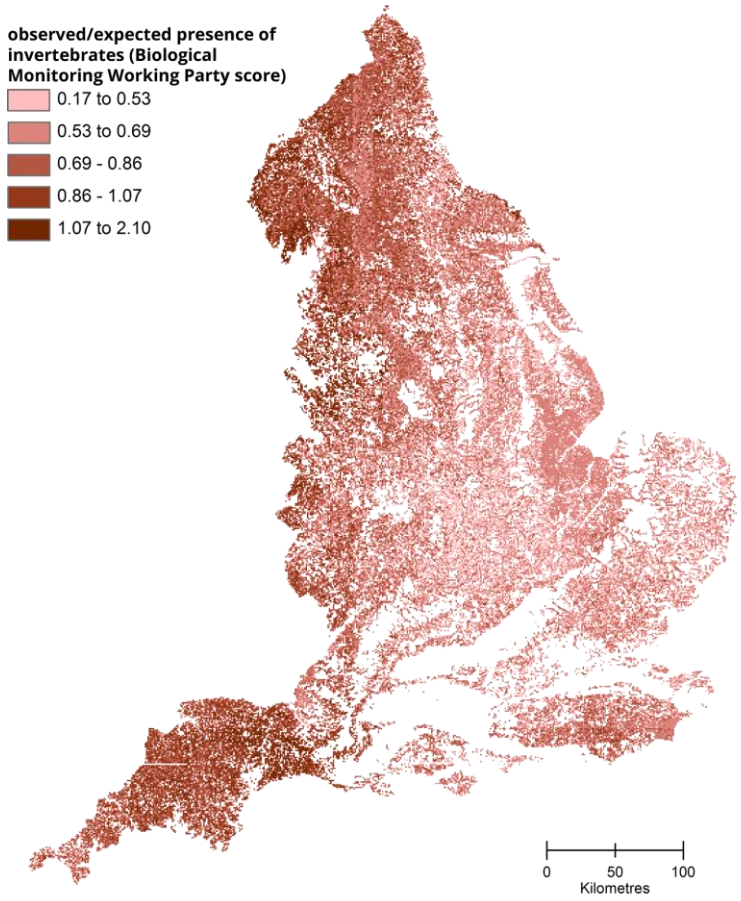
Headwater stream quality

Invertebrates in headwater streams



Headwater stream quality
Measured by comparing predicted observed/expected presence of invertebrates (Biological Monitoring Working Party score)

What does this map show?

Freshwater invertebrates vary in their sensitivity or tolerance of nutrient enrichment and therefore the communities of invertebrates present in headwater streams provide good indicators of water quality. This map shows a comparison of the observed and expected presence of invertebrate indicator species in headwater streams, based on Biological Monitoring Working Party (BMWP) scores. The BMWP score is an index for measuring the biological quality of rivers using selected families of invertebrates as biological indicators [1]. A higher value on the map indicates that the water quality of headwater streams, as shown by the invertebrates, is better.

Headwater streams are generally upstream of Environment Agency water quality monitoring points for the Water Framework Directive. This map therefore tells us about the water quality in the smallest streams at the tops of river catchments.

The UK National Ecosystem Assessment (UKNEA 2011) recognises the importance of freshwater invertebrates as a component of natural capital and part of complex food webs which support fish and plant production, breaking down detritus and algae and ultimately contributing to improved water quality. Invertebrates which live part of their lives in water and part as flying insects also contribute to terrestrial food webs.

The map seems to show a differentiation between higher water quality in semi-natural landscapes and lower water quality in areas subject to more intensive agricultural management. No standard error map is provided with the approach taken here due to the complexity involved in interpreting errors as part of a ratio, or comparison.

How was this map produced?

This map was produced using observed/expected BWMP scores from headwater stream invertebrate samples, taken at 478 headwater stream sites across two survey years in the CEH Countryside Survey [2] (1998 and 2007). From the invertebrates collected, observed BMWP scores were calculated for each sample site. Expected BMWP scores were calculated for "reference" invertebrate communities, based on the physical characteristics of the sampled sites. Predictions were extrapolated up to a national level using statistical analysis.

What are the limitations of this map?

1. Areas not containing a headwater stream were not included in the models.

2. The map shows mean values at a 1 km square resolution.

3. The values for each 1 km square are generated from a statistical model of samples from 478 headwater stream sites across two survey years (1998 and 2007). Hence the map does not show direct measurements at all locations.

Further detail on the steps for creating this map

1. Headwater streams were identified based on Strahler order (1-3), see **Figure 1**.

2. Freshwater invertebrate samples were taken from 478 Countryside Survey sample locations in headwater streams using standard protocols [2] across two survey years (1998 and 2007).

3. Width, depth and substrate composition were recorded at each sample site.

4. The Biological Monitoring Working Party (BMWP) score (an index for measuring the biological quality of rivers using selected families of macroinvertebrates as biological indicators) [1] were calculated for each site (Observed BWMP).

5. An Expected BWMP score was calculated using the RIVPACS (River Invertebrate Prediction and Classification System) computer model. This model calculated an expected 'reference' macroinvertebrate community for each sample site, based on its physical characteristics.

6. For grid squares that were not sampled, 'Observed' BWMP scores were extrapolated to a national scale using a statistical model (Boosted Regression Tree) tested on the Countryside Survey data. This was based on the predicted relationships between catchment characteristics (altitude, slope, stream order, woody cover along streams, and % land cover of arable, improved grassland or urban) and water quality for a randomly generated river sampling site in each unmonitored 1km square.

7. Expected BWMP scores for un-monitored sites were calculated by assigning the RIVPACS scores to the randomly generated river sampling site in each unmonitored grid square, based on average land class [3].

8. Observed/Expected BWMP scores were calculated for each sample site

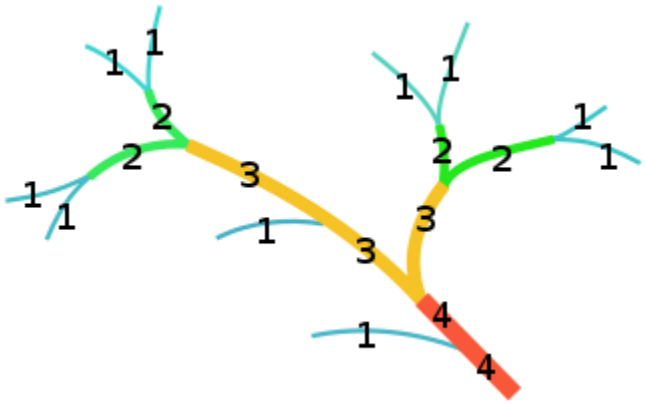


***Figure 1**. Diagram showing the Strahler stream order*

How to obtain the data

Data can be downloaded from https://eip.ceh.ac.uk/naturalengland-ncmaps.

> Norton, L.; Dunbar, M.; Greene, S.; Scholefield, P. (2016). Headwater stream quality for Britain. NERC Environmental Information Data Centre. http://doi.org/10.5285/85e7beb6-e031-4397-a090-841b8c907d1b

References

1. Armitage, P.D., Moss, D., Wright, J.F. et al. (1983). The performance of a new biological water-quality score system based on macroinvertebrates over a wide range of unpolluted running water sites. Water Research 17, 333-347.

2. Murphy, J., Weatherby, A. (2008). Freshwater Manual. Technical Report No.5/07/NERC/Centre for Ecology and Hydrology 71pp

3. Bunce et al. (2007). ITE land classification of Great Britain 2007 http://doi.org/10.5285/5f0605e4-aa2a-48ab-b47c-bf5510823e8f

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