streams and contained 547 taxa. The samples were taken from eight of in total 10 predefined habitat types. Table 1 presents the number of samples obtained from each habitat type separately for each stream.

To investigate taxon-specific habitat preferences, first, the species distributions over the eight habitat types were tested against random distributions with chi-squared analyses. Then, two independent methods were used to determine preferences for specific habitat types:

- (1) Weighted-averaging with the program  $C_2$  was used to calculate species optima and tolerances (Juggins 2003).
- (2) Indexes of representation (IR) were calculated according to the methods described by Hildrew and Townsend (1976). (Note that from the total of 547 taxa, 192 taxa were distributed in a manner that significantly deviated from random,  $P < 0.05$ . No Bonferroni correction was used and it can therefore be expected that with 547 significance tests being carried out, significant non-random distributions should occur in 27 taxa based on random expectations, i.e. 27 of the 192 significant chi-square results may have occurred randomly).

Some taxa occurred in low numbers, or were not identified to the species level, troubling reliable interpretations on habitat preferences. Therefore, not all taxa were used. Taxa were deemed meaningful for further interpretation when:

- (1) More than five specimens were encountered in the samples
- (2) The distributions over the eight habitat types significantly deviated from random distributions
- (3) Taxa were identified to the species level unless higher groups could be assumed to have similar habitat requirements.

This ultimately left 128 taxa that could be used to interpret habitat preferences.

Table 1. Streams, habitat types and numbers of obtained samples.

| stream           | habitat type  | number of samples | stream              | habitat type  | number of samples |
|------------------|---------------|-------------------|---------------------|---------------|-------------------|
| Bosbeek          | leaves        | 3                 | Reusel              | detritus      | 7                 |
|                  | detritus      | 9                 |                     | gravel        | 3                 |
|                  | sand          | 3                 |                     | vegetation    | 5                 |
| total Bosbeek    | 3             | 15                |                     | sand          | 4                 |
| Bunderbosbeek    | gravel        | 2                 | total Reusel        | 4             | 19                |
| Elsbeek          | leaves        | 11                | Rodebeek            | leaves        | 2                 |
|                  | detritus      | 1                 |                     | detritus      | 6                 |
|                  | gravel        | 17                |                     | gravel        | 3                 |
|                  | clay          | 1                 |                     | sand          | 4                 |
|                  | mud           | 15                | total Rodebeek      | 4             | 15                |
|                  | branches/wood | 9                 | Rosep               | detritus      | 6                 |
|                  | vegetation    | 8                 |                     | vegetation    | 12                |
|                  | sand          | 17                |                     | sand          | 3                 |
| total Elsbeek    | 8             | 79                | total Rosep         | 3             | 21                |
| Fredbeek         | leaves        | 3                 | Seelbeek            | grind         | 2                 |
|                  | detritus      | 6                 | Springendal         | leaves        | 68                |
|                  | gravel        | 2                 |                     | detritus      | 64                |
|                  | sand          | 4                 |                     | gravel        | 69                |
| total Fredbeek   | 4             | 15                |                     | clay          | 2                 |
| Jufferbeek       | gravel        | 1                 |                     | mud           | 60                |
|                  | sand          | 1                 |                     | branches/wood | 2                 |
| total Jufferbeek | 2             | 2                 |                     | vegetation    | 35                |
| Koudebeek        | leaves        | 3                 |                     | sand          | 80                |
|                  | detritus      | 6                 | total Springendal   | 8             | 380               |
|                  | sand          | 6                 | Strabekervloedgraaf | gravel        | 2                 |
| total Koudebeek  | 3             | 15                | Tongerensebeek      | leaves        | 3                 |
| Oude beek        | gravel        | 7                 |                     | detritus      | 3                 |
|                  | detritus      | 5                 |                     | gravel        | 3                 |
|                  | vegetation    | 4                 |                     | vegetation    | 4                 |
|                  | sand          | 3                 |                     | sand          | 3                 |
| total Oudebeek   | 5             | 19                | total Tong. beek    | 5             | 16                |
| Platsbeek        | gravel        | 2                 |                     |               |                   |

### 3. Results

#### 3.1 Taxon habitat preferences

Weighted-averaging methods in the program  $C_2$  are conventionally used to calculate taxon specific optima and tolerances for continuous habitat variables (Juggins 2003). However, when investigating preferences for several habitat types, variables are used as binominal variables; i.e. a sample is taken from the habitat type 'leaves' (score 1) or not (score 0). Because eight habitats were sampled, the majority of the variable scores for any specific taxon will thus be zero. This can cause a problem, especially for calculating tolerances. Therefore, a preliminary analysis is carried out, to investigate if the  $C_2$  optimum and tolerance results are meaningful for these data.

For this preliminary analysis, the optima, tolerances and IR-values for the habitat-type 'leaves' were used. The weighted-averaged tolerances are strongly correlated with the optima ( $r=0.62$ ,  $n=128$ ,  $P<0.001$ , Figure 1), following a curved trend of increasing tolerance with optimum until an optimum of 0.5 after which tolerance decreases with increasing optimum. This indicates non-independence of the two values, strongly suggesting that these methods can not be used to explore habitat preferences within these data, as the calculated tolerances seem not appropriate. In addition, the optima are compared to the IR-values (Figure 2). Again these are highly correlated ( $r=0.79$ ,  $n=128$ ,  $P<0.001$ ), suggesting that, in large part, the same information is comprised in the IR values as is comprised in the weighted-averaged optima, at least for these data. Therefore, in subsequent analyses, the weighted average optima and tolerances are not used and interpretations on habitat preferences are based on the IR results only. For completeness, the  $C_2$  results for optima and tolerances for all other habitat types are included in Appendix 1.

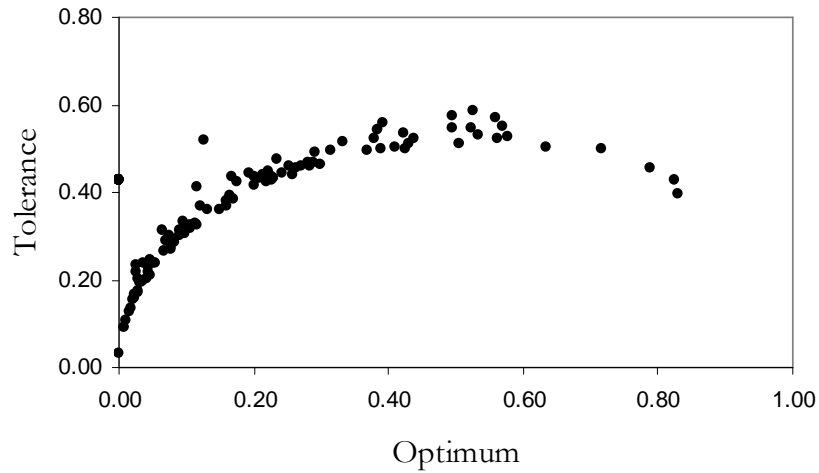


Figure 1. Correlation between optimum and tolerance as calculated by the program C2 for the leaves habitat-type.

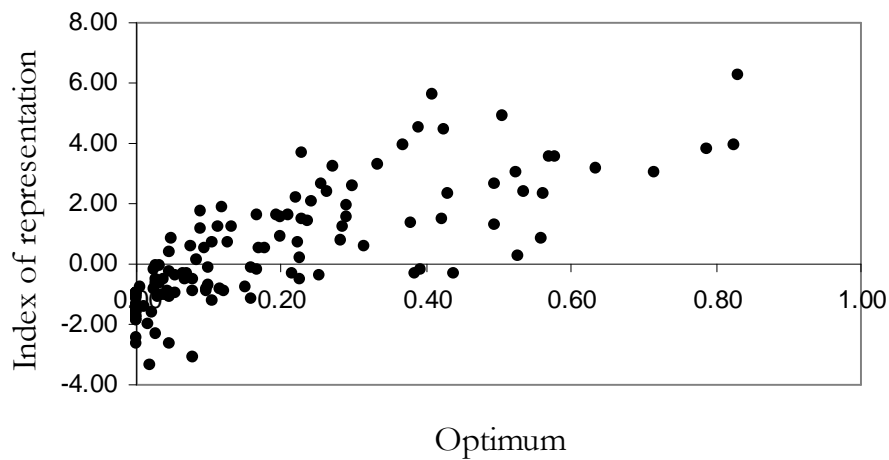


Figure 2. Correlation between the optimum and IR for the leaves habitat type.

Table 2 presents the results of the chi-square and IR analyses for the 128 non-randomly distributed species. According to Tolcamp (1980), IR-values are especially meaningful when they deviate more than two from zero (marked gray in table 2), with positive



values indicating a preference for the habitat type and negative values indicating aversion. Each habitat type has a substantial number of species representing either preference or aversion (Table 2) except for habitat type clay, which has only four. However, this result should be interpreted with caution, because the low number of representative taxa for clay could be caused by the low number of samples for that habitat type (3, Table 1).

Table 2. Index of Representation (IR) results. Presented for each taxon are: (1) the IR-value for each of the eight sampled habitat types, (2) N, which represents the abundance of a taxon in all samples and (3) the chi- and P- value that resulted from testing for non-random distribution. Gray markings indicate IR-values that deviate more than 2 from zero.

| taxon name/ habitat type       | index of representation |          |       |       |                   |                 |       |        | N   | chi   | P<    |
|--------------------------------|-------------------------|----------|-------|-------|-------------------|-----------------|-------|--------|-----|-------|-------|
|                                | leaves                  | detritus | clay  | mud   | branches/<br>wood | Veg-<br>itation | sand  | gravel |     |       |       |
| Agabus sp larve                | 3.31                    | -0.04    | -0.23 | -1.17 | 1.79              | 0.68            | -1.53 | -1.43  | 11  | 20.42 | 0.005 |
| Agapetus fuscipes              | -2.48                   | -0.87    | -0.51 | -1.75 | -0.97             | -1.59           | -2.11 | 8.42   | 52  | 89.13 | 0.001 |
| Amphinemura standfussi         | 3.94                    | -0.60    | -0.72 | -1.40 | 0.06              | -1.69           | -3.66 | 3.46   | 105 | 46.58 | 0.001 |
| Apsectrotanypus trifascipennis | -0.93                   | 2.92     | -0.49 | 0.37  | -0.94             | 2.33            | -0.74 | -3.03  | 49  | 25.81 | 0.001 |
| Asellus aquaticus              | 1.63                    | -0.48    | -0.65 | -0.17 | 5.19              | 4.99            | -3.30 | -2.73  | 85  | 73.50 | 0.001 |
| Athripsodes aterrimus          | -1.24                   | 0.54     | -0.32 | -1.00 | -0.62             | 4.97            | -1.64 | -0.47  | 21  | 30.87 | 0.001 |
| Aulodrilus japonicus           | -0.82                   | 4.36     | -0.65 | -1.68 | -1.24             | 2.45            | -0.90 | -2.70  | 84  | 38.59 | 0.001 |
| Bactis rhodani                 | -1.88                   | -1.59    | -0.34 | -1.69 | -0.65             | -0.99           | -1.75 | 7.57   | 23  | 70.78 | 0.001 |
| Bactis vernus                  | -0.75                   | -0.55    | -0.33 | -1.65 | -0.63             | 4.78            | -1.23 | 0.44   | 22  | 28.67 | 0.001 |
| Bereodes minutus               | 3.05                    | -0.16    | -0.24 | -1.22 | -0.47             | 2.28            | -1.59 | -1.50  | 12  | 21.11 | 0.005 |
| Brillia modesta                | 6.23                    | -0.27    | -0.77 | -1.24 | 1.24              | -0.11           | -3.63 | -0.69  | 119 | 56.25 | 0.001 |
| Caenis horaria                 | -0.54                   | 0.77     | -0.31 | -0.88 | -0.59             | 4.69            | -1.01 | -1.89  | 19  | 28.68 | 0.001 |
| Calopteryx virgo               | -1.04                   | 0.60     | -0.19 | -0.93 | -0.36             | 4.74            | -1.22 | -1.14  | 7   | 27.78 | 0.001 |
| Centropilum luteolum           | -1.11                   | 0.41     | -0.20 | -1.00 | 2.24              | 3.27            | -0.53 | -1.22  | 8   | 19.89 | 0.01  |
| Chaetocladius gr piger         | 0.41                    | -1.22    | -0.44 | 0.07  | 3.90              | 0.29            | -2.53 | 2.11   | 39  | 28.02 | 0.001 |
| Chaetopteryx villosa           | -0.69                   | 2.56     | -0.32 | -1.00 | -0.62             | 0.41            | -2.11 | 1.04   | 21  | 14.21 | 0.05  |
| Chironomus sp                  | -0.42                   | 0.01     | -0.40 | 3.52  | 1.86              | 0.74            | -2.22 | -1.22  | 32  | 23.17 | 0.005 |
| Clinotanypus nervosus          | -1.36                   | 1.17     | -0.24 | 0.42  | -0.47             | 3.14            | -0.97 | -1.50  | 12  | 16.71 | 0.05  |
| Cloeon dipterum                | 0.74                    | -0.75    | -0.30 | 0.51  | -0.57             | 3.49            | -0.93 | -1.84  | 18  | 18.22 | 0.05  |
| Conchapelopia sp               | 3.67                    | 0.62     | -0.80 | -1.23 | 5.02              | 2.53            | -3.48 | -2.65  | 128 | 66.72 | 0.001 |
| Corynoneura celeripes          | 3.53                    | 0.36     | -0.25 | -1.27 | 1.57              | 0.44            | -1.66 | -1.56  | 13  | 22.14 | 0.005 |
| Corynoneura coronata agg       | 1.41                    | -1.56    | -0.25 | 0.30  | 3.62              | 2.10            | -1.66 | -0.92  | 13  | 25.71 | 0.001 |
| Corynoneura lobata agg         | -0.62                   | -1.50    | -0.24 | -1.22 | 1.67              | 3.14            | -1.59 | 1.84   | 12  | 22.76 | 0.005 |
| Corynoneura scutellata agg     | 0.89                    | -0.27    | -0.19 | -0.93 | 2.44              | 2.49            | -1.22 | -1.14  | 7   | 16.74 | 0.05  |
| Cricotopus gr sylvestris       | -0.21                   | -1.22    | -0.20 | -1.00 | -0.38             | 4.32            | -1.30 | 0.41   | 8   | 23.24 | 0.005 |
| Cryptochironomus sp            | -1.75                   | -0.90    | -0.32 | 0.96  | 1.05              | 2.50            | 0.86  | -1.42  | 20  | 15.01 | 0.05  |
| Dendrocoelum lacteum           | 3.78                    | 0.60     | -0.19 | -0.93 | -0.36             | -0.89           | -1.22 | -1.14  | 7   | 19.25 | 0.01  |

| taxon name/ habitat type     | index of representation |          |       |       |                   |                 |       |        | N   | chi    | P<    |
|------------------------------|-------------------------|----------|-------|-------|-------------------|-----------------|-------|--------|-----|--------|-------|
|                              | leaves                  | detritus | clay  | mud   | branches/<br>wood | Veg-<br>itation | sand  | gravel |     |        |       |
| Dicranota sp                 | -2.65                   | 0.58     | 1.83  | -1.24 | -1.47             | -0.93           | 0.35  | 3.34   | 119 | 26.51  | 0.001 |
| Diplocladius cultriger       | 0.58                    | -1.00    | 3.53  | -0.56 | 3.46              | 1.93            | -1.72 | -0.38  | 14  | 32.88  | 0.001 |
| Dixa gr maculata             | 0.85                    | 0.46     | -0.29 | -0.76 | -0.56             | 3.68            | -1.90 | -1.22  | 17  | 20.53  | 0.005 |
| Dixa submaculata             | 0.52                    | 1.01     | -0.21 | -1.06 | -0.40             | 2.97            | -1.38 | -1.30  | 9   | 15.02  | 0.05  |
| Dryopidae                    | -0.05                   | -0.38    | -0.32 | -1.58 | 4.37              | 2.50            | -1.57 | 0.13   | 20  | 30.54  | 0.001 |
| Dugesia gonocephala          | 1.84                    | 0.88     | -1.02 | 1.52  | -1.96             | -0.36           | -3.10 | 0.56   | 211 | 21.43  | 0.005 |
| Elodes minuta                | 5.58                    | 2.15     | -0.79 | -0.92 | -0.85             | 1.54            | -3.81 | -3.21  | 126 | 65.22  | 0.001 |
| Elocophila sp                | -3.09                   | 0.72     | 0.86  | 0.87  | -1.01             | -2.18           | 2.36  | 0.72   | 221 | 23.45  | 0.005 |
| Enchytraeidae                | 1.24                    | -1.05    | -0.68 | -0.75 | 2.54              | 2.33            | -1.29 | -0.58  | 93  | 17.52  | 0.05  |
| Endochironomus gr dispar     | 1.21                    | 1.83     | -0.31 | -1.54 | -0.59             | 1.96            | -1.51 | -1.35  | 19  | 15.55  | 0.05  |
| Erpobdella octoculata        | 2.55                    | 0.53     | -0.55 | -1.63 | 1.82              | 4.71            | -3.00 | -2.45  | 60  | 50.34  | 0.001 |
| Eukiefferiella brevicar agg  | 0.13                    | -2.93    | -0.53 | -2.64 | -1.01             | -1.71           | -2.86 | 9.74   | 56  | 122.83 | 0.001 |
| Eukiefferiella claripennis   | -1.11                   | -2.29    | -0.37 | -1.86 | -0.71             | 0.48            | -2.44 | 7.32   | 28  | 70.40  | 0.001 |
| Gammarus fossarum            | -0.54                   | 2.89     | -0.31 | -1.54 | -0.59             | -1.46           | 0.98  | -0.82  | 19  | 15.22  | 0.05  |
| Gammarus pulex               | 2.62                    | 2.51     | -1.39 | 0.84  | -1.15             | 0.50            | -3.11 | -2.06  | 388 | 31.35  | 0.001 |
| Glossiphonia complanata      | 1.24                    | 2.01     | -0.47 | -1.91 | -0.90             | 3.62            | -2.07 | -1.82  | 44  | 30.93  | 0.001 |
| Glyptotendipes pellucidus    | 2.62                    | 2.39     | -0.38 | -0.32 | 0.65              | 0.41            | -2.48 | -2.33  | 29  | 24.99  | 0.001 |
| Gyraulus albus               | -0.20                   | 0.71     | -0.27 | -1.36 | -0.52             | 4.09            | -0.66 | -1.68  | 15  | 22.71  | 0.005 |
| Heterotanytarsus apicalis    | 1.50                    | 3.69     | -0.36 | -0.68 | -0.69             | -1.13           | -1.07 | -2.21  | 26  | 24.20  | 0.005 |
| Heterotrissocladius marcidus | 1.59                    | 1.08     | -0.59 | 3.50  | -0.24             | 0.04            | -2.03 | -3.07  | 70  | 29.87  | 0.001 |
| Hydropsyche angustipennis    | -0.22                   | -0.61    | -0.38 | -1.90 | -0.73             | 4.28            | -2.48 | 1.96   | 29  | 33.02  | 0.001 |
| Hygrobates fluvialis         | -0.96                   | -0.12    | -0.17 | -0.86 | -0.33             | 4.04            | -1.13 | -0.12  | 6   | 19.47  | 0.01  |
| Lebertia lineata             | -1.13                   | 0.77     | -0.31 | -0.88 | -0.59             | 3.32            | -1.01 | -0.29  | 19  | 15.23  | 0.05  |
| Lebertia stigmatifera        | -0.30                   | 2.09     | -0.50 | -0.93 | -0.96             | 4.70            | -1.77 | -2.44  | 51  | 37.66  | 0.001 |
| Leptophlebia marginata       | 3.05                    | 2.51     | -0.24 | -1.22 | -0.47             | -1.16           | -1.59 | -1.50  | 12  | 23.52  | 0.005 |
| Limnephilus extricatus       | 0.24                    | -0.04    | -0.23 | -1.17 | -0.45             | 4.28            | -0.87 | -1.43  | 11  | 22.80  | 0.005 |
| Limnephilus lunatus          | -0.30                   | -0.57    | -0.28 | -0.70 | 3.17              | 4.62            | -1.30 | -1.73  | 16  | 37.01  | 0.001 |
| Limnius volckmari            | -0.96                   | -0.12    | -0.17 | -0.86 | -0.33             | -0.82           | -1.13 | 3.66   | 6   | 17.16  | 0.05  |
| Limnodrilus hoffmeisteri     | -2.34                   | 1.70     | -0.59 | -0.88 | 1.56              | 2.24            | -0.42 | -0.53  | 69  | 17.34  | 0.05  |
| Limnophyes sp                | 2.37                    | -1.59    | -0.34 | 0.68  | 2.44              | 2.12            | -2.21 | -1.11  | 23  | 25.29  | 0.001 |

| taxon name/ habitat type            | index of representation |          |       |       |                   |                 |       |        | N   | chi   | P<    |
|-------------------------------------|-------------------------|----------|-------|-------|-------------------|-----------------|-------|--------|-----|-------|-------|
|                                     | leaves                  | detritus | clay  | mud   | branches/<br>wood | Veg-<br>itation | sand  | gravel |     |       |       |
| <i>Ljania bipapillata</i>           | 3.19                    | 1.64     | -0.40 | -1.99 | -0.76             | 3.37            | -2.60 | -2.45  | 32  | 41.69 | 0.001 |
| <i>Lumbriculus variegatus</i>       | -0.30                   | -0.57    | -0.28 | 0.72  | 6.87              | 0.15            | -0.76 | -1.15  | 16  | 50.13 | 0.001 |
| <i>Lype reducta</i>                 | 0.55                    | 4.59     | -0.43 | -1.21 | -0.82             | -0.08           | -2.09 | -1.49  | 37  | 30.27 | 0.001 |
| <i>Macropelopia</i> sp              | 1.96                    | 3.60     | -0.65 | 1.41  | -0.43             | 0.18            | -2.56 | -3.71  | 84  | 39.81 | 0.001 |
| <i>Micropsectra</i> gr atrofasciata | 1.30                    | -1.17    | -0.43 | 1.97  | 2.77              | 2.28            | -2.49 | -1.54  | 38  | 28.59 | 0.001 |
| <i>Micropsectra</i> gr notescens    | 1.77                    | 3.02     | -0.68 | 1.02  | -1.30             | 1.40            | -2.86 | -2.97  | 93  | 34.42 | 0.001 |
| <i>Mideopsis orbicularis</i>        | -0.96                   | -0.12    | -0.17 | -0.86 | -0.33             | 4.04            | -0.24 | -1.06  | 6   | 19.36 | 0.01  |
| <i>Molanna angustata</i>            | -1.11                   | 0.41     | -0.20 | -1.00 | -0.38             | 4.32            | -0.53 | -1.22  | 8   | 23.02 | 0.005 |
| <i>Nais communis</i>                | 1.47                    | -0.96    | -0.45 | 2.62  | 3.76              | 1.11            | -2.27 | -2.05  | 41  | 34.89 | 0.001 |
| <i>Nais elinguis</i>                | -0.29                   | -2.63    | 1.90  | 1.12  | 6.49              | 0.90            | -1.01 | 0.03   | 37  | 55.83 | 0.001 |
| <i>Nais variabilis</i>              | 2.22                    | -0.35    | -0.43 | 0.66  | 4.05              | 0.90            | -1.73 | -2.25  | 37  | 30.95 | 0.001 |
| <i>Nanocladus rectinervis</i>       | -1.47                   | 0.24     | -0.26 | -0.56 | 1.48              | 4.32            | -1.72 | -0.38  | 14  | 26.55 | 0.001 |
| <i>Nemoura avicularis</i>           | 1.34                    | 2.52     | -0.30 | -1.50 | -0.57             | -1.42           | 0.09  | -1.29  | 18  | 14.52 | 0.05  |
| <i>Nemoura cinerea</i>              | 2.36                    | 0.68     | -0.64 | -1.00 | 3.69              | 0.58            | -2.49 | -0.85  | 82  | 28.28 | 0.001 |
| <i>Nemurella pictetii</i>           | 3.96                    | 2.09     | -0.52 | -1.47 | -1.00             | -0.48           | -2.83 | -0.71  | 55  | 32.24 | 0.001 |
| <i>Neolimnomyia</i> sp              | -2.66                   | -0.55    | -0.48 | 0.96  | 0.18              | 2.56            | -0.24 | 0.48   | 46  | 15.39 | 0.05  |
| <i>Nepa cinerea</i>                 | 0.69                    | -0.41    | -0.20 | 0.01  | 7.48              | 0.10            | -1.30 | -1.22  | 8   | 59.81 | 0.001 |
| <i>Odontomesa fulva</i>             | -1.75                   | 0.65     | -0.32 | -0.31 | -0.60             | -0.83           | 3.77  | -1.93  | 20  | 22.71 | 0.005 |
| <i>Ophidonais serpentina</i>        | -0.86                   | -0.48    | -0.27 | -0.63 | -0.52             | 7.17            | -1.78 | -1.68  | 15  | 59.05 | 0.001 |
| <i>Oulimnius tuberculatus</i>       | -1.36                   | 1.17     | -0.24 | -1.22 | -0.47             | 3.14            | -1.59 | 0.50   | 12  | 17.64 | 0.05  |
| <i>Paracladopelma laminata</i> agg  | -1.40                   | 0.71     | -0.35 | -1.15 | -0.66             | 0.18            | 3.07  | -1.65  | 24  | 16.49 | 0.05  |
| <i>Paracladopelma nigritula</i>     | -1.98                   | 1.34     | -0.49 | 0.43  | -0.93             | -0.17           | 3.08  | -2.66  | 48  | 23.64 | 0.005 |
| <i>Paratendipes albimanus</i>       | -0.92                   | 0.73     | -0.40 | 0.45  | 1.80              | 3.78            | -1.13 | -2.48  | 33  | 26.75 | 0.001 |
| <i>Pedicia</i> sp                   | 1.19                    | -1.75    | -0.50 | -2.09 | 1.14              | 1.42            | -0.49 | 1.52   | 50  | 14.97 | 0.05  |
| <i>Pericoma</i> sp                  | 3.53                    | -1.56    | -0.25 | -1.27 | 3.62              | 0.44            | -1.66 | -0.28  | 13  | 32.75 | 0.001 |
| <i>Phaenopspectra</i> sp            | -0.10                   | -2.13    | 2.02  | 1.84  | 6.84              | 2.13            | -1.94 | -1.33  | 34  | 68.84 | 0.001 |
| <i>Physa fontinalis</i>             | -0.62                   | -0.83    | -0.24 | -0.40 | -0.47             | 6.58            | -1.59 | -1.50  | 12  | 49.61 | 0.001 |
| <i>Pilaria</i> sp                   | -1.84                   | 1.42     | -0.33 | -0.44 | -0.63             | 2.87            | -1.23 | -0.06  | 22  | 15.90 | 0.05  |
| <i>Pisidium casertanum</i>          | -0.79                   | 2.76     | 0.06  | -0.12 | -1.32             | -0.30           | 1.53  | -2.94  | 190 | 21.11 | 0.005 |
| <i>Plectrocnemia conspersa</i>      | 4.46                    | 3.99     | -0.89 | -0.67 | -1.13             | 2.55            | -5.50 | -3.12  | 161 | 84.80 | 0.001 |

| taxon name/ habitat type | index of representation |          |       |       |                   |                 |       |        | N   | chi   | P<    |
|--------------------------|-------------------------|----------|-------|-------|-------------------|-----------------|-------|--------|-----|-------|-------|
|                          | leaves                  | detritus | clay  | mud   | branches/<br>wood | Veg-<br>itation | sand  | gravel |     |       |       |
| Polycelis felina         | -1.62                   | -0.66    | -0.29 | -1.45 | -0.56             | 2.95            | -1.90 | 3.26   | 17  | 28.54 | 0.001 |
| Polycelis nigra/tenuis   | 1.54                    | 0.04     | -0.32 | -1.61 | -0.62             | 3.01            | -1.64 | -0.47  | 21  | 17.45 | 0.05  |
| Polycelis tenuis         | 1.58                    | -0.83    | -0.24 | -1.22 | 8.09              | 0.56            | -1.59 | -0.83  | 12  | 73.72 | 0.001 |
| Polypedilum nubeculosum  | -0.36                   | 0.71     | -0.35 | 0.59  | 3.88              | 2.01            | -1.37 | -2.12  | 24  | 26.52 | 0.001 |
| Polypedilum scalaenum    | -3.33                   | 1.79     | 0.57  | 0.97  | -1.76             | -0.60           | 2.25  | -1.03  | 269 | 25.13 | 0.001 |
| Proasellus meridianus    | 0.79                    | -0.18    | -0.55 | -0.61 | 6.47              | 3.79            | -3.07 | -1.64  | 62  | 69.68 | 0.001 |
| Procladius sp            | 0.74                    | 2.97     | -0.56 | 1.14  | 0.80              | 0.72            | -2.01 | -3.14  | 63  | 26.06 | 0.001 |
| Prodiamesa olivacea      | -1.17                   | 2.35     | -0.83 | 2.83  | -0.33             | -2.19           | 1.21  | -2.94  | 139 | 30.58 | 0.001 |
| Psammoryctides barbatus  | -1.57                   | 1.16     | -0.28 | -1.41 | -0.54             | 3.87            | -0.76 | -0.57  | 16  | 22.07 | 0.005 |
| Ptychoptera lacustris    | -1.02                   | 0.47     | -0.50 | 3.05  | -0.96             | 0.11            | 0.36  | -2.12  | 51  | 16.35 | 0.05  |
| Radix sp                 | -1.18                   | -1.30    | -0.21 | 1.78  | 4.54              | -1.01           | -1.38 | 1.79   | 9   | 32.96 | 0.001 |
| Rheocricotopus fuscipes  | 2.31                    | 1.18     | -0.60 | -1.35 | 0.58              | 0.97            | -3.17 | 0.36   | 73  | 20.39 | 0.005 |
| Rheotanytarsus sp        | -1.00                   | -1.75    | -0.36 | -0.13 | 0.77              | 3.55            | -2.35 | 2.33   | 26  | 28.33 | 0.001 |
| Rhyacodrilus coccineus   | -1.52                   | 3.10     | 7.05  | -1.36 | -0.52             | -1.30           | -0.10 | -0.48  | 15  | 65.75 | 0.001 |
| Sialis fuliginosa        | 1.56                    | 2.91     | -0.42 | 1.75  | -0.80             | -1.48           | -1.62 | -2.56  | 35  | 26.16 | 0.001 |
| Sialis lutaria           | 0.18                    | 3.12     | -0.39 | -0.89 | -0.74             | 1.97            | -1.33 | -2.37  | 30  | 22.52 | 0.005 |
| Silo nigricornis         | -1.80                   | -1.98    | -0.32 | -1.61 | -0.62             | 1.06            | 0.26  | 4.07   | 21  | 28.04 | 0.001 |
| Simulium costatum        | -0.96                   | -1.06    | -0.17 | -0.86 | -0.33             | -0.82           | -1.13 | 4.60   | 6   | 26.07 | 0.001 |
| Simulium erythrocephala  | -1.04                   | -1.14    | -0.19 | -0.93 | -0.36             | 7.00            | -1.22 | -1.14  | 7   | 55.18 | 0.001 |
| Simulium intermedium     | -0.07                   | -1.14    | -0.19 | -0.93 | -0.36             | 3.62            | -1.22 | 0.60   | 7   | 17.28 | 0.05  |
| Simulium ornatum         | -0.93                   | -1.15    | -0.28 | -0.70 | -0.54             | 2.38            | -1.84 | 2.89   | 16  | 20.50 | 0.005 |
| Simulium trifasciatum    | -0.35                   | -0.33    | -0.39 | -1.96 | -0.75             | -0.26           | -2.56 | 5.48   | 31  | 41.49 | 0.001 |
| Slavina appendiculata    | 3.26                    | 0.41     | -0.48 | -0.35 | 1.24              | 1.18            | -1.89 | -2.29  | 47  | 22.86 | 0.005 |
| Specaria josinae         | -0.29                   | 3.23     | -0.34 | -1.10 | -0.65             | 0.88            | -0.40 | -2.07  | 23  | 17.47 | 0.05  |
| Sperchon glandulosus     | 4.93                    | 0.41     | -0.46 | -0.97 | -0.87             | -0.34           | -1.98 | -1.38  | 42  | 32.29 | 0.001 |
| Sperchon setiger         | -0.11                   | -0.38    | -0.26 | -1.32 | -0.50             | 0.34            | -1.72 | 3.32   | 14  | 16.36 | 0.05  |
| Sperchon sp nymf         | -0.53                   | 1.35     | -0.23 | -1.17 | -0.45             | 3.38            | -1.53 | -0.74  | 11  | 18.04 | 0.05  |
| Sperchon squamosus       | 2.04                    | -0.26    | -0.39 | 0.14  | -0.74             | 2.52            | -2.52 | -0.68  | 30  | 18.08 | 0.05  |
| Sperchon thienemanni     | -0.52                   | 1.92     | -0.45 | -2.26 | -0.86             | 5.30            | -2.95 | -0.24  | 41  | 46.84 | 0.001 |
| Sphaerium corneum        | -1.62                   | 1.58     | -0.29 | -0.76 | -0.56             | 3.68            | -0.84 | -1.22  | 17  | 21.82 | 0.005 |

| taxon name/ habitat type                   | index of representation |          |       |       |                   |                 |       |        | N   | chi   | P<    |
|--|-------------------------|----------|-------|-------|-------------------|-----------------|-------|--------|-----|-------|-------|
|  | leaves                  | detritus | clay  | mud   | branches/<br>wood | Veg-<br>itation | sand  | gravel |     |       |       |
| <i>Spirosperma ferox</i>                   | -1.41                   | 1.65     | -0.25 | -1.27 | -0.49             | 3.75            | -0.45 | -1.56  | 13  | 23.33 | 0.005 |
| <i>Stictochironomus</i> sp                 | -0.87                   | 3.11     | -0.45 | -2.23 | -0.85             | -0.71           | 1.21  | -0.91  | 40  | 19.13 | 0.01  |
| <i>Stylaria lacustris</i>                  | 0.58                    | -1.00    | 3.53  | -1.32 | -0.50             | 5.12            | -1.14 | -1.62  | 14  | 45.88 | 0.001 |
| <i>Tanytarsus</i> sp                       | -0.50                   | 0.20     | 0.75  | 0.85  | 3.94              | 1.84            | -1.00 | -2.15  | 97  | 26.08 | 0.001 |
| <i>Thienemanniella flaviforceps</i><br>agg | -0.93                   | -1.15    | -0.28 | -0.70 | -0.54             | 6.85            | -1.30 | -1.15  | 16  | 53.05 | 0.001 |
| <i>Tipula lateralis</i>                    | 0.52                    | -1.30    | -0.21 | -0.11 | 4.54              | 1.97            | -1.38 | -0.53  | 9   | 28.66 | 0.001 |
| <i>Tubifex ignotus</i>                     | -1.64                   | 1.96     | -0.38 | -1.37 | -0.73             | 3.17            | -0.46 | -1.04  | 29  | 20.47 | 0.005 |
| <i>Tvetenia discoloripes</i> agg           | -1.00                   | -1.22    | -0.29 | -1.45 | -0.56             | 2.23            | -1.90 | 3.82   | 17  | 28.20 | 0.001 |
| <i>Velia caprai</i>                        | 2.32                    | -0.83    | -0.24 | -0.40 | -0.47             | 3.14            | -1.59 | -1.50  | 12  | 21.15 | 0.005 |
| <i>Wettina podagrica</i>                   | 0.85                    | -0.16    | -0.24 | -0.40 | -0.47             | 3.14            | -0.97 | -1.50  | 12  | 14.22 | 0.05  |
| <i>Zavreliomyia</i> sp                     | 4.49                    | 2.61     | -0.70 | 0.73  | 0.87              | 0.52            | -4.39 | -3.17  | 100 | 58.29 | 0.001 |

### 3.2 Habitat type comparison

Information on taxon specific habitat preferences can be obtained from Table 2. However, more general information on the habitat type differences can be obtained by assembling the taxa-specific IR results:

*Table 3. Significant IR correlations between different habitat types.*

| habitat types          | r     | n   | P      |
|------------------------|-------|-----|--------|
| leaves vs sand         | -0.62 | 128 | <0.001 |
| leaves vs gravel       | -0.32 | 128 | <0.001 |
| detritus vs branches   | -0.42 | 128 | <0.001 |
| detritus vs vegetation | -0.20 | 128 | 0.02   |
| detritus vs gravel     | -0.53 | 128 | <0.001 |
| mud vs branches/ wood  | +0.25 | 128 | 0.01   |
| mud vs vegetation      | -0.19 | 128 | 0.03   |
| mud vs gravel          | -0.38 | 128 | <0.001 |
| branches/ wood vs sand | -0.18 | 128 | 0.04   |
| vegetation vs gravel   | -0.25 | 128 | 0.01   |

#### *Habitat type leaves*

Strong negative correlations of the habitat type leaves with the habitat types sand and gravel, suggest that taxa that preferred leaves generally had an aversion to sand and gravel and vice versa (Table 3). Furthermore, Figure 3 shows that several preference indicator taxa (IR value >2) for leaves are also preference indicators for detritus, branches/ wood and vegetation. Figure 3 confirms the correlation results; preference indicators for leaves often have aversion to (IR value <-2) gravel and sand.

#### *Habitat type detritus*

According to the correlation analysis, taxa with a preference for detritus generally had aversion to the habitat types branches/ wood, vegetation and gravel (Table 3). By contrast, on some occasions, taxa indicating preference for detritus also preferred vegetation and leaves (Figure 4). Furthermore, Figure 4 shows that preference for detritus, next to vegetation and gravel, frequently coincides with aversion to sand.

#### *Habitat type clay*

Few samples are available and therefore this habitat type is not included in the correlation analysis. From Figure 5 it appears that taxa preferring clay mostly have aversion to branches/ wood and vegetation.

#### *Habitat type mud*

In general, preference for the mud habitat type was positively correlated to preference for branches/ wood and seemed to coincide with aversion to vegetation and gravel (Table 3). However, in spite of the positive relationship, several preference indicators for mud were aversion indicators for sand (Figure 6). Furthermore, preference indication for mud coincided with that for branches/ wood and detritus on several occasions (Figure 6).

#### *Habitat type branches/ wood*

Preference for branches/ wood was correlated with aversion to sand (Table 3). In addition, preference indicators frequently also indicated leaves and especially vegetation (Figure 7).

#### *Habitat type vegetation*

By far most indicator taxa were found for habitat type vegetation (65). Although the correlation analysis showed that preference for vegetation coincided with aversion to gravel (Table 3), vegetation seemed a relatively distinct habitat type, as the percentages of taxa that were also indicator for other habitat types were low overall (Figure 8).

#### *Habitat type sand*

This habitat type shared no preference indicators with any other habitat type (Figure 9). Several of the taxa preferring sand had aversion to leaves (which was also negatively correlated, Table 3), vegetation and gravel (Figure 9).

#### *Habitat type gravel*

IR values for this habitat type negatively correlated to that of four other habitat types; leaves, detritus, mud and vegetation (Table 3), indicating the strong distinction of this habitat. However, Figure 10 shows it that gravel preference indicators also indicate preference for vegetation on several occasions.



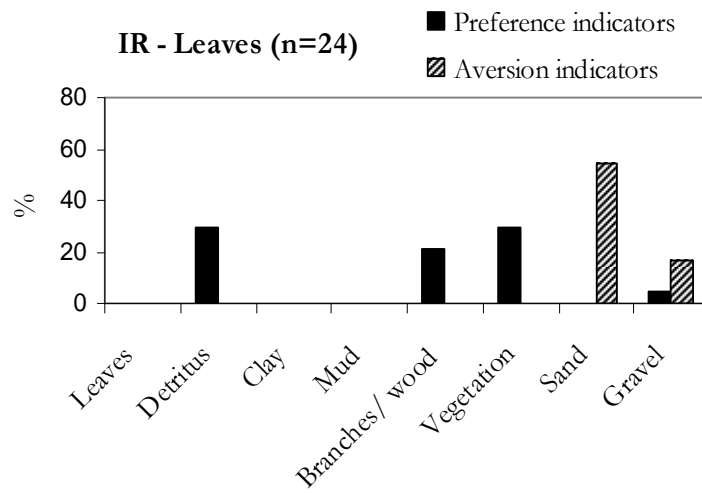


Figure 3. The percentage of total leaves-indicator taxa (24) that also indicate preference or aversion for other habitat types.

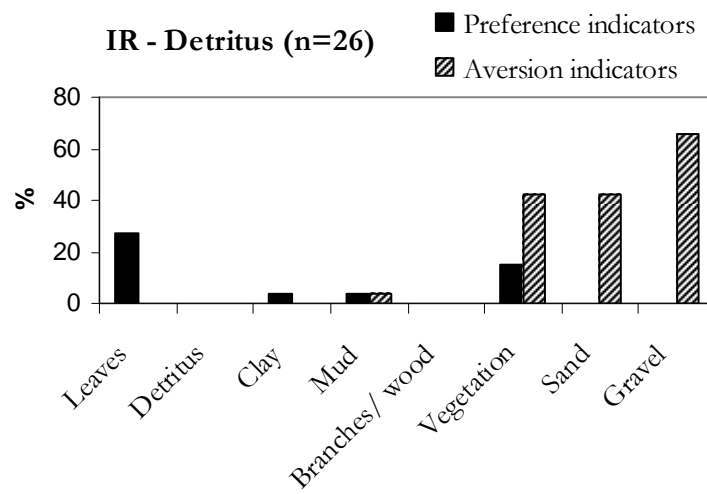


Figure 4. The percentage of total detritus-indicator taxa (26) that also indicate preference or aversion for other habitat types.

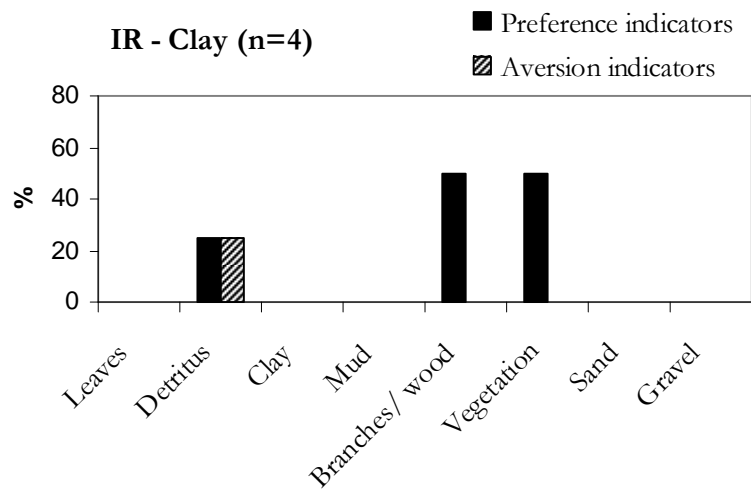


Figure 5. The percentage of total clay-indicator taxa (4) that also indicate preference or aversion for other habitat types.

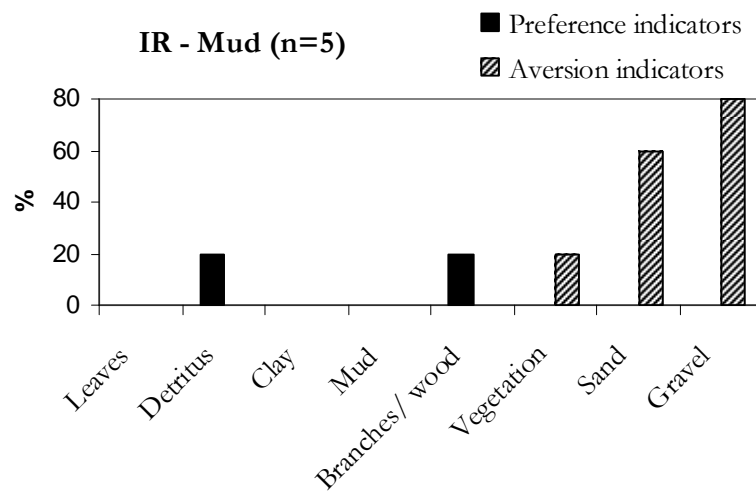


Figure 6. The percentage of total mud-indicator taxa (5) that also indicate preference or aversion for other habitat types.

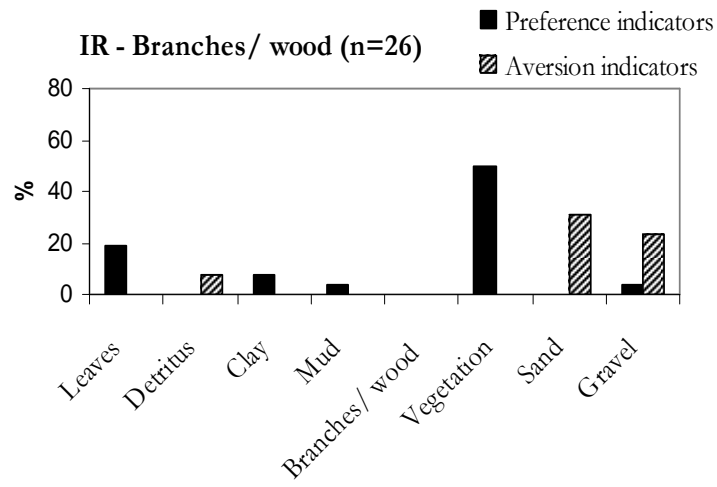


Figure 7. The percentage of total branches/wood-indicator taxa (26) that also indicate preference or aversion for other habitat types.

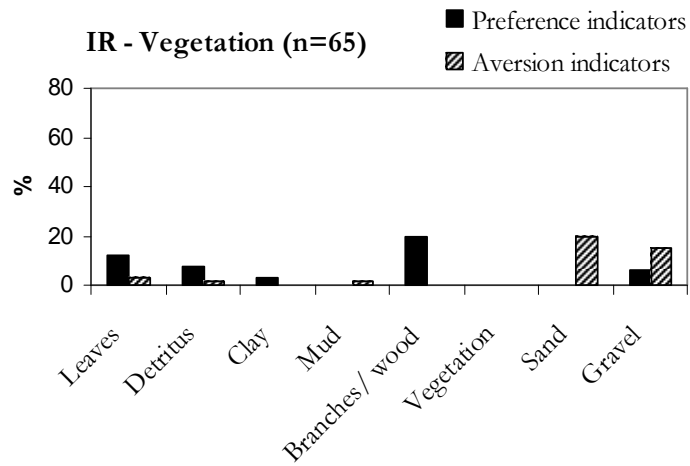


Figure 8. The percentage of total vegetation-indicator taxa (65) that also indicate preference or aversion for other habitat types.

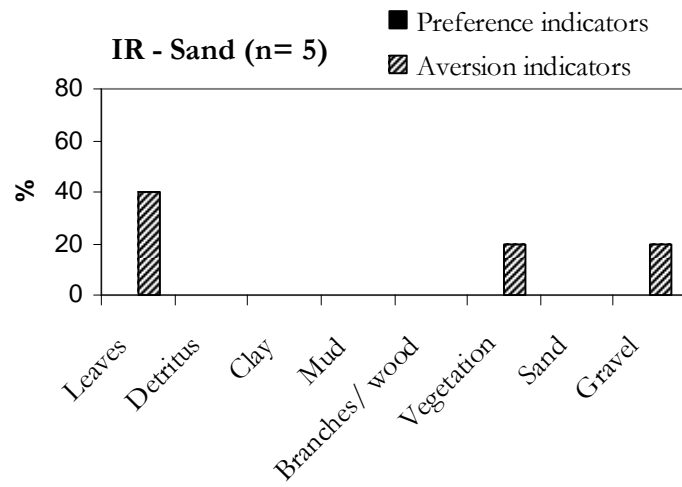


Figure 9. The percentage of total sand-indicator taxa (5) that also indicate preference or aversion for other habitat types.

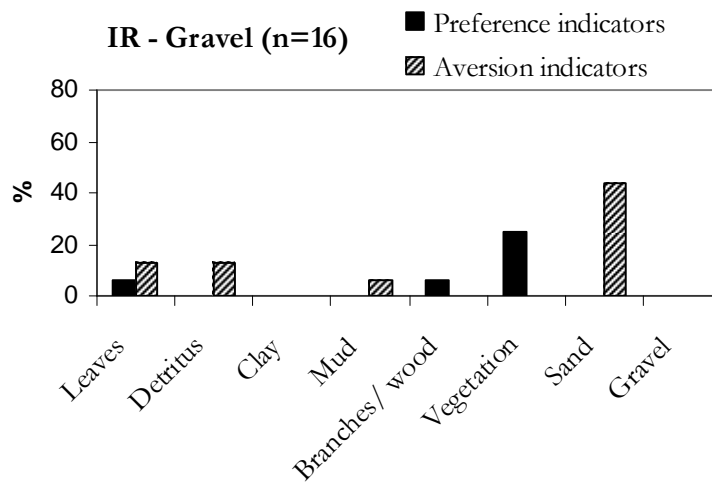


Figure 10. The percentage of total gravel-indicator taxa (16) that also indicate preference or aversion for other habitat types.

### 3.3 Habitat ranking

Table 4 translates the IR analysis results to a 10-habitat type ranking system, which can be a useful tool for water managers. This system is based on 10 predefined habitat types, as presented in Table 4. Habitat types for specific taxa were ranked according to the positive IR values in Table 2, with a sum of ranks that always equals 10. For example, if a taxon has an IR value of 4.1 for leaves and 1.2 for detritus and all negative for the other habitat types, the habitat type leaves receives a ranking of:

$$(10 / (4.1+1.2)) \times 4.1 = 7.7 = \text{rank } 8.$$

Detritus then receives:

$$(10 / (4.1+1.2)) \times 1.2 = 2.3 = \text{rank } 2.$$

The rest of the habitat types receive rank 0, the sum of ranks equals 10. However, because the ultimate ranks are round down to whole numbers, the sum not always equals 10 naturally. In such cases, the rank closest to a higher or lower value is round down to a higher or lower rank. For example: A taxa received the ranks 3.4, 2.3 and 4.3 for leaves, detritus and clay respectively, and 0 for the rest of the habitat types. Rounding down to whole numbers would give ranks 3, 2 and 4, which equals 9 not 10. In this case, since rank 3.4 was closer to receiving another round down rank than 2.3 and 4.3, it received rank 4 rather than 3 to make the sum of ranks equal 10.

There were no samples obtained from two of the 10 predefined habitat types; rocks and surface water. In the samples there were no characteristic surface water taxa encountered and therefore the habitat type surface water receives rank 0 for all taxa in this analysis. By contrast, taxa that received high ranking for gravel generally were taxa that are known to prefer rocky habitats as well. Therefore, the ranks scored for gravel were equally divided over the types gravel and rocks. Hence for those two habitat types ranks can be expressed in halves (Table 4).

Table 4. 10-Habitat type ranking results.

| taxon name / habitat type      | rank   |          |      |     |                   |            |      |        |       |                   |
|--------------------------------|--------|----------|------|-----|-------------------|------------|------|--------|-------|-------------------|
|                                | leaves | detritus | clay | mud | branches/<br>wood | Vegetation | sand | gravel | rocks | surf ace<br>water |
| Agabus sp larve                | 6      | 0        | 0    | 0   | 3                 | 1          | 0    | 0      | 0     | 0                 |
| Agapetus fuscipes              | 0      | 0        | 0    | 0   | 0                 | 0          | 0    | 5.0    | 5.0   | 0                 |
| Amphinemura standfussi         | 5      | 0        | 0    | 0   | 0                 | 0          | 0    | 2.5    | 2.5   | 0                 |
| Apsectrotanypus trifascipennis | 0      | 5        | 0    | 1   | 0                 | 4          | 0    | 0      | 0     | 0                 |
| Asellus aquaticus              | 1      | 0        | 0    | 0   | 5                 | 4          | 0    | 0      | 0     | 0                 |
| Athripsodes aterrimus          | 0      | 1        | 0    | 0   | 0                 | 9          | 0    | 0      | 0     | 0                 |
| Aulodrilus japonicus           | 0      | 6        | 0    | 0   | 0                 | 4          | 0    | 0      | 0     | 0                 |
| Baetis rhodani                 | 0      | 0        | 0    | 0   | 0                 | 0          | 0    | 5.0    | 5.0   | 0                 |
| Baetis vernus                  | 0      | 0        | 0    | 0   | 0                 | 9          | 0    | 0.5    | 0.5   | 0                 |
| Bereodes minutus               | 6      | 0        | 0    | 0   | 0                 | 4          | 0    | 0      | 0     | 0                 |
| Brillia modesta                | 8      | 0        | 0    | 0   | 2                 | 0          | 0    | 0      | 0     | 0                 |
| Caenis horaria                 | 0      | 1        | 0    | 0   | 0                 | 9          | 0    | 0      | 0     | 0                 |
| Calopteryx virgo               | 0      | 1        | 0    | 0   | 0                 | 9          | 0    | 0      | 0     | 0                 |
| Centropilum luteolum           | 0      | 1        | 0    | 0   | 4                 | 5          | 0    | 0      | 0     | 0                 |
| Chaetocladius gr piger         | 1      | 0        | 0    | 0   | 6                 | 0          | 0    | 1.5    | 1.5   | 0                 |
| Chaetopteryx villosa           | 0      | 6        | 0    | 0   | 0                 | 1          | 0    | 1.5    | 1.5   | 0                 |
| Chironomus sp                  | 0      | 0        | 0    | 6   | 3                 | 1          | 0    | 0      | 0     | 0                 |
| Clinotanypus nervosus          | 0      | 2        | 0    | 1   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Cloeon dipterum                | 2      | 0        | 0    | 1   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Conchapelopia sp               | 3      | 1        | 0    | 0   | 4                 | 2          | 0    | 0      | 0     | 0                 |
| Corynoneura celeripes          | 6      | 0        | 0    | 0   | 3                 | 1          | 0    | 0      | 0     | 0                 |
| Corynoneura coronata agg       | 2      | 0        | 0    | 0   | 5                 | 3          | 0    | 0      | 0     | 0                 |
| Corynoneura lobata agg         | 0      | 0        | 0    | 0   | 2                 | 5          | 0    | 1.5    | 1.5   | 0                 |
| Corynoneura scutellata agg     | 2      | 0        | 0    | 0   | 4                 | 4          | 0    | 0      | 0     | 0                 |
| Cricotopus gr sylvestris       | 0      | 0        | 0    | 0   | 0                 | 9          | 0    | 0.5    | 0.5   | 0                 |
| Cryptochironomus sp            | 0      | 0        | 0    | 2   | 2                 | 5          | 1    | 0      | 0     | 0                 |
| Dendrocoelum lacteum           | 9      | 1        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |
| Dicranota sp                   | 0      | 1        | 3    | 0   | 0                 | 0          | 1    | 2.5    | 2.5   | 0                 |
| Diplocladius cultriger         | 0      | 0        | 4    | 0   | 4                 | 2          | 0    | 0      | 0     | 0                 |
| Dixa gr maculata               | 2      | 1        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Dixa submaculata               | 1      | 2        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Dryopidae                      | 0      | 0        | 0    | 0   | 6                 | 4          | 0    | 0      | 0     | 0                 |
| Dugesia gonocephala            | 4      | 2        | 0    | 3   | 0                 | 0          | 0    | 0.5    | 0.5   | 0                 |
| Elodes minuta                  | 6      | 2        | 0    | 0   | 0                 | 2          | 0    | 0      | 0     | 0                 |
| Eloeophila sp                  | 0      | 1        | 2    | 2   | 0                 | 0          | 4    | 0.5    | 0.5   | 0                 |
| Enchytraeidae                  | 2      | 0        | 0    | 0   | 4                 | 4          | 0    | 0      | 0     | 0                 |
| Endochironomus gr              | 2      | 4        | 0    | 0   | 0                 | 4          | 0    | 0      | 0     | 0                 |

| taxon name / habitat type       | rank   |          |      |     |                   |            |      |        |       |                   |  |
|---------------------------------|--------|----------|------|-----|-------------------|------------|------|--------|-------|-------------------|--|
|                                 | leaves | detritus | clay | mud | branches/<br>wood | Vegetation | sand | gravel | rocks | surf ace<br>water |  |
| dispar                          |        |          |      |     |                   |            |      |        |       |                   |  |
| Erpobdella octoculata           | 3      | 1        | 0    | 0   | 2                 | 5          | 0    | 0      | 0     | 0                 |  |
| Eukiefferiella brevicar<br>agg  | 0      | 0        | 0    | 0   | 0                 | 0          | 0    | 5.0    | 5.0   | 0                 |  |
| Eukiefferiella claripennis      | 0      | 0        | 0    | 0   | 0                 | 1          | 0    | 4.5    | 4.5   | 0                 |  |
| Gammarus fossarum               | 0      | 7        | 0    | 0   | 0                 | 0          | 3    | 0      | 0     | 0                 |  |
| Gammarus pulex                  | 4      | 4        | 0    | 1   | 0                 | 1          | 0    | 0      | 0     | 0                 |  |
| Glossiphonia complanata         | 2      | 3        | 0    | 0   | 0                 | 5          | 0    | 0      | 0     | 0                 |  |
| Glyphotaenius pellucidus        | 4      | 4        | 0    | 0   | 1                 | 1          | 0    | 0      | 0     | 0                 |  |
| Gyraulidus albus                | 0      | 1        | 0    | 0   | 0                 | 9          | 0    | 0      | 0     | 0                 |  |
| Heterotanytarsus apicalis       | 3      | 7        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Heterotrissocladius<br>marcidus | 2      | 2        | 0    | 6   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Hydropsyche<br>angustipennis    | 0      | 0        | 0    | 0   | 0                 | 7          | 0    | 1.5    | 1.5   | 0                 |  |
| Hygrobatidus fluviatilis        | 0      | 0        | 0    | 0   | 0                 | 10         | 0    | 0      | 0     | 0                 |  |
| Lebertia lineata                | 0      | 2        | 0    | 0   | 0                 | 8          | 0    | 0      | 0     | 0                 |  |
| Lebertia stigmatifera           | 0      | 3        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |  |
| Leptophlebia marginata          | 5      | 5        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Limnephilus extricatus          | 1      | 0        | 0    | 0   | 0                 | 9          | 0    | 0      | 0     | 0                 |  |
| Limnephilus lunatus             | 0      | 0        | 0    | 0   | 4                 | 6          | 0    | 0      | 0     | 0                 |  |
| Limnius volckmari               | 0      | 0        | 0    | 0   | 0                 | 0          | 0    | 5.0    | 5.0   | 0                 |  |
| Limnodrilus hoffmeisteri        | 0      | 3        | 0    | 0   | 3                 | 4          | 0    | 0      | 0     | 0                 |  |
| Limnophyes sp                   | 3      | 0        | 0    | 1   | 3                 | 3          | 0    | 0      | 0     | 0                 |  |
| Ljania bipapillata              | 4      | 2        | 0    | 0   | 0                 | 4          | 0    | 0      | 0     | 0                 |  |
| Lumbriculus variegatus          | 0      | 0        | 0    | 1   | 9                 | 0          | 0    | 0      | 0     | 0                 |  |
| Lype reducta                    | 1      | 9        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Macropelopia sp                 | 3      | 5        | 0    | 2   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Micropsectra gr<br>atofasciata  | 2      | 0        | 0    | 2   | 3                 | 3          | 0    | 0      | 0     | 0                 |  |
| Micropsectra gr notescens       | 3      | 4        | 0    | 1   | 0                 | 2          | 0    | 0      | 0     | 0                 |  |
| Mideopsis orbicularis           | 0      | 0        | 0    | 0   | 0                 | 10         | 0    | 0      | 0     | 0                 |  |
| Molanna angustata               | 0      | 1        | 0    | 0   | 0                 | 9          | 0    | 0      | 0     | 0                 |  |
| Nais communis                   | 2      | 0        | 0    | 3   | 4                 | 1          | 0    | 0      | 0     | 0                 |  |
| Nais elinguis                   | 0      | 0        | 2    | 1   | 6                 | 1          | 0    | 0      | 0     | 0                 |  |
| Nais variabilis                 | 3      | 0        | 0    | 1   | 5                 | 1          | 0    | 0      | 0     | 0                 |  |
| Nanocladius rectinervis         | 0      | 0        | 0    | 0   | 3                 | 7          | 0    | 0      | 0     | 0                 |  |
| Nemoura avicularis              | 4      | 6        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Nemoura cinerea                 | 3      | 1        | 0    | 0   | 5                 | 1          | 0    | 0      | 0     | 0                 |  |
| Nemurella pictetii              | 7      | 3        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |  |
| Neolimnomyia sp                 | 0      | 0        | 0    | 2   | 1                 | 6          | 0    | 0.5    | 0.5   | 0                 |  |
| Nepa cinerea                    | 1      | 0        | 0    | 0   | 9                 | 0          | 0    | 0      | 0     | 0                 |  |

| taxon name / habitat type      | rank   |          |      |     |                   |            |      |        |       |                   |
|--------------------------------|--------|----------|------|-----|-------------------|------------|------|--------|-------|-------------------|
|                                | leaves | detritus | clay | mud | branches/<br>wood | Vegetation | sand | gravel | rocks | surf ace<br>water |
| Odontomesa fulva               | 0      | 1        | 0    | 0   | 0                 | 0          | 9    | 0      | 0     | 0                 |
| Ophidonais serpentina          | 0      | 0        | 0    | 0   | 0                 | 10         | 0    | 0      | 0     | 0                 |
| Oulimnius tuberculatus         | 0      | 2        | 0    | 0   | 0                 | 7          | 0    | 0.5    | 0.5   | 0                 |
| Paracladopelma laminata<br>agg | 0      | 2        | 0    | 0   | 0                 | 0          | 8    | 0      | 0     | 0                 |
| Paracladopelma nigrifulva      | 0      | 3        | 0    | 1   | 0                 | 0          | 6    | 0      | 0     | 0                 |
| Paratendipes albimanus         | 0      | 1        | 0    | 1   | 3                 | 5          | 0    | 0      | 0     | 0                 |
| Pedicia sp                     | 2      | 0        | 0    | 0   | 2                 | 3          | 0    | 1.5    | 1.5   | 0                 |
| Pericoma sp                    | 5      | 0        | 0    | 0   | 5                 | 0          | 0    | 0      | 0     | 0                 |
| Phaenopsectra sp               | 0      | 0        | 2    | 1   | 5                 | 2          | 0    | 0      | 0     | 0                 |
| Physa fontinalis               | 0      | 0        | 0    | 0   | 0                 | 10         | 0    | 0      | 0     | 0                 |
| Pilaria sp                     | 0      | 3        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Pisidium casertanum            | 0      | 6        | 0    | 0   | 0                 | 0          | 4    | 0      | 0     | 0                 |
| Plectrocnemia conspersa        | 4      | 4        | 0    | 0   | 0                 | 2          | 0    | 0      | 0     | 0                 |
| Polycelis felina               | 0      | 0        | 0    | 0   | 0                 | 5          | 0    | 2.5    | 2.5   | 0                 |
| Polycelis nigra/tenuis         | 3      | 0        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Polycelis tenuis               | 2      | 0        | 0    | 0   | 8                 | 0          | 0    | 0      | 0     | 0                 |
| Polypedilum nubeculosum        | 0      | 1        | 0    | 1   | 5                 | 3          | 0    | 0      | 0     | 0                 |
| Polypedilum scalaenum          | 0      | 3        | 1    | 2   | 0                 | 0          | 4    | 0      | 0     | 0                 |
| Proasellus meridianus          | 1      | 0        | 0    | 0   | 6                 | 3          | 0    | 0      | 0     | 0                 |
| Procladius sp                  | 1      | 5        | 0    | 2   | 1                 | 1          | 0    | 0      | 0     | 0                 |
| Prodiamesa olivacea            | 0      | 4        | 0    | 4   | 0                 | 0          | 2    | 0      | 0     | 0                 |
| Psammoryctides barbatus        | 0      | 2        | 0    | 0   | 0                 | 8          | 0    | 0      | 0     | 0                 |
| Ptychoptera lacustris          | 0      | 1        | 0    | 8   | 0                 | 0          | 1    | 0      | 0     | 0                 |
| Radix sp                       | 0      | 0        | 0    | 2   | 6                 | 0          | 0    | 1.0    | 1.0   | 0                 |
| Rheocricotopus fuscipes        | 4      | 2        | 0    | 0   | 1                 | 2          | 0    | 0.5    | 0.5   | 0                 |
| Rheotanytarsus sp              | 0      | 0        | 0    | 0   | 1                 | 5          | 0    | 2.0    | 2.0   | 0                 |
| Rhyacodrilus coccineus         | 0      | 3        | 7    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |
| Sialis fuliginosa              | 2      | 5        | 0    | 3   | 0                 | 0          | 0    | 0      | 0     | 0                 |
| Sialis lutaria                 | 0      | 6        | 0    | 0   | 0                 | 4          | 0    | 0      | 0     | 0                 |
| Silo nigricornis               | 0      | 0        | 0    | 0   | 0                 | 2          | 0    | 4.0    | 4.0   | 0                 |
| Simulium costatum              | 0      | 0        | 0    | 0   | 0                 | 0          | 0    | 5.0    | 5.0   | 0                 |
| Simulium erythrocephala        | 0      | 0        | 0    | 0   | 0                 | 10         | 0    | 0      | 0     | 0                 |
| Simulium intermedium           | 0      | 0        | 0    | 0   | 0                 | 9          | 0    | 0.5    | 0.5   | 0                 |
| Simulium ornatum               | 0      | 0        | 0    | 0   | 0                 | 5          | 0    | 2.5    | 2.5   | 0                 |
| Simulium trifasciatum          | 0      | 0        | 0    | 0   | 0                 | 0          | 0    | 5.0    | 5.0   | 0                 |
| Slavina appendiculata          | 5      | 1        | 0    | 0   | 2                 | 2          | 0    | 0      | 0     | 0                 |
| Specaria josinae               | 0      | 8        | 0    | 0   | 0                 | 2          | 0    | 0      | 0     | 0                 |
| Sperchon glandulosus           | 9      | 1        | 0    | 0   | 0                 | 0          | 0    | 0      | 0     | 0                 |
| Sperchon setiger               | 0      | 0        | 0    | 0   | 0                 | 1          | 0    | 4.5    | 4.5   | 0                 |
| Sperchon sp nymf               | 0      | 3        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |



| taxon name / habitat type           | rank   |          |      |     |                   |            |      |        |       |                   |
|-------------------------------------|--------|----------|------|-----|-------------------|------------|------|--------|-------|-------------------|
|                                     | leaves | detritus | clay | mud | branches/<br>wood | Vegetation | sand | gravel | rocks | surf ace<br>water |
| Sperchon squamosus                  | 4      | 0        | 0    | 0   | 0                 | 6          | 0    | 0      | 0     | 0                 |
| Sperchon thienemanni                | 0      | 3        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Sphaerium corneum                   | 0      | 3        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Spirosperma ferox                   | 0      | 3        | 0    | 0   | 0                 | 7          | 0    | 0      | 0     | 0                 |
| Stictochironomus sp                 | 0      | 7        | 0    | 0   | 0                 | 0          | 3    | 0      | 0     | 0                 |
| Stylaria lacustris                  | 1      | 0        | 4    | 0   | 0                 | 5          | 0    | 0      | 0     | 0                 |
| Tanytarsus sp                       | 0      | 0        | 1    | 1   | 5                 | 3          | 0    | 0      | 0     | 0                 |
| Thienemanniella<br>flaviforceps agg | 0      | 0        | 0    | 0   | 0                 | 10         | 0    | 0      | 0     | 0                 |
| Tipula lateralis                    | 1      | 0        | 0    | 0   | 6                 | 3          | 0    | 0      | 0     | 0                 |
| Tubifex ignotus                     | 0      | 4        | 0    | 0   | 0                 | 6          | 0    | 0      | 0     | 0                 |
| Tvetenia<br>discoloripes agg        | 0      | 0        | 0    | 0   | 0                 | 4          | 0    | 3.0    | 3.0   | 0                 |
| Velia caprai                        | 4      | 0        | 0    | 0   | 0                 | 6          | 0    | 0      | 0     | 0                 |
| Wettina podagrica                   | 2      | 0        | 0    | 0   | 0                 | 8          | 0    | 0      | 0     | 0                 |
| Zavreliomyia sp                     | 5      | 3        | 0    | 1   | 1                 | 0          | 0    | 0      | 0     | 0                 |

## Summary

A total of 604 habitat-specific macroinvertebrate community samples were taken from 16 different Dutch lowland streams and contained 547 taxa. The samples were taken from eight predefined habitat types. To investigate taxon-specific habitat preferences, first, the species distributions over the habitat types were tested against random distributions with chi-squared analyses. Then, two independent methods were used, weighted-averaging and the indexes of representation (IR), to determine preferences for specific habitat types. A pre-analysis showed that, in large part, the same information is comprised in the IR values as is comprised in the weighted-averaged optima, at least for these data. Therefore, in subsequent analyses interpretations on habitat preferences were based on the IR results only. Optima were found for 128 non-randomly distributed species. The IR analysis results were transformed to a 10-habitat type ranking system, which can be a useful tool for water managers. This system is based on 10 predefined habitat types. Habitat types for specific taxa were ranked according to the positive IR values.

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**Appendix 1 Weighted-average optima and tolerances and IR values for 128 taxa with significant non-random distributions over the eight habitat types.**

| taxon name/<br>habitat type       |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|-----------------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Agabus sp larve                   | Opt | 0.33   | 0.10     | 0.00  | 0.00  | 0.33              | 0.24       | 0.00  | 0.00   | 11  | 20.42 | 0.005 |
|                                   | Tol | 0.52   | 0.32     | 0.09  | 0.33  | 0.52              | 0.47       | 0.30  | 0.36   |     |       |       |
|                                   | IR  | 3.31   | -0.04    | -0.23 | -1.17 | 1.79              | 0.68       | -1.53 | -1.43  |     |       |       |
| Agapetus fuscipes                 | Opt | 0.00   | 0.01     | 0.00  | 0.00  | 0.00              | 0.00       | 0.00  | 0.98   | 52  | 89.13 | 0.001 |
|                                   | Tol | 0.03   | 0.12     | 0.09  | 0.03  | 0.27              | 0.04       | 0.05  | 0.14   |     |       |       |
|                                   | IR  | -2.48  | -0.87    | -0.51 | -1.75 | -0.97             | -1.59      | -2.11 | 8.42   |     |       |       |
| Amphinemura<br>standfussi         | Opt | 0.37   | 0.15     | 0.00  | 0.02  | 0.00              | 0.06       | 0.01  | 0.40   | 105 | 46.58 | 0.001 |
|                                   | Opt | 0.49   | 0.36     | 0.09  | 0.12  | 0.07              | 0.24       | 0.08  | 0.50   |     |       |       |
|                                   | Tol | 3.94   | -0.60    | -0.72 | -1.40 | 0.06              | -1.69      | -3.66 | 3.46   |     |       |       |
| Apsectrotanypus<br>trifascipennis | IR  | 0.10   | 0.53     | 0.00  | 0.07  | 0.00              | 0.23       | 0.08  | 0.00   | 49  | 25.81 | 0.001 |
|                                   | Opt | 0.32   | 0.53     | 0.09  | 0.26  | 0.27              | 0.45       | 0.29  | 0.36   |     |       |       |
|                                   | Tol | -0.93  | 2.92     | -0.49 | 0.37  | -0.94             | 2.33       | -0.74 | -3.03  |     |       |       |
| Asellus aquaticus                 | IR  | 0.21   | 0.12     | 0.00  | 0.02  | 0.30              | 0.34       | 0.00  | 0.02   | 85  | 73.50 | 0.001 |
|                                   | Opt | 0.43   | 0.34     | 0.09  | 0.14  | 0.48              | 0.50       | 0.06  | 0.13   |     |       |       |
|                                   | Opt | 1.63   | -0.48    | -0.65 | -0.17 | 5.19              | 4.99       | -3.30 | -2.73  |     |       |       |
| Athripsodes<br>aterrimus          | Tol | 0.11   | 0.15     | 0.00  | 0.04  | 0.00              | 0.49       | 0.08  | 0.13   | 21  | 30.87 | 0.001 |
|                                   | IR  | 0.32   | 0.38     | 0.09  | 0.19  | 0.27              | 0.52       | 0.29  | 0.35   |     |       |       |
|                                   | Opt | -1.24  | 0.54     | -0.32 | -1.00 | -0.62             | 4.97       | -1.64 | -0.47  |     |       |       |
| Aulodrilus<br>japonicus           | Tol | 0.10   | 0.50     | 0.00  | 0.10  | 0.00              | 0.19       | 0.11  | 0.01   | 84  | 38.59 | 0.001 |
|                                   | IR  | 0.30   | 0.51     | 0.09  | 0.31  | 0.27              | 0.40       | 0.32  | 0.08   |     |       |       |
|                                   | Opt | -0.82  | 4.36     | -0.65 | -1.68 | -1.24             | 2.45       | -0.90 | -2.70  |     |       |       |
| Baetis rhodani                    | Opt | 0.00   | 0.00     | 0.00  | 0.00  | 0.00              | 0.01       | 0.01  | 0.98   | 23  | 70.78 | 0.001 |
|                                   | Tol | 0.43   | 0.06     | 0.09  | 0.33  | 0.27              | 0.08       | 0.08  | 0.13   |     |       |       |
|                                   | IR  | -1.88  | -1.59    | -0.34 | -1.69 | -0.65             | -0.99      | -1.75 | 7.57   |     |       |       |
| Baetis vernus                     | Opt | 0.01   | 0.02     | 0.00  | 0.00  | 0.00              | 0.94       | 0.00  | 0.03   | 22  | 28.67 | 0.001 |
|                                   | Tol | 0.09   | 0.16     | 0.09  | 0.33  | 0.27              | 0.26       | 0.07  | 0.18   |     |       |       |
|                                   | IR  | -0.75  | -0.55    | -0.33 | -1.65 | -0.63             | 4.78       | -1.23 | 0.44   |     |       |       |
| Bercodes minutus                  | Opt | 0.72   | 0.03     | 0.00  | 0.00  | 0.00              | 0.26       | 0.00  | 0.00   | 12  | 21.11 | 0.005 |
|                                   | Opt | 0.50   | 0.18     | 0.09  | 0.33  | 0.27              | 0.48       | 0.30  | 0.36   |     |       |       |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Brillia modesta             | Tol | 3.05   | -0.16    | -0.24 | -1.22 | -0.47             | 2.28       | -1.59 | -1.50  | 119 | 56.25 | 0.001 |
|                             | IR  | 0.83   | 0.06     | 0.00  | 0.01  | 0.00              | 0.03       | 0.01  | 0.05   |     |       |       |
|                             | Opt | 0.39   | 0.26     | 0.09  | 0.12  | 0.07              | 0.19       | 0.08  | 0.23   |     |       |       |
| Caenis horaria              | Tol | 6.23   | -0.27    | -0.77 | -1.24 | 1.24              | -0.11      | -3.63 | -0.69  | 19  | 28.68 | 0.001 |
|                             | IR  | 0.04   | 0.10     | 0.00  | 0.01  | 0.00              | 0.85       | 0.00  | 0.00   |     |       |       |
|                             | Opt | 0.24   | 0.38     | 0.09  | 0.15  | 0.27              | 0.45       | 0.06  | 0.36   |     |       |       |
| Calopteryx virgo            | Opt | -0.54  | 0.77     | -0.31 | -0.88 | -0.59             | 4.69       | -1.01 | -1.89  | 7   | 27.78 | 0.001 |
|                             | Tol | 0.00   | 0.35     | 0.00  | 0.00  | 0.00              | 0.65       | 0.00  | 0.00   |     |       |       |
|                             | IR  | 0.43   | 0.53     | 0.09  | 0.33  | 0.27              | 0.53       | 0.30  | 0.36   |     |       |       |
| Centropilum luteolum        | Opt | -1.04  | 0.60     | -0.19 | -0.93 | -0.36             | 4.74       | -1.22 | -1.14  | 8   | 19.89 | 0.01  |
|                             | Tol | 0.00   | 0.41     | 0.00  | 0.00  | 0.01              | 0.51       | 0.07  | 0.00   |     |       |       |
|                             | IR  | 0.43   | 0.62     | 0.09  | 0.33  | 0.10              | 0.63       | 0.33  | 0.36   |     |       |       |
| Chaetocladius gr piger      | Opt | -1.11  | 0.41     | -0.20 | -1.00 | 2.24              | 3.27       | -0.53 | -1.22  | 39  | 28.02 | 0.001 |
|                             | Tol | 0.05   | 0.29     | 0.00  | 0.01  | 0.03              | 0.23       | 0.26  | 0.14   |     |       |       |
|                             | IR  | 0.24   | 0.51     | 0.09  | 0.10  | 0.18              | 0.47       | 0.49  | 0.39   |     |       |       |
| Chironomus sp               | Opt | 0.41   | -1.22    | -0.44 | 0.07  | 3.90              | 0.29       | -2.53 | 2.11   | 32  | 23.17 | 0.005 |
|                             | Tol | 0.25   | 0.16     | 0.00  | 0.28  | 0.05              | 0.25       | 0.00  | 0.01   |     |       |       |
|                             | IR  | 0.46   | 0.39     | 0.09  | 0.47  | 0.23              | 0.46       | 0.05  | 0.12   |     |       |       |
| Chaetopteryx villosa        | Opt | -0.42  | 0.01     | -0.40 | 3.52  | 1.86              | 0.74       | -2.22 | -1.22  | 21  | 14.21 | 0.05  |
|                             | Tol | 0.10   | 0.44     | 0.00  | 0.02  | 0.00              | 0.05       | 0.00  | 0.39   |     |       |       |
|                             | IR  | 0.31   | 0.52     | 0.09  | 0.13  | 0.27              | 0.23       | 0.30  | 0.51   |     |       |       |
| Cloeon dipterum             | Opt | -0.69  | 2.56     | -0.32 | -1.00 | -0.62             | 0.41       | -2.11 | 1.04   | 18  | 18.22 | 0.05  |
|                             | IR  | 0.13   | 0.00     | 0.00  | 0.01  | 0.00              | 0.85       | 0.01  | 0.00   |     |       |       |
|                             | Opt | 0.52   | 0.11     | 0.09  | 0.13  | 0.27              | 0.56       | 0.17  | 0.36   |     |       |       |
| Clinotanytus nervosus       | Tol | 0.74   | -0.75    | -0.30 | 0.51  | -0.57             | 3.49       | -0.93 | -1.84  | 12  | 16.71 | 0.05  |
|                             | IR  | 0.00   | 0.46     | 0.00  | 0.13  | 0.00              | 0.33       | 0.08  | 0.00   |     |       |       |
|                             | Opt | 0.43   | 0.53     | 0.09  | 0.35  | 0.27              | 0.50       | 0.29  | 0.36   |     |       |       |
| Conchapelopia sp            | Opt | -1.36  | 1.17     | -0.24 | 0.42  | -0.47             | 3.14       | -0.97 | -1.50  | 128 | 66.72 | 0.001 |
|                             | Tol | 0.23   | 0.11     | 0.00  | 0.04  | 0.15              | 0.42       | 0.02  | 0.04   |     |       |       |
|                             | IR  | 0.43   | 0.33     | 0.09  | 0.20  | 0.36              | 0.51       | 0.13  | 0.19   |     |       |       |
|                             | Opt | 3.67   | 0.62     | -0.80 | -1.23 | 5.02              | 2.53       | -3.48 | -2.65  |     |       |       |

| taxon name/<br>habitat type   |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|-------------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Corynoneura<br>celeripes      | Tol | 0.58   | 0.31     | 0.00  | 0.00  | 0.04              | 0.08       | 0.00  | 0.00   | 13  | 22.14 | 0.005 |
|                               | IR  | 0.53   | 0.49     | 0.09  | 0.33  | 0.20              | 0.28       | 0.30  | 0.36   |     |       |       |
|                               | Opt | 3.53   | 0.36     | -0.25 | -1.27 | 1.57              | 0.44       | -1.66 | -1.56  |     |       |       |
| Corynoneura<br>coronata agg   | Opt | 0.24   | 0.00     | 0.00  | 0.38  | 0.23              | 0.05       | 0.00  | 0.11   | 13  | 25.71 | 0.001 |
|                               | Tol | 0.48   | 0.44     | 0.09  | 0.54  | 0.47              | 0.24       | 0.30  | 0.35   |     |       |       |
|                               | IR  | 1.41   | -1.56    | -0.25 | 0.30  | 3.62              | 2.10       | -1.66 | -0.92  |     |       |       |
| Corynoneura<br>lobata agg     | Opt | 0.03   | 0.00     | 0.00  | 0.00  | 0.03              | 0.08       | 0.00  | 0.86   | 12  | 22.76 | 0.005 |
|                               | Tol | 0.20   | 0.44     | 0.09  | 0.33  | 0.20              | 0.34       | 0.30  | 0.43   |     |       |       |
|                               | IR  | -0.62  | -1.50    | -0.24 | -1.22 | 1.67              | 3.14       | -1.59 | 1.84   |     |       |       |
| Corynoneura<br>scutellata agg | Opt | 0.20   | 0.20     | 0.00  | 0.00  | 0.20              | 0.40       | 0.00  | 0.00   | 7   | 16.74 | 0.05  |
|                               | Opt | 0.44   | 0.44     | 0.09  | 0.33  | 0.44              | 0.53       | 0.30  | 0.36   |     |       |       |
|                               | Tol | 0.89   | -0.27    | -0.19 | -0.93 | 2.44              | 2.49       | -1.22 | -1.14  |     |       |       |
| Cryptochironomus<br>sp        | IR  | 0.00   | 0.15     | 0.00  | 0.15  | 0.02              | 0.29       | 0.37  | 0.02   | 20  | 15.01 | 0.05  |
|                               | Opt | 0.43   | 0.38     | 0.09  | 0.38  | 0.14              | 0.47       | 0.50  | 0.14   |     |       |       |
|                               | Tol | -1.75  | -0.90    | -0.32 | 0.96  | 1.05              | 2.50       | 0.86  | -1.42  |     |       |       |
| Cricotopus gr<br>sylvestris   | IR  | 0.39   | 0.00     | 0.00  | 0.00  | 0.00              | 0.26       | 0.00  | 0.35   | 8   | 23.24 | 0.005 |
|                               | Opt | 0.56   | 0.44     | 0.09  | 0.33  | 0.27              | 0.50       | 0.30  | 0.54   |     |       |       |
|                               | Opt | -0.21  | -1.22    | -0.20 | -1.00 | -0.38             | 4.32       | -1.30 | 0.41   |     |       |       |
| Dendrocoelum<br>lacteam       | Tol | 0.79   | 0.21     | 0.00  | 0.00  | 0.00              | 0.00       | 0.00  | 0.00   | 7   | 19.25 | 0.01  |
|                               | IR  | 0.46   | 0.46     | 0.09  | 0.33  | 0.27              | 0.45       | 0.30  | 0.36   |     |       |       |
|                               | Opt | 3.78   | 0.60     | -0.19 | -0.93 | -0.36             | -0.89      | -1.22 | -1.14  |     |       |       |
| Diplocladius<br>cultriger     | Tol | 0.31   | 0.03     | 0.03  | 0.03  | 0.26              | 0.29       | 0.00  | 0.06   | 14  | 32.88 | 0.001 |
|                               | IR  | 0.50   | 0.18     | 0.18  | 0.18  | 0.47              | 0.48       | 0.30  | 0.25   |     |       |       |
|                               | Opt | 0.58   | -1.00    | 3.53  | -0.56 | 3.46              | 1.93       | -1.72 | -0.38  |     |       |       |
| Dicranota sp                  | Opt | 0.05   | 0.20     | 0.01  | 0.11  | 0.00              | 0.07       | 0.18  | 0.38   | 119 | 26.51 | 0.001 |
|                               | Tol | 0.21   | 0.41     | 0.12  | 0.31  | 0.27              | 0.25       | 0.38  | 0.49   |     |       |       |
|                               | IR  | -2.65  | 0.58     | 1.83  | -1.24 | -1.47             | -0.93      | 0.35  | 3.34   |     |       |       |
| Dixa gr maculata              | Opt | 0.05   | 0.18     | 0.00  | 0.03  | 0.00              | 0.69       | 0.00  | 0.06   | 17  | 20.53 | 0.005 |

| taxon name/<br>habitat type        |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi    | P<    |
|------------------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|--------|-------|
| Dixa submaculata                   | Tol | 0.25   | 0.45     | 0.09  | 0.19  | 0.27              | 0.54       | 0.30  | 0.27   | 9   | 15.02  | 0.05  |
|                                    | IR  | 0.85   | 0.46     | -0.29 | -0.76 | -0.56             | 3.68       | -1.90 | -1.22  |     |        |       |
|                                    | Opt | 0.10   | 0.29     | 0.00  | 0.00  | 0.00              | 0.62       | 0.00  | 0.00   |     |        |       |
| Dryopidae                          | Opt | 0.33   | 0.51     | 0.09  | 0.33  | 0.27              | 0.55       | 0.30  | 0.36   | 20  | 30.54  | 0.001 |
|                                    | Tol | 0.52   | 1.01     | -0.21 | -1.06 | -0.40             | 2.97       | -1.38 | -1.30  |     |        |       |
|                                    | IR  | 0.03   | 0.24     | 0.00  | 0.00  | 0.05              | 0.38       | 0.01  | 0.28   |     |        |       |
| Dugesia<br>gonocephala             | Opt | 0.19   | 0.47     | 0.09  | 0.33  | 0.25              | 0.54       | 0.11  | 0.49   | 211 | 21.43  | 0.005 |
|                                    | Tol | -0.05  | -0.38    | -0.32 | -1.58 | 4.37              | 2.50       | -1.57 | 0.13   |     |        |       |
|                                    | IR  | 0.12   | 0.35     | 0.00  | 0.05  | 0.00              | 0.33       | 0.02  | 0.14   |     |        |       |
| Elodes minuta                      | Opt | 0.33   | 0.48     | 0.09  | 0.23  | 0.27              | 0.48       | 0.13  | 0.35   | 126 | 65.22  | 0.001 |
|                                    | Opt | 1.84   | 0.88     | -1.02 | 1.52  | -1.96             | -0.36      | -3.10 | 0.56   |     |        |       |
|                                    | IR  | 0.41   | 0.38     | 0.00  | 0.02  | 0.00              | 0.17       | 0.01  | 0.02   |     |        |       |
| Elocophila sp                      | IR  | 0.50   | 0.50     | 0.09  | 0.13  | 0.06              | 0.38       | 0.07  | 0.14   | 221 | 23.45  | 0.005 |
|                                    | Opt | 5.58   | 2.15     | -0.79 | -0.92 | -0.85             | 1.54       | -3.81 | -3.21  |     |        |       |
|                                    | Tol | 0.08   | 0.20     | 0.01  | 0.14  | 0.01              | 0.09       | 0.31  | 0.15   |     |        |       |
| Enchytraeidae                      | IR  | 0.27   | 0.41     | 0.10  | 0.35  | 0.11              | 0.28       | 0.47  | 0.36   | 93  | 17.52  | 0.05  |
|                                    | Opt | -3.09  | 0.72     | 0.86  | 0.87  | -1.01             | -2.18      | 2.36  | 0.72   |     |        |       |
|                                    | Opt | 0.11   | 0.30     | 0.00  | 0.11  | 0.03              | 0.28       | 0.11  | 0.05   |     |        |       |
| Endochironomus<br>gr dispar        | Tol | 0.33   | 0.48     | 0.09  | 0.33  | 0.19              | 0.47       | 0.32  | 0.22   | 19  | 15.55  | 0.05  |
|                                    | IR  | 1.24   | -1.05    | -0.68 | -0.75 | 2.54              | 2.33       | -1.29 | -0.58  |     |        |       |
|                                    | Opt | 0.13   | 0.44     | 0.00  | 0.00  | 0.00              | 0.39       | 0.02  | 0.02   |     |        |       |
| Erpobdella<br>octocolata           | Tol | 0.36   | 0.53     | 0.09  | 0.33  | 0.27              | 0.52       | 0.14  | 0.14   | 60  | 50.34  | 0.001 |
|                                    | IR  | 1.21   | 1.83     | -0.31 | -1.54 | -0.59             | 1.96       | -1.51 | -1.35  |     |        |       |
|                                    | Opt | 0.30   | 0.20     | 0.00  | 0.03  | 0.14              | 0.29       | 0.01  | 0.03   |     |        |       |
| Eukiefferiella<br>brevicealcar agg | Opt | 0.46   | 0.41     | 0.09  | 0.18  | 0.35              | 0.46       | 0.11  | 0.17   | 56  | 122.83 | 0.001 |
|                                    | Tol | 2.55   | 0.53     | -0.55 | -1.63 | 1.82              | 4.71       | -3.00 | -2.45  |     |        |       |
|                                    | IR  | 0.08   | 0.01     | 0.00  | 0.00  | 0.00              | 0.01       | 0.01  | 0.90   |     |        |       |
| Eukiefferiella<br>claripennis      | Opt | 0.28   | 0.08     | 0.09  | 0.33  | 0.27              | 0.08       | 0.08  | 0.31   | 28  | 70.40  | 0.001 |
|                                    | Tol | 0.13   | -2.93    | -0.53 | -2.64 | -1.01             | -1.71      | -2.86 | 9.74   |     |        |       |
|                                    | IR  | 0.04   | 0.00     | 0.00  | 0.00  | 0.00              | 0.03       | 0.00  | 0.93   |     |        |       |

| taxon name/<br>habitat type     |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|---------------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Gammarus<br>fossarum            | Opt | 0.22   | 0.44     | 0.09  | 0.33  | 0.27              | 0.17       | 0.30  | 0.27   | 19  | 15.22 | 0.05  |
|                                 | Opt | -1.11  | -2.29    | -0.37 | -1.86 | -0.71             | 0.48       | -2.44 | 7.32   |     |       |       |
|                                 | Tol | 0.03   | 0.81     | 0.00  | 0.00  | 0.00              | 0.00       | 0.02  | 0.14   |     |       |       |
|                                 | IR  | 0.24   | 0.58     | 0.09  | 0.33  | 0.27              | 0.45       | 0.21  | 0.52   |     |       |       |
|                                 | Opt | -0.54  | 2.89     | -0.31 | -1.54 | -0.59             | -1.46      | 0.98  | -0.82  |     |       |       |
| Gammarus pulex                  | Tol | 0.26   | 0.34     | 0.00  | 0.07  | 0.01              | 0.28       | 0.01  | 0.03   | 388 | 31.35 | 0.001 |
|                                 | IR  | 0.44   | 0.48     | 0.09  | 0.26  | 0.09              | 0.45       | 0.10  | 0.17   |     |       |       |
|                                 | Opt | 2.62   | 2.51     | -1.39 | 0.84  | -1.15             | 0.50       | -3.11 | -2.06  |     |       |       |
| Glyphotaelius<br>pellucidus     | Opt | 0.49   | 0.16     | 0.00  | 0.02  | 0.01              | 0.32       | 0.00  | 0.00   | 29  | 24.99 | 0.001 |
|                                 | Tol | 0.55   | 0.40     | 0.09  | 0.15  | 0.08              | 0.51       | 0.30  | 0.36   |     |       |       |
|                                 | IR  | 2.62   | 2.39     | -0.38 | -0.32 | 0.65              | 0.41       | -2.48 | -2.33  |     |       |       |
| Glossiphonia<br>complanata      | Opt | 0.28   | 0.40     | 0.00  | 0.01  | 0.00              | 0.21       | 0.05  | 0.05   | 44  | 30.93 | 0.001 |
|                                 | Tol | 0.46   | 0.50     | 0.09  | 0.11  | 0.27              | 0.41       | 0.22  | 0.22   |     |       |       |
|                                 | IR  | 1.24   | 2.01     | -0.47 | -1.91 | -0.90             | 3.62       | -2.07 | -1.82  |     |       |       |
| Gyraulus albus                  | Opt | 0.17   | 0.11     | 0.00  | 0.00  | 0.00              | 0.70       | 0.02  | 0.00   | 15  | 22.71 | 0.005 |
|                                 | Opt | 0.43   | 0.37     | 0.09  | 0.33  | 0.27              | 0.53       | 0.17  | 0.36   |     |       |       |
|                                 | Tol | -0.20  | 0.71     | -0.27 | -1.36 | -0.52             | 4.09       | -0.66 | -1.68  |     |       |       |
| Heterotanytarsus<br>apicalis    | IR  | 0.42   | 0.52     | 0.00  | 0.02  | 0.00              | 0.03       | 0.02  | 0.00   | 26  | 24.20 | 0.005 |
|                                 | Opt | 0.54   | 0.54     | 0.09  | 0.13  | 0.27              | 0.17       | 0.13  | 0.36   |     |       |       |
|                                 | Tol | 1.50   | 3.69     | -0.36 | -0.68 | -0.69             | -1.13      | -1.07 | -2.21  |     |       |       |
| Heterotrissocladius<br>marcidus | IR  | 0.17   | 0.43     | 0.00  | 0.12  | 0.01              | 0.21       | 0.07  | 0.00   | 70  | 29.87 | 0.001 |
|                                 | Opt | 0.39   | 0.52     | 0.09  | 0.34  | 0.08              | 0.43       | 0.27  | 0.05   |     |       |       |
|                                 | Opt | 1.59   | 1.08     | -0.59 | 3.50  | -0.24             | 0.04       | -2.03 | -3.07  |     |       |       |
| Hydropsyche<br>angustipennis    | Tol | 0.02   | 0.14     | 0.00  | 0.00  | 0.00              | 0.47       | 0.00  | 0.37   | 29  | 33.02 | 0.001 |
|                                 | IR  | 0.16   | 0.37     | 0.09  | 0.33  | 0.27              | 0.54       | 0.30  | 0.52   |     |       |       |
|                                 | Opt | -0.22  | -0.61    | -0.38 | -1.90 | -0.73             | 4.28       | -2.48 | 1.96   |     |       |       |
| Hygrobates<br>fluviatilis       | Tol | 0.00   | 0.09     | 0.00  | 0.00  | 0.00              | 0.82       | 0.00  | 0.09   | 6   | 19.47 | 0.01  |
|                                 | IR  | 0.43   | 0.34     | 0.09  | 0.33  | 0.27              | 0.45       | 0.30  | 0.34   |     |       |       |
|                                 | Opt | -0.96  | -0.12    | -0.17 | -0.86 | -0.33             | 4.04       | -1.13 | -0.12  |     |       |       |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N  | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|----|-------|-------|
| Lebertia lineata            | Opt | 0.03   | 0.26     | 0.00  | 0.12  | 0.00              | 0.41       | 0.06  | 0.12   | 19 | 15.23 | 0.05  |
|                             | Tol | 0.18   | 0.46     | 0.09  | 0.34  | 0.27              | 0.51       | 0.24  | 0.34   |    |       |       |
|                             | IR  | -1.13  | 0.77     | -0.31 | -0.88 | -0.59             | 3.32       | -1.01 | -0.29  |    |       |       |
| Lebertia stigmatifera       | Opt | 0.44   | 0.18     | 0.00  | 0.02  | 0.00              | 0.33       | 0.03  | 0.01   | 51 | 37.66 | 0.001 |
|                             | Tol | 0.52   | 0.41     | 0.09  | 0.13  | 0.27              | 0.49       | 0.17  | 0.09   |    |       |       |
|                             | IR  | -0.30  | 2.09     | -0.50 | -0.93 | -0.96             | 4.70       | -1.77 | -2.44  |    |       |       |
| Leptophlebia marginata      | Opt | 0.52   | 0.48     | 0.00  | 0.00  | 0.00              | 0.00       | 0.00  | 0.00   | 12 | 23.52 | 0.005 |
|                             | Opt | 0.55   | 0.55     | 0.09  | 0.33  | 0.27              | 0.45       | 0.30  | 0.36   |    |       |       |
|                             | Tol | 3.05   | 2.51     | -0.24 | -1.22 | -0.47             | -1.16      | -1.59 | -1.50  |    |       |       |
| Limnodrilus hoffmeisteri    | IR  | 0.03   | 0.27     | 0.00  | 0.10  | 0.09              | 0.32       | 0.12  | 0.07   | 69 | 17.34 | 0.05  |
|                             | Opt | 0.17   | 0.46     | 0.09  | 0.31  | 0.29              | 0.49       | 0.33  | 0.27   |    |       |       |
|                             | Tol | -2.34  | 1.70     | -0.59 | -0.88 | 1.56              | 2.24       | -0.42 | -0.53  |    |       |       |
| Limnophyes sp               | IR  | 0.26   | 0.03     | 0.00  | 0.13  | 0.11              | 0.42       | 0.00  | 0.05   | 23 | 25.29 | 0.001 |
|                             | Opt | 0.46   | 0.17     | 0.09  | 0.35  | 0.32              | 0.51       | 0.30  | 0.23   |    |       |       |
|                             | Opt | 2.37   | -1.59    | -0.34 | 0.68  | 2.44              | 2.12       | -2.21 | -1.11  |    |       |       |
| Limnephilus extricatus      | Tol | 0.53   | 0.05     | 0.00  | 0.00  | 0.00              | 0.39       | 0.03  | 0.00   | 11 | 22.80 | 0.005 |
|                             | IR  | 0.59   | 0.26     | 0.09  | 0.33  | 0.27              | 0.57       | 0.19  | 0.36   |    |       |       |
|                             | Opt | 0.24   | -0.04    | -0.23 | -1.17 | -0.45             | 4.28       | -0.87 | -1.43  |    |       |       |
| Limnephilus lunatus         | Tol | 0.06   | 0.16     | 0.00  | 0.01  | 0.04              | 0.71       | 0.01  | 0.00   | 16 | 37.01 | 0.001 |
|                             | IR  | 0.31   | 0.46     | 0.09  | 0.14  | 0.25              | 0.58       | 0.14  | 0.36   |    |       |       |
|                             | Opt | -0.30  | -0.57    | -0.28 | -0.70 | 3.17              | 4.62       | -1.30 | -1.73  |    |       |       |
| Limnius volckmari           | Opt | 0.00   | 0.07     | 0.00  | 0.00  | 0.00              | 0.00       | 0.00  | 0.93   | 6  | 17.16 | 0.05  |
|                             | Tol | 0.43   | 0.29     | 0.09  | 0.33  | 0.27              | 0.45       | 0.30  | 0.29   |    |       |       |
|                             | IR  | -0.96  | -0.12    | -0.17 | -0.86 | -0.33             | -0.82      | -1.13 | 3.66   |    |       |       |
| Ljania bipapillata          | Opt | 0.64   | 0.20     | 0.00  | 0.00  | 0.00              | 0.16       | 0.00  | 0.00   | 32 | 41.69 | 0.001 |
|                             | Tol | 0.50   | 0.42     | 0.09  | 0.33  | 0.27              | 0.38       | 0.30  | 0.36   |    |       |       |
|                             | IR  | 3.19   | 1.64     | -0.40 | -1.99 | -0.76             | 3.37       | -2.60 | -2.45  |    |       |       |
| Lumbriculus variegatus      | Opt | 0.21   | 0.11     | 0.00  | 0.36  | 0.14              | 0.07       | 0.07  | 0.04   | 16 | 50.13 | 0.001 |
|                             | Opt | 0.44   | 0.33     | 0.09  | 0.52  | 0.38              | 0.28       | 0.28  | 0.20   |    |       |       |
|                             | Tol | -0.30  | -0.57    | -0.28 | 0.72  | 6.87              | 0.15       | -0.76 | -1.15  |    |       |       |



| taxon name/<br>habitat type  |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N  | chi   | P<    |
|------------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|----|-------|-------|
| Lype reducta                 | IR  | 0.17   | 0.61     | 0.00  | 0.03  | 0.00              | 0.08       | 0.03  | 0.08   | 37 | 30.27 | 0.001 |
|                              | Opt | 0.39   | 0.50     | 0.09  | 0.17  | 0.27              | 0.29       | 0.17  | 0.29   |    |       |       |
|                              | Tol | 0.55   | 4.59     | -0.43 | -1.21 | -0.82             | -0.08      | -2.09 | -1.49  |    |       |       |
| Macropelopia sp              | IR  | 0.29   | 0.31     | 0.00  | 0.18  | 0.02              | 0.05       | 0.01  | 0.13   | 84 | 39.81 | 0.001 |
|                              | Opt | 0.47   | 0.48     | 0.09  | 0.40  | 0.14              | 0.23       | 0.12  | 0.35   |    |       |       |
|                              | Opt | 1.96   | 3.60     | -0.65 | 1.41  | -0.43             | 0.18       | -2.56 | -3.71  |    |       |       |
| Mideopsis orbicularis        | Tol | 0.00   | 0.04     | 0.00  | 0.00  | 0.00              | 0.91       | 0.04  | 0.00   | 6  | 19.36 | 0.01  |
|                              | IR  | 0.43   | 0.28     | 0.09  | 0.33  | 0.27              | 0.38       | 0.28  | 0.36   |    |       |       |
|                              | Opt | -0.96  | -0.12    | -0.17 | -0.86 | -0.33             | 4.04       | -0.24 | -1.06  |    |       |       |
| Micropsectra gr atrofasciata | Tol | 0.50   | 0.01     | 0.00  | 0.09  | 0.04              | 0.10       | 0.00  | 0.26   | 38 | 28.59 | 0.001 |
|                              | IR  | 0.57   | 0.09     | 0.09  | 0.33  | 0.24              | 0.34       | 0.05  | 0.51   |    |       |       |
|                              | Opt | 1.30   | -1.17    | -0.43 | 1.97  | 2.77              | 2.28       | -2.49 | -1.54  |    |       |       |
| Micropsectra gr notescens    | Opt | 0.09   | 0.13     | 0.00  | 0.63  | 0.00              | 0.14       | 0.00  | 0.01   | 93 | 34.42 | 0.001 |
|                              | Tol | 0.31   | 0.37     | 0.09  | 0.53  | 0.27              | 0.38       | 0.06  | 0.08   |    |       |       |
|                              | IR  | 1.77   | 3.02     | -0.68 | 1.02  | -1.30             | 1.40       | -2.86 | -2.97  |    |       |       |
| Molanna angustata            | Opt | 0.00   | 0.18     | 0.00  | 0.00  | 0.00              | 0.64       | 0.18  | 0.00   | 8  | 23.02 | 0.005 |
|                              | Tol | 0.43   | 0.42     | 0.09  | 0.33  | 0.27              | 0.52       | 0.42  | 0.36   |    |       |       |
|                              | IR  | -1.11  | 0.41     | -0.20 | -1.00 | -0.38             | 4.32       | -0.53 | -1.22  |    |       |       |
| Nais communis                | Opt | 0.23   | 0.11     | 0.00  | 0.30  | 0.10              | 0.18       | 0.02  | 0.07   | 41 | 34.89 | 0.001 |
|                              | Opt | 0.43   | 0.32     | 0.09  | 0.47  | 0.30              | 0.39       | 0.13  | 0.26   |    |       |       |
|                              | Tol | 1.47   | -0.96    | -0.45 | 2.62  | 3.76              | 1.11       | -2.27 | -2.05  |    |       |       |
| Nais elinguis                | IR  | 0.39   | 0.00     | 0.00  | 0.08  | 0.10              | 0.18       | 0.02  | 0.22   | 37 | 55.83 | 0.001 |
|                              | Opt | 0.54   | 0.44     | 0.04  | 0.31  | 0.33              | 0.43       | 0.17  | 0.46   |    |       |       |
|                              | Tol | -0.29  | -2.63    | 1.90  | 1.12  | 6.49              | 0.90       | -1.01 | 0.03   |    |       |       |
| Nais variabilis              | IR  | 0.22   | 0.15     | 0.00  | 0.27  | 0.07              | 0.23       | 0.05  | 0.01   | 37 | 30.95 | 0.001 |
|                              | Opt | 0.43   | 0.36     | 0.09  | 0.46  | 0.27              | 0.43       | 0.22  | 0.11   |    |       |       |
|                              | Opt | 2.22   | -0.35    | -0.43 | 0.66  | 4.05              | 0.90       | -1.73 | -2.25  |    |       |       |
| Nanocladius rectinervis      | Tol | 0.00   | 0.17     | 0.00  | 0.06  | 0.08              | 0.53       | 0.00  | 0.17   | 14 | 26.55 | 0.001 |
|                              | IR  | 0.43   | 0.39     | 0.09  | 0.24  | 0.29              | 0.53       | 0.30  | 0.39   |    |       |       |
|                              | Opt | -1.47  | 0.24     | -0.26 | -0.56 | 1.48              | 4.32       | -1.72 | -0.38  |    |       |       |
| Nemurella pictetii           | Tol | 0.83   | 0.11     | 0.00  | 0.00  | 0.00              | 0.06       | 0.00  | 0.01   | 55 | 32.24 | 0.001 |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N  | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|----|-------|-------|
| Neolimnomyia sp             | IR  | 0.43   | 0.35     | 0.09  | 0.03  | 0.27              | 0.26       | 0.05  | 0.09   | 46 | 15.39 | 0.05  |
|                             | Opt | 3.96   | 2.09     | -0.52 | -1.47 | -1.00             | -0.48      | -2.83 | -0.71  |    |       |       |
|                             | Opt | 0.00   | 0.06     | 0.00  | 0.45  | 0.01              | 0.29       | 0.11  | 0.09   |    |       |       |
|                             | Tol | 0.43   | 0.25     | 0.09  | 0.54  | 0.09              | 0.49       | 0.34  | 0.31   |    |       |       |
| Nepa cinerea                | IR  | -2.66  | -0.55    | -0.48 | 0.96  | 0.18              | 2.56       | -0.24 | 0.48   | 8  | 59.81 | 0.001 |
|                             | Opt | 0.22   | 0.11     | 0.00  | 0.11  | 0.44              | 0.11       | 0.00  | 0.00   |    |       |       |
|                             | Tol | 0.45   | 0.34     | 0.09  | 0.34  | 0.53              | 0.34       | 0.30  | 0.36   |    |       |       |
| Nemoura avicularis          | IR  | 0.69   | -0.41    | -0.20 | 0.01  | 7.48              | 0.10       | -1.30 | -1.22  | 18 | 14.52 | 0.05  |
|                             | Opt | 0.38   | 0.57     | 0.00  | 0.00  | 0.00              | 0.00       | 0.05  | 0.00   |    |       |       |
|                             | Opt | 0.52   | 0.53     | 0.09  | 0.33  | 0.27              | 0.45       | 0.23  | 0.06   |    |       |       |
|                             | Tol | 1.34   | 2.52     | -0.30 | -1.50 | -0.57             | -1.42      | 0.09  | -1.29  |    |       |       |
| Nemoura cinerea             | IR  | 0.53   | 0.21     | 0.00  | 0.01  | 0.07              | 0.13       | 0.03  | 0.01   | 82 | 28.28 | 0.001 |
|                             | Opt | 0.53   | 0.44     | 0.09  | 0.12  | 0.27              | 0.36       | 0.18  | 0.12   |    |       |       |
|                             | Tol | 2.36   | 0.68     | -0.64 | -1.00 | 3.69              | 0.58       | -2.49 | -0.85  |    |       |       |
| Odontomesa fulva            | IR  | 0.00   | 0.12     | 0.00  | 0.07  | 0.00              | 0.01       | 0.80  | 0.00   | 20 | 22.71 | 0.005 |
|                             | Opt | 0.43   | 0.37     | 0.09  | 0.29  | 0.27              | 0.10       | 0.46  | 0.36   |    |       |       |
|                             | Opt | -1.75  | 0.65     | -0.32 | -0.31 | -0.60             | -0.83      | 3.77  | -1.93  |    |       |       |
| Ophidonais serpentina       | Tol | 0.12   | 0.12     | 0.00  | 0.00  | 0.00              | 0.77       | 0.00  | 0.00   | 15 | 59.05 | 0.001 |
|                             | IR  | 0.41   | 0.41     | 0.09  | 0.04  | 0.27              | 0.54       | 0.30  | 0.36   |    |       |       |
|                             | Opt | -0.86  | -0.48    | -0.27 | -0.63 | -0.52             | 7.17       | -1.78 | -1.68  |    |       |       |
| Oulimnius tuberculatus      | Tol | 0.00   | 0.13     | 0.00  | 0.00  | 0.00              | 0.65       | 0.00  | 0.21   | 12 | 17.64 | 0.05  |
|                             | IR  | 0.43   | 0.40     | 0.09  | 0.33  | 0.27              | 0.56       | 0.30  | 0.48   |    |       |       |
|                             | Opt | -1.36  | 1.17     | -0.24 | -1.22 | -0.47             | 3.14       | -1.59 | 0.50   |    |       |       |
| Paracladopelma laminata agg | Opt | 0.01   | 0.23     | 0.00  | 0.01  | 0.00              | 0.07       | 0.66  | 0.01   | 24 | 16.49 | 0.05  |
|                             | Tol | 0.11   | 0.45     | 0.09  | 0.11  | 0.27              | 0.28       | 0.50  | 0.11   |    |       |       |
|                             | IR  | -1.40  | 0.71     | -0.35 | -1.15 | -0.66             | 0.18       | 3.07  | -1.65  |    |       |       |
| Paracladopelma nigritula    | Opt | 0.02   | 0.36     | 0.00  | 0.11  | 0.00              | 0.05       | 0.46  | 0.01   | 48 | 23.64 | 0.005 |
|                             | Tol | 0.13   | 0.50     | 0.09  | 0.32  | 0.27              | 0.22       | 0.52  | 0.09   |    |       |       |
|                             | IR  | -1.98  | 1.34     | -0.49 | 0.43  | -0.93             | -0.17      | 3.08  | -2.66  |    |       |       |
| Paratendipes albimanus      | Opt | 0.04   | 0.63     | 0.00  | 0.07  | 0.00              | 0.22       | 0.03  | 0.00   | 33 | 26.75 | 0.001 |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Pericoma sp                 | Opt | 0.23   | 0.54     | 0.09  | 0.29  | 0.06              | 0.46       | 0.19  | 0.36   | 13  | 32.75 | 0.001 |
|                             | Tol | -0.92  | 0.73     | -0.40 | 0.45  | 1.80              | 3.78       | -1.13 | -2.48  |     |       |       |
|                             | IR  | 0.57   | 0.00     | 0.00  | 0.00  | 0.15              | 0.23       | 0.00  | 0.05   |     |       |       |
|                             | Opt | 0.55   | 0.44     | 0.09  | 0.33  | 0.40              | 0.47       | 0.30  | 0.23   |     |       |       |
|                             | Tol | 3.53   | -1.56    | -0.25 | -1.27 | 3.62              | 0.44       | -1.66 | -0.28  |     |       |       |
| Pedicia sp                  | IR  | 0.09   | 0.01     | 0.00  | 0.00  | 0.01              | 0.10       | 0.23  | 0.54   | 50  | 14.97 | 0.05  |
| Phaenopsectra sp            | Opt | 0.30   | 0.12     | 0.09  | 0.05  | 0.12              | 0.32       | 0.45  | 0.52   | 34  | 68.84 | 0.001 |
|                             | Opt | 1.19   | -1.75    | -0.50 | -2.09 | 1.14              | 1.42       | -0.49 | 1.52   |     |       |       |
|                             | Tol | 0.16   | 0.01     | 0.00  | 0.24  | 0.16              | 0.36       | 0.01  | 0.05   |     |       |       |
| Physa fontinalis            | IR  | 0.38   | 0.10     | 0.07  | 0.45  | 0.39              | 0.50       | 0.10  | 0.23   | 12  | 49.61 | 0.001 |
|                             | Opt | -0.10  | -2.13    | 2.02  | 1.84  | 6.84              | 2.13       | -1.94 | -1.33  |     |       |       |
|                             | Tol | 0.03   | 0.03     | 0.00  | 0.10  | 0.00              | 0.84       | 0.00  | 0.00   |     |       |       |
| Pilaria sp                  | IR  | 0.19   | 0.19     | 0.09  | 0.32  | 0.27              | 0.40       | 0.30  | 0.36   | 22  | 15.90 | 0.05  |
|                             | Opt | -0.62  | -0.83    | -0.24 | -0.40 | -0.47             | 6.58       | -1.59 | -1.50  |     |       |       |
|                             | Opt | 0.00   | 0.27     | 0.00  | 0.06  | 0.00              | 0.42       | 0.09  | 0.15   |     |       |       |
| Pisidium casertanum         | Tol | 0.43   | 0.46     | 0.09  | 0.25  | 0.27              | 0.51       | 0.30  | 0.37   | 190 | 21.11 | 0.005 |
|                             | IR  | -1.84  | 1.42     | -0.33 | -0.44 | -0.63             | 2.87       | -1.23 | -0.06  |     |       |       |
|                             | Opt | 0.15   | 0.37     | 0.00  | 0.08  | 0.00              | 0.20       | 0.18  | 0.02   |     |       |       |
| Plectrocnemia conspersa     | Tol | 0.36   | 0.49     | 0.03  | 0.27  | 0.02              | 0.41       | 0.38  | 0.14   | 161 | 84.80 | 0.001 |
|                             | IR  | -0.79  | 2.76     | 0.06  | -0.12 | -1.32             | -0.30      | 1.53  | -2.94  |     |       |       |
|                             | Opt | 0.42   | 0.25     | 0.00  | 0.05  | 0.00              | 0.24       | 0.01  | 0.03   |     |       |       |
| Polycelis felina            | Opt | 0.50   | 0.44     | 0.09  | 0.22  | 0.06              | 0.43       | 0.07  | 0.16   | 17  | 28.54 | 0.001 |
|                             | Tol | 4.46   | 3.99     | -0.89 | -0.67 | -1.13             | 2.55       | -5.50 | -3.12  |     |       |       |
|                             | IR  | 0.00   | 0.30     | 0.00  | 0.00  | 0.00              | 0.45       | 0.00  | 0.25   |     |       |       |
| Polycelis nigra/tenuis      | Opt | 0.43   | 0.49     | 0.09  | 0.33  | 0.27              | 0.53       | 0.30  | 0.46   | 21  | 17.45 | 0.05  |
|                             | Tol | -1.62  | -0.66    | -0.29 | -1.45 | -0.56             | 2.95       | -1.90 | 3.26   |     |       |       |
|                             | IR  | 0.29   | 0.13     | 0.00  | 0.00  | 0.00              | 0.52       | 0.01  | 0.05   |     |       |       |
| Polycelis tenuis            | Opt | 0.49   | 0.36     | 0.09  | 0.33  | 0.27              | 0.54       | 0.12  | 0.23   | 12  | 73.72 | 0.001 |
|                             | Opt | 1.54   | 0.04     | -0.32 | -1.61 | -0.62             | 3.01       | -1.64 | -0.47  |     |       |       |
|                             | Tol | 0.19   | 0.03     | 0.00  | 0.00  | 0.19              | 0.55       | 0.00  | 0.03   |     |       |       |
| Polycelis tenuis            | IR  | 0.44   | 0.20     | 0.09  | 0.33  | 0.44              | 0.56       | 0.30  | 0.20   | 12  | 73.72 | 0.001 |
|                             | Opt | 1.58   | -0.83    | -0.24 | -1.22 | 8.09              | 0.56       | -1.59 | -0.83  |     |       |       |
|                             | Tol | 0.19   | 0.03     | 0.00  | 0.00  | 0.19              | 0.55       | 0.00  | 0.03   |     |       |       |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Polypedilum<br>nubeculosum  | Tol | 0.05   | 0.27     | 0.00  | 0.15  | 0.07              | 0.38       | 0.07  | 0.00   | 24  | 26.52 | 0.001 |
|                             | IR  | 0.24   | 0.46     | 0.09  | 0.37  | 0.27              | 0.50       | 0.27  | 0.36   |     |       |       |
|                             | Opt | -0.36  | 0.71     | -0.35 | 0.59  | 3.88              | 2.01       | -1.37 | -2.12  |     |       |       |
| Polypedilum<br>scalaenum    | Opt | 0.02   | 0.28     | 0.00  | 0.25  | 0.00              | 0.20       | 0.19  | 0.07   | 269 | 25.13 | 0.001 |
|                             | Tol | 0.13   | 0.45     | 0.04  | 0.44  | 0.03              | 0.40       | 0.39  | 0.25   |     |       |       |
|                             | IR  | -3.33  | 1.79     | 0.57  | 0.97  | -1.76             | -0.60      | 2.25  | -1.03  |     |       |       |
| Procladius sp               | Opt | 0.11   | 0.35     | 0.00  | 0.26  | 0.02              | 0.24       | 0.02  | 0.00   | 63  | 26.06 | 0.001 |
|                             | Tol | 0.32   | 0.49     | 0.09  | 0.45  | 0.13              | 0.44       | 0.15  | 0.06   |     |       |       |
|                             | IR  | 0.74   | 2.97     | -0.56 | 1.14  | 0.80              | 0.72       | -2.01 | -3.14  |     |       |       |
| Proasellus<br>meridianus    | Opt | 0.28   | 0.07     | 0.00  | 0.04  | 0.23              | 0.36       | 0.00  | 0.02   | 62  | 69.68 | 0.001 |
|                             | Opt | 0.47   | 0.26     | 0.09  | 0.20  | 0.44              | 0.50       | 0.07  | 0.13   |     |       |       |
|                             | Tol | 0.79   | -0.18    | -0.55 | -0.61 | 6.47              | 3.79       | -3.07 | -1.64  |     |       |       |
| Prodiamesa<br>olivacea      | IR  | 0.16   | 0.29     | 0.00  | 0.27  | 0.01              | 0.08       | 0.15  | 0.04   | 139 | 30.58 | 0.001 |
|                             | Opt | 0.37   | 0.46     | 0.09  | 0.45  | 0.09              | 0.27       | 0.36  | 0.21   |     |       |       |
|                             | Tol | -1.17  | 2.35     | -0.83 | 2.83  | -0.33             | -2.19      | 1.21  | -2.94  |     |       |       |
| Psammoryctides<br>barbatus  | IR  | 0.00   | 0.24     | 0.00  | 0.00  | 0.00              | 0.66       | 0.08  | 0.02   | 16  | 22.07 | 0.005 |
|                             | Opt | 0.43   | 0.47     | 0.09  | 0.33  | 0.27              | 0.52       | 0.30  | 0.15   |     |       |       |
|                             | Opt | -1.57  | 1.16     | -0.28 | -1.41 | -0.54             | 3.87       | -0.76 | -0.57  |     |       |       |
| Ptychoptera<br>lacustris    | Tol | 0.04   | 0.22     | 0.00  | 0.46  | 0.00              | 0.17       | 0.09  | 0.02   | 51  | 16.35 | 0.05  |
|                             | IR  | 0.20   | 0.43     | 0.09  | 0.52  | 0.27              | 0.39       | 0.29  | 0.14   |     |       |       |
|                             | Opt | -1.02  | 0.47     | -0.50 | 3.05  | -0.96             | 0.11       | 0.36  | -2.12  |     |       |       |
| Radix sp                    | Tol | 0.00   | 0.00     | 0.00  | 0.31  | 0.38              | 0.00       | 0.00  | 0.31   | 9   | 32.96 | 0.001 |
|                             | IR  | 0.43   | 0.44     | 0.09  | 0.50  | 0.53              | 0.45       | 0.30  | 0.50   |     |       |       |
|                             | Opt | -1.18  | -1.30    | -0.21 | 1.78  | 4.54              | -1.01      | -1.38 | 1.79   |     |       |       |
| Rheocricotopus<br>fuscipes  | Opt | 0.43   | 0.17     | 0.00  | 0.02  | 0.01              | 0.12       | 0.02  | 0.24   | 73  | 20.39 | 0.005 |
|                             | Tol | 0.51   | 0.38     | 0.09  | 0.15  | 0.09              | 0.34       | 0.13  | 0.44   |     |       |       |
|                             | IR  | 2.31   | 1.18     | -0.60 | -1.35 | 0.58              | 0.97       | -3.17 | 0.36   |     |       |       |
| Rhyacodrilus<br>coccineus   | Opt | 0.00   | 0.84     | 0.04  | 0.00  | 0.00              | 0.00       | 0.08  | 0.04   | 15  | 65.75 | 0.001 |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N  | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|----|-------|-------|
| Rheotanytarsus sp           | Tol | 0.43   | 0.49     | 0.25  | 0.33  | 0.27              | 0.45       | 0.36  | 0.27   | 26 | 28.33 | 0.001 |
|                             | IR  | -1.52  | 3.10     | 7.05  | -1.36 | -0.52             | -1.30      | -0.10 | -0.48  |    |       |       |
|                             | Opt | 0.04   | 0.03     | 0.00  | 0.05  | 0.02              | 0.35       | 0.00  | 0.52   |    |       |       |
|                             | Opt | 0.20   | 0.17     | 0.09  | 0.24  | 0.14              | 0.51       | 0.30  | 0.53   |    |       |       |
|                             | Tol | -1.00  | -1.75    | -0.36 | -0.13 | 0.77              | 3.55       | -2.35 | 2.33   |    |       |       |
| Sialis fuliginosa           | IR  | 0.20   | 0.41     | 0.00  | 0.30  | 0.00              | 0.03       | 0.06  | 0.00   | 35 | 26.16 | 0.001 |
|                             | Opt | 0.41   | 0.51     | 0.09  | 0.48  | 0.27              | 0.19       | 0.24  | 0.36   |    |       |       |
|                             | Tol | 1.56   | 2.91     | -0.42 | 1.75  | -0.80             | -1.48      | -1.62 | -2.56  |    |       |       |
| Sialis lutaria              | IR  | 0.23   | 0.46     | 0.00  | 0.04  | 0.00              | 0.23       | 0.04  | 0.00   | 30 | 22.52 | 0.005 |
|                             | Opt | 0.43   | 0.51     | 0.09  | 0.21  | 0.27              | 0.43       | 0.21  | 0.36   |    |       |       |
|                             | Opt | 0.18   | 3.12     | -0.39 | -0.89 | -0.74             | 1.97       | -1.33 | -2.37  |    |       |       |
| Silo nigricornis            | Tol | 0.00   | 0.00     | 0.00  | 0.00  | 0.00              | 0.09       | 0.06  | 0.86   | 21 | 28.04 | 0.001 |
|                             | IR  | 0.43   | 0.44     | 0.09  | 0.33  | 0.27              | 0.30       | 0.25  | 0.38   |    |       |       |
|                             | Opt | -1.80  | -1.98    | -0.32 | -1.61 | -0.62             | 1.06       | 0.26  | 4.07   |    |       |       |
| Simulium costatum           | Tol | 0.00   | 0.00     | 0.00  | 0.00  | 0.00              | 0.00       | 0.00  | 1.00   | 6  | 26.07 | 0.001 |
|                             | IR  | 0.43   | 0.44     | 0.09  | 0.33  | 0.27              | 0.45       | 0.30  | 0.36   |    |       |       |
|                             | Opt | -0.96  | -1.06    | -0.17 | -0.86 | -0.33             | -0.82      | -1.13 | 4.60   |    |       |       |
| Simulium erythrocephala     | Opt | 0.00   | 0.00     | 0.00  | 0.00  | 0.00              | 1.00       | 0.00  | 0.00   | 7  | 55.18 | 0.001 |
|                             | Tol | 0.43   | 0.44     | 0.09  | 0.33  | 0.27              | 0.45       | 0.30  | 0.36   |    |       |       |
|                             | IR  | -1.04  | -1.14    | -0.19 | -0.93 | -0.36             | 7.00       | -1.22 | -1.14  |    |       |       |
| Simulium intermedium        | Opt | 0.03   | 0.00     | 0.00  | 0.00  | 0.00              | 0.84       | 0.00  | 0.13   | 7  | 17.28 | 0.05  |
|                             | Tol | 0.22   | 0.44     | 0.09  | 0.33  | 0.27              | 0.49       | 0.30  | 0.46   |    |       |       |
|                             | IR  | -0.07  | -1.14    | -0.19 | -0.93 | -0.36             | 3.62       | -1.22 | 0.60   |    |       |       |
| Simulium ornatum            | Opt | 0.12   | 0.02     | 0.00  | 0.01  | 0.00              | 0.30       | 0.00  | 0.54   | 16 | 20.50 | 0.005 |
|                             | Opt | 0.37   | 0.16     | 0.09  | 0.13  | 0.27              | 0.52       | 0.30  | 0.56   |    |       |       |
|                             | Tol | -0.93  | -1.15    | -0.28 | -0.70 | -0.54             | 2.38       | -1.84 | 2.89   |    |       |       |
| Simulium trifasciatum       | IR  | 0.07   | 0.45     | 0.00  | 0.00  | 0.00              | 0.07       | 0.00  | 0.41   | 31 | 41.49 | 0.001 |
|                             | Opt | 0.29   | 0.56     | 0.09  | 0.33  | 0.27              | 0.28       | 0.30  | 0.56   |    |       |       |
|                             | Tol | -0.35  | -0.33    | -0.39 | -1.96 | -0.75             | -0.26      | -2.56 | 5.48   |    |       |       |
| Slavina appendiculata       | IR  | 0.27   | 0.26     | 0.00  | 0.08  | 0.02              | 0.34       | 0.03  | 0.01   | 47 | 22.86 | 0.005 |

| taxon name/<br>habitat type |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N  | chi   | P<    |
|-----------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|----|-------|-------|
| Sperchon<br>glandulosus     | Opt | 0.46   | 0.45     | 0.09  | 0.27  | 0.14              | 0.49       | 0.16  | 0.12   | 42 | 32.29 | 0.001 |
|                             | Opt | 3.26   | 0.41     | -0.48 | -0.35 | 1.24              | 1.18       | -1.89 | -2.29  |    |       |       |
|                             | Tol | 0.51   | 0.31     | 0.00  | 0.04  | 0.00              | 0.05       | 0.04  | 0.06   |    |       |       |
|                             | IR  | 0.51   | 0.47     | 0.09  | 0.19  | 0.27              | 0.22       | 0.19  | 0.25   |    |       |       |
| Sperchon sp nymf            | Opt | 4.93   | 0.41     | -0.46 | -0.97 | -0.87             | -0.34      | -1.98 | -1.38  | 11 | 18.04 | 0.05  |
|                             | Tol | 0.07   | 0.33     | 0.00  | 0.00  | 0.00              | 0.53       | 0.00  | 0.07   |    |       |       |
|                             | IR  | 0.26   | 0.50     | 0.09  | 0.33  | 0.27              | 0.53       | 0.30  | 0.26   |    |       |       |
| Sperchon setiger            | Opt | -0.53  | 1.35     | -0.23 | -1.17 | -0.45             | 3.38       | -1.53 | -0.74  | 14 | 16.36 | 0.05  |
|                             | Opt | 0.10   | 0.07     | 0.00  | 0.00  | 0.00              | 0.13       | 0.00  | 0.70   |    |       |       |
|                             | Tol | 0.32   | 0.26     | 0.09  | 0.33  | 0.27              | 0.36       | 0.30  | 0.48   |    |       |       |
|                             | IR  | -0.11  | -0.38    | -0.26 | -1.32 | -0.50             | 0.34       | -1.72 | 3.32   |    |       |       |
| Sperchon<br>squamosus       | Opt | 0.24   | 0.10     | 0.00  | 0.06  | 0.00              | 0.53       | 0.00  | 0.06   | 30 | 18.08 | 0.05  |
|                             | Tol | 0.44   | 0.31     | 0.09  | 0.25  | 0.27              | 0.51       | 0.30  | 0.25   |    |       |       |
|                             | IR  | 2.04   | -0.26    | -0.39 | 0.14  | -0.74             | 2.52       | -2.52 | -0.68  |    |       |       |
| Sperchon<br>thienemanni     | Opt | 0.08   | 0.45     | 0.00  | 0.00  | 0.00              | 0.42       | 0.00  | 0.06   | 41 | 46.84 | 0.001 |
|                             | Opt | 0.27   | 0.51     | 0.09  | 0.33  | 0.27              | 0.51       | 0.30  | 0.24   |    |       |       |
|                             | Tol | -0.52  | 1.92     | -0.45 | -2.26 | -0.86             | 5.30       | -2.95 | -0.24  |    |       |       |
| Specaria josinae            | IR  | 0.05   | 0.73     | 0.00  | 0.01  | 0.00              | 0.13       | 0.09  | 0.00   | 23 | 17.47 | 0.05  |
|                             | Opt | 0.23   | 0.49     | 0.09  | 0.10  | 0.27              | 0.37       | 0.32  | 0.36   |    |       |       |
|                             | Tol | -0.29  | 3.23     | -0.34 | -1.10 | -0.65             | 0.88       | -0.40 | -2.07  |    |       |       |
| Spirosperma ferox           | IR  | 0.00   | 0.43     | 0.00  | 0.00  | 0.00              | 0.51       | 0.06  | 0.00   | 13 | 23.33 | 0.005 |
|                             | Opt | 0.43   | 0.53     | 0.09  | 0.33  | 0.27              | 0.53       | 0.25  | 0.36   |    |       |       |
|                             | Opt | -1.41  | 1.65     | -0.25 | -1.27 | -0.49             | 3.75       | -0.45 | -1.56  |    |       |       |
| Sphaerium<br>corneum        | Tol | 0.00   | 0.63     | 0.00  | 0.07  | 0.00              | 0.22       | 0.07  | 0.02   | 17 | 21.82 | 0.005 |
|                             | IR  | 0.43   | 0.52     | 0.09  | 0.27  | 0.27              | 0.44       | 0.27  | 0.14   |    |       |       |
|                             | Opt | -1.62  | 1.58     | -0.29 | -0.76 | -0.56             | 3.68       | -0.84 | -1.22  |    |       |       |
| Stylaria lacustris          | Tol | 0.08   | 0.03     | 0.01  | 0.00  | 0.00              | 0.84       | 0.03  | 0.00   | 14 | 45.88 | 0.001 |
|                             | IR  | 0.30   | 0.21     | 0.13  | 0.33  | 0.27              | 0.42       | 0.21  | 0.36   |    |       |       |
|                             | Opt | 0.58   | -1.00    | 3.53  | -1.32 | -0.50             | 5.12       | -1.14 | -1.62  |    |       |       |
| Stictoichironomus<br>sp     | Opt | 0.02   | 0.63     | 0.00  | 0.00  | 0.00              | 0.07       | 0.18  | 0.10   | 40 | 19.13 | 0.01  |

| taxon name/<br>habitat type         |     | leaves | detritus | clay  | mud   | branches<br>/wood | Vegetation | sand  | gravel | N   | chi   | P<    |
|-------------------------------------|-----|--------|----------|-------|-------|-------------------|------------|-------|--------|-----|-------|-------|
| Tanytarsus sp                       | Tol | 0.16   | 0.50     | 0.09  | 0.33  | 0.27              | 0.26       | 0.40  | 0.31   | 97  | 26.08 | 0.001 |
|                                     | IR  | -0.87  | 3.11     | -0.45 | -2.23 | -0.85             | -0.71      | 1.21  | -0.91  |     |       |       |
|                                     | Opt | 0.23   | 0.12     | 0.00  | 0.18  | 0.02              | 0.11       | 0.27  | 0.07   |     |       |       |
|                                     | Tol | 0.44   | 0.34     | 0.02  | 0.40  | 0.16              | 0.33       | 0.46  | 0.27   |     |       |       |
|                                     | IR  | -0.50  | 0.20     | 0.75  | 0.85  | 3.94              | 1.84       | -1.00 | -2.15  |     |       |       |
| Thienemanniella<br>flaviforceps agg | Opt | 0.08   | 0.03     | 0.00  | 0.03  | 0.00              | 0.82       | 0.03  | 0.03   | 16  | 53.05 | 0.001 |
|                                     | Opt | 0.29   | 0.17     | 0.09  | 0.17  | 0.27              | 0.41       | 0.17  | 0.17   |     |       |       |
|                                     | Tol | -0.93  | -1.15    | -0.28 | -0.70 | -0.54             | 6.85       | -1.30 | -1.15  |     |       |       |
| Tipula lateralis                    | IR  | 0.18   | 0.00     | 0.00  | 0.06  | 0.12              | 0.59       | 0.00  | 0.06   | 9   | 28.66 | 0.001 |
|                                     | Opt | 0.42   | 0.44     | 0.09  | 0.26  | 0.36              | 0.55       | 0.30  | 0.26   |     |       |       |
| Tubifex ignotus                     | Tol | 0.52   | -1.30    | -0.21 | -0.11 | 4.54              | 1.97       | -1.38 | -0.53  | 29  | 20.47 | 0.005 |
|                                     | IR  | 0.02   | 0.24     | 0.00  | 0.01  | 0.00              | 0.65       | 0.05  | 0.03   |     |       |       |
|                                     | Opt | 0.15   | 0.45     | 0.09  | 0.08  | 0.27              | 0.50       | 0.24  | 0.17   |     |       |       |
| Tvetenia<br>discoloripes agg        | Opt | -1.64  | 1.96     | -0.38 | -1.37 | -0.73             | 3.17       | -0.46 | -1.04  | 17  | 28.20 | 0.001 |
|                                     | Tol | 0.05   | 0.02     | 0.00  | 0.00  | 0.00              | 0.51       | 0.00  | 0.42   |     |       |       |
|                                     | IR  | 0.24   | 0.14     | 0.09  | 0.33  | 0.27              | 0.53       | 0.30  | 0.52   |     |       |       |
| Velia caprai                        | Opt | -1.00  | -1.22    | -0.29 | -1.45 | -0.56             | 2.23       | -1.90 | 3.82   | 12  | 21.15 | 0.005 |
|                                     | Tol | 0.56   | 0.06     | 0.00  | 0.06  | 0.00              | 0.31       | 0.00  | 0.00   |     |       |       |
|                                     | IR  | 0.52   | 0.26     | 0.09  | 0.26  | 0.27              | 0.49       | 0.30  | 0.36   |     |       |       |
| Wettina podagrica                   | Opt | 2.32   | -0.83    | -0.24 | -0.40 | -0.47             | 3.14       | -1.59 | -1.50  | 12  | 14.22 | 0.05  |
|                                     | Tol | 0.56   | 0.30     | 0.00  | 0.01  | 0.00              | 0.12       | 0.01  | 0.00   |     |       |       |
| Zavreliomyia sp                     | Tol | 0.57   | 0.53     | 0.09  | 0.11  | 0.27              | 0.37       | 0.11  | 0.36   | 100 | 58.29 | 0.001 |
|                                     | IR  | 0.85   | -0.16    | -0.24 | -0.40 | -0.47             | 3.14       | -0.97 | -1.50  |     |       |       |
|                                     | Opt | 0.39   | 0.20     | 0.00  | 0.15  | 0.08              | 0.14       | 0.00  | 0.03   |     |       |       |
|                                     | Tol | 0.50   | 0.41     | 0.09  | 0.37  | 0.28              | 0.36       | 0.05  | 0.18   |     |       |       |
|                                     | IR  | 4.49   | 2.61     | -0.70 | 0.73  | 0.87              | 0.52       | -4.39 | -3.17  |     |       |       |

