Developing a coherent framework for assessing priority freshwater habitats in England JP016

Technical summary

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Background

This report documents collaborative work undertaken by Natural England and the Centre for Ecology and Hydrology, in association with the Environment Agency, to develop proposals for a more coherent way of assessing the freshwater habitat resource in relation to England's biodiversity strategy. It is intended to inform various strategic reviews of monitoring programmes being undertaken by statutory agencies and research institutes in England.

The work forms part of wider strategic efforts to rationalise the roles of key delivery mechanisms (protected sites, priority habitats, Water Framework Directive) in the conservation of freshwater and wetland biodiversity, rooted in the 'freshwater and wetland habitat narrative' (Mainstone *et al.* 2016). This wider work has included new interpretations of UK priority habitat definitions and new digital mapping of priority river and lake habitats, under the auspices of the Terrestrial Biodiversity Group who oversee the implementation of England's current 10-year strategy 'Biodiversity 2020'.

The freshwater and wetland habitat narrative explains the importance of natural ecosystem/habitat function to the conservation of characteristic species assemblages. Natural function of freshwater habitats may be described as their function in the absence of human intervention, in relation to natural hydrology, water chemistry/quality, geomorphological process (physical habitat provision), connectivity and species assemblages. The narrative lays out principles for protecting and restoring natural function as far as this is practical given local circumstances. It emphasises the potential synergies between the Water Framework Directive (WFD), protected freshwater wildlife sites and priority habitat and species objectives, and provides a means of protecting and restoring freshwater and wetland biodiversity in ways that have wider benefits for natural capital, particularly in respect of water management (such as flood risk, water resources and water quality).

The new priority river and lake habitat maps aim to identify the most naturally functioning rivers, streams and lakes in England, to highlight their existence and generate additional focus for their protection. Maps of restoration priorities have also been generated, to prioritise the restoration of other sites back towards the levels of natural function exhibited by sites on the priority habitat maps. All of these maps require refinement so that they are as useful in local decision-making as possible, to reflect local priorities for restoring higher levels of natural function as far as this is possible and desirable.

Using recent priority habitat mapping work as a foundation, we have developed an assessment framework to monitor changes in the levels of natural ecosystem function in the freshwater habitat resource, in ways that relate specifically to strategic targets for

Biodiversity 2020 and successor initiatives. The work has covered rivers/streams, lakes and ponds (although it should be noted that no recent changes have been made to the mapping of priority pond habitat, which is led by the Freshwater Habitats Trust).

The breadth and detail of this work has provided a major technical challenge and the full report is correspondingly detailed, covering a range of habitat types that would traditionally have been the subject of separate reports. The full report is available on the **Natural England Access to Evidence catalogue.**

General design of the assessment framework

The assessment structure divides the entire habitat resource into different components (or zones). All of these components can make a contribution to priority habitat objectives through restoration of some degree of natural ecosystem function.

Waterbody types	Sites on the priority habitat map	Sites on the restoration priorities map	Sites in the wider habitat resource
Small waterbodies (i.e. WFD data generally not available)	Habitat resource zone 1a	Habitat resource zone 2a	Habitat resource zone 3a
Larger waterbodies (i.e. WFD data available)	Habitat resource zone 1b	Habitat resource zone 2b	Habitat resource zone 3b

Note: For ponds only zones 1a, 2a and 3a are relevant

The separation of small and large waterbodies is critical in addressing the major gap in our knowledge of streams and small lakes. WFD monitoring is focused on rivers and larger lakes yet the majority of the running water and lake habitat resources consists of smaller-scale habitats. This knowledge gap tends to be obscured in the river habitat resource because WFD reporting happens at a 'river water body' scale, which means that unmonitored streams are aggregated with downstream monitored river sections to produce a single assessment of status.

A good deal of freshwater monitoring is already based on the concept of natural ecosystem function. A considerable amount of relevant monitoring is therefore already conducted, and the envisaged framework would seek to use this information as much as possible. The most relevant programmes are:

- WFD monitoring and other Environment Agency data gathering (e.g. River Habitat Survey baseline assessments)
- Common Standards Monitoring of protected wildlife sites
- Countryside Survey

Citizen science monitoring initiatives, and other forms of monitoring such as remote sensing and DNA techniques, also have the potential to play a significant role in the future. The Environmental Change Network and Upland Waters Monitoring Network are extremely important in evaluating long-term change, but their limited spatial coverage makes them less suited to the reporting of habitat condition across the whole surface water resource.

There is significant variation in sampling design across existing monitoring programme/activities. For example:

the whole habitat resource may be assessed, or sites might be targeted on the basis of risk/representativeness;

- if using a representative sampling design this may be random, stratified, and/or at fixed sites over time;
- sampling can occur multiple times a year or once every few years depending on the attributes being sampled.

Reporting frequency may align with monitoring frequency or may be very different. For instance, water quality sampling is often done at monthly or quarterly intervals to capture temporal variability, but is reported using a number of years of monitoring data. In contrast, physical habitat surveys may be conducted once every few years, and reported on the same basis.

All this means that a mixed sampling design is needed to exploit available data to the full, and this has implications for what inferences can be drawn about the habitat resource as a whole in reporting.

A 5-class classification system has been adopted, using a range of attributes relating to key elements of natural function and running from high naturalness (Class 1) to low naturalness (Class 5). This allows incremental changes to be portrayed simply and fits the general structure of WFD assessment and reporting. It also provides flexibility in how strategic targets for the habitat resource are set that recognises the practical constraints to restoring natural function in different places. The approach builds on WFD reporting data, adding in other data from various sources to provide a more complete picture of (in the report we refer to this as 'WFD Plus').

Selecting attributes

Considering rivers/streams, lakes and ponds separately, the project considered potential attributes for characterising key aspects of natural ecosystem function. Pragmatism was needed in this exercise to ensure we focused attention on attributes for which data are already collected, or could reasonably be collected (or available data reprocessed for our purposes) at relatively little additional effort.

We had to consider what role structural and functional attributes could reasonably play in the assessment. Given the objective of characterising the level of natural ecosystem function it could reasonably be expected that the focus should be on indicators of ecological processes, such as the rate of leaf litter decomposition or community metabolism. However, given the pragmatic focus on exploiting existing monitoring programmes, the project needed to look at conventional monitoring practices but within a more functional context. The indicators of habitat naturalness we have chosen should have strong links with natural ecological processes, even though they may not characterise those processes directly.

Data illustrations

Data illustrations were produced for many potential attributes (summary below), looking at how data might be collated and classified according to natural function and then classifying available data to show how the assessment might work. The extent to which this was possible varied between priority habitat types and individual attributes. A large number of attributes were considered and these illustrations constitute a large part of the final report.

Element of natural function	Rivers/streams	Lakes	Ponds
Connectivity	Longitudinal barriers Lateral (flooding)	Longitudinal barriers	Number of ponds in the landscape
Hydrology	Flow regime	Not illustrated	Not illustrated
Water quality	Not illustrated	WFD water quality determinands	CS07 water quality data
Physical habitat	Flow habitat mosaic Vegetation complexity Riparian trees Woody material Exposed sediments	Shoreline modifications Fringing wetlands (hydrosere) Semi-natural riparian habitats Riparian trees Woody debris	Shading Grazing Hydrosere condition score (adjacent land, shoreline and pond base)
Species assemblage	Invasive non-natives Invertebrate similarity Index	Not illustrated	PSYM (metric representing the biological quality of ponds based on plants and invertebrates) Invasive non-natives

In many cases the precise nature of the assessment of attributes was not settled, and further work would be needed on data processing methods. The existing data used to illustrate the operation of attributes varied in amount and representativeness. Added to the preliminary nature of the priority habitat maps available, this made it difficult to generate data illustrations that reflect the real status of the habitat resource, particularly in respect of the different zones of the habitat resource (as in the table above).

Proposals

The attributes proposed for inclusion in the assessment framework are laid out in separate tables for rivers (including streams), lakes and ponds at the end of this summary, together with brief information on data sources and the nature of the envisaged assessment. There are necessarily numerous attributes for each habitat type, because none of the key elements of natural ecosystem function (hydrology, water quality, physical habitat provision and species composition) can act as a surrogate for another. The parallels with the six-yearly WFD River Basin Characterisation process are noticeable in relation to rivers and lakes, and there is considerable scope for procedural linkages (in terms of both data collection and analysis).

Biological attributes (particularly community metrics) are often thought of as an integrating vehicle for assessing human impacts on freshwater ecosystems, but in reality there are serious limitations to what biological data can tell us about the naturalness of ecosystem function, particularly considering the practical constraints on monitoring schemes. We can aspire to more refined biological assessments, with more explicit consideration of impacts on

all key components of natural function, but we still need to see biological data as one component of a wider range of attributes needed for the envisaged assessment framework.

In terms of the nature and size of the monitoring programme, proposals for monitoring outside of the protected site series are summarised in the table below. The protected site monitoring programme, governed by Common Standards guidance, will provide additional data for the assessment although care will be needed not to introduce sampling bias towards sites that are receiving particular management attention.

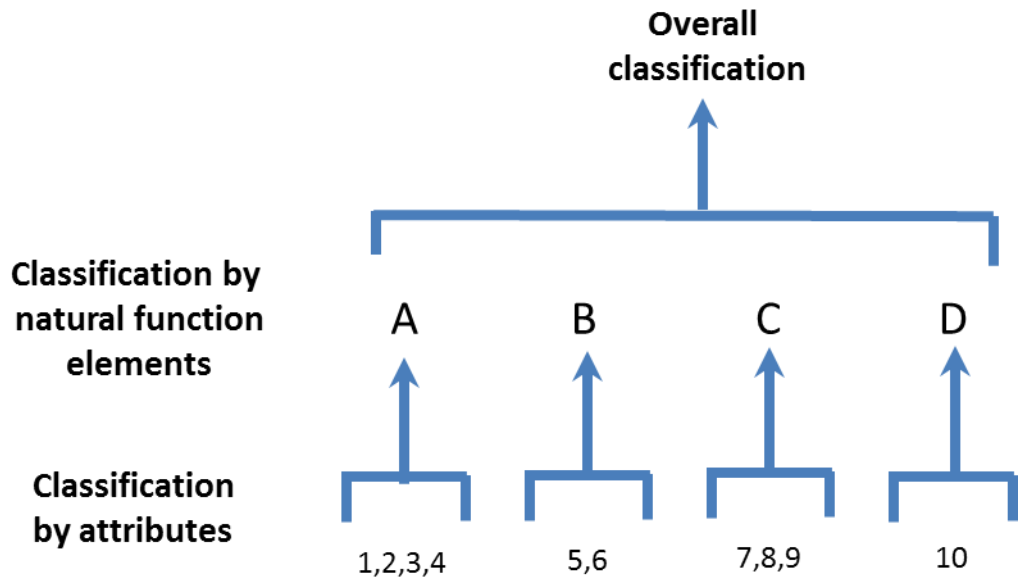
<table>
<tr><th>Priority habitat type</th><th>Small waterbodies</th><th>Large waterbodies</th></tr>
<tr><td>Rivers/streams</td><td>For representative sampling of certain attributes, use combination of Countryside Survey, baseline RHS survey and available WFD data on headwater streams. Seek alignment of CS and RHS baseline survey frequency with envisaged 5-year reporting cycle – can be achieved by annualising CS survey effort (i.e. 20% of sites surveyed per year on a rolling programme).</td><td>Use WFD (surveillance and risk-based) data to assess all waterbodies in relation to relevant WFD attributes. Make assessment of additional attributes on a full inventory or representative basis depending on the nature of each attribute. For representatively sampled attributes ensure sufficient coverage of river types included in the UK priority habitat definition.</td></tr>
<tr><td>Lakes</td><td colspan="2">Representative sampling of the entire lake habitat resource on the GB lakes inventory, stratified geographically and by priority lake habitat type. Representative sites to be monitored on a rolling basis within an annual survey programme, with all sites visited within a five-year period. For larger lakes a WFD Plus approach would be used.</td></tr>
<tr><td>Ponds</td><td>Countryside Survey monitoring programme and/or Citizen Science data (sub-sampled to remove sampling bias).</td><td></td></tr>
</table>

Strategic monitoring reviews being undertaken by various organisations in England are giving prominence to more innovative methods, particularly remote sensing and DNA techniques. It has not been possible to build in attributes based on these techniques, although this may become possible in the future. This report acts as a useful foundation for considering what these techniques might do better, and how they might fit into a refined operational monitoring framework In the short-term, remote sensing techniques could play a useful role in selecting representative sampling sites and in extrapolating assessments at representative sites to the wider habitat resource.

Equally, there may be parallel attributes to those listed which would perform the same function. The nature of the assessment is more important than the precise attributes used. The focus on existing monitoring schemes means that the envisaged framework will have to be flexible to accommodate changes to those schemes. Any changes to attributes over time will have consequences for the comparability of results between reporting cycles.

A hierarchical approach is proposed to combining the results of individual attributes, firstly into key elements of natural function, then into an overall assessment of condition (see the

Figure below). This retains understanding of all aspects of natural function, so that protection and restoration measures can be targeted at each aspect.



The proposed approach to setting strategic biodiversity targets using this assessment framework makes use of the 5-class classification. There are considerable constraints to the restoration of natural ecosystem function in England, due to population densities and associated development. The 5-class classification allows targets to be expressed in a realistic way, aiming for different proportions of the habitat resource to be protected and restored at different levels of natural function. Any significant restoration of natural function anywhere in the habitat resource, in any element and from any level to any level in the classification, can contribute to priority habitat objectives. Targets can be set for each habitat resource zone, for each element of natural ecosystem function and (with suitable rules for aggregation of classification results) for natural function overall. Sites on the priority habitat maps will have high targets for natural function, sites on the restoration priorities map will have variable targets depending on local constraints but will generally be quite high, whilst sites in the wider habitat resource will have variable targets but generally more modest in ambition.

The parallels between the approach envisaged and the structure of WFD reporting are clear. Whilst they are not (and cannot) be the same, similarities in the structure and process of assessment will help to streamline effort in making assessments.

Some detailed technical recommendations

In addition to these proposals, the project made some specific recommendations:

- the development of trait analysis of biological data, which can provide fresh insights into impacts on natural ecosystem function;
- the wider and more coherent application of citizen science to all types of small waterbody, including headwater streams and small lakes alongside ponds (where such science is more mainstream);
- the incorporation of slightly different or new recording of some hydromorphological/ riparian features when undertaking lake macrophyte surveys for WFD (this would

help to implement the proposals in the last section without adding significant amounts of monitoring effort);

- incorporation of hydromorphological attributes of naturalness into PondNet and CS pond monitoring along with continued pond water quality monitoring by PondNet;
- the extension of the RIVPACS prediction system to headwater streams so that the macroinvertebrate element of the assessment proposals for rivers can be robustly implemented.

Closing remarks

The technical proposals made in this report are proposals only. Whether they are implemented depends on a range of factors, including the outcome of the strategic monitoring reviews that are currently taking place. Their implementation would require concerted effort at integration and collaboration by a range of organisations. The technical complexity of the proposals hopefully shines a light on the complexity of monitoring freshwater habitats, and the resources required to generate a robust picture of habitat condition across a large, dynamic and patchily impacted habitat resource.

References

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. Available at: http://publications.naturalengland.org.uk/publication/6524433387749376?category=429415 (Accessed 10/1017).

Table 10.1 Proposed river attributes.

Element	Attribute		Existing data sources	Method	New data required (if any)	Statistical approach to sampling
Longitudinal connectivity	Number and total height of structures	Headwaters	EA River Obstructions dataset.	Aggregate data by habitat resource zones and classify into 5-class classification	Knowledge of structures is patchy for headwaters but new obstructions app will improve coverage.	Full data inventory but recognising that the baseline will change as new structures are added to the GIS layer.
		Non-headwaters	EA River Obstructions dataset	Aggregate data into habitat resource zones and classify into 5-class classification	The layer will be updated regularly so suitable for 5-yearly assessment No need for additional bespoke resource.	Full data inventory. The baseline should not change significantly
Lateral connectivity	Proportion of natural floodplain free to inundate at all return periods Proportion of inundated land under semi-natural vegetation Level of microtopographic variation in inundated semi-natural vegetation.	Headwaters	Not appropriate	Not appropriate	Not appropriate	Not appropriate
		Non-headwaters	National EA 1-in-100 year flood map. National EA flood defence asset map. National land cover map National priority habitat inventory map	GIS overlay.to generate classification results for each habitat resource zone	None as long as the flood defence assets GIS layer is regularly updated or there is some other way of logging changes in extant flood defence structures that can be used.	Full data inventory
Vertical connectivity	None proposed at this time	Headwaters				
		Non-headwaters				
Naturalness of flow regime	% deviation from naturalised flows at a defined range of flow conditions	Headwaters	EA Water Resources information on aquifer status	Expert judgement on each habitat resource zone by WFD waterbody based on water resource status of relevant aquifer.	None	Aim for full data inventory
		Non-headwaters	EA Water Resources GIS	Processing of observed and naturalised flow data at all Assessment Points in the WRGIS, to generate classification results for each habitat resource zone in each WFD waterbody	None	Full data inventory
Naturalness of physical habitat mosaic	Flow habitat mosaic (FHMA) Riparian vegetation complexity (RVCA) Riparian trees (RTA)	Headwaters	River Habitat Survey – Countryside Survey and baseline EA assessments	Process relevant RHS data to generate score for individual sites, and aggregate site scores to habitat resource level	Coverage of Countryside Survey and baseline EA assessments needs to be reviewed, in terms of spatial coverage of sites and return period of assessments.	Representative sampling*. Statistical design differs between Countryside Survey and EA baseline assessments
		Non-headwaters	River Habitat Survey – Countryside Survey, baseline EA assessments	As above	Baseline EA assessments provide sufficient coverage of	Representative sampling*

	Woody material (WMA) Exposed sediments (ESA) Habitat Modification Score (HMS)				representative sites. There is other RHS surveying undertaken on the main river network but generally focused on impacted reaches so carries sampling bias.	
Naturalness of water quality regime	WFD chemical status WFD ecological status	Headwaters	Countryside survey, EA WFD data	Classify data at monitoring site level within each habitat resource zone. Countryside Survey is a one-off survey repeated ever few years, so does not generate robust water quality assessments that take account of short-term temporal variation. However, one-off water quality samples taken can be used to generate low-confidence assessments of chemical status. Macroinvertebrate samples can be converted into ecological status assessments	WFD monitoring programme contains significant numbers of headwater sites. Coverage of Countryside Survey needs to be reviewed, in terms of spatial coverage of sites and return period of assessments.	Representative sampling*
		Non-headwaters	EA WFD data	Classify data at monitoring site level within each habitat resource zone. Chemical status includes nutrient and organic pollution status as well as compliance with EQSs of a range of toxins. Ecological status includes WFD classification metrics for macroinvertebrates, plants, diatoms and fish.	None	Full data inventory although some data will be based on historical status assessment and lack of known risk that would alter that assessment.
Characteristic assemblages	Benthic macroinvertebrate similarity index	Headwaters	Countryside Survey, EA WFD monitoring – raw data	This is a standard metric generated at Countryside Survey sites. EA WFD data would need to be analysed along with assemblage predictions from RIVPACS to generate index values	Coverage of Countryside Survey needs to be reviewed, in terms of spatial coverage of sites and return period of assessments. WFD monitoring programme contains significant numbers of headwater sites	Representative sampling*
		Non-headwaters	EA WFD monitoring – raw data	EA raw data would need to be analysed along with assemblage predictions from RIVPACS to generate index values, which could then be classified and used to generate a result per WFD waterbody. It is anticipated that there would be sufficient data of	None.	Representative sampling from the EA macroinvertebrate database. Stratified random sampling of WFD monitoring sites likely to be most appropriate.

				mixed-taxon resolution to avoid the need to use family-level data.		
Non-native species	Number of non-native species present	Headwaters	NBN data	Resolve tetrad data from previous 5 years onto the river network and sum the number of species within the relevant part of each WFD waterbody that are on the UKTAG high-impact list.	None. Encouragement can be given to recorders to generate more data for submission to NBN.	Full spatial coverage but recognising the patchiness of available data.
		Non-headwaters	NBN data	As above	As above	As above

* Representative sampling requires that there are sufficient sites to adequately capture variation in habitat condition within the six habitat resources zones defined in this report, as well as the different river types listed in the UK definition of priority river habitat - Habitats Directive Annex II H3260 (watercourses with Ranunculion vegetation, chalk rivers, active shingle rivers and headwater streams.

Blue-shaded boxes – WFD Plus elements. Note that some of these make use of EA data that are not used for WFD classification purposes, or use EA data collected for WFD classification purposes but in a different way.

Table 10.2 Proposed lake attributes

Element	Attribute		Existing data sources	Method	New data required (if any)	Statistical approach
Longitudinal connectivity	Number of permanent structures	WFD lakes	EA River Obstructions dataset.	Number within a river node of the lake and classified into 5-class classification This could be improved when intelligent rivers network and lake inventory are combined to check obstructions are online to the lake.	Knowledge of structures is not complete but new obstructions 'app' will improve coverage. Structures on lakes can be recorded alongside any additional lake shoreline recording	Full data inventory, but recognising that the baseline will change as new structures are added to the GIS layer.
		Non-WFD lakes				
Lateral connectivity	Proportion of shorelines which are natural	WFD lakes	LHS, WFD macrophyte surveys	Shorelines classified into a 5 class classification	Record % of entire shoreline monitored during WFD macrophyte surveys	WFD monitored water bodies only, non-statistical approach to selection of water bodies monitored
		Non-WFD lakes	None	Shorelines classified into a 5 class classification	Record % of entire shoreline modified, when surveying lakes and/or using remote sensing	Requires a stratified random sampling regime
	Proportion of lakes with emergent vegetation	WFD lakes	EA WFD macrophyte surveys, LHS	% shoreline with emergent vegetation needs to be classified into a 5 class system	Need to record % of lake circumference with emergent vegetation Definition of marginal fringe needs to be altered or an additional metric needs to be added for EA WFD macrophyte surveys	WFD monitored water bodies only, non-statistical approach to selection of water bodies monitored
		Non-WFD lakes	None	% shoreline with emergent vegetation needs to be classified into a 5 class system, records could potentially include site observations and remote sensing data although the	Need to record % of lake circumference with emergent vegetation	Requires a stratified random sampling regime

				latter has not yet been trialled.		
Naturalness of hydrological regime		WFD lakes	EA data	Deviation from naturalised flow on the lake outflow	It has not been possible to undertake data illustrations on this data and the extent of data availability is unclear.	Non-statistical approach to water body selection depends on where data is available. Does not cover ground water fed lakes.
	Non-available at this time	Non-WFD lakes	EA data	Deviation from naturalised flow on the lake outflow	It has not been possible to undertake data illustrations on this data and the extent of data availability is unclear.	Non-statistical approach to water body selection depends on where data is available. Does not cover ground water fed lakes.
Naturalness of physical habitat	Presence of natural substrate (none proposed at present) Semi- natural riparian habitat % shoreline tree lined	WFD lakes	Earth observation of riparian land use LHS trees	Process Land class data within a 50 m riparian zone of the lake Percentage of perimeter which is tree lined, earth observation and direct observation could be used.	Process earth observation data Need to record % of perimeter which is tree lined, (could be done as part of macrophyte surveys) earth observation and direct observation could be used.	Earth observation data would represent a full inventory No direct observations at present could be introduce to macrophyte surveys.
		Non-WFD lakes	Earth observation of riparian land use	% of riparian land which is semi natural	Process earth observation data Need to record % of perimeter which is tree lined, earth observation and direct observation could be used.	Earth observation data would represent a full inventory Requires a stratified random sampling regime
Naturalness of water quality regime	Number of lakes reaching good and high status overall for the suite of water quality and biological monitoring	WFD lakes	EA WFD reporting database	Data are already pre-processed and classified by WFD waterbody. Chemical status includes water quality status as well as compliance with EQSs of a range of toxins. Ecological status includes	Dependent on the continued monitoring of WFD lakes	WFD monitored water bodies only, non-statistical approach to selection of water bodies monitored

				WFD classification metrics for plants, phytobenthos and phytoplankton.		
		Non-WFD lakes	None	Could potentially encourage citizen science (see pond section). Earth observation of lake chlorophyll concentration may be beneficial but would not give a full picture.	Additional survey required	Requires a stratified random sampling regime
Non-native species	Number of non-native species present	WFD lakes	NBN data	Resolve tetrad data from previous 5 years onto the lake inventory GIS layer and sum the number of species within each WFD waterbody that are on the UKTAG high-impact list.	None. Encouragement can be given to recorders to generate more data for submission to NBN.	Full spatial coverage but recognising the patchiness of available data.
		Non-WFD lakes	NBN data	As above	As above	As above

Table 10.5 Proposed pond attributes.

Element	Attribute	Existing data sources	Method	New data required (if any)	Statistical approach
Landscape connectivity	Number of ponds	Countryside Survey	Counts in 1km^2 survey squares are extrapolated to national scale. Losses and gains in pond numbers between surveys can be similarly extrapolated. Data can be stratified by pond size and land use. Urban areas not included.	Countryside Survey needs to be continued	Representative sampling
Naturalness of water quality regime	Nitrate and phosphate concentration Turbidity	Countryside Survey, PondNet	Sites are classified into 5 classes according to whether they exceed the NPS nutrient thresholds and have high or low turbidity.	Countryside Survey and/ or PondNet need to be continued. Turbidity scales should be aligned. The use of nutrient field test kits may allow more frequent sampling in a representative subset of ponds in either network.	Representative sampling
	ANC		There are no ANC data from either network, currently limited to alkalinity and pH measurements.	ANC should be added to any future Countryside Survey pond water quality analysis particularly those in low alkalinity areas	
Naturalness of hydrological regime	Presence of ditches and water control structures	None, Countryside survey and PondNet record some hydrological features but they are not adequate to assess naturalness.	Presence of artificial inflows, outflows and any water level control structures need to be recorded	Discussions are underway to introduce this to PondNet, it should also be included in any future Countryside Survey	Representative sampling
Naturalness of the hydrosere	Natural pond base	Partially covered in Countryside Survey and PondNet	Individual ponds are classified into 5 classes according to how many of the 4 components are modified/managed.	Countryside survey and/ orPondNet need to be continued. Both surveys need to clearly report on shoreline modifications and naturalness of the pond base.	Representative sampling
	Natural shoreline				
	Semi natural land use 5m from pond edge	PondNet, Countryside Survey			
	Semi natural land use at 100m from pond edge				
Shading	Percentage of pond margin overhung by trees or percentage of perimeter shaded	PondNet, Countryside Survey	The percentage shading is used to classify ponds into 5 classes, with no inference to quality. The aim is to be able to report on the diversity of the extent of shading across the whole habitat resource.	Countryside Survey and/ or PondNet need to be continued	Representative sampling
Grazing	Grazing intensity score	PondNet, Countryside Survey	The intensity of grazing score is used to classify ponds into 5 classes, with no inference to quality. The aim is to be able to report on the diversity of the intensity of grazing across the whole habitat resource.	Countryside Survey and/ or PondNet need to be continued	Representative sampling
Characteristic assemblages	PSYM score	PondNet, Countryside survey	The PSYM score is used to classify individual ponds into 5 quality classes.	Countryside Survey and/ or PondNet need to be continued, ideally to include pond macroinvertebrate survey	Representative sampling
Non-native species	Number of non-native species	PondNet, Countryside survey	The number of invasive species (0,1,2,3,>3) is used to classify individual ponds into 5 classes.	Countryside Survey and/ or PondNet need to be continued. Currently mostly relevant to plants, but should include fauna	Representative sampling

Further information

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