Derbyshire Natural Capital Strategy – Appendix 12

Contents

Appendix 12 – Monitoring Plan

Introduction

This monitoring plan is part of the Derbyshire Natural Capital Strategy (NCS). It is designed to help the continued monitoring of natural capital within Derbyshire, with a focus on habitats as key resources underpinning the delivery of many natural capital themes. Monitoring natural capital will also support initiatives for nature recovery, biodiversity net gain, and wider ecosystem service delivery. Monitoring is essential to understand the current extent and condition of habitats, and monitor the effects of established and emerging threats, such as development, pollution, invasive non-native species, and climate change. Habitats underpin the

A workshop was help on May 25th 2022, where stakeholders discussed the habitats, species and specific threats of highest importance within Derbyshire, and what were the greatest monitoring needs; this information has been used to inform the development of the monitoring plan. The workshop included representatives from the following organisations:

- Environment Agency
- Derby City Council
- Derbyshire Wildlife Trust
- Forestry Commission
- Peak District National Park Authority
- National Forest Company
- Natural England
- National Trust
- RSPB
- Woodland Trust

Objectives of this monitoring plan

The objective of the monitoring plan is to document the priority monitoring requirements for Derbyshire that feed into the NCS, that address the main environmental issues identified by stakeholders. The monitoring plan focuses on the use of remote sensing technology where appropriate, as many indicators require frequent monitoring over large geographic areas, that could not be achieved by other means alone. It is not intended to take the place of a comprehensive environmental monitoring plan, but to identify priorities and methods that can assist the implementation of the NCS.

Monitoring priorities

The monitoring priorities identified by stakeholders are listed in Table 1. The issues raised operated across a range of scales (e.g. species vs. habitat; site vs. landscape) and disciplines (e.g. habitat classification vs. chemical water quality). The range of priorities highlight the breadth of ecosystem services valued by society (from food provision to flood regulation, biodiversity and recreation), underpinned by habitats and species which are major contributors to the stock of natural capital.

Table 1: Monitoring priorities identified by workshop attendees

Pressure/Risk	Affected Habitats	Regions affected
Agricultural intensification	Natural habitats	East Derbyshire has a higher proportion of larger farms
Flood risk	Lowland areas	Downstream areas, particularly the Lower Derwent settlements
Drought risk	Natural habitats, agriculture	Upland, wetland and freshwater habitats may be more at risk. Agricultural areas.
Increased demand for housing/land development	Natural habitats	Urban fringes and green belt
Climate change impacts on species distribution	All over for habitats/	Upland species may be more at risk as closer to their climate extremes
Water quality- agricultural runoff and developmental pressures	Rivers and their wider hydrological catchments	River Wye particularly high phosphorus levels around Buxton
Invasive species (mink, signal crayfish, Himalayan balsam, deer)	Rivers and adjoining habitats. Upland areas.	Deer overgrazing on SW peak, Eastern Moors and S Derbyshire
Recreational pressures	Natural habitats within key tourism areas	
Loss of soils and upland peat through erosion	Peatland	Upland areas
Ash dieback and other tree disease	Woodland	
Lack of transitional habitats; too many hard boundaries and lack of connectivity between habitats	All habitats	
Water abstraction upstream	Rivers, lowland habitats	
Biodiversity declines from inappropriate management	All habitats	
Fire (managed burns and wildfire)	Moorlands	Upland areas
Heather and *Molinia* monocultures	Primarily upland habitats	Upland areas

Monitoring methods

Many different types of data and recording methodologies can be used for long-term monitoring. The strengths and weaknesses of each option should be evaluated to ensure that the selected methods are fit-for-purpose; whether the type of monitoring collects the type of information needed, whether it is accurate enough, timely enough, and cost-effective enough. Six broad monitoring methods are outlined below, with a focus on monitoring habitat extent and condition, as these are key attributes from which many aspects of natural capital can be derived or inferred.

External monitoring data

Monitoring data collected for other projects or by other organisations could be sourced and assessed for incorporation into the NCS monitoring strategy; the benefit of this approach would be the conservation of resources through applying a 'collect once, use many times' approach to the data. However, monitoring schemes designed for other purposes may not completely meet the needs of the NCS monitoring plan, for example in terms of the type of data captured (e.g. habitat classification method, which habitats/features are monitored), or the frequency of data capture. Examples of existing monitoring that could provide useful input to the NCS monitoring indicators include SSSI monitoring (Common Standards Monitoring) and Water Framework Directive monitoring.

Field survey

Monitoring by professional field survey enables capture of high precision, high-confidence data, and this method may be the only option for some types of monitoring, for example where identification of particular species, or certain environmental sampling is required. However, field survey is very resource-intensive and often proves to be too expensive to repeat over wide areas on a regular basis. For this reason field survey often works best when focussed on high priority areas, or used in conjunction with other monitoring methods for the purpose of calibration and validation.

Aerial Photograph Interpretation (API)

API is a valuable method for many types of monitoring; it's advantages include the ability to assess large geographical areas in a short space of time, and the relatively low associated cost. However, this type of analysis is restricted by the quality and timing of the image capture, and the level of skill of the interpreter; imagery may not always be captured at the ideal point in time for identifying the monitoring feature. Furthermore, some features are not detectable from an aerial view, for example small habitats that are hidden by tree canopy cover.

Citizen science

Citizen science could involve data collection campaigns organised by external bodies, or ones set up specifically in support of the NCS monitoring. Citizen science data can be a low-cost method of obtaining regular monitoring data. However, many of the people contributing towards citizen science projects are non-specialists, and therefore a more stringent validation process is required when using this type of data for monitoring. Furthermore, the spatial coverage of data submitted by this method may be quite limited, or biased towards certain areas depending on where individuals live or visit most regularly.

Unmanned Aerial Systems (UAS)

UAS systems provide higher spatial and spectral resolution imagery than obtained by standard aerial photography; this means that individual plant species coverage, and aspects of plant health, can be assessed for many species. However, image acquisition is highly weather-dependent, and only small areas can be captured at any one time, which when combined with the image processing requirements can make this an expensive monitoring method.

Satellite image analysis

Satellite image analysis 2 provides a rapid and repeatable method of analysing land cover and land cover change. Although the spatial resolution obtained is lower than that of UAS and other aerial imagery, the geographical coverage is much greater and a regular repeat cycle can be depended upon, making this method very cost-effective. For example, Sentinel-2 captures data at 10m resolution and has a re-visit time of five days, although analysis is obstructed by cloud cover. Conversely, Sentinel-1 radar data is unaffected by cloud, but is more suited to field-scale (~50m resolution) studies. The spectral resolution of optical sensors allows analysis of functional properties of vegetation communities such as productivity, wetness and bareness, that are suited to many types of condition and change analysis.as well as the ability to discriminate broad vegetation types.

Baseline data and update procedure

The Habitat Asset Register (HAR) created for the Derbyshire Natural Capital Strategy is a seamless habitat baseline for Derbyshire, comprised of the most current datasets and local knowledge available to the project. However, habitat cover and land management do not remain static in time, and regular updates of the HAR will be necessary in order to maintain confidence in the data and enable its continued re-use. The update procedure should follow an agreed file naming system in order to maintain version control.

Table 2 lists the attribute fields contained within the vector version of the Habitat Asset Register. The table has been populated with fields to enable users to identify which parts of the HAR have changed between versions (by querying the 'UPDATED' field), who was responsible for the update, and what types of data have been incorporated.

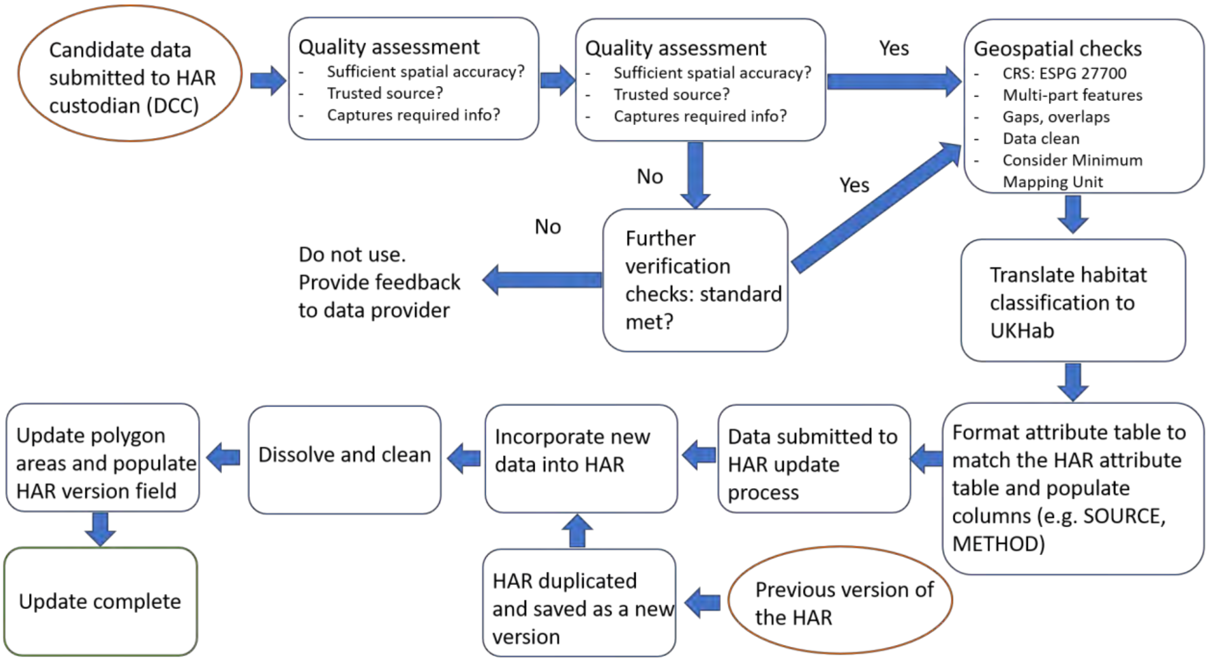
Table 2: Attribute fields contained within the Habitat Asset Register

Field name	**Data type**	Description
CLASSNAME	Integer	Unique ID identifying individual HARCLASS values
HARCLASS	String	The full UKHab classification code for the habitat
L2_CODE	String	UKHab Level 2 code (basic habitat types e.g. grassland, woodland)
LD_CODE	String	Most detailed UKHab code available, covering UKHab Levels 3-5 (includees priority habitat types and Annex 1 habitat types)
SEC_CODE	String	UKHab secondary habitat code
UKHAB_L2	String	UKHab Level 2 label: full text name of the habitat described by the code contained in field L2_CODE
UKHAB_LD	String	Full text name of the habitat described by the code contained in field LD_CODE
UKHABSEC	String	Full text name of the habitat/land use/ land management type described by the code contained in field SEC_CODE
Area_ha	Float	Polygon area in hectares
SOURCE	String	Data provider/source
METHOD	String	Method of data capture e.g. NVC survey; Aerial Photo Interpretation
S_DATE	Date	Date of original data capture by the surveyor
UPDATED	Date	Date of incorporation into the Habitat Asset Register
EDITOR	String	Name of person/department/organisation responsible for amending the data.
VERSION	Integer	Dataset version

There are potentially many sources of data that could be used to update the HAR. Data collected specifically for the purpose of updating the HAR is likely to require a relatively low level of checking, as the habitat classification method (UKHab), and resolution of the data, are likely to be compatible with the existing HAR format.

Alternatively (or in addition), datasets could be accepted from other sources including outside organisations (e.g. Natural England, Derbyshire Wildlife Trust) and individuals; but these types of data would require a more rigorous quality checking process prior to being incorporated into a new version of the HAR. Depending on factors such as: the amount of candidate update data available; the amount of staff resource dedicated to the process; and data processing times, a HAR update cycle could be scheduled on a monthly, annual, or five-yearly cycle, depending on business need. Figure 1 presents a workflow describing the different components of the HAR update process.

Figure 1: HAR update process



Monitoring plan

The key indicators and outline monitoring methodologies are detailed in Table 3. Many of the indicators reflect the requirement to maintain an up-to-date HAR to facilitate change detection; for example, increases or decreases in habitat extent. Other indicators involve analysis of specific components of a habitat, and interpreting how this indicator relates to habitat condition, subsequent ecosystem service delivery, and therefore the value of this natural capital feature. For example, the frequency of bare ground within an agricultural or peatland context can be a negative indicator for water quality, due to soil erosion. Conversely, bare ground within the context of open mosaic habitats can be a positive indicator due to the variety of ecological niches it provides, having high value for biodiversity and related ecosystem services that functioning diverse ecosystems support.

The HAR was one input dataset used in the production of the natural capital baseline accounts; over time many of these input datasets will become superseded by new versions (e.g. the latest WFD monitoring cycle), datasets that are not superseded become more unreliable as they age, but new datasets may become available. In order to maintain an accurate representation of natural capital benefits, and to identify trends of gain and loss, it is recommended that a data review and refresh of the accounts is undertaken on a five year cycle.

Table 3: Key indicators and monitoring methods

<table>
<tr><th>Indicator</th><th>Key habitats</th><th>Data</th><th>Outline methodology</th><th>Timings</th><th>Example frequency</th></tr>
<tr><td rowspan="5">Extent of habitat</td><td>Agricultural habitat features: hedgerows, field margins, headlands, ponds</td><td>Aerial photography, LiDAR (where available), verified external data</td><td rowspan="5">• Define Area of Interest
• Update the existing Habitat Asset Register using appropriate earth observation imagery and manual interpretation.
And / Or:
• Update the existing Habitat Asset Register using verified external data.</td><td>Summer</td><td>Annual</td></tr>
<tr><td>Peat moorlands</td><td>Sentinel-2, verified external data</td><td>Summer</td><td>Annual</td></tr>
<tr><td>Grasslands</td><td>Sentinel-2, verified external data</td><td>Summer</td><td>Annual</td></tr>
<tr><td>Urban trees</td><td>CIR Aerial photography, citizen science, verified external data</td><td>Summer</td><td>3-5 years</td></tr>
<tr><td>Woodland</td><td>Sentinel-2, verified external data</td><td>Summer</td><td>Annual</td></tr>
<tr><td rowspan="4">Extent of core and stepping stone habitat</td><td>Grasslands</td><td rowspan="4">Habitat Asset Register</td><td rowspan="4">• Define Area of Interest
• Select core habitat classes from the Habitat Asset Register.
• Dissolve habitat polygons.
• Apply size filters to identify core and stepping stone areas.</td><td rowspan="4">Any</td><td rowspan="4">Annual</td></tr>
<tr><td>Heathland</td></tr>
<tr><td>Wetlands</td></tr>
<tr><td>Woodland</td></tr>
<tr><td rowspan="2">Grazing pressure</td><td>Peat moorlands</td><td rowspan="2">Sentinel-2 with field survey</td><td rowspan="2">• Define Area of Interest.
• Select habitats within the area from the Habitat Asset Register.
• Define indicator of grazing pressure e.g. heather dominance, bare ground, sward height.
• Obtain cloud-free imagery.</td><td rowspan="2">Summer</td><td rowspan="2">Annual</td></tr>
<tr><td>Grasslands</td></tr>
</table>

			• Image-based indicator classification, using field survey for calibration and validation.		
Extent of bare ground	Peat moorlands Grasslands Open mosaic habitats	Sentinel-2, CIR aerial photography	• Define Area of Interest. • Select habitats within the area from the Habitat Asset Register. • Obtain cloud-free imagery. • Image analysis to classify the extent of bare ground in each image/time period. • Export output to show the current extent and distribution of bare ground.	Summer	Annual
Frequency of bare ground	Agricultural lands	Sentinel-2	• Define Area of Interest • Select agricultural areas from the Habitat Asset Register and define the Area of Interest. • Identify extent and distribution of bare ground as described above. • Combine outputs over a period of time to produce summary statistics e.g. number of bare periods per year/5 years	Any	Monthly
Grazing pressure	Peat moorlands	Sentinel-2 with field survey	• Define Area of Interest. • Select habitats within the area from the Habitat Asset Register.	Summer	Annual

	Grasslands		• Define indicator of grazing pressure e.g. heather dominance, extent of bare ground, sward height. • Obtain cloud-free imagery. • Image-based indicator classification, using field survey for calibration and validation.		
Surface wetness	Peat moorlands	Sentinel-2	• Define Area of Interest. • Select habitats within the area from the Habitat Asset Register. • Obtain cloud-free imagery. • Image-based classification of wetness classes.	Summer and winter	Annual
Water table	Peat moorlands	Field survey	• Define Area of Interest • Install dip-wells, walrags or rust rods	Summer	Monthly
Biodiversity: presence of key indicator species e.g. breeding birds, butterflies	Woodlands	Field survey, citizen science, verified external data	• Define Area of Interest • Species-dependent e.g. transect, DNA analysis	Species-dependent	Annual
	Grasslands				
	Peat moorlands				
	Rivers				
Peat depth	Peat moorlands	Field survey	• Define Area of Interest • Install surface-level rods	Summer	Annual
Evidence of fire	Grasslands	Sentinel-2	• Define Area of Interest. • Select habitats within the area from the Habitat Asset Register.	Any	Monthly during risk and recovery periods
	Peat moorlands				

			• Obtain cloud-free imagery. • Image-based classification of fire damage / vegetation recovery.		
Flood extent	Floodplain habitats Wetlands Rivers	Sentinel-1	• Define Area of Interest. • Select habitats within the area from the Habitat Asset Register. • Obtain imagery. • Classify extent of inundation.	Any	Post-flood
Nitrate and phosphate concentration	Rivers Wetlands	Field survey, verified external data	• Define Area of Interest • High resolution automated measurement or analysis of external data.	Any	Daily, Monthly
Presence of INNS	Wetlands Rivers	Field survey, UAS, citizen science	• Define Area of Interest • Species-dependent e.g. transect, DNA analysis, image-based classification	Species-dependent	Annual
Die-back of trees due to disease	Woodlands	CIR Aerial photography, UAS, Sentinel-2, field survey, citizen science, verified external data	• Define Area of Interest. • Collect field data to establish presence of disease. • Obtain imagery. • Tree crown delineation (image analysis, manual editing, incorporation of external data) to establish baseline tree crown data.	Summer	Annual

			• Image analysis of tree crown productivity and other indices. • Monitor tree crown status between years to establish health status and disease spread. • Field data for validation.		