Environmental DNA provides greater insight to biodiversity and ecosystem function compared to traditional approaches, via spatio-temporal nestedness and turnover partitioning

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Supplementary Information

Supplementary Table 1. Breakdown of genera per landuse type given as percent of total genera richness per site, by method.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| HigherTaxa | Genus | Agriculture | Urban | Woodland | Moorland | AcidGrassland |
| eDNA / Traditional |
| Amphipoda | Gammarus | 0.007 / 0.043 | 0 / 0.021 | 0.004 / 0.029 | 0.01 / 0 | 0.012 / 0 |
| Chilopoda | Strigamia | 0.002 / 0 | 0.002 / 0 | 0.003 / 0 | 0 / 0 | 0.003 / 0 |
| Chironomid | Psectrocladius | 0.004 / 0 | 0.007 / 0 | 0.007 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Micropsectra | 0.019 / 0 | 0.022 / 0 | 0.017 / 0 | 0.014 / 0 | 0.012 / 0 |
| Chironomid | Conchapelopia | 0.015 / 0 | 0.012 / 0 | 0.01 / 0 | 0.007 / 0 | 0.012 / 0 |
| Chironomid | Simulium | 0.021 / 0.032 | 0.022 / 0.038 | 0.017 / 0.033 | 0.014 / 0.062 | 0.012 / 0.062 |
| Chironomid | Chaetocladius | 0.004 / 0 | 0.014 / 0 | 0.011 / 0 | 0.009 / 0 | 0.004 / 0 |
| Chironomid | Macropelopia | 0.015 / 0 | 0.016 / 0 | 0.016 / 0 | 0.01 / 0 | 0.012 / 0 |
| Chironomid | Procladius | 0.004 / 0 | 0.002 / 0 | 0.004 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Heterotanytarsus | 0.007 / 0 | 0.016 / 0 | 0.016 / 0 | 0.009 / 0 | 0.004 / 0 |
| Chironomid | Limnophyes | 0.013 / 0 | 0.016 / 0 | 0.014 / 0 | 0.013 / 0 | 0.01 / 0 |
| Chironomid | Orthocladius | 0.017 / 0 | 0.022 / 0 | 0.017 / 0 | 0.011 / 0 | 0.01 / 0 |
| Chironomid | Corynoneura | 0.021 / 0.003 | 0.018 / 0.004 | 0.016 / 0.004 | 0.014 / 0.022 | 0.012 / 0.017 |
| Chironomid | Brachypogon | 0.002 / 0 | 0.007 / 0 | 0.004 / 0 | 0.003 / 0 | 0.001 / 0 |
| Chironomid | Prosimulium | 0.004 / 0 | 0.004 / 0.004 | 0.003 / 0 | 0 / 0.015 | 0 / 0.008 |
| Chironomid | Parametriocnemus | 0.002 / 0 | 0.007 / 0 | 0.006 / 0 | 0.005 / 0 | 0.004 / 0 |
| Chironomid | Prodiamesa | 0.007 / 0 | 0.002 / 0.004 | 0.006 / 0 | 0.01 / 0 | 0.012 / 0 |
| Chironomid | Metriocnemus | 0.011 / 0 | 0.016 / 0.004 | 0.01 / 0 | 0.008 / 0 | 0.007 / 0 |
| Chironomid | Culicoides | 0.009 / 0 | 0.009 / 0 | 0.006 / 0 | 0.008 / 0 | 0.004 / 0 |
| Chironomid | Phaenopsectra | 0.004 / 0 | 0.007 / 0 | 0.001 / 0 | 0.003 / 0 | 0.001 / 0 |
| Chironomid | Thienemanniella | 0.006 / 0 | 0.005 / 0 | 0.006 / 0 | 0.002 / 0 | 0 / 0 |
| Chironomid | Paraphaenocladius | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Zavrelimyia | 0.002 / 0 | 0.005 / 0 | 0.003 / 0 | 0.002 / 0 | 0.003 / 0 |
| Chironomid | Krenopelopia | 0.006 / 0 | 0.009 / 0 | 0.006 / 0 | 0.001 / 0 | 0.001 / 0 |
| Chironomid | Pseudorthocladius | 0.004 / 0 | 0.007 / 0 | 0.004 / 0 | 0.006 / 0 | 0.006 / 0 |
| Chironomid | Cricotopus | 0.004 / 0 | 0.004 / 0 | 0.01 / 0 | 0.005 / 0 | 0.003 / 0 |
| Chironomid | Eukiefferiella | 0.011 / 0 | 0.016 / 0 | 0.013 / 0 | 0.011 / 0 | 0.012 / 0 |
| Chironomid | Tanytarsus | 0 / 0 | 0.005 / 0 | 0.004 / 0 | 0.006 / 0 | 0.003 / 0 |
| Chironomid | Parochlus | 0 / 0 | 0.009 / 0 | 0.001 / 0 | 0.005 / 0 | 0 / 0 |
| Chironomid | Ablabesmyia | 0 / 0 | 0.004 / 0 | 0.004 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Rheocricotopus | 0.013 / 0 | 0.011 / 0 | 0.013 / 0 | 0.011 / 0 | 0.01 / 0 |
| Chironomid | Stempellinella | 0.009 / 0 | 0.011 / 0 | 0.009 / 0 | 0.008 / 0 | 0.01 / 0 |
| Chironomid | Tvetenia | 0.015 / 0 | 0.014 / 0 | 0.013 / 0 | 0.014 / 0 | 0.012 / 0 |
| Chironomid | Rheotanytarsus | 0.004 / 0 | 0 / 0 | 0.009 / 0 | 0.001 / 0 | 0.001 / 0 |
| Chironomid | Paratrichocladius | 0.002 / 0 | 0.005 / 0 | 0.007 / 0 | 0.005 / 0 | 0.001 / 0 |
| Chironomid | Polypedilum | 0.015 / 0 | 0.007 / 0 | 0.009 / 0 | 0.011 / 0 | 0.01 / 0 |
| Chironomid | Trissopelopia | 0.006 / 0 | 0.002 / 0 | 0.004 / 0 | 0.009 / 0 | 0.01 / 0 |
| Chironomid | Antocha | 0.002 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Diamesa | 0.002 / 0 | 0 / 0 | 0.007 / 0 | 0.002 / 0 | 0.003 / 0.008 |
| Chironomid | Tipula | 0.006 / 0 | 0.011 / 0.008 | 0.009 / 0 | 0.011 / 0 | 0.012 / 0.008 |
| Chironomid | Dicranomyia | 0.006 / 0 | 0.002 / 0 | 0.004 / 0 | 0.003 / 0 | 0.004 / 0 |
| Chironomid | Paracricotopus | 0.002 / 0 | 0 / 0 | 0.004 / 0 | 0.003 / 0 | 0 / 0 |
| Chironomid | Dicrotendipes | 0 / 0 | 0.004 / 0 | 0.001 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Palpomyia | 0.006 / 0 | 0.004 / 0 | 0.006 / 0 | 0.006 / 0 | 0.01 / 0 |
| Chironomid | Microtendipes | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.002 / 0 | 0 / 0 |
| Chironomid | Psychoda | 0.009 / 0.003 | 0.009 / 0.004 | 0.01 / 0 | 0.009 / 0 | 0.012 / 0 |
| Chironomid | Pseudosmittia | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.001 / 0 | 0.003 / 0 |
| Chironomid | Thaumalea | 0.004 / 0 | 0.002 / 0 | 0.001 / 0 | 0.003 / 0 | 0.004 / 0 |
| Chironomid | Serromyia | 0 / 0 | 0.004 / 0 | 0.001 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Forcipomyia | 0 / 0 | 0.004 / 0 | 0.001 / 0 | 0.005 / 0 | 0.003 / 0 |
| Chironomid | Bryophaenocladius | 0 / 0 | 0.002 / 0 | 0.003 / 0 | 0.001 / 0 | 0.001 / 0 |
| Chironomid | Hilara | 0.004 / 0 | 0.004 / 0 | 0.001 / 0 | 0.003 / 0 | 0.001 / 0 |
| Chironomid | Krenosmittia | 0 / 0 | 0.002 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Rhamphomyia | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Chironomus | 0.006 / 0 | 0.005 / 0 | 0 / 0 | 0.001 / 0 | 0.006 / 0 |
| Chironomid | Phaonia | 0.006 / 0 | 0.002 / 0 | 0 / 0 | 0.003 / 0 | 0.003 / 0 |
| Chironomid | Beris | 0 / 0 | 0.002 / 0 | 0 / 0 | 0.001 / 0 | 0.001 / 0 |
| Chironomid | Gymnometriocnemus | 0.009 / 0 | 0.002 / 0 | 0.004 / 0 | 0.009 / 0 | 0.01 / 0 |
| Chironomid | Cladotanytarsus | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.002 / 0 | 0 / 0 |
| Chironomid | Smittia | 0.004 / 0 | 0 / 0 | 0 / 0 | 0.002 / 0 | 0.004 / 0 |
| Chironomid | Anopheles | 0.004 / 0 | 0.002 / 0 | 0.003 / 0 | 0.003 / 0 | 0.003 / 0 |
| Chironomid | Pericoma | 0.006 / 0.01 | 0 / 0.004 | 0.003 / 0.008 | 0.006 / 0 | 0.007 / 0 |
| Chironomid | Brillia | 0 / 0.003 | 0 / 0.004 | 0 / 0.004 | 0.003 / 0 | 0.006 / 0 |
| Chironomid | Paracladopelma | 0 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.001 / 0 |
| Chironomid | Schizohelea | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.001 / 0 |
| Chironomid | Atrichopogon | 0.002 / 0 | 0 / 0 | 0.001 / 0 | 0.002 / 0 | 0.001 / 0 |
| Chironomid | Camptocladius | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.003 / 0 |
| Chironomid | Eristalis | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 |
| Chironomid | Bezzia | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Dasyhelea | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Heleniella | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Dixa | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.006 / 0 |
| Chironomid | Ptychoptera | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.001 / 0 |
| Chironomid | Paratanytarsus | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 | 0 / 0 |
| Chironomid | Parachironomus | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Chironomid | Culex | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 |
| Chironomid | Dolichopus | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Cladocera | Chydorus | 0.006 / 0 | 0.004 / 0 | 0 / 0 | 0 / 0 | 0.004 / 0 |
| Cladocera | Eurycercus | 0 / 0 | 0.004 / 0 | 0 / 0 | 0 / 0.007 | 0 / 0 |
| Cladocera | Polyphemus | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Cladocera | Leptodora | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Coelenterata | Hydra | 0.015 / 0 | 0.009 / 0 | 0.011 / 0 | 0.014 / 0 | 0.012 / 0 |
| Coelenterata | Craspedacusta | 0 / 0 | 0 / 0 | 0.004 / 0 | 0.003 / 0 | 0.006 / 0 |
| Coleoptera | Agabus | 0.007 / 0 | 0.012 / 0.004 | 0.004 / 0 | 0.005 / 0.015 | 0.003 / 0 |
| Coleoptera | Hydroporus | 0.006 / 0 | 0.004 / 0 | 0.004 / 0 | 0.003 / 0.007 | 0.001 / 0 |
| Coleoptera | Plateumaris | 0.002 / 0 | 0.004 / 0 | 0.004 / 0 | 0.002 / 0 | 0 / 0 |
| Coleoptera | Enochrus | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Coleoptera | Oreodytes | 0.007 / 0.014 | 0.002 / 0.008 | 0.006 / 0.008 | 0.008 / 0 | 0.007 / 0.008 |
| Coleoptera | Elmis | 0.004 / 0.039 | 0.007 / 0.029 | 0.007 / 0.051 | 0.011 / 0.03 | 0.006 / 0.026 |
| Coleoptera | Limnius | 0 / 0.039 | 0 / 0.025 | 0.006 / 0.051 | 0.006 / 0.007 | 0.009 / 0.034 |
| Coleoptera | Hydraena | 0.002 / 0.036 | 0.002 / 0.025 | 0.004 / 0.042 | 0.002 / 0 | 0.004 / 0.008 |
| Coleoptera | Helophorus | 0.006 / 0.003 | 0.004 / 0.008 | 0.003 / 0.004 | 0.002 / 0 | 0.004 / 0 |
| Coleoptera | Dytiscus | 0 / 0 | 0.002 / 0 | 0 / 0 | 0.002 / 0 | 0 / 0 |
| Coleoptera | Oulimnius | 0 / 0.018 | 0.005 / 0.021 | 0.006 / 0.025 | 0.003 / 0.062 | 0 / 0.043 |
| Coleoptera | Platambus | 0.004 / 0 | 0.007 / 0 | 0.004 / 0 | 0.006 / 0.007 | 0 / 0.008 |
| Coleoptera | Dryops | 0.002 / 0 | 0 / 0.021 | 0.003 / 0.004 | 0.002 / 0 | 0.003 / 0 |
| Coleoptera | Elodes | 0.015 / 0.003 | 0.007 / 0.021 | 0.009 / 0.012 | 0.008 / 0 | 0.012 / 0 |
| Coleoptera | Orectochilus | 0 / 0.01 | 0 / 0.017 | 0.003 / 0.016 | 0.002 / 0 | 0.001 / 0.008 |
| Coleoptera | Cercyon | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Coleoptera | Anacaena | 0 / 0 | 0.004 / 0 | 0 / 0.004 | 0.003 / 0 | 0 / 0.008 |
| Coleoptera | Hydrocyphon | 0.004 / 0.01 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Coleoptera | Donacia | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Coleoptera | Megasternum | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.001 / 0 | 0 / 0 |
| Collembola | Isotoma | 0.004 / 0 | 0.009 / 0 | 0.009 / 0 | 0.001 / 0 | 0.003 / 0 |
| Collembola | Isotomurus | 0.011 / 0 | 0.007 / 0 | 0.007 / 0 | 0.011 / 0 | 0.012 / 0 |
| Collembola | Hypogastrura | 0.004 / 0 | 0 / 0 | 0.001 / 0 | 0.001 / 0 | 0.007 / 0 |
| Copepoda | Eudiaptomus | 0 / 0 | 0.007 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Copepoda | Paracyclops | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.004 / 0 |
| Copepoda | Eucyclops | 0.004 / 0 | 0 / 0 | 0.003 / 0 | 0.002 / 0 | 0.01 / 0 |
| Copepoda | Acanthocyclops | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.004 / 0 |
| Copepoda | Canthocamptus | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.002 / 0 | 0 / 0 |
| Ephemeroptera | Leptophlebia | 0.004 / 0.007 | 0.011 / 0 | 0.009 / 0 | 0.001 / 0.045 | 0 / 0 |
| Ephemeroptera | Baetis | 0.019 / 0.043 | 0.016 / 0.052 | 0.017 / 0.042 | 0.014 / 0.022 | 0.012 / 0.053 |
| Ephemeroptera | Serratella | 0.002 / 0.021 | 0 / 0.012 | 0.006 / 0.016 | 0.005 / 0 | 0.004 / 0.017 |
| Ephemeroptera | Rhithrogena | 0.013 / 0.039 | 0.002 / 0.029 | 0.006 / 0.025 | 0.01 / 0 | 0.01 / 0 |
| Ephemeroptera | Ecdyonurus | 0.007 / 0.043 | 0 / 0.025 | 0.01 / 0.025 | 0.011 / 0 | 0.01 / 0.008 |
| Ephemeroptera | Caenis | 0 / 0.01 | 0 / 0.004 | 0.001 / 0.008 | 0.002 / 0 | 0 / 0 |
| Ephemeroptera | Electrogena | 0.009 / 0 | 0.009 / 0.008 | 0.007 / 0 | 0.009 / 0 | 0.004 / 0.043 |
| Ephemeroptera | Paraleptophlebia | 0.002 / 0.007 | 0 / 0 | 0.004 / 0 | 0.008 / 0 | 0.006 / 0 |
| Ephemeroptera | Heptagenia | 0 / 0.007 | 0 / 0 | 0.004 / 0 | 0.002 / 0 | 0 / 0.008 |
| Ephemeroptera | Habrophlebia | 0.002 / 0 | 0 / 0 | 0.001 / 0 | 0.005 / 0 | 0.012 / 0 |
| Ephemeroptera | Ephemera | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.003 / 0 |
| Gastropoda | Potamopyrgus | 0.007 / 0.018 | 0 / 0.021 | 0.004 / 0.029 | 0.008 / 0 | 0.012 / 0 |
| Gastropoda | Ancylus | 0.011 / 0.032 | 0 / 0.021 | 0.009 / 0.029 | 0.01 / 0 | 0.012 / 0.034 |
| Gastropoda | Physella | 0 / 0 | 0 / 0.012 | 0 / 0 | 0 / 0 | 0.006 / 0 |
| Hemiptera | Velia | 0.011 / 0 | 0.009 / 0.008 | 0.01 / 0.004 | 0.005 / 0.015 | 0.006 / 0 |
| Hemiptera | Hesperocorixa | 0.002 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Hemiptera | Aquarius | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 |
| Hemiptera | Sigara | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Hirudinea | Erpobdella | 0 / 0.014 | 0 / 0.012 | 0.006 / 0 | 0.005 / 0 | 0.006 / 0.026 |
| Hirudinea | Glossiphonia | 0.002 / 0.007 | 0 / 0.008 | 0 / 0.008 | 0.002 / 0 | 0.004 / 0 |
| Hirudinea | Helobdella | 0.004 / 0.01 | 0 / 0.004 | 0.003 / 0 | 0.005 / 0 | 0.007 / 0 |
| Hirudinea | Piscicola | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.004 / 0 |
| Hydracarina | Lebertia | 0 / 0 | 0 / 0 | 0.006 / 0 | 0.003 / 0 | 0.004 / 0 |
| Isopoda | Asellus | 0 / 0.007 | 0 / 0.021 | 0.006 / 0.012 | 0.005 / 0 | 0.012 / 0 |
| Isopoda | Proasellus | 0 / 0 | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.004 / 0 |
| Lepidoptera | Nymphula | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Megaloptera | Sialis | 0.002 / 0.003 | 0.005 / 0 | 0.003 / 0 | 0.002 / 0 | 0.006 / 0 |
| Microturbellaria | Microstomum | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.004 / 0 |
| Nematoda | Plectus | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 | 0 / 0 |
| Neuroptera | Osmylus | 0 / 0 | 0.002 / 0 | 0 / 0 | 0.001 / 0 | 0.003 / 0 |
| Odonata | Aeshna | 0.002 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 |
| Odonata | Calopteryx | 0.004 / 0 | 0.004 / 0 | 0 / 0 | 0.003 / 0 | 0.006 / 0 |
| Odonata | Pyrrhosoma | 0.002 / 0 | 0.009 / 0 | 0.004 / 0 | 0 / 0.022 | 0.001 / 0 |
| Odonata | Sympetrum | 0 / 0 | 0.002 / 0 | 0.001 / 0 | 0 / 0 | 0 / 0 |
| Oligochaeta | Vejdovskyella | 0.007 / 0 | 0.012 / 0 | 0.014 / 0 | 0.007 / 0 | 0.003 / 0 |
| Oligochaeta | Chaetogaster | 0.021 / 0 | 0.012 / 0 | 0.013 / 0 | 0.013 / 0 | 0.012 / 0 |
| Oligochaeta | Lumbriculus | 0.015 / 0 | 0.018 / 0 | 0.013 / 0 | 0.013 / 0 | 0.012 / 0 |
| Oligochaeta | Dendrodrilus | 0.017 / 0 | 0.016 / 0 | 0.016 / 0 | 0.011 / 0 | 0.01 / 0 |
| Oligochaeta | Nais | 0.011 / 0 | 0.022 / 0 | 0.016 / 0 | 0.014 / 0 | 0.012 / 0 |
| Oligochaeta | Lumbricus | 0.019 / 0 | 0.02 / 0 | 0.014 / 0 | 0.014 / 0 | 0.012 / 0 |
| Oligochaeta | Eiseniella | 0.009 / 0.01 | 0.007 / 0.004 | 0.011 / 0 | 0.014 / 0 | 0.012 / 0 |
| Oligochaeta | Stylodrilus | 0.004 / 0 | 0.016 / 0 | 0.007 / 0 | 0.013 / 0 | 0.009 / 0.008 |
| Oligochaeta | Henlea | 0.006 / 0 | 0 / 0 | 0.003 / 0 | 0.001 / 0 | 0.009 / 0 |
| Oligochaeta | Aporrectodea | 0.015 / 0 | 0.007 / 0 | 0.007 / 0 | 0.013 / 0 | 0.012 / 0 |
| Oligochaeta | Slavina | 0 / 0 | 0.005 / 0 | 0.006 / 0 | 0.005 / 0 | 0.006 / 0 |
| Oligochaeta | Allolobophora | 0.009 / 0 | 0.004 / 0 | 0.004 / 0 | 0.01 / 0 | 0.012 / 0 |
| Oligochaeta | Enchytraeus | 0.002 / 0 | 0 / 0 | 0.004 / 0 | 0.001 / 0 | 0.004 / 0 |
| Oligochaeta | Stylaria | 0 / 0 | 0.005 / 0 | 0.006 / 0 | 0.006 / 0 | 0.003 / 0 |
| Oligochaeta | Mesenchytraeus | 0.002 / 0 | 0.005 / 0 | 0.001 / 0 | 0.003 / 0 | 0.003 / 0 |
| Oligochaeta | Octolasion | 0.011 / 0 | 0.002 / 0 | 0.006 / 0 | 0.007 / 0 | 0.009 / 0 |
| Oligochaeta | Cernosvitoviella | 0.006 / 0 | 0.002 / 0 | 0.001 / 0 | 0.002 / 0 | 0.007 / 0 |
| Oligochaeta | Pristina | 0.007 / 0 | 0 / 0 | 0.003 / 0 | 0.007 / 0 | 0.012 / 0 |
| Oligochaeta | Lumbricillus | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.001 / 0 | 0.007 / 0 |
| Oligochaeta | Specaria | 0 / 0 | 0.004 / 0 | 0.001 / 0 | 0.003 / 0 | 0.001 / 0 |
| Oligochaeta | Ophidonais | 0 / 0 | 0 / 0 | 0.004 / 0 | 0.003 / 0 | 0.003 / 0 |
| Oligochaeta | Fridericia | 0.002 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Oligochaeta | Marionina | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 | 0 / 0 |
| Ostracoda | Candona | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.002 / 0 | 0.003 / 0 |
| Ostracoda | Cypridopsis | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 |
| Plecoptera | Nemurella | 0.011 / 0.003 | 0.014 / 0 | 0.014 / 0.004 | 0.011 / 0.045 | 0.007 / 0 |
| Plecoptera | Leuctra | 0.023 / 0.043 | 0.022 / 0.052 | 0.017 / 0.051 | 0.014 / 0.095 | 0.012 / 0.062 |
| Plecoptera | Siphonoperla | 0.013 / 0.028 | 0.014 / 0.034 | 0.013 / 0.033 | 0.009 / 0.053 | 0.007 / 0.062 |
| Plecoptera | Diura | 0.004 / 0 | 0.007 / 0.004 | 0.001 / 0 | 0 / 0.03 | 0 / 0 |
| Plecoptera | Isoperla | 0.013 / 0.028 | 0.018 / 0.034 | 0.009 / 0.029 | 0.009 / 0.022 | 0.006 / 0.071 |
| Plecoptera | Capnia | 0.004 / 0 | 0.004 / 0 | 0.001 / 0 | 0.001 / 0 | 0 / 0 |
| Plecoptera | Brachyptera | 0.004 / 0.014 | 0.005 / 0.025 | 0 / 0.016 | 0.006 / 0 | 0.001 / 0.008 |
| Plecoptera | Amphinemura | 0.006 / 0 | 0.016 / 0.021 | 0.009 / 0.012 | 0.005 / 0.015 | 0.003 / 0.034 |
| Plecoptera | Protonemura | 0.007 / 0.014 | 0.022 / 0.034 | 0.014 / 0.029 | 0.014 / 0.038 | 0.009 / 0.034 |
| Plecoptera | Taeniopteryx | 0 / 0 | 0.007 / 0 | 0.003 / 0 | 0 / 0.022 | 0 / 0 |
| Plecoptera | Chloroperla | 0.009 / 0.01 | 0.002 / 0.025 | 0.001 / 0.025 | 0.01 / 0 | 0 / 0.017 |
| Plecoptera | Nemoura | 0 / 0.01 | 0 / 0.012 | 0 / 0.012 | 0.002 / 0.03 | 0.006 / 0 |
| Plecoptera | Perlodes | 0.006 / 0.01 | 0.002 / 0.012 | 0.001 / 0.016 | 0.006 / 0.007 | 0.001 / 0 |
| Porifera | Ephydatia | 0 / 0 | 0.002 / 0 | 0.006 / 0 | 0.002 / 0 | 0.006 / 0 |
| Rotifera | Philodina | 0.004 / 0 | 0.009 / 0 | 0.004 / 0 | 0.002 / 0 | 0 / 0 |
| Rotifera | Rotaria | 0.002 / 0 | 0.005 / 0 | 0 / 0 | 0.005 / 0 | 0.012 / 0 |
| Rotifera | Adineta | 0 / 0 | 0.002 / 0 | 0.004 / 0 | 0 / 0 | 0 / 0 |
| Rotifera | Keratella | 0.002 / 0 | 0.002 / 0 | 0.003 / 0 | 0.001 / 0 | 0 / 0 |
| Rotifera | Euchlanis | 0 / 0 | 0 / 0 | 0 / 0 | 0.002 / 0 | 0 / 0 |
| Rotifera | Polyarthra | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 |
| Rotifera | Brachionus | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 |
| Rotifera | Synchaeta | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.001 / 0 |
| Tardigrada | Macrobiotus | 0 / 0 | 0.002 / 0 | 0.001 / 0 | 0.001 / 0 | 0 / 0 |
| Trichoptera | Chaetopteryx | 0.007 / 0.01 | 0.012 / 0.004 | 0.009 / 0.004 | 0.006 / 0.045 | 0.006 / 0 |
| Trichoptera | Halesus | 0.011 / 0.01 | 0.018 / 0.004 | 0.013 / 0.02 | 0.01 / 0.03 | 0.01 / 0.008 |
| Trichoptera | Limnephilus | 0.007 / 0 | 0.009 / 0 | 0.006 / 0 | 0.006 / 0 | 0.006 / 0 |
| Trichoptera | Plectrocnemia | 0.007 / 0.01 | 0.009 / 0.012 | 0.004 / 0.029 | 0.001 / 0.095 | 0.003 / 0.053 |
| Trichoptera | Drusus | 0.009 / 0.028 | 0.011 / 0.017 | 0.01 / 0.029 | 0.01 / 0.045 | 0.009 / 0 |
| Trichoptera | Rhyacophila | 0.015 / 0.043 | 0.02 / 0.052 | 0.013 / 0.046 | 0.011 / 0.045 | 0.012 / 0.043 |
| Trichoptera | Hydropsyche | 0.015 / 0.039 | 0.004 / 0.047 | 0.011 / 0.033 | 0.011 / 0 | 0.012 / 0.043 |
| Trichoptera | Sericostoma | 0.013 / 0.039 | 0.002 / 0.029 | 0.011 / 0.029 | 0.011 / 0 | 0.012 / 0.026 |
| Trichoptera | Philopotamus | 0.015 / 0.014 | 0 / 0.012 | 0.006 / 0.029 | 0.011 / 0 | 0.012 / 0 |
| Trichoptera | Odontocerum | 0.011 / 0.021 | 0 / 0.012 | 0.001 / 0.025 | 0.009 / 0 | 0.01 / 0 |
| Trichoptera | Polycentropus | 0 / 0.007 | 0.005 / 0.004 | 0.007 / 0 | 0.006 / 0.038 | 0 / 0.071 |
| Trichoptera | Cyrnus | 0 / 0 | 0.004 / 0 | 0.003 / 0 | 0 / 0.007 | 0 / 0 |
| Trichoptera | Adicella | 0.002 / 0 | 0.002 / 0 | 0 / 0 | 0.002 / 0 | 0.007 / 0 |
| Trichoptera | Oxyethira | 0 / 0 | 0.007 / 0 | 0.006 / 0 | 0.003 / 0.022 | 0 / 0.043 |
| Trichoptera | Glossosoma | 0 / 0.014 | 0 / 0.017 | 0.003 / 0.008 | 0.005 / 0 | 0.006 / 0 |
| Trichoptera | Chimarra | 0 / 0 | 0 / 0 | 0.003 / 0 | 0 / 0 | 0 / 0 |
| Trichoptera | Potamophylax | 0.015 / 0.007 | 0.02 / 0.008 | 0.016 / 0.008 | 0.014 / 0.022 | 0.012 / 0 |
| Trichoptera | Wormaldia | 0.009 / 0.003 | 0.011 / 0.012 | 0.007 / 0.012 | 0.006 / 0 | 0.007 / 0 |
| Trichoptera | Lepidostoma | 0.002 / 0.014 | 0 / 0 | 0.003 / 0.004 | 0.002 / 0 | 0 / 0.008 |
| Trichoptera | Psychomyia | 0 / 0.007 | 0 / 0 | 0.003 / 0 | 0.002 / 0 | 0 / 0 |
| Trichoptera | Hydroptila | 0 / 0.003 | 0 / 0 | 0.003 / 0 | 0 / 0 | 0 / 0.008 |
| Trichoptera | Anabolia | 0 / 0 | 0 / 0 | 0.003 / 0 | 0.005 / 0 | 0.001 / 0 |
| Trichoptera | Lype | 0.004 / 0 | 0 / 0 | 0.003 / 0.004 | 0.007 / 0 | 0.012 / 0 |
| Trichoptera | Crunoecia | 0.009 / 0 | 0 / 0.008 | 0.003 / 0.004 | 0.003 / 0 | 0.006 / 0 |
| Trichoptera | Agapetus | 0.015 / 0.014 | 0 / 0.017 | 0.003 / 0.016 | 0.005 / 0 | 0.009 / 0 |
| Trichoptera | Goera | 0 / 0.003 | 0 / 0 | 0 / 0 | 0.005 / 0 | 0 / 0 |
| Trichoptera | Silo | 0 / 0.021 | 0 / 0 | 0.001 / 0.008 | 0.003 / 0 | 0.001 / 0 |
| Trichoptera | Ecclisopteryx | 0 / 0 | 0 / 0 | 0.001 / 0 | 0.002 / 0 | 0 / 0 |
| Trichoptera | Micropterna | 0.002 / 0.003 | 0 / 0 | 0.006 / 0 | 0.005 / 0 | 0.001 / 0 |
| Trichoptera | Agrypnia | 0 / 0 | 0.004 / 0 | 0.001 / 0 | 0 / 0 | 0 / 0 |
| Trichoptera | Stenophylax | 0 / 0 | 0 / 0 | 0 / 0 | 0.002 / 0 | 0.004 / 0 |
| Trichoptera | Glyphotaelius | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 |
| Trichoptera | Apatania | 0 / 0 | 0 / 0 | 0 / 0 | 0 / 0 | 0.003 / 0 |

Supplementary Figure 1. Visual illustration of the environmental PCA used to construct the environmental gradient (PC1). The colors indicate the landuse type of the respective points and correspond to the associated colors in Figures 1 and 2, with black = urban, green = agriculture, blue = forest, red = acid grasslands and brown = moorlands. Polygons are used to indicate landuse groups and are colored in the same manner as the points themselves.

