Characterising Hertfordshire chalk stream habitats using MoRPh

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The recently developed Modular River Physical (MoRPh) survey (Shuker *et al.* 2017) was trialled in Hertfordshire. Led by academic experts Professors Angela Gurnell and Geraldene Wharton, a series of training workshops was held, where river enthusiasts braved the rain to learn the new technique (Figures 1 and 2). In the first six months, 233 MoRPh surveys were conducted (Shuker *et al.* 2017). Since then over 200 surveys have been completed (Figure 3) in Hertfordshire and the surrounding area. The majority of these have been conducted on the groundwater-fed, chalk streams.

MoRPh indices were generated for the chalk streams (See England *et al.* in this journal for details of the indices) and are presented in Figure 4. The results show that the chalk streams have both low physical habitat complexity of the channel (index 8) and riparian margins (index 10) but a high number of aquatic morphotypes (a classification based on their physical structure, e.g. emergent narrow leaves) (index 9) and high riparian vegetation complexity (index 11). These results are consistent with the early results reviewed by Shuker *et al.* (2017). The channels have few flow types (index 1) showing they are hydrologically simple with most sites having a fine average bed material size (index 5) consisting of mainly sand and silt – although some sites have an average gravel-pebble bed material size. Other characteristics of Hertfordshire chalk rivers are that they all tend to have highest energy extensive flow types (index 2) of smooth, then rippled, and the coarsest extensive bed material particle size (index 4) of gravel/pebble

Figure 1. *Modular River Physical (MoRPh) survey training - River Bulbourne (photo Lucy Shuker).*

Figure 2. *Lucy Shuker leading a training session on the River Chess. (photo Judy England).*

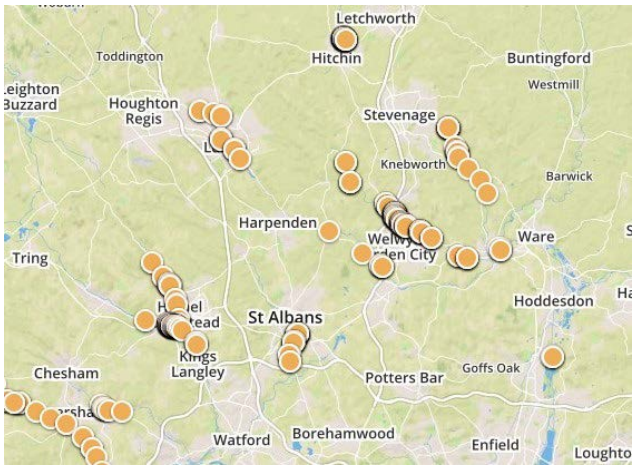
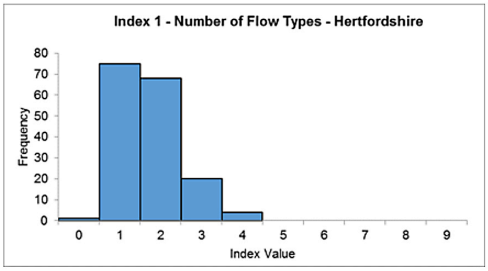
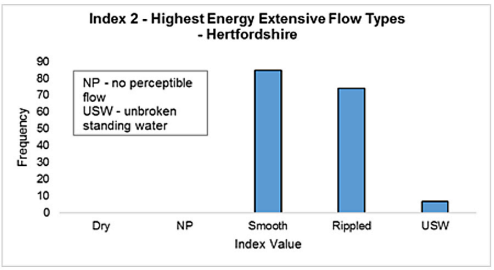
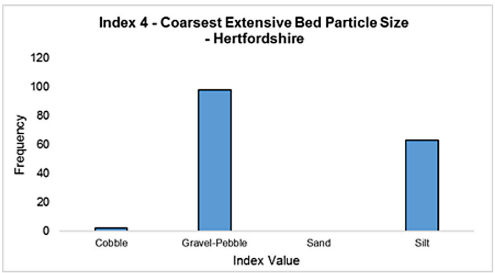
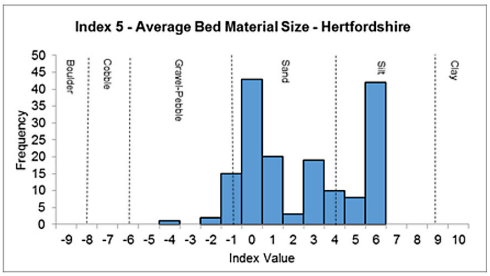


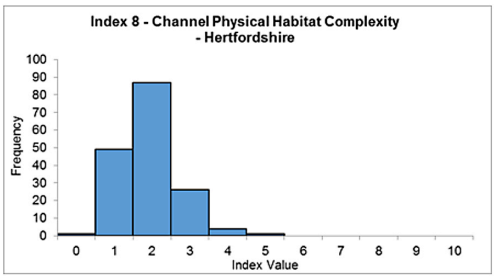
Figure 3. *The distribution of MoRPh surveys undertaken in the Hertfordshire area (source: www.modularriversurvey.org).*

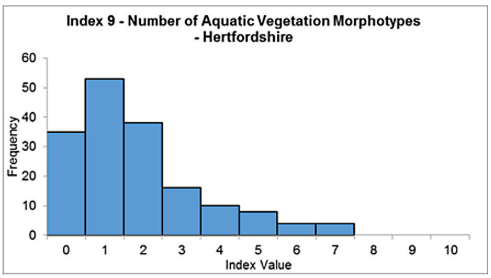


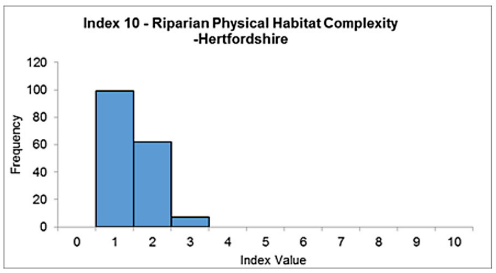


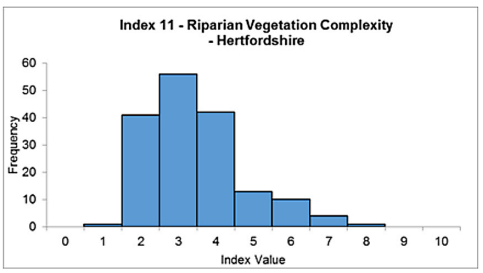


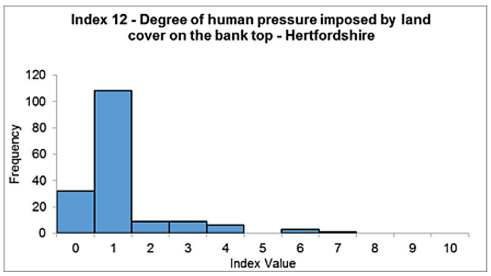












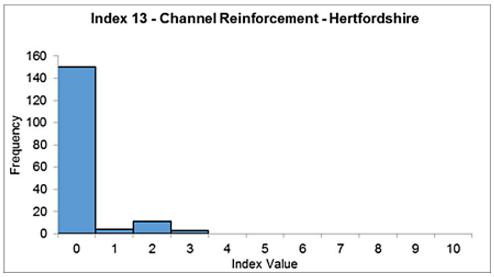


Figure 4. *Frequency distributions of MoRPh indices for chalk streams in Hertfordshire and the surrounding area during 2016. Each histogram is plotted to show the observed data in relation to the maximum potential range of each index (the potential ranges are shown on the horizontal axis) (Beach, 2017).*

then silt. These results support the findings of Shuker *et al.* (2017). The results indicate that across the rivers surveyed there is little channel modification/ reinforcement to the channel bed or banks (index 13) and there is a limited amount of hydrological and morphological human pressure imposed by adjacent land use (index 12). The final two frequency histograms show that most of the surveyed modules have no reinforcement of their bed top pressure on the rivers (index 12).

Indices 8 and 11 were chosen to compare the differences between the different chalk streams in more detail. The physical habitat complexity (index 8) and riparian vegetation complexity (index 11) give an overview of channel quality on which the river wildlife depends. The physical habitat complexity (index 8) is presented in Figure 5. Both the greatest and the lowest physical complexity were recorded in the River Gade indicating that some sections of the channel have diverse in-stream habitats and other sections are very uniform in structure. All the rivers recorded an index value of 2 as the highest value, with the exception of the River Chess, which was 3, suggesting that this river may exhibit greater lengths of a more complex channel. The riparian vegetation complexity (index 11) is presented in Figure 6. The highest values were recorded at one module of the River Bulbourne and the lowest for one module of the River Mimram. The results typically ranged from 2 to 6, with the exception of the River Chess where values of 7 were regularly recorded, indicating more complex riparian vegetation along sections of the channel length. Figure 7 presents a series of photographs from MoRPh surveys on the chalk streams with varying physical habitat and riparian vegetation complexity to provide a visualization of what the differing scores denote. When used in combination, these indices (and others) can be used to compare the habitat between sites

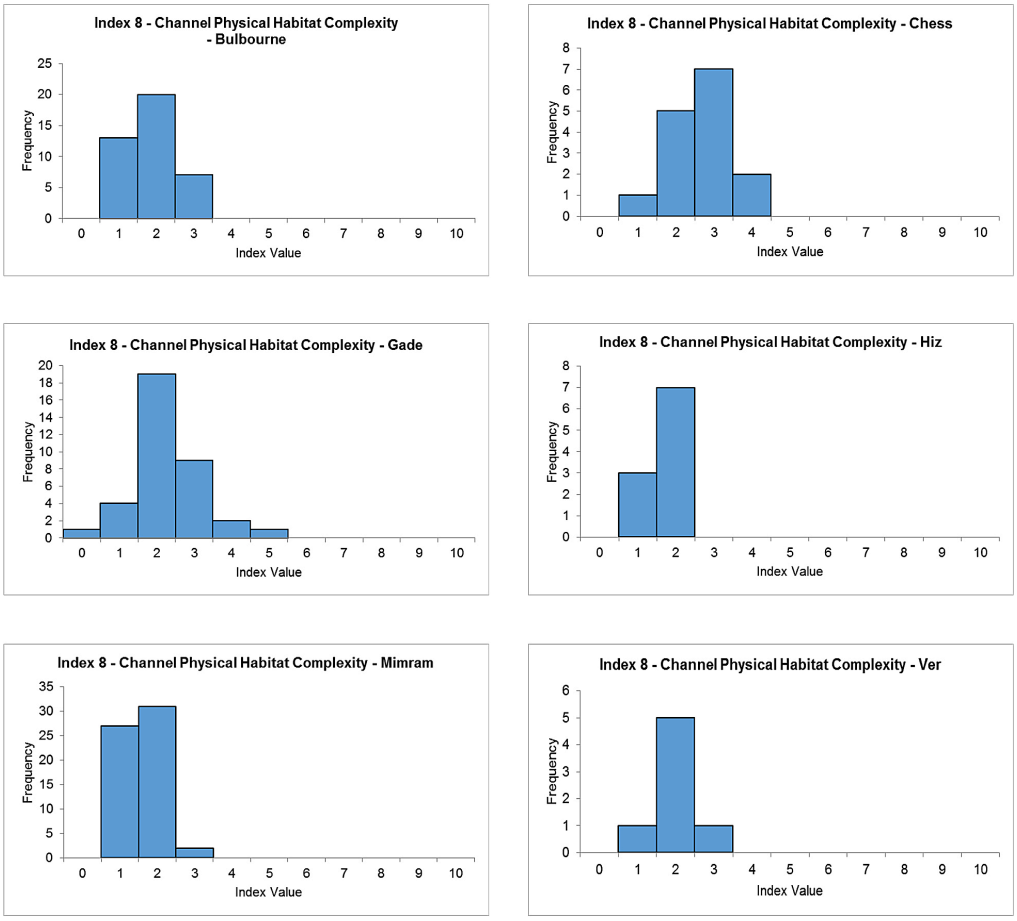


Figure 5. *Frequency distributions of physical habitat complexity (MoRPh index 8) for six chalk streams. Each histogram is plotted to show the observed data in relation to the maximum potential range of each index (the potential ranges are shown on the horizontal axis).*

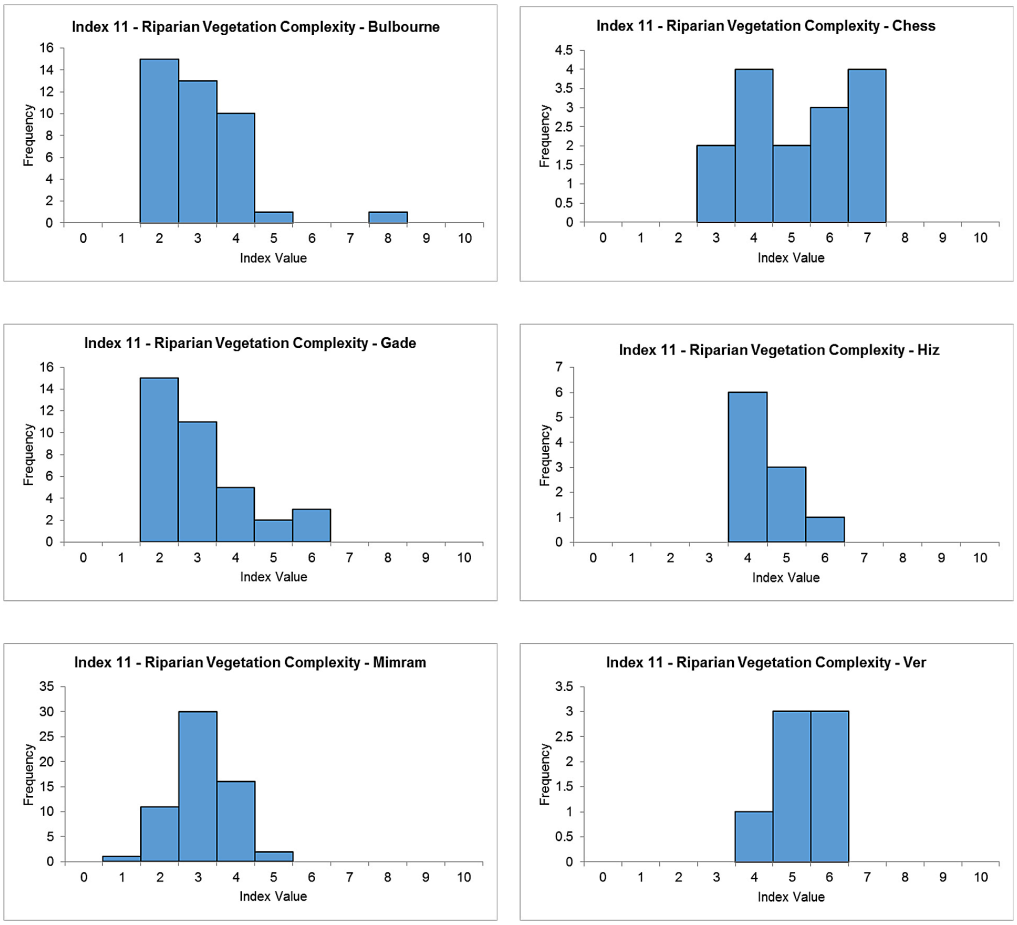


Figure 6. *Frequency distributions of physical habitat complexity (MoRPh index 11) for six chalk streams. Each histogram is plotted to show the observed data in relation to the maximum potential range of each index (the potential ranges are shown on the horizontal axis).*

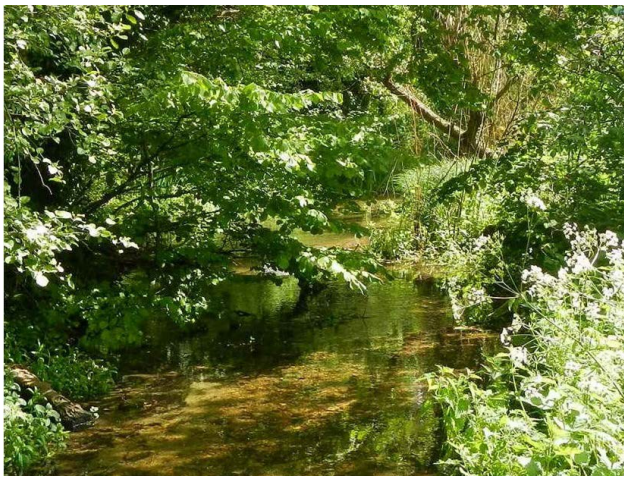


Figure 7. *Sites with varying channel habitat and riparian habitat complexity. left: River Bulbourne, Hemel Hempstead and right: River Gade near Water End. (Photos Brishan Finn Leeming).*

Figure 8. *Spatial comparison of MoRPh indices from a section of the River Lee. Showing channel physical habitat complexity (top map) and riparian vegetation complexity (bottom map).*

along sections of river (Figure 8) and identify areas which provide good wildlife habitats and others where restoration may be appropriate.

The results from the MoRPh surveys from chalk streams show the rivers have considerable variability. They illustrate that MoRPh survey technique is able to detect differences in the hydraulic, sediment, morphological and vegetation habitat characteristics and so has great promise as a spatial monitoring tool. As more surveys are undertaken we should be able to use this approach to both identify where river restoration may be needed and monitor the changes as schemes are implemented.

References:

Beach, E. (2017). An appraisal of Citizen Science in the assessment of Chalk River Restoration. University of Hertfordshire MSc Thesis.

Shuker, L. J., Gurnell, A. M., Wharton, G., Gurnell, D. J., England, J., Finn Leeming, B. F. and Beach, E. (2017). MoRPh: a citizen science tool for monitoring and appraising physical habitat changes in rivers. *Water and Environment Journal*, 31, (3): 418–424.

Acknowledgements:

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