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Priority lake habitat in England – mapping and targeting measures

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Priority lake habitat in England – mapping and targeting measures

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Summary

- This paper outlines an analysis of nationally available datasets to generate a new map of priority lake habitat for England.

- Lakes in England were selected as priority habitat based on natural functioning (physical, chemical and biological), capturing the most natural remaining examples as far as can be determined from nationally available data.

- In addition to explaining the development of the new priority habitat map, this paper provides advice on how the map might best be used, how to target and prioritise restoration activity on lakes that do not feature on the map, and how to identify and give recognition to any restoration works that contribute to wider priority lake habitat objectives.

- **The priority habitat map** (Figure 1 in the report) – This provides a focus for preventing deterioration of our most natural remaining lakes and undertaking any limited restoration of natural processes that may be desirable (as indicated in Figure 3).

- **Priority lakes for restoration** - Figure 4 shows lakes which are not sufficiently natural to feature on the priority habitat map, but are less impacted than other lakes. These should be considered a priority for restoration of natural processes. **Action on these lakes should be considered of equal importance to the protection and enhancement of lakes on the priority habitat map.**

- The production of a map of lake priority habitat has been severely limited by the lack of data on both the lake environment and its biota; consequently less than 10% of English lakes have been considered in detail in the production of this map and further work is required to consider the remaining lakes.

- Local knowledge and interpretation also have to play an important role in the use of the outputs of this work. The national map should be updated to reflect any future work. Resources need to be made available for this process.

- The priority habitat map excludes many SSSIs designated for their lake habitat because of impacts on natural processes. These impacts are being addressed through the SSSI remedies programme, which is governed by a separate Biodiversity 2020 target under Outcome 1A.

Contents

1. Introduction

Lakes operating under natural processes and free from anthropogenic impact provide the best and most sustainable expression of lake habitats and cater for characteristic species assemblages. Key elements are:

- a natural hydrological regime;
- a natural nutrient and sediment delivery regime;
- a lack of other pollutants;
- minimal physical modifications to the lake morphology;
- natural hydrological and biological connectivity;
- an absence of non-native species;
- low intensity fishery activities.

Lakes relatively free from anthropogenic impacts are rare in the UK, but they provide the best defence against climate change, maximising the ability of lake ecosystems to adapt to changing conditions. They also provide the best and most sustainable interfaces with other priority habitats, including rivers and wetlands.

Current UK priority habitat definitions for lakes (JNCC, 2011a) cast the net widely across the habitat resource. Four categories can be considered within the lake habitat type, these are; aquifer fed naturally fluctuating water bodies, oligotrophic and dystrophic lakes, mesotrophic lakes and eutrophic lakes. All lakes could potentially be considered in one of these categories.

The inclusion of all lakes in the priority lake habitat descriptions fails to provide information on what is special about lake priority habitat or guide action which would be appropriate for improving priority lake habitat condition. The principle of natural functioning has been used to refine the operational interpretation of priority habitat in England, and the mapping exercise outlined below is based on this (see Mainstone and Hall, in draft, for details).

An initial lake priority habitat map has now been generated for England that works within the broad UK definition, but focuses on natural functioning as the principal criterion, in recognition of the vital importance of natural processes in delivering sustainable lake habitats supporting characteristic biodiversity. The production of a map of lake priority habitat has been severely limited by the lack of data on both the lake environment and its biota; consequently less than 10% of English lakes have been considered in detail in the production of this map and further work is required to consider the remaining lakes.

2. Rationale for priority habitat mapping

The purpose of the new priority lake habitat map for England is to:

- help organisations protect the most natural remaining examples of lakes from further impacts on natural processes.
- highlight any aspects of habitat integrity of these sites (hydrological, chemical, physical, biological) that could most usefully be improved to bring all major components of habitat integrity to a high level.

However, restoration of sites that do not feature on the priority habitat map is critically important, such that priorities need to be specified in the wider lake habitat resource. For this reason, a map of restoration priorities beyond the priority habitat map is also needed, to help restore sites towards natural function and potential future inclusion on the priority habitat map.

The Water Framework Directive (WFD) is an important mechanism to achieve restoration of natural lake function. The WFD objective is to protect, enhance and restore all defined water bodies with the aim of achieving good ecological status (GES) (or 'good ecological potential' for heavily modified or artificial water bodies).The priority habitat driver seeks to add value to WFD-related work by:

- helping to protect our most natural lakes in a condition that is better than GES but may not be 'high ecological status';
- where appropriate, drive improvements beyond GES;
- act as a holistic driver for protecting lakes of all sizes, not just our larger lakes recognised by the WFD.

The use envisaged of the priority habitat map in protecting and improving our most natural remaining examples of lakes is considered in Section 4 and 5. Section 6 explains how priorities for restoration of natural habitat function might best be identified beyond the sites on the priority habitat map.

In terms of Biodiversity 2020 targets, assessment of Outcome 1 needs to be based on the status of lakes on the priority habitat map and lakes of restoration priority identified beyond the priority habitat map. Lake conservation and restoration actions carried out on both sets of lakes will therefore contribute directly to the delivery of Biodiversity 2020. Any additional lakes which are found to be of suitable quality (see section 8), may be added to the maps and therefore also contribute to Biodiversity 2020.

3. Development of the map

Despite an increase in the survey work carried out on lakes due to the requirements of the WFD, environmental and biological data on lakes are still very limited. Out of a total of 2969 lakes above 2ha in England, only 529 are classified as WFD water bodies. WFD water bodies include all lakes over 50 ha and a number of smaller water bodies including SSSIs and SACs and drinking water protected areas amongst others. Out of these, many are reservoirs and are only monitored for total phosphate. As a consequence there were only 226 WFD water bodies, for which there were sufficient data on which to perform the naturalness analysis. Many of these are SSSIs and large lakes; there are a large number of small lakes that we know very little about.

The naturalness classification used to map the priority lake habitat involves evaluation of three main components of habitat integrity: hydrology, physical morphology, and indicators of eutrophication (both chemical and biological).

The assessment of SSSIs and SACs for favourable condition also considers key components of habitat integrity, but in a different way to the WFD. SSSIs and SACs which are considered to be in favourable condition can be considered to be priority habitat.

For lakes where these data are not available, land cover in the catchment is used as a proxy for water quality, as the two are reasonably well correlated. This approach gives an indication of the sites most likely to be worth considering as priority habitat. Lakes identified in this way should be considered possible lake priority habitat, because using land cover alone is a limited assessment of their natural functioning. Possible lake priority habitat sites will require further investigation.

The details of the attributes and class thresholds used are provided in Table 1. The naturalness class is not a scoring system that can be summed, instead, it is a way of identifying lakes with the most natural habitat components and all components should be at an acceptable standard.

Table 1. Class boundaries used in the naturalness analysis.

(HES = high ecological status, GES = good ecological status, MES = moderate ecological status, PES = poor ecological status and BES = bad ecological status).

Habitat integrity component and attribute	**Naturalness class**				
	1	**2**	**3**	**4**	**5**
1. Physical morphology					
Heavily modified	No		Yes		
2. Hydrology					
WFD hydrology standard	HES	Supports GES	Does not support GES		
3. Indicator of eutrophication					
1. Dissolved oxygen	HES	GES	MES	PES	BES
2. Total Phosphate	HES	GES	MES	PES	BES
3. Chironomids	HES	GES	MES	PES	BES
4. Macrophytes	HES	GES	MES	PES	BES
5. Benthic diatoms	HES	GES	MES	PES	BES
6. Chlorophyll a	HES	GES	MES	PES	BES
4. Conservation status (not given a class number)					
	SSSI or SAC in favourable condition		SSSI or SAC in unfavourable condition		
5. Land cover in the lake catchment					
a) % semi-natural vegetation	>90%	70-90%	50-70%	25-50%	<25%
b) % urban	<2%	2-5%	5-10%	10-25%	>25%

Data were not available for all of the attributes in Table 1 for all sites and some attributes which were developed for WFD purposes do not reflect natural functioning in its entirety, but represents the best available information (See Hall, in draft, for a detailed explanation of the method). Consequently there is a requirement for further local ground-truthing.

The WFD typology has been used to identify the different lake types. Although there is not an exact fit between the priority habitat description and the WFD typology, it is the best and most comprehensive data on lake type.

4. The priority habitat map

Figure 1 shows the lakes that are classified towards the upper end of the naturalness range using the analysis of the WFD data; specifically, it shows all lakes with recorded naturalness at least class 2 across all three components of habitat integrity. It also shows all SSSIs and SACs which are in favourable condition and have not been assessed for WFD. These sites can be considered lake priority habitat.

Figure 2 includes the lakes with the most natural land cover in the catchment; these lakes are considered most likely to be in good condition for water quality although other factors can also influence this. These lakes are worthy of more local investigation including analysis of morphological, hydrological and biological pressures. These sites should be considered possible priority habitat.

Figure 3 illustrates where limited action to restore natural processes may be desirable on lakes featured on the priority habitat map, indicating the habitat integrity component where action might beneficially be undertaken. Any restoration activity required should be limited, as these sites are already on the priority habitat map and therefore at relatively good levels of natural function. It has only been possible to undertake this analysis on WFD lakes, since no equivalent data were available on other lakes.

These maps have been compiled using very limited data, and any lake assessed only using land cover data requires further assessment. The priority habitat map is not definitive and its use should be sufficiently flexible to recognise lakes with similar levels of naturalness identified at a local level.

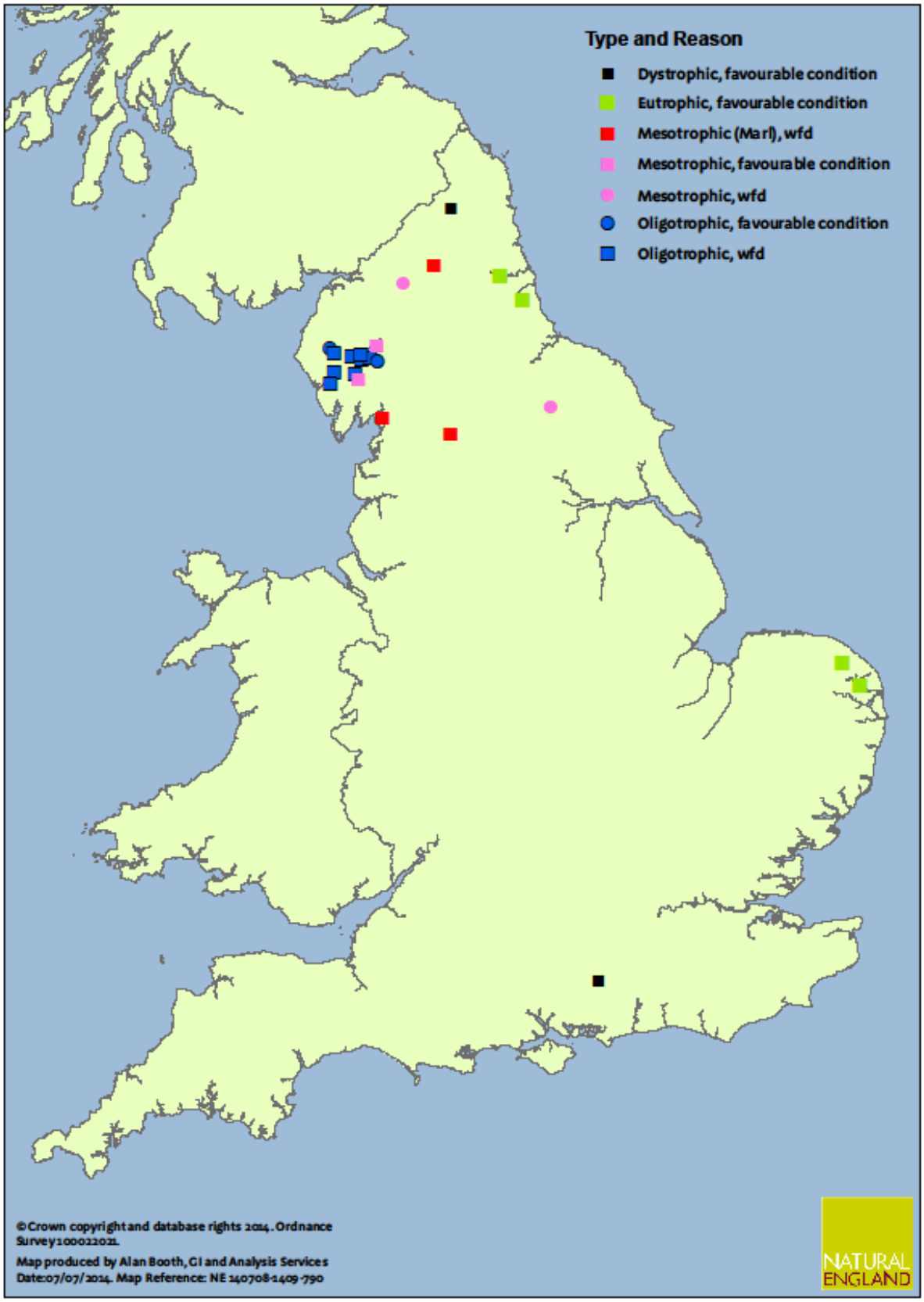

Figure 1. The priority lake habitat map, indicating lake type and whether the lake was selected based on WFD data or SSSI favourable condition assessment.

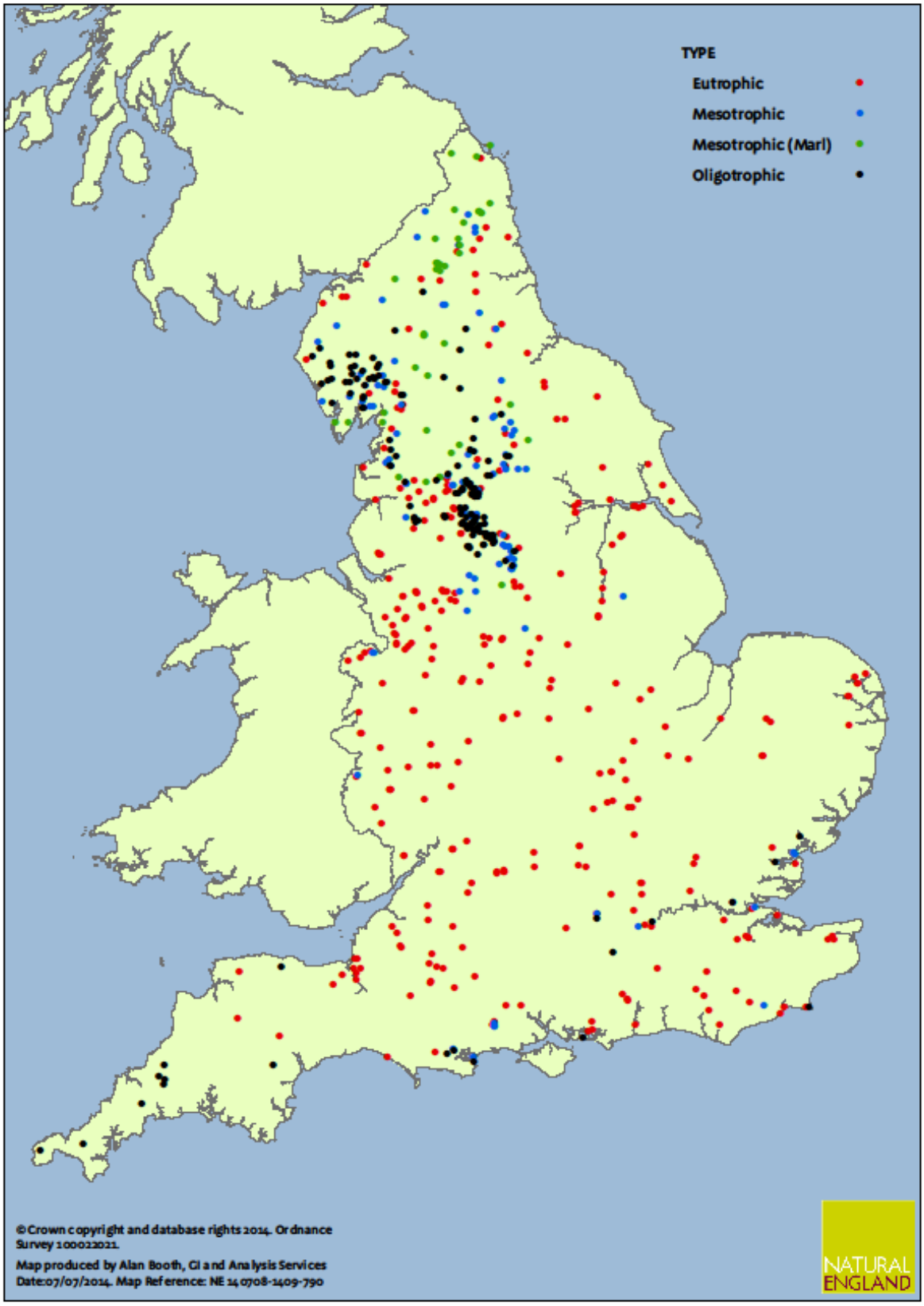

Figure 2. Lakes with insufficient data to be included on the priority lake habitat map, but worthy of further investigation based on catchment land cover data.

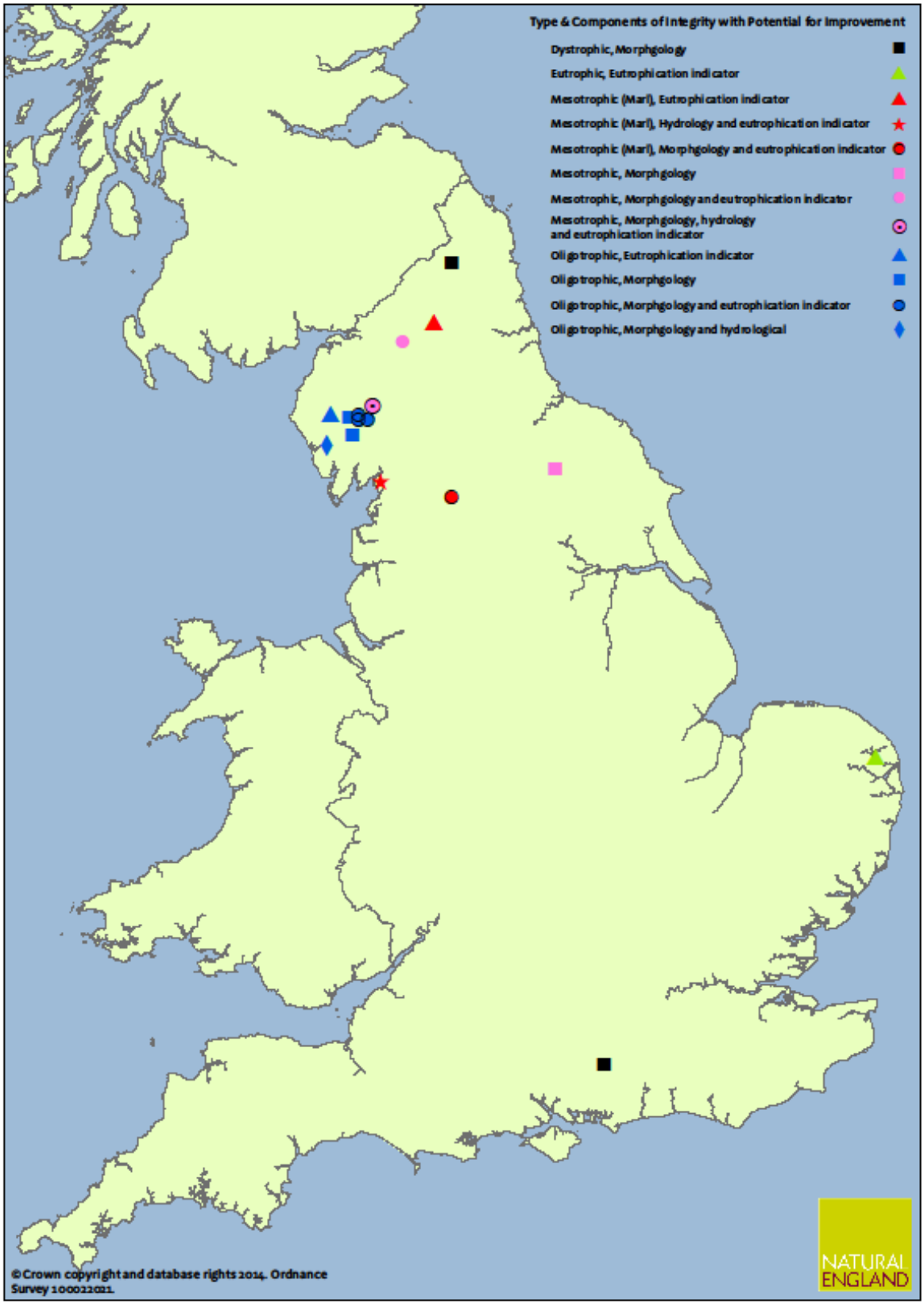

Figure 3. A version of the priority habitat map, indicating components of habitat integrity that might be targeted for improvement.

5. Using the priority habitat map in decision-making

Protecting the best lakes

Figure 1 can be used to identify where preventative measures are needed to protect lakes against losses of naturalness. As the lakes in Figure 2 have not yet been fully assessed, but are the non-WFD lakes most likely to be lake priority habitat, these should be treated in a similar way to sites on Figure 1, until a more complete assessment of their status can be made. This is particularly relevant to local planning authorities and EA and NE staff involved in relevant consenting activities. In WFD terms, very few lakes are considered to be at high ecological status in England, since one or more of the criteria used to define HES (physical habitat condition, hydrological regime, water quality status, absence of non-native species) are not compliant. This means that nearly all English lakes fail to receive the added protection against deterioration that HES provides. The priority habitat map adds value to the WFD by providing additional recognition of our most natural lakes.

Improving the best lakes

Figure 3 can be used to target the improvement of our most natural lakes, by restoring natural processes to improve the habitat. If the lake then reaches HES, it will provide the extra protection associated with this status. Figure 3 illustrates the integrity components which would need to be further improved if the site was to reach HES. Using this map to target action is a way of maximising the benefits of restoration measures, since action is focused on removing a limited number of constraints to an otherwise natural system. This information is relevant to EA and NE staff, local NGOs and other stakeholders seeking to identify and implement suitable improvement measures on these lakes (for instance through agi-environment funding or other mechanisms).

6. Priorities for restoring lakes not featured on the priority habitat map

In order for the remaining lakes, which are not on the priority habitat map, to reach an equivalent level of naturalness, and consequently be included on the priority habitat map, restoration activity is required. Lake restoration is complex, often involves a high cost, is logistically difficult, can take a long time and results are not certain. Lakes which are closest to, but not yet achieving, the level of naturalness required for inclusion on the priority habitat map, could be where success is most likely. Figure 4 shows sites in this situation, where only one component of habitat integrity is insufficient, and only by a relatively small margin (naturalness class 3 rather than 2, see Table 1). In these cases it may be possible to act on this component to raise the lake to a level of naturalness that would allow its future inclusion on the map.

Lake SSSIs that currently fall outside of the priority habitat map have their own programme of remedies to address impacts as far as possible, and should already be flagged up through the SSSI programme. Biodiversity 2020 contains separate targets for SSSIs and priority habitat in outcome 1, Figure 4 relates to the priority habitat targets.

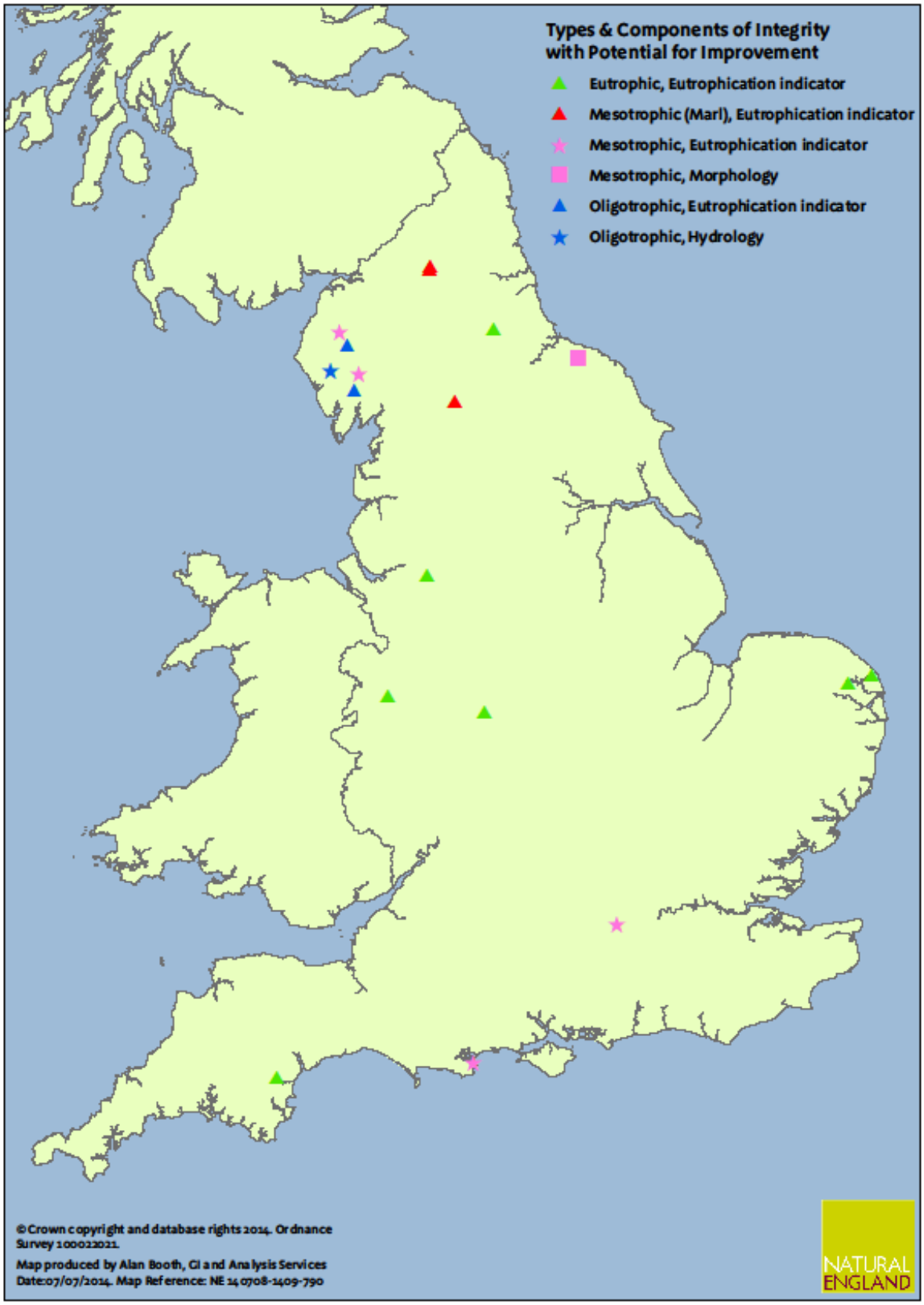

Figure 4. Lakes that do not feature on the priority habitat map and which should be considered a priority for restoration action, indicating components of habitat integrity that might be targeted for improvement.

7. Recognising the value of measures for lakes in the wider environment

In practical terms, there are socio-economic constraints on the extent to which natural functioning can be restored to lakes. These constraints vary widely depending on population density and the spatial distribution of different anthropogenic activities. Immovable constraints to restoring natural functioning (such as a site being used as a reservoir) have to be recognised. The extent to which any one lake can operate in a natural way will depend on site-specific circumstances.

Any measures that seek to restore natural lake functioning should be considered to be a contribution to restoring priority lake habitat. This provides a basis on which to further prioritise measures under Biodiversity 2020, in a way that encourages restoration based on natural functioning.

8. Recommendations for developing the priority lake habitat map

Assessing lakes as priority habitat using the principle of natural lake functioning has been hindered by the lack of data on individual lakes. This is not a situation which is likely to change in the near future and has resulted in many lakes being partially assessed using land cover data. An alternative approach is required to determine if these potential sites really are priority habitat. This approach might be to assess lakes using data on pressures, which are known to affect natural lake functioning. If a lake is functioning naturally these would be expected to be absent. Table 2 shows a list of potential pressures which could be used. As many of these are recorded either on maps or as a result of licensing activities, more data is available on pressures than on ecological quality. This further assessment would require the analysis of a number of pressure data sets in a GIS environment. This would increase the confidence in sites identified.

Local screening is another method for assessing the lakes highlighted by the initial national analysis of possible priority habitat. A locally updatable version of the map might be provided, or flexibility might be built into decision-making to allow for local verification of lakes as priority habitat. A method to do this which assesses natural functioning of the components of habitat integrity needs to be developed. This could also use an absence of pressures approach as opposed to biological, chemical, physical and hydrological monitoring or in addition to some simple biological monitoring.

Table 2. Pressures acting upon the natural functioning of lakes.

Habitat integrity component	Attribute	Pressure
Physical	Natural shore line	Moorings Hard engineered bank
	Intact hydrosere	Damage to vegetation through boat activity Drainage of surrounding wetland Abstraction Angling access and platforms
	Natural littoral substrate	Artificial substrate Increased sediment load
	Semi-natural riparian vegetation	Surrounding land use
Water quality	Total Phosphate	Point discharges Diffuse pollution Carp
	Dissolved oxygen	Eutrophication leading to an increased oxygen demand
	Acidity	Acid deposition
Hydrology	Natural water levels	Abstraction directly from the lake and within the catchment Impoundments and weirs
	Natural connectivity	Impoundments and weirs Drainage and abstraction
Biology	Natural communities - absence of INNS	INNS
	Natural Communities - absence of skewed fish communities due to stocking	Fish stocking

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