Guidance on river and stream naturalness assessment

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Acknowledgements

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Purpose

This assessment system has been developed to allow all stakeholders to contribute to our understanding of the naturalness of the river network. Data collected using this system will be used to periodically update the priority river habitat map for England, and will also be used in discussions to update the associated map of river restoration priorities. Over time these national maps will more accurately reflect local circumstances and priorities. The assessment is geared towards headwater streams (both naturally temporary and permanently flowing) where we have the greatest knowledge gap, but it is possible (with suitable interpretation) to generate an assessment of larger rivers. Headwater streams are defined as stream sections within 2.5 km from source using 1:50,000 scale Ordnance Survey maps.

Background

The assessment framework is a refinement of that used by Nigel Holmes to undertake rapid surveys of headwater streams (see Holmes 2010), and also broadly follows the structure of the naturalness assessment used to generate the priority river habitat map (Mainstone *et al*. 2014). The idea is that it provides an 'entry-level' assessment of naturalness/natural function that can be used by a wide range of individuals with little experience and expertise in freshwater habitats, but can also be used for rapid assessments by experienced professionals.

Levels of naturalness and natural function (or deviations from unimpacted reference conditions) provide a common language for expressing our aspirations for freshwater habitats under different policy mechanisms - protected site legislation (SSSIs and SACs), the Water Framework Directive, and priority habitat objectives. Further explanation of this is provided in the 'freshwater and wetland habitat narrative' and CaBA biodiversity guidance. This entry-level assessment is therefore broadly compatible with more detailed, quantitative assessment systems such as River Habitat Survey and MORPh, meaning that data from such systems can be translated into the naturalness classes described below.

Data entry

Natural England has established a partnership with the Freshwater Biological Association to host a website dedicated to priority river and lake habitats. Naturalness assessments can be uploaded via a data portal, which also allows all data collected to be displayed. The data portal has a standard on-line form which assists with data input – a printable version for use in the field is provided in Annex I.

Timing of visits

There is no restriction on when a site is inspected within the year, although some impacts on naturalness will be more apparent through the summer months (e.g. indicators of pollution, presence of non-native plant species). Multiple visits can be made to increase the confidence of the assessment**.**

Length of river/stream to assess

This may be up to 500 metres in length but might be considerably shorter, if for instance there are access difficulties or the naturalness of the stream varies considerably along shorter distances. Note that the data portal divides the river network into pre-defined reaches, and your surveyed section will contribute to the assessment of that reach. If you want to record significant differences in naturalness within one of these pre-defined reaches, you can undertake a series of assessments in contiguous sections.

The naturalness assessment framework

The system divides naturalness into four components: physical, hydrological, chemical and biological (Table 1). For each component there are descriptions of five different levels (classes) of naturalness, and the user chooses the description that most closely fits the site being inspected. A table of class descriptions is provided on the following page.

For experienced surveyors accustomed to robust, quantitative assessment systems this might be a culture shock, but the intention of the system is to forfeit some data precision in order to extend our data ‘reach’ across the habitat resource, and particularly into the headwater stream network. The fuzziness in the data will be factored into the way we use it. To help account for uncertainties in the assessment there is a confidence assessment built in (see later).

You don’t have to make an assessment of all four naturalness components if you don’t feel able. The assessment of physical naturalness is probably the one that most people will feel most comfortable with, because physical habitat is very visible and easiest to characterise with a single visit. For other components there may or may not be visible indicators on which an assessment can be based. Generally an assessment made with low associated confidence is more useful than no assessment at all.

Case studies are provided in Annex II to help you assign a site to naturalness classes based on simple visual inspection. If you are uncertain just use a lower confidence rating for your assessment, or omit assessment of naturalness components that you are particularly concerned about.

Table 1. Naturalness class descriptions.

Class[1]	Naturalness components			
	Physical	Hydrological	Chemical	Biological
1	No evidence of human physical modifications within the reach – channel straightening/deepening/ widening, bank reprofiiling or reinforcements, impounding structures (weirs/dams). At least patchy cover (>1/3 of surveyed length) of riparian trees*, providing lead litter and woody material to the channel, some of which is retained. Tree roots strongly influencing channel dynamics (patterns of erosion and deposition, channel sinuosity). Riparian zone (up to 5 metres from bank top) with semi-natural vegetation.	No evidence of impacts on the natural flow regime from abstraction, diversion, upstream impoundment or discharges (e.g. abstraction pipes or pumps, leats, discharge pipes, upstream artificial lakes). Note that if the reach is in the headwaters it may naturally dry up in the summer months – such naturally intermittent stream sections are highly important for a range of specialist species.	No evidence of pollution within the reach. No sewage fungus, or substantial filamentous algal growths that are likely to be attributable to nutrient enrichment. No direct effluent discharges. If used, water quality test kits do not register any positive results. Biological sampling indicates no impacts on water or sediment quality.	No evidence of non-native species (plants or animals). As a minimum assessment this should include Himalayan Balsam, Japanese knotweed and Giant Hogweed.
2	Physical modifications (described above) of limited spatial extent within the reach - no more than 5% of surveyed length). BUT no artificial impounding structures. At least patchy cover (>1/3 of channel length) of riparian trees*, providing leaf litter and woody material to the channel, some of which is retained. Tree roots having some influence on channel dynamics (patterns of erosion and deposition, channel sinuosity). Riparian zone (up to 5 metres from bank top) with semi-natural vegetation.	Evidence of minor impacts on the natural flow regime from abstraction, diversion, upstream impoundment or discharges (e.g. abstraction or discharge points creating a discernible difference in flow).	Evidence of low-level pollution. Small amounts of sewage fungus in the reach, or patches of filamentous algal growth that are likely to be attributable to nutrient enrichment (e.g. downstream of effluent discharge). If used, water quality test kits register positive results but at low concentrations. Biological sampling indicates only minor impacts on water or sediment quality.	One or more non-native species are present in small numbers or spatial extent. Non-native plants should occupy no more than 5% of channel length. Non-native animals (e.g. signal crayfish) should rarely be encountered during searches.
3	Physical modifications of moderate spatial extent – no more than 30% of reach length. Artificial impounding structures may be present but rare and with limited impact on physical habitat or free movement of species.	Evidence of moderate impacts on the natural flow regime from abstraction, diversion, upstream impoundment or discharges. e.g. abstraction or discharge points creating an appreciable difference in flow.	There may be moderate levels of filamentous algal growth or sewage fungus through most of the reach. If used, water quality test kits register moderate levels of pollution. Biological sampling indicates moderate impacts on water or sediment quality.	One or more non-native species have a significant presence in the reach, occupying up to 25% of the reach.
4	Physical modifications extensive – more than 30% of reach length but still some segments of natural channel and bank. And/or artificial impoundments have a considerable impact on physical habitat.	Natural flows are heavily depleted by abstraction, upstream impoundment or water diversion	There may be high levels of filamentous algal growth or sewage fungus through most of the reach. If used, water quality test kits register high levels of pollution. . Biological sampling indicates high impact on water or sediment quality.	One or more non-native species are a major component of the flora or fauna, occupying up to 60% of reach length.
5	Physically modified throughout the reach (i.e. 100% of reach length). Channel is uniformly straightened and oversized, or with reinforced banks.	The reach is dry for the majority of the year due to abstraction or water diversion.	Major pollution issues. There may be very high levels of filamentous algal growth or sewage fungus throughout the reach, or chronically poor water clarity (not just after heavy rain). If used, water quality test kits register very high pollutant concentrations. Biological sampling indicates high impact on water or sediment quality - very few types of aquatic invertebrates present.	One or more non-native species are widespread in the reach, dominating the riparian zone or the channel.

* Riparian trees should be present where natural environmental conditions allow, which includes higher altitudes up to at least 700 metres (Natural England 2018).

- **Physical naturalness** – The class descriptions for this component are based on evidence of artificial physical modifications. Generally physical modifications reduce natural habitat complexity and dynamism on which characteristic biological assemblages rely. In some cases a stream channel may appear natural/unmodified but lack habitat complexity – lack of complexity in such cases is often due to a lack of riparian trees and woody material, which is counted as a loss of naturalness (i.e. an artificial modification) in the class descriptions above. Equally, a stream may have moderate amounts of habitat complexity but it is generated by artificial modifications, e.g. a weir. Such modifications may introduce new habitat features (which some species will benefit from), but they interfere with natural habitat function and result in impacts on the wider habitat mosaic.

- **Hydrological naturalness** - Impacts on hydrological naturalness are generally difficult to assess from a one-off site visit, because a judgement needs to be made in relation to what the natural flow regime would be in the absence of hydrological modifications. The natural flow regime is variable and so what would be expected at the time of an inspection is very uncertain. There may be a very obvious modification, for instance a direct abstraction point or leat, perhaps with noticeably lower flows downstream than upstream – even here the scale of modification may not be obvious at the time of survey. Without clear physical signs of hydrological modification, field assessments are likely to be of low confidence. However, confidence can be increased by investigating other data sources, such as the Environment Agency's water resource assessment for the area. Such assessments may highlight issues such as groundwater abstraction pressure, which will affect the natural baseflow of the watercourse. *Note that a complete absence of flow, or even of water, is not necessarily an indication of lack of hydrological naturalness. Many stream and even river sections in England only flow for part of the year and support a range of species adapted to such conditions – natural temporary stream sections are an important component of the stream resource and need to be conserved in this state.*

- **Chemical naturalness** – Pollution comes in many forms, some of which are difficult to assess without repeat visits and expensive chemical analysis or assessment of the effects on the biological community. Simple visual signs of organic pollution and nutrient enrichment include sewage fungus and heavy growths of filamentous algae. The Freshwater Habitats Trust website provides guidance on simple assessments of water quality, including the use of test kits. Use the FHT guidance to help assign a naturalness class. There may be other sources of information that you can draw on to help with the assessment, for instance the Riverfly Partnership including the more detailed SmartRivers add-on. Note that Water Framework Directive data on waterbody status is not likely to reflect the chemical naturalness of headwater streams, because WFD monitoring is typically undertaken at points at the downstream end of WFD waterbodies on larger rivers.

- **Biological naturalness** - This assessment relates only to the presence of non-native species, i.e. direct biological effects on biological naturalness. Impacts on natural biological assemblages due to physical, chemical and hydrological modifications of the site are dealt with in the assessment of those naturalness components and should not be included here. There are many non-native species that can seriously affect the naturalness of the biological community, some of which are tricky to identify. Guidance on identifying the most invasive non-native plant and animal species is provided on this website and in the mobile phone apps PlantTracker and Aquainvaders

Describing the level of confidence in your assessment

A simple 3 class system is used to describe how certain you are about your assessment of each naturalness component.

- **High** – Very confident that the naturalness class description reflects the naturalness of the surveyed section.
- **Moderate** – Fairly confident that the naturalness class description reflects the naturalness of the surveyed section.
- **Low** – Not confident that your best judgement of the naturalness class reflects the naturalness of the surveyed section.

Supplementary information

a) Notes

Provide a short description of the surveyed reach in relation to each naturalness component, drawing attention to any particular features of interest, impacts of concern, or difficulties with the assessment. If you have used any forms of assessment other than simple visual inspection please explain their use here.

b) Intermittent flow

Stream sections with naturally intermittent flows are an extremely important ecological component of the river network, providing habitat niches not found elsewhere and supporting a range of specialist species. It's important that we gain a better understanding of their distribution and the scale and distribution of impacts on their natural function. It can be difficult to distinguish between a natural temporary stream section and a section that naturally has perennial flow but is impacted by abstraction or water diversion. Make the best judgement you can and choose an appropriate level of confidence to indicate your level of uncertainty.

c) Photographs and attached files

Photographs of the character of the reach will help us to understand your assessment. Take at least one photo of the general physical character of the channel and riparian zone. Other photos can focus on particular features of the reach, e.g. riparian flushes, trees and their roots interacting with the channel, dry sections, evidence of particular impacts such as weirs, abstraction pipes, drains, or sewage fungus. You may also want to attach a file providing more detail about the site, such as a full site description or a species list.

d) Key habitat features

Recording of key habitat features is not essential but will help in linking naturalness to habitat complexity when we analyse data nationally. A list of standard features is included in the data form (see Annex I) but other features can be added. Examples of different habitat features are provided in the photo library in Annex III.

e) Species

Headwater streams provide a very wide range of niches for very many species. Some species are widespread whilst others have very restricted distributions or are heavily under-recorded. Some

are specialists of headwater streams whilst others also use other habitats, including larger rivers, standing waters and wetlands. Some are easy to identify but others require considerable practice or specialist expertise, particularly mosses, liverworts and invertebrates for which headwater streams are a particularly important habitat.

Species and genera named on the form are generally widespread in headwater streams and relatively easy for non-specialists to identify. Some other headwater species which are less common and not well recorded are listed in Annex IV. To identify any of these species you need to develop an adequate level of expertise. Local recording groups and specialist recording schemes (like the Riverfly partnership and SmartRivers) can help you with this. Records for these more obscure species should be captured via specialist recording schemes or directly via irecord, so that they can be collated by the Biological Records Centre and passed on to the National Biodiversity Network.

We will use species data to help demonstrate the importance of habitat naturalness to both characteristic and rare/threatened species, particularly in relation to the full natural habitat mosaic needed to support headwater stream assemblages.

References and further reading

Holmes, N.T.H. (2010) An investigation of the watercourses in Sussex arising from the chalk aquifer of the South Downs: merged reports from December 2009 & December 2010. A report to the Sussex Wetland Landscapes Project. Sussex Wildlife Trust.

Mainstone, C.P., Hall, R. and Diack, I. (2016) A narrative for conserving freshwater and wetland habitats in England. Natural England Research Reports, Number 064:

Mainstone, C.P., Laize, C., Webb, G. and Skinner, A. (2014) Priority river habitat in England – mapping and targeting measures. Natural England joint publication JP006.

Mainstone, C.P., Skinner, A., Peters, S. and Rogers, M. (2015) Refining the priority river habitat map for England: a report on recent revisions and proposals for on-going refinement. Natural England joint publication JP012.

Natural England (2018) Generating more integrated biodiversity objectives – rationale, principles and practice. Natural England Research Report Number NERR071.

List of annexes

Annex I – Printable river naturalness survey form to use in the field

[See separate file]

Annex II – Examples of classifying stream naturalness

[See separate file]

Annex III – Photo-library of key habitat features

[See separate file]

Annex IV – List of species of high priority for recording

[See separate file]

Frequently asked questions

How can data from more detailed quantitative assessment systems be translated into naturalness classes?

The simplicity of the assessment is intended to encourage as many people as possible to get involved. We also want to be able to use data collected by more detailed quantitative assessment systems or data. Such systems are often used by professionals but can be used by volunteers with sufficient training. Indeed, people with no prior experience who may start off using the simple class descriptions of the naturalness assessment above may in time become sufficiently interested to use more complicated assessment systems.

- **River Habitat Survey** assesses physical habitat over 500 metre sections and so can contribute to the physical naturalness assessment, but it also generates other data that can contribute to other naturalness components. Data are captured on a database managed by the Environment Agency, although only data from qualified RHS surveyors are permitted (to ensure data reliability). The most obvious translation to the naturalness assessment described here is Habitat Modification Class, since this considers physical modifications directly and was used in the original data analysis that produced the priority habitat map. Other data elements collected by RHS can contribute to the assessment of other naturalness components (e.g. non-native species).

- The **MoRPh** method assesses physical habitat over shorter river/stream lengths (10 to 40 m river length) proportionate to river width. Contiguous MoRPh surveys can be made to capture the range of physical habitats and river dynamics present over longer sections. A website receives MoRPh data from surveyors, generates a range of indicators of habitat complexity and human pressures for each survey, maps the indicators and permits surveyors to download data from the MoRPh database. There is potential for MoRPh to contribute to the assessment of all four naturalness components.

We will be exploring how best to translate data from different quantitative systems into the simple class descriptions in Table 1. This will enable the direct transfer of data from these systems to the data portal. If successful, any data that you submit to databases such as for RHS and MoRPh, and potential the Riverfly partnership, will be automatically translated over. Alternatively you can undertake the simple naturalness assessment at the same time as more quantitative surveying and input the information to the data portal separately.

Will this naturalness system be used in the assessment of priority habitat condition?

Whilst the principal use of this system relates to priority habitat mapping, it is being developed with the possibility of its use as a citizen science contribution to assessing the condition of the river habitat resource in relation to priority habitat objectives. This could add information to the coverage that is possible through the use of strategic monitoring programmes as proposed in Mainstone *et al.* (2018), which need to form the foundation of any robust condition assessment framework. The proposals for priority habitat condition assessment are based on the same principles of naturalness and natural habitat function, and relate not only to sites on the priority habitat map but the whole river habitat resource.

Why isn't habitat diversity/complexity a component of the assessment?

The original survey structure used by Holmes (2010) had a separate physical habitat diversity component. The freshwater and wetland habitat narrative assumes there is a reasonable association between naturalness and habitat diversity (as long as river size is taken into account – see below). If a stream is highly natural and not highly diverse then this may be a natural situation and not something a site should be marked down for. Conversely, if a site is diverse but modified then it is not reflecting the natural ecological/biodiversity and dynamic character of the river and not something it should be marked up for. Other considerations are given below.

1. There is systematic variation in the scale of habitat diversity according to river size (smaller streams have finer resolution habitat mosaics than larger rivers) and other characteristics (hydraulics, sediment delivery regime etc), which makes it difficult to use a simple system of habitat diversity assessment across the whole habitat resource.

2. There might be a temporal mis-match between naturalness and habitat complexity that will disappear over time – a site may be renaturalising following historical modifications that are not now evident.

3. There can be an apparent mis-match between naturalness and habitat complexity that relates to not factoring in riparian trees to the naturalness assessment. In this assessment system a lack of riparian trees and fallen woody material in the channel is included as a loss of naturalness – where they are present and are allowed to influence the reshaping of the channel they generate the habitat diversity that would be expected from a natural stream/river.

4. Including habitat diversity as an integral part of a simple assessment system, intended for use by all stakeholders including inexperienced ones, would be potentially off-putting and could lead to reduced engagement.

There is a part of the data input form where surveyors can (if they choose) note habitat features. These data can be used to analyse the relationship between naturalness and habitat diversity at a later stage.