

# Introducing the Modular River Survey

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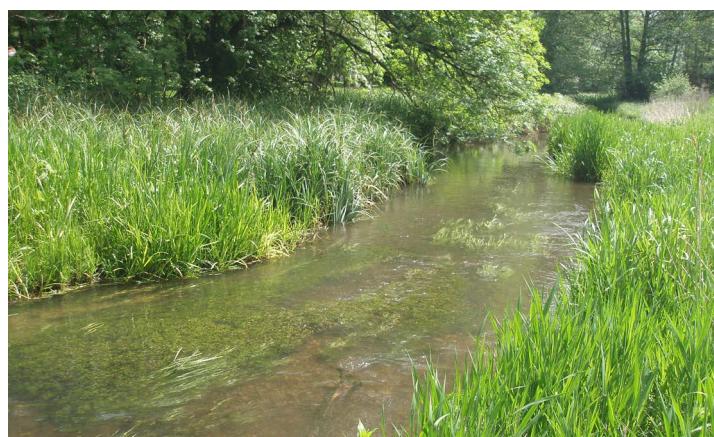
The rivers and floodplains of Hertfordshire are a vital resource for wildlife and society. However, years of alterations have degraded the character of some areas, resulting in a loss of characteristic habitat, biodiversity and the benefits we rely on. The extent of alteration justifies the need for river restoration alongside measures that conserve them to prevent further damage.

In order to identify where we need to conserve good habitat (Figure 1) and where restoration work

may be appropriate (Figure 2), we need to assess the current habitat conditions. The Modular River Survey (ModRS) is a new way for river enthusiasts and citizen scientists to get involved with recording and assessing physical habitat and natural physical functioning of their local rivers and streams.

Using a geomorphological approach, the ModRS provides a method that volunteers and river professionals can use for monitoring the physical habitat mosaic and human interventions and pressures within short river reaches (10m to 40m in length). The survey outputs will be of interest to anyone working on rivers within catchment partnerships or local groups. Records are stored in the ModRS database with outputs visible on catchment maps on this website. ModRS was developed by academics at Queen Mary, University of London with support from the Environment Agency and has been extensively trialled in Hertfordshire.

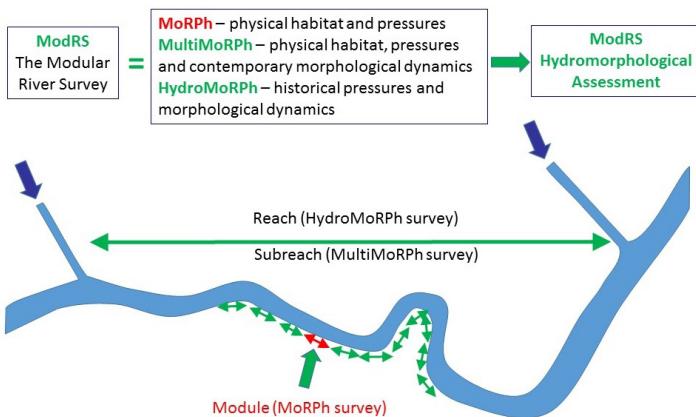
ModRS provides a hierarchical approach to river assessment (see Figure 3). Modular River Physical (MoRPh) survey is the smallest survey unit and provides a habitat-scale assessment that characterises the local physical structure of a river channel and its margins relevant to ecological indicators such as river fly (macroinvertebrates), fish or aquatic plants (macrophytes). A sequence of 10 or more contiguous MoRPh creates a MultiMoRPh unit which allows morphological patterns and dynamics to be investigated. Information from the MultiMoRPh units will fit into reach-scale assessments of hydromorphology (HydroMoRPh), which integrate the MoRPh and



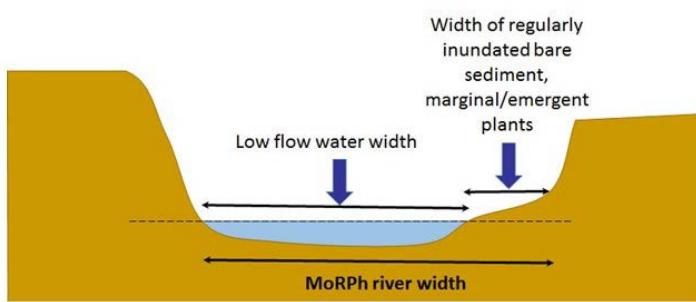
**Figure 1.** River Mimram at Tewin Water Schools, showing good instream and riverside habitat composition (photo David Leeming).



**Figure 2.** River Beane near Whitehall showing a straightened channel with poor instream and riverside habitat composition (photo David Leeming).



**Figure 3.** The hierarchy of the Modular River Survey (source: *The MoRPh Survey Technical Manual*, Gurnell et al. 2016).



**Figure 4.** How to calculate the length of the MoRPh module (Source: *The MoRPh Survey Technical Manual*, Gurnell et al. 2016).

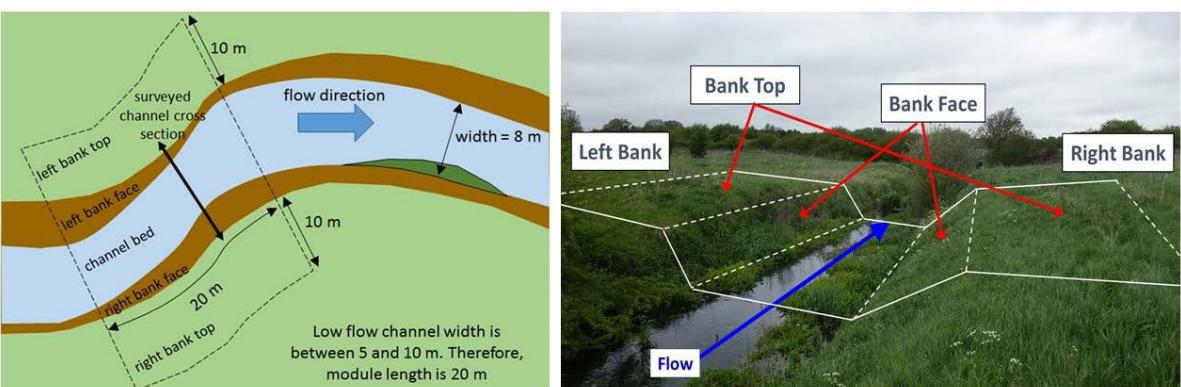
MultiMoRPh field data into a desk-based historical and contemporary analysis of physical forms, adjustments and processes within the river and its floodplain. HydroMoRPh procedures are still under development.

#### How does MoRPh work?

The MoRPh survey is applied to river 'modules', which characterize the local physical habitat mosaic and human interventions and pressures. The length of the MoRPh module is scaled to the width of the river channel up to 40m, since it is not suitable for application to larger rivers (Figure 4). The survey module extends 10m back from the bank tops on both sides of the river (Figure 5). By limiting the module length using the channel width, the survey covers a sufficient area to place a biological or water quality monitoring point into its physical habitat context.

To complete the survey the surveyor systematically records general site information (sheet 1), information on the bank tops / floodplain within 10m of the channel (sheet 2), the bank faces and channel edges (sheet 3), and the channel bed (sheet 4). The broad categories within MoRPh surveys are listed in table 1.

Each of these survey sheets is organised so that physical features



**Figure 5.** MoRPh survey structure (Source: *MoRPh Survey Training Material*).

**Table 1.** Broad categories of materials, physical features and vegetation recorded within a MoRPh survey.

| Materials              |   | Physical features   | Riparian (terrestrial) & aquatic vegetation   |
|------------------------|---|---|---|
| Sheet 2<br>Bank top    |   | Water-related features<br>Artificial ground cover   | Terrestrial vegetation structure<br>Tree and large wood features<br>Invasive non-native species   |
| Sheet 3<br>Bank face   | Natural materials<br>Reinforcement materials  | Natural & modified bank profiles<br>Natural physical features of the bank face and channel margin<br>Artificial physical features | Terrestrial vegetation structure<br>Tree and large wood features<br>Aquatic vegetation at the channel margin<br>Invasive non-native species |
| Sheet 4<br>Channel bed | Channel bed natural materials, including degree of siltation<br>Channel bed reinforcement materials | Natural physical features<br>Water surface flow patterns<br>Artificial physical features  | Aquatic vegetation<br>Terrestrial vegetation, and large wood interacting with the wetted channel<br>Invasive non-native species             |

are followed by vegetation properties. Within these categories, natural features are recorded in addition to human-modified ones. The survey sheets provide space for notes to record observations that may help interpret the survey. A code sheet and optional field guide are provided to aid completion of the sheets within the field (Figure 6). The key to recording the information is ‘record *WHAT YOU SEE* not what you know’.

MoRPh survey data and accompanying photographs are entered into a database via the Modular River Survey website. Surveyors gain a log-in following completion of one day of training. Through this log-in, all trained MoRPh surveyors can upload survey data to the MoRPh database. The survey data are reviewed for completeness and data quality and either approved

or queried with the surveyor. Surveyors can only edit their own surveys, but they can view or download any of the surveys that have been collected. Once the data have been uploaded, the site maps the raw data with fourteen indices calculated to summarize the flow patterns, sediments, physical habitats, vegetation, human interventions and pressures within each surveyed module (Table 2).

MoRPh indices represent the weighted sum of the abundances and types of groups of surveyed features or characteristics. Each index increases in value with an increase in the magnitude, complexity or severity of the property being indicated, and the potential minimum and maximum values of each index provide a basis for interpreting individual values from particular modules. The MoRPh survey and indices are being trialled

The figure displays three survey sheets from the MoRPh Survey Training Material. The first sheet, 'MoRPh - GENERAL INFORMATION', contains fields for surveyor and client details, survey date, location, and a diagram of a river bend with a survey point labeled 'A'. The second sheet, 'MoRPh - CHANNEL BED MEASUREMENTS', includes a table for 'WATER SURFACE FLOW' with columns for 'Flow Type', 'Width', 'Depth', and 'Velocity'. The third sheet, 'MoRPh - BANK PROFILE MEASUREMENTS', has sections for 'BANK PROFILE TYPE' and 'Sediment size', with tables for 'Vertical' and 'Resected' profiles.

### Survey sheets:

1. General information
2. Bank tops (within 10 m)
3. Bank faces
4. River channel bed

| MoRPh CODES   |   |
|---|---|
| Bank profile type                                     | Natural / Unmodified  |
| V Vertical  | Vertical  |
| VO Vertical with toe overhang                         | Vertical with toe overhang  |
| VI Underside or Vertical with undercut                | Underside or vertical undercut  |
| VT Vertical with toe                                  | Vertical with toe   |
| SI Steep (> 45 degrees)                               | Steep (> 45 degrees)  |
| GE Gentle (< 45 degrees)                              | Gentle (< 45 degrees)   |
| CM Concave  | Concave   |
| RE Resected   | Resected  |
| FS Artificial two-stage                               | Artificial two-stage  |
| EM Embankment   | Embankment  |
| SE Set-back embankment                                | Set-back embankment   |
| PC Pochaded   | Pochaded  |
| Flow type   | Sediment size   |
| FF Free fall  | AN Artificial   |
| CH Chute  | BE Bedrock  |
| BW Broken standing waves                              | BO Boulder  |
| LW Low standing waves                                 | ED Edifice  |
| UW Unbroken standing waves                            | GP Gravel-pebble  |
| UP Upflow   | SA Sand   |
| CF Chaotic flow (mixture of free fall, chute, BW, UW) | SC Silty  |
| RP Rapid  | CL Clay   |
| SM Smooth   | OR Organic debris, twigs etc. not fully decomposed                          |
| NP Non-perceptible flow                               | PE Peat   |
| DR Dry  | CA Coarse (i.e. mixed, mainly sand and finer) [for bank face material only] |
| Not visible   |   |
| Reinforcement type                                    |   |
| CC Concrete   | PG Pedestrian, footpath   |
| CB Concrete & brick / laid stone (cemented)           | TR Transport infrastructure (road, railway, car park)                       |
| BR Brick / laid stone (cemented)                      | IC Buildings (commercial / industrial)                                      |
| SP Stone  | PD Pavements (cemented)   |
| WP Wood piling / panels                               | SY Storage area   |
| BW Builders waste / hard core (lipped)                | LD Landfill area  |
| RR Rip rap (large laid stone, uncemented)             | AR Arable agriculture / fallow  |
| GA Grass  | PR Permanent vegetated agriculture (e.g. pasture, orchard)                  |
| WS Willow spiling                                     | PR Permanently vegetated/recreation (e.g. playing fields)                   |
| RE Planted reeds                                      | OW Open water (e.g. canal, reservoir)                                       |
| BC Bluebellies / coil                                 |   |
| WD Nested out-reinforcement                           |   |
| Artificial cover type                                 |   |
| Sediment size   |   |

### Codes used during MoRPh surveys:

Bank profile, Water surface flow types, Reinforcement, Land cover, Sediment size

**Figure 6.** Survey sheets and code sheets (source: MoRPh Survey Training Material).

**Table 2.**The 14 indices currently estimated from each MoRPh survey.

| Index type                             | Index number and name   |
|--|---|
| River channel characteristics          | INDEX 1: Number of flow types<br>INDEX 2: Highest energy extensive flow type<br>INDEX 3: Number of bed material types<br>INDEX 4: Coarsest extensive bed material particle size<br>INDEX 5: Average bed material size<br>INDEX 6: Average bed material particle size class<br>INDEX 7: Extent of bed siltation<br>INDEX 8: Channel physical habitat complexity<br>INDEX 9: Number of aquatic vegetation morphotypes |
| Riparian (bank face and top) character | INDEX 10: Riparian physical habitat complexity<br>INDEX 11: Riparian vegetation complexity  |
| Human pressures and impacts            | INDEX 12: Degree of human pressure imposed by land cover on the bank tops<br>INDEX 13: Channel reinforcement<br>INDEX 14: Extent of non-native invasive plants  |

together in Hertfordshire. For more information about the survey please see Shuker *et al.* (2017) and the Modular survey website: [www.modularriversurvey.org/](http://www.modularriversurvey.org/).

## References

Gurnell, A. M., Wharton, G., Shuker, L. and England, J. (2016) *The MoRPh Survey: A Modular River Physical Survey for Citizen Scientists Technical Reference Manual 2016*. Available from: [www.modularriversurvey.org](http://www.modularriversurvey.org).

Gurnell, A. M., Wharton, G., Shuker, L. and England, J. (2017) *The MoRPh Survey: A Modular River Physical Survey for Citizen Scientists Field Guide*. Available from: [www.modularriversurvey.org](http://www.modularriversurvey.org).  
Shuker, L. J., Gurnell, A. M., Wharton, G., Gurnell, D. J., England, J., Finn Leeming, B. F. & Beach, E. (2017), MoRPh: a citizen science tool for monitoring and appraising physical habitat changes in rivers. *Water and Environment Journal*, 31: 418–424. doi:10.1111/wej.12259.