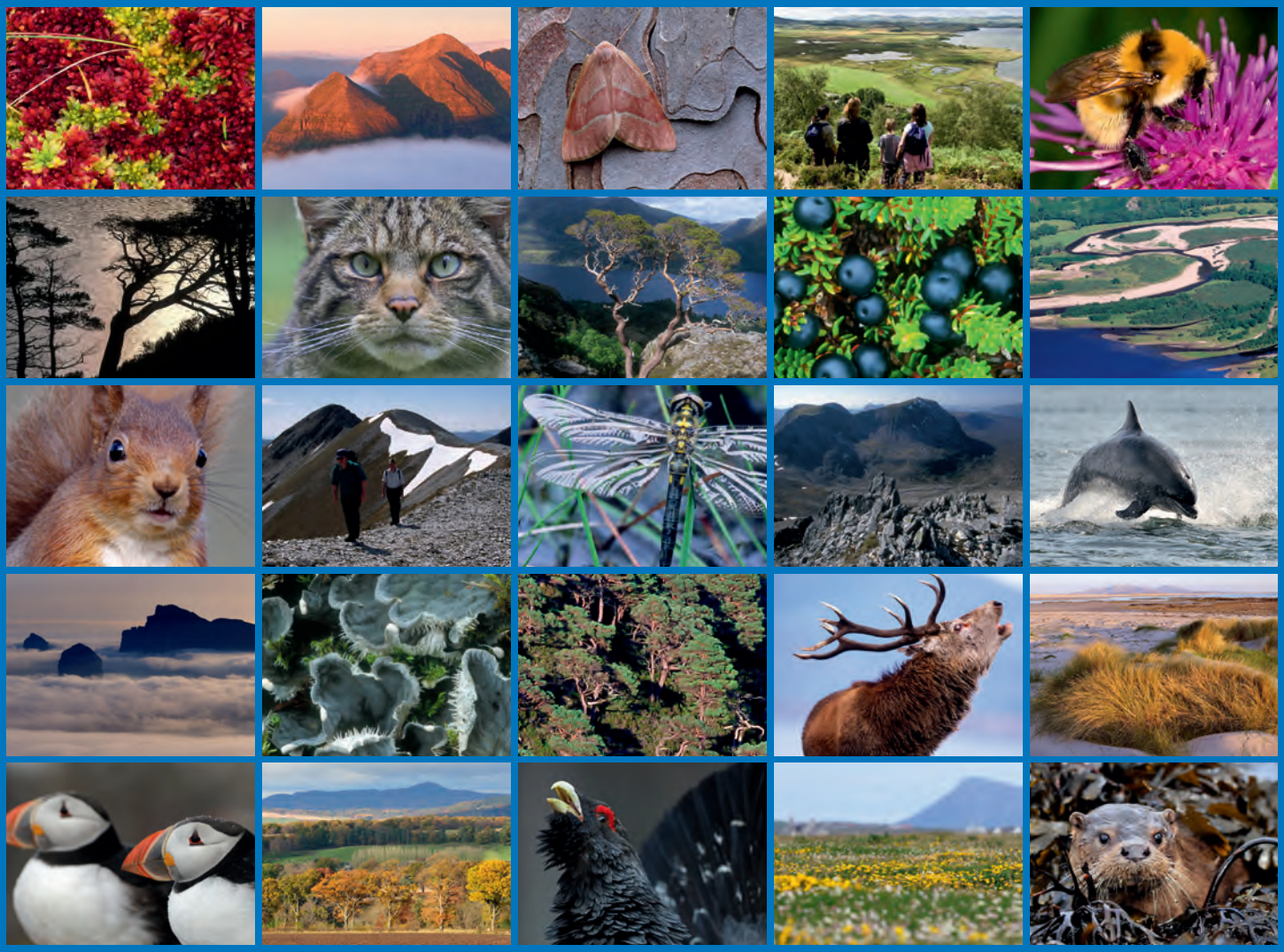
Scottish Natural Heritage
Commissioned Report No. 698

Implications of the INSPIRE Directive for SNH-held Habitat Data



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COMMISSIONED REPORT

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Implications of the INSPIRE Directive for SNH-held Habitat Data

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COMMISSIONED REPORT

Summary

Implications of the INSPIRE Directive for SNH-held Habitat Data

Commissioned Report No.: 698
Project no: 13432
Contractor: Margaret Carlisle
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Keywords

INSPIRE; habitat data; Habitats Directive Annex I; EUNIS.

Background

The INSPIRE Directive (Infrastructure for Spatial Information in the European Community http://inspire.jrc.ec.europa.eu/) came into force on 15 May 2007 and will be implemented in various stages, with full implementation required by 2019. This report discusses the implications of the Directive for SNH-held Habitat Data. The results are summarised as 5 Main Requirements, 8 Additional Requirements and 10 Recommendations.

Main Requirements

1. Habitats metadata must be INSPIRE compliant and available for discovery by **Dec 2013.** All habitat data collected after Dec 2013 must be INSPIRE compliant and must speedily be made available for view, query and download, from **Dec 2014** onwards.
2. All legacy habitat data (collected before Dec 2013) should be transformed to become INSPIRE compliant, and then must be made available for view, query and download, from **2019** onwards.
3. **Any legacy habitat data which cannot be made compliant must be archived and not used for any statutory purpose from 2019 onwards**.
4. All habitat data must be classified using at least one of the two current pan-European Habitats classifications – namely, Habitats Directive Annex I or EUNIS.
5. If many habitat types are attributed to one feature (polygon or polyline), then an transformation approach must be developed which enables the INSPIRE objectives of view, query and download for external stakeholders.

Additional Requirements

A. SNH should consider setting up a feedback process to incorporate 'citizen science' correction of errors in the dataset, instigated by the view service. This would increase public confidence, and thus increase the success of implementation of statutory duties.
B. SNH should consider the applicability of the themes Environmental Monitoring Facilities and Observations & Measurements for their applicability to the SNH Habitat data holding.
C. The decision for data structures for new data should take precedence over any decisions about legacy data.

D. MEDIN requirements for marine data must be incorporated into all SNH internal debate regarding data management.
E. The staff resources required to make data coherent and compliant should not be underestimated, and this issue should be incorporated into all SNH internal debate regarding data management.
F. 3rd party copyright issues for many of the marine datasets (those obtained via Marine Scotland, other datasets from developers/commercial interests, and other Statutory Nature Conservation Bodies) need to be clarified, documented and legitimised via licence agreements.
G. SNH should assess how often habitat polygon data (whether SSSI feature maps or the original NVC polygons) are being used by SCM assessors, and how important these data are to the process. SNH should also assess how often SCM derived data are being fed into the spatial data holdings (both species & habitats).
H. Reporting round 2 of SCM is just about to finish, round 3 just about to start. There is an opportunity here for SNH to instigate best practice, which should certainly include GPS recording for Site Features.

Recommendations

1. SNH is finalising proposals that HD Annex I habitats will be used for reporting but where needed to display habitats that are not on Annex I of the Habitats Directive SNH will need to use EUNIS. This decision should be strongly communicated to all SNH staff.
2. There is currently work being done to reclassify each of the 500+ NVC surveys on a survey by survey basis, based upon look up tables and experience of the sites. This will take about 2 years to complete. This ongoing project should be strongly communicated to all SNH staff. For other data, there remains the option of using the EEA key (many-to-one), but this will result in much poorer granularity and may not provide a product that is fit-for-purpose. This option should also be communicated to all SNH staff.
3. The coverage (i.e. the % of Scotland's land area) of terrestrial habitat data held by SNH needs to be calculated in order to be able to assess likely staff-time costs of making legacy data INSPIRE compliant.
4. There is the potential to incorporate survey data from developers within SNH's terrestrial habitat data holding. It is recommended that SNH explore the possibilities for incorporating such external survey data.
5. A system of early drafting of formal exchange agreements will be required if SNH is to pursue a policy of incorporating 3rd party data.
6. SNH should consider volunteering to become the prime Scottish LMO (Legally Mandated Organisation) for terrestrial habitat data – i.e. to be the organisation who take others' habitat data and distributing them via WMS/WFS/download.
7. If CEH Countryside Survey Landcover 2007 data are used as the basis for habitat mapping then SNH must draft an exchange agreement that will enable SNH to distribute the results via WMS/WFS/download.
8. SNH should consider setting up a 'coaching' system to ensure that non-GIG officers are capable and confident of exploiting the available data to its fullest extent.

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Table of Contents **Page**

List of Figures & Tables **Page**

Abbreviations

Principle abbreviations in the report

BAP	Biodiversity Action Plan
CEH	Centre for Ecology & Hydrology
CMS	Casework Management System
DAC	Data Archive Centre
EEA	European Environment Agency
EIA	Environmental Impact Assessment
ESRI	Environmental Systems Research Institute
EU	European Union
EUNIS	European Union Nature Information System
GHS	Geographic Information System
GML	Geography Markup Language
GMO	Genetically Modified Organism
GPS	Global Positioning System
HD	Habitats Directive
IACS	Integrated Administration and Control System
ICZM	Integrated Coastal Zone Management
IHS	Integrated Habitat Survey
INSPIRE	Infrastructure for Spatial Information in the European Community
IR	Implementing Rules (INSPIRE)
JNCC	Joint Nature Conservation Committee
KML	Keyhole Markup Language
LA	Local Authority
LMO	Legally Mandated Organisation
MEDIN	Marine Environmental Data & Information Network
MESH	Mapping European Seabed Habitats (JNCC)
MNCR	Marine Nature Conservation Review
MPA	Marine Protected Area
NE	Natural England
NVC	National Vegetation Classification
RS	Remote Sensing
SAC	Special Area of Conservation
SCM	Site condition monitoring
SDIC	Spatial Data Interest Community
SEA	Strategic Environmental Assessment
SEIS	Shared Environment Information System
SDI	Spatial Data Infrastructure
SIACS	Scottish IACS
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UK	United Kingdom
WFS	Web Feature Service
WMS	Web Map Service

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Ben James: Policy & advice manager – Marine Survey & Monitoring
Brian Dickson: SCM Data Manager
Susan Watt: Policy and Advice Officer – Habitats Lead
Duncan Blake: GIS Analysis Team Coordinator
David Law: Senior Casework Manager
Stan Whitaker: Biodiversity Implementation Team Leader
Morag Milne: Natural Care, SRDP Policy and Advice Officer
Tracey Robinson: Audit Response Task Force Project Manager

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1. INTRODUCTION

The INSPIRE Directive (Infrastructure for Spatial Information in the European Community http://inspire.jrc.ec.europa.eu/) came into force on 15 May 2007 and will be implemented in various stages, with full implementation required by 2019.

The INSPIRE directive aims to create a European Union (EU) spatial data infrastructure (SDI). This will enable the sharing of environmental spatial information among public sector organisations, assist in policy-making across boundaries and better facilitate public access to spatial information.

INSPIRE has two initial, straightforward, priority requirements for Habitats data. These are:

Requirement 1: Habitats metadata must be INSPIRE compliant and available for discovery by **Dec 2013**. All Habitats spatial data collected after Dec 2013 must be INSPIRE compliant and must speedily be made available for view, query and download, from **Dec 2014** onwards.

Requirement 2: All legacy Habitats spatial data (collected before Dec 2013) should be transformed to become INSPIRE compliant, and then must be made available for view, query and download, from **2019** onwards.

However, INSPIRE recognises that it may not be cost-feasible to transform all legacy data. There is therefore an option for a public authority to archive, rather than transform & publish, legacy data. However, it is vitally important if doing this to remember the terms of the Aarhus Directive (reproduced in full in Annex 1 and discussed further in Annex 2). The Aarhus Directive gives the public the right to comment on projects, plans and programmes relating to the environment and the right to review procedures to challenge public decisions [pertaining to these projects, plans and programmes].

The author interprets "*public decisions*" and "*projects, plans and programmes*" as being the statutory duties of a public authority such as SNH.

The author interprets "*reviewing procedures*" as including accessing exactly the same spatial data that the public authority used to arrive at the public decision being challenged, whether via simply viewing a WMS (web mapping service) or whether via downloading the data for one's own query/analysis.

Thus, the Aarhus Directive requires that the spatial data used for statutory purposes must be made available.

The INSPIRE Directive requires that any spatial data that is made available must, from 2019 onwards and with no exceptions, meet INSPIRE standards.

The logical inference of these two statements is the third priority requirement:

Requirement 3: Any legacy Habitats data which cannot be made INSPIRE compliant must be archived – if they are thus archived they must not be used for any statutory purpose from 2019 onwards.

INSPIRE thus works in combination with the Aarhus Directive, as illustrated in Figure 1.

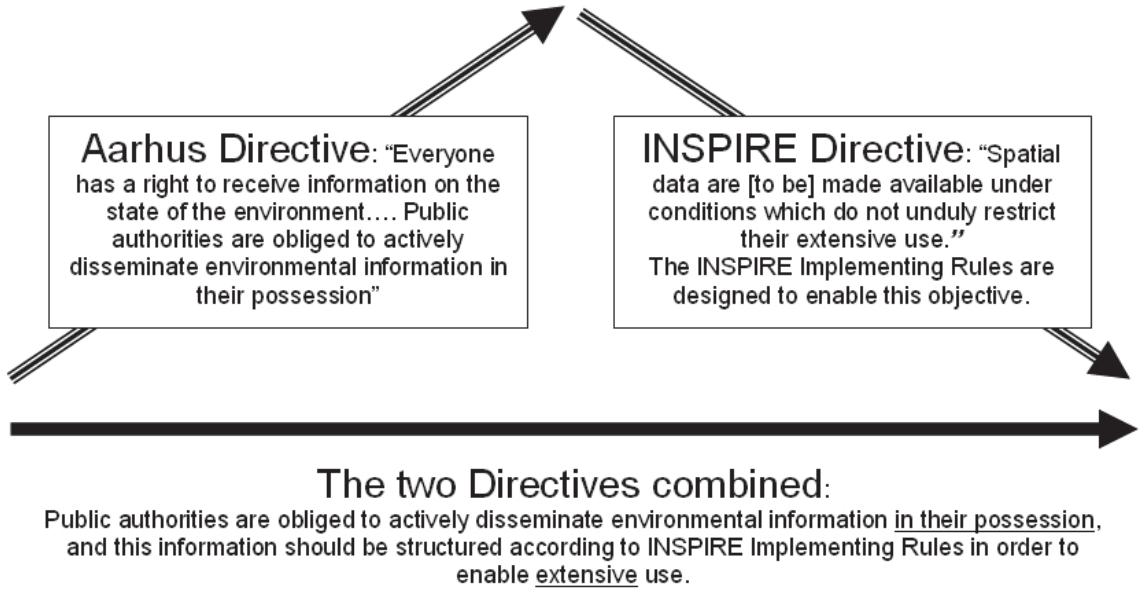


Figure 1. The combined effect of the Aarhus & INSPIRE Directives

The Aarhus & INSPIRE Directives are relevant to all environmental legislation and policies. This is discussed in detail in Annex 2, and illustrated here in Figure 2.

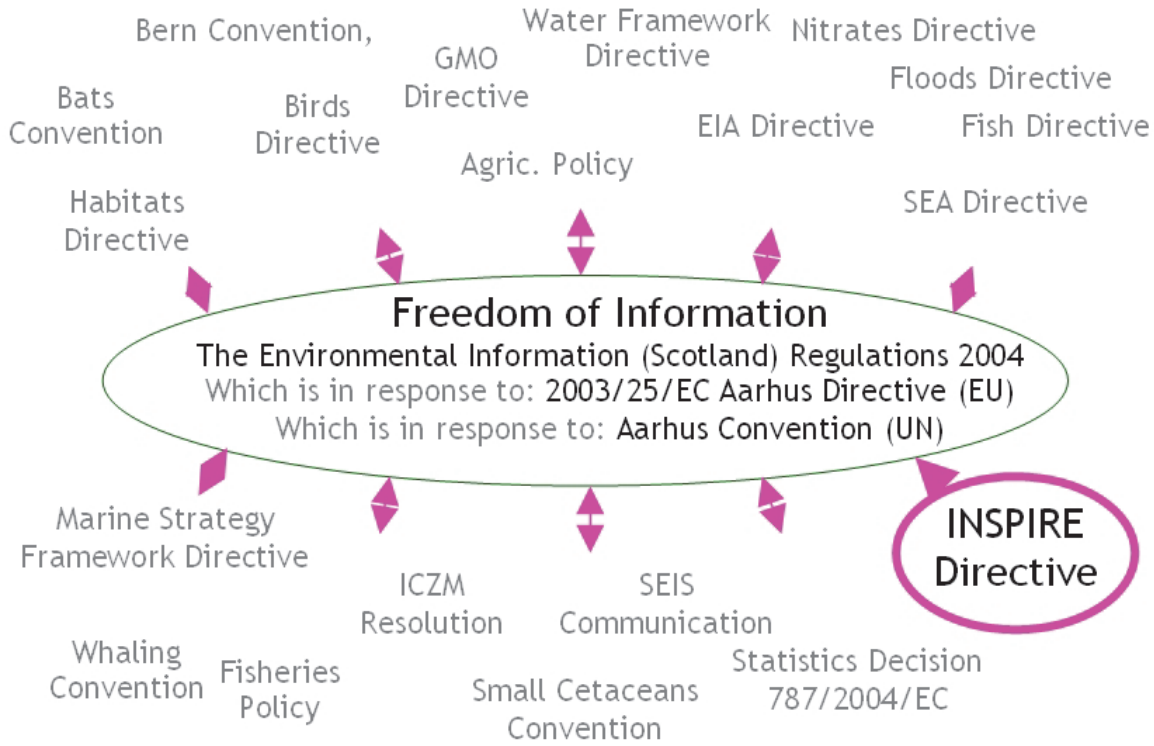


Figure 2. The relationship of environmental legislation and policies with the Aarhus & INSPIRE Directives.

In Scotland the Aarhus Directive is enacted as the Environmental Information (Scotland) Regulations 2004 (access to environmental information is governed by these regulations, which work in tandem with the Freedom of Information (Scotland) Act 2002).

The spatial information considered under the INSPIRE directive is extensive and includes a great variety of topical and technical themes, 34 in total (listed in full in Annex 3). The primary INSPIRE theme under discussion in this report is "*Habitats & Biotopes*", but also considered are "*Environmental Monitoring Facilities*" and "*Observations & Measurements Guidelines*".

INSPIRE defines Habitats & Biotopes as follows: "*Geographical areas characterised by specific ecological conditions, processes, structure, and (life support) functions that physically support the organisms that live there. Includes terrestrial and aquatic areas distinguished by geographical, abiotic and biotic features, whether entirely natural or semi-natural.*"

INSPIRE is based on a number of common principles:

- Data should be collected only once and kept where it can be maintained most effectively.
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- It should be easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

To these ends the INSPIRE Directive requires that common Implementing Rules (IRs) are adopted in a number of specific areas:

1. Metadata
2. Data Specifications
3. Network Services
4. Data and Service Sharing
5. Monitoring and Reporting

The implications for SNH for these five IRs was previously discussed in the SNH report "*INSPIRE Directive Implementation Plan*" of Jan 2011. This report is reproduced in full here as Annex 4.

This report, however, is concerned mostly with one of these Implementing Rules – namely, the INSPIRE Data Specifications for Habitats & Biotopes, Environmental Monitoring Facilities and the Guidelines for Observations & Measurements. These INSPIRE Data Specifications are currently (March 2012) being finalised following the participative principle of a consensus building process. Stakeholders, based on their registration as a Spatial Data Interest Community (SDIC) or a Legally Mandated Organisation (LMO) have had the opportunity to bring forward user requirements and reference materials, propose experts for the specification development, and to participate in the review of the data specifications. It should be noted that SNH, as a network partner in the Nature-SDI*plus* project (a registered SDIC), has been involved with this process to a limited degree. The full process of developing the Data Specifications is described in Annex 5.

Because of the importance of the data and service sharing IR, this report will also keep in mind the issues re. view services WMS/WFS (Web Mapping Service / Web Feature Service) and external download. The following quote details the requirements laid out in the INSPIRE Directive:

"*View services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;*

Download services, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;"

As noted above, the Data Specification process is ongoing, and the final Data Specifications are not yet published. However, for the purposes of this report it is sufficient to use the most recently published versions, namely versions 2.0 and 1.0.

The INSPIRE Data Specifications (Habitats & Biotopes hereafter referred to as **HB-DSv2.0**, Environmental Monitoring Facilities hereafter referred to as **EF-DSv2.0**, and Observations and Measurements Guidelines hereafter referred to as **O&M-Gv1.0**) have three major implications for SNH-held Habitat Data:

- Classification issues
- Data structures for new data
- Data transformation issues for legacy data.

These are discussed in the next two sections (2 & 3). This discussion is the result of a workshop undertaken at Great Glen House on the 6th Feb 2012. A major outcome of this discussion was the realisation of a requirement for SNH to have an overview of current and potential uses within the organisation itself. To this end five use cases have been developed, and are presented in section 4. Section 5 is a general discussion and section 6 concludes this report.

Throughout the report requirements are highlighted and recommendations made. This is done using the following text box format.

Requirement X: Essential to meet INSPIRE and/or Aarhus directives.

Additional Requirement X: Essential to minimise resource costs.

Recommendation X: Advisable to minimise resource costs.

2. CLASSIFICATION ISSUES

2.1 INSPIRE classification requirements

Requirement 4: All habitat data must be classified using at least one of the two current pan-European Habitats classifications – namely, Habitats Directive Annex I or EUNIS.

The INSPIRE **HB-DSv2.0** specifies that all habitat data must be classified using at least one of the two current pan-European Habitats classifications – namely, HD Annex I or EUNIS. It should be noted that this requirement does not negate the additional use of a national classification – it is perfectly acceptable to run national and pan-European classifications side-by-side.

Specifically, the specification proposes *"to use "habitat types" from the Habitats Directive as the major encoding where appropriate and to take EUNIS habitat classification for other habitat types. As a result all habitat features will have one or two habitat type encodings, an obligatory one from either the "European Union habitats" list or the "EUNIS habitat classification" list and an optional second one from a registered local/national coding list."*

A survey of 43 European habitats datasets (Carlisle & Green 2009) found that the majority (56%) were classified only according to national or regional classification schemes, and only 28% were classified according to either HD Annex I or EUNIS. The task of re-classification from national to pan-European schemes is therefore pertinent to all EU holders of habitat data, not just to SNH.

SNH's existing data holding for habitat data comprises the use of several classifications/ definitions, namely:

1. NVC National Vegetation Classification
2. Phase 1 survey
3. Integrated Habitat Survey (IHS)
4. Birks and Radcliffe
5. BAP priority habitats
6. Marine Nature Conservation Review MNCR (mostly version 04.05)
7. HD Annex I (used for the new Shingle survey)
8. SSSI feature maps (Annex I habitats)

Each pan-European classification scheme has strengths and weaknesses, which are discussed in the following two sections.

2.1.1 *Habitats Directive Annex I classification*

Figure 3. Hierarchical visualisation of HD Annex I codes (partial list looking at bog classifications) (© EEA http://eunis.eea.europa.eu/habitats.jsp*). Full list also available at* http://converters.eionet.europa.eu/xmlfile/habitats.xml.

Pros:

- Enshrined in legislation.
- Fits Article 17 Reporting requirements.
- A relatively compact list – 78 UK habitats.

Cons:

- Older list (1997).
- Not flexible (practically impossible to get new habitats or biotopes added, as would require legislative changes)
- Poor granularity for marine habitats.
- Not exhaustive – no brownfield or intensive agricultural habitats, because designed for conservation priority habitats only.

2.1.2 EUNIS classification

Figure 4. Hierarchical visualisation of EUNIS codes (partial list looking at bog classifications) (© EEA http://eunis.eea.europa.eu/habitats.jsp*).*

Pros:

- Generally better granularity (thematic resolution) than HD Annex I, and potentially more flexible (i.e. may be possible to add new habitat types).
- Nested hierarchy easy to use at any level.
- Good for marine habitats. There is a public key available to convert MNCR 04.05 to EUNIS (http://jncc.defra.gov.uk/pdf/EUNIS_Correlation_2007-11_20101206v2.pdf).
- More exhaustive than HD Annex I - encompasses urban, brownfield and agricultural habitats.
- More recent (2007).

Cons:

- Needs to be converted to HD anyway for Article 17 reporting.
- Not always better granularity than HD Annex I – for example, habitat H7140 is contained within D2.3 Transition mires and quaking bogs
- Very long list – 5000 EU habitats (UK habitats a subset of this figure).
- Because not enshrined in legislation, possible it could be superseded in future.
- Does not meet all needs , re. "*The mapping and comparison of stock and change of habitats in Europe was not possible using EUNIS. The improvement of reporting at the European level required a habitat classification system that is based on strict rules and can be processed statistically. These are the General Habitat Categories (GHC)*." Bunce *et al* 2011.

2.2 SNH Decision One

To conclude: SNH has already done much work on deciding which pan-European classifications to use for future data collection, HD Annex I or EUNIS classification (or, indeed, whether or not to use both).

The result was a conclusion that SNH should be using some combination of HD Annex I and EUNIS to display datasets and that SNH will need to have recourse to both as needs be. This is in line with one of the recommendations of the HB-DSv2.0 – the emphasis is on the Annex I habitats for reporting but where needed to display habitats that are not on Annex I of the Directive (It is not a full habitat classification) SNH will need to use EUNIS.

Recommendation 1: SNH will be using some combination of HD Annex I and EUNIS to display datasets and SNH staff will need to have recourse to both as needs be. This information should be strongly communicated to all SNH staff.

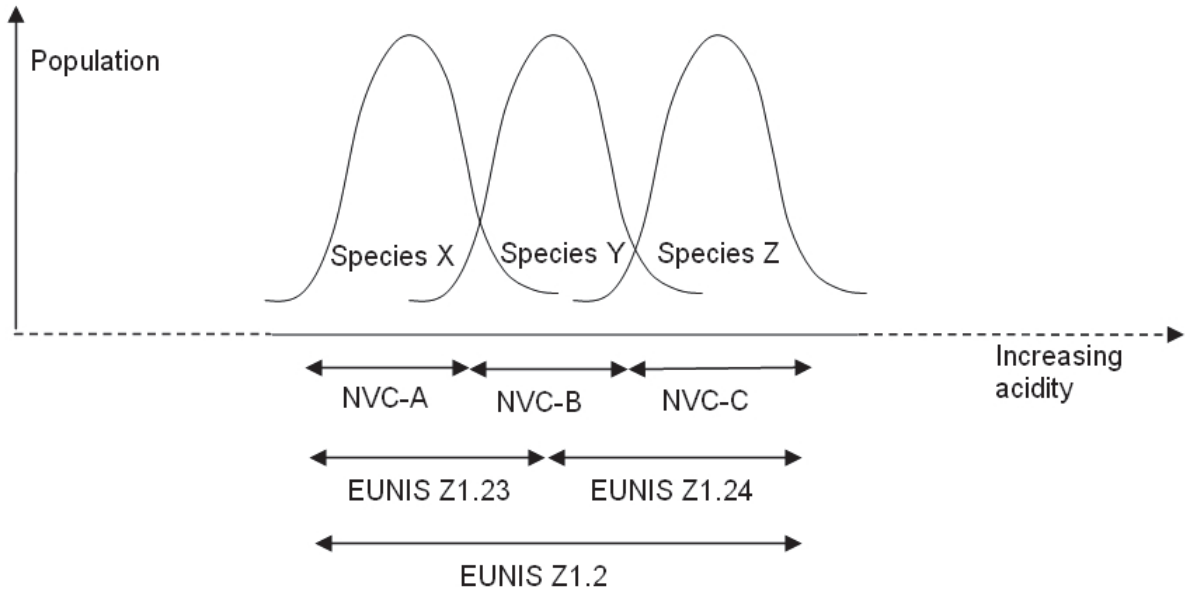
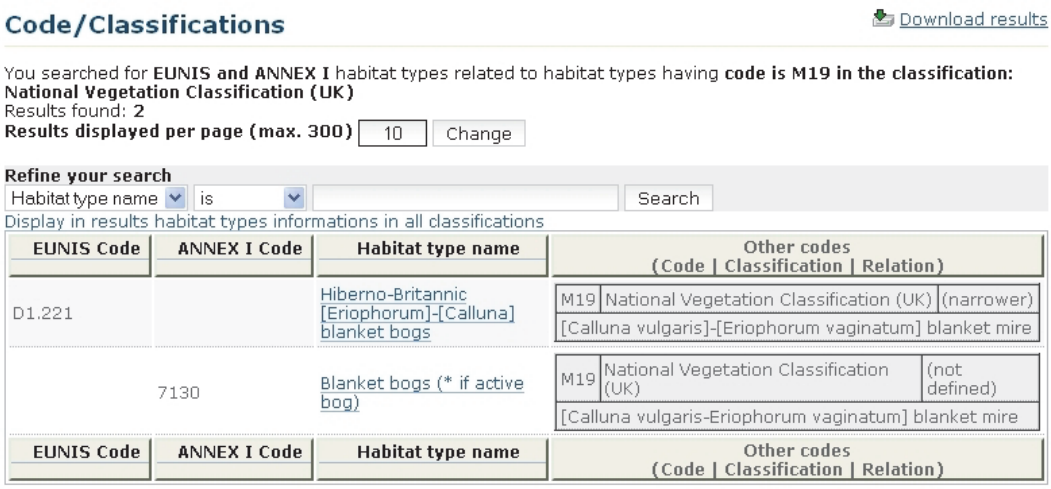


Figure 5. Diagram showing difficulties matching NVC to EUNIS/HD Annex I

Conversion of NVC to one of the two pan-European datasets on a 1-to-1 basis is not a straightforward task, as they do not map 1-to-1. Figure 5 shows a highly simplified illustration of this, with 3 plant species populations mapped along the dimension of increasing soil acidity. In this theoretical example the 3 NVC codes correspond to the maxima of the distributions of the 3 species, but the two EUNIS codes correspond to the distributions of Species X and Z only, and Species Y is effectively split between them. Therefore a feature that has been assigned NVC code B cannot be straightforwardly assigned to either EUNIS Z1.23 or Z1.24 without additional knowledge of the presence of either Species X or Z. However, the hierarchical granularity of EUNIS means that NVC code B can be assigned to the next level 'up' i.e. to EUNIS code Z1.2. This illustration is a simple, one dimensional example – the real relationship between classifications is multi-dimensional (i.e. includes altitude, temperature range, precipitation etc. etc.). However, the basic outcome still holds – namely that any NVC code can be assigned to a EUNIS code, though this may be a code with very poor granularity.

In order to facilitate the re-classification task, the European Environment Agency (EEA) provide a service at http://eunis.eea.europa.eu/habitats.jsp whereby one can convert NVC,

Phase 1 and BAP priority habitat codes into HD Annex I and EUNIS codes. IHS and Birks & Radcliffe are not included. An example is shown in Figure 6 below.



Code/Classifications

Download results

You searched for **EUNIS and ANNEX I** habitat types related to habitat types having **code is M19 in the classification: National Vegetation Classification (UK)**
Results found: **2**
Results displayed per page (max. 300) 10 Change

Refine your search
Habitat type name | is | Search
Display in results habitat types informations in all classifications

EUNIS Code	ANNEX I Code	Habitat type name	Other codes (Code | Classification | Relation)
D1.221		Hiberno-Britannic [Eriophorum]-[Calluna] blanket bogs	M19 | National Vegetation Classification (UK) | (narrower) [Calluna vulgaris]-[Eriophorum vaginatum] blanket mire
	7130	Blanket bogs (* if active bog)	M19 | National Vegetation Classification (UK) | (not defined) [Calluna vulgaris-Eriophorum vaginatum] blanket mire
EUNIS Code	ANNEX I Code	Habitat type name	Other codes (Code | Classification | Relation)

Figure 6. EEA key for converting NVC class M19 to EUNIS & HD Annex I codes (© EEA)

As noted above, NVC does map to EUNIS on a many-to-one basis. The EEA key provides such a service, but the resulting EUNIS granularity may be very poor.

So, for legacy datasets, there are two options.

Firstly, it would be possible to use the EEA key to undertake a straightforward "Find, Replace" task. This would be quick, but it would lose a great deal of detail in terms of granularity. SNH examined the EEA key but did not find it gave meaningful results, and did not result in a product of any value for SNH's statutory duties.

Secondly, the approach currently being undertaken by the Knowledge and Information Management Unit (KIMU) within SNH. This team state that "*There are many, many relationships between NVC and Annex1 and these vary from location to location. Hence we currently have a contract with an ecological company to give us the transformations for each of our 500+ NVC surveys on a survey by survey basis based upon look up tables developed by Ian Strachan and experience of the sites. Therefore it will take about 2 years to transform our legacy NVC data to HD Annex 1 and BAP priority habitats*." This approach will enable retention of an equivalent level of granularity.

Given the ongoing work by the KIMU team, the decision between the two options has effectively already been made for current habitat data, namely the second option. Note, however, that the EEA key may be useful to keep as a second option, as it will allow quick conversion of older legacy datasets if it is decided to retain them after 2019.

Recommendation 2: There is currently work being done to reclassify each of the current 500+ NVC surveys on a survey by survey basis, based upon look-up tables and experience of the sites. This will take about 2 years to complete. This ongoing project should be strongly communicated to all SNH staff. For other, older, data, there remains the option of using the EEA key (many-to-one), but this will result in much poorer granularity, and may not provide a product that is fit-for-purpose. This option should also be communicated to all SNH staff.

3. DATA STRUCTURES

This is the priority decision for SNH as regards compliance with INSPIRE for habitats data. There are several potential data structures, each with their strengths and weaknesses – these are illustrated and discussed below. Note that the 'pros' and 'cons' are generic and are not specific to SNH's business need.

3.1 Area-class maps

Area-class habitat maps are defined as having all the potential habitat classifications in one layer.

3.1.1 Area-class polygon& polyline maps

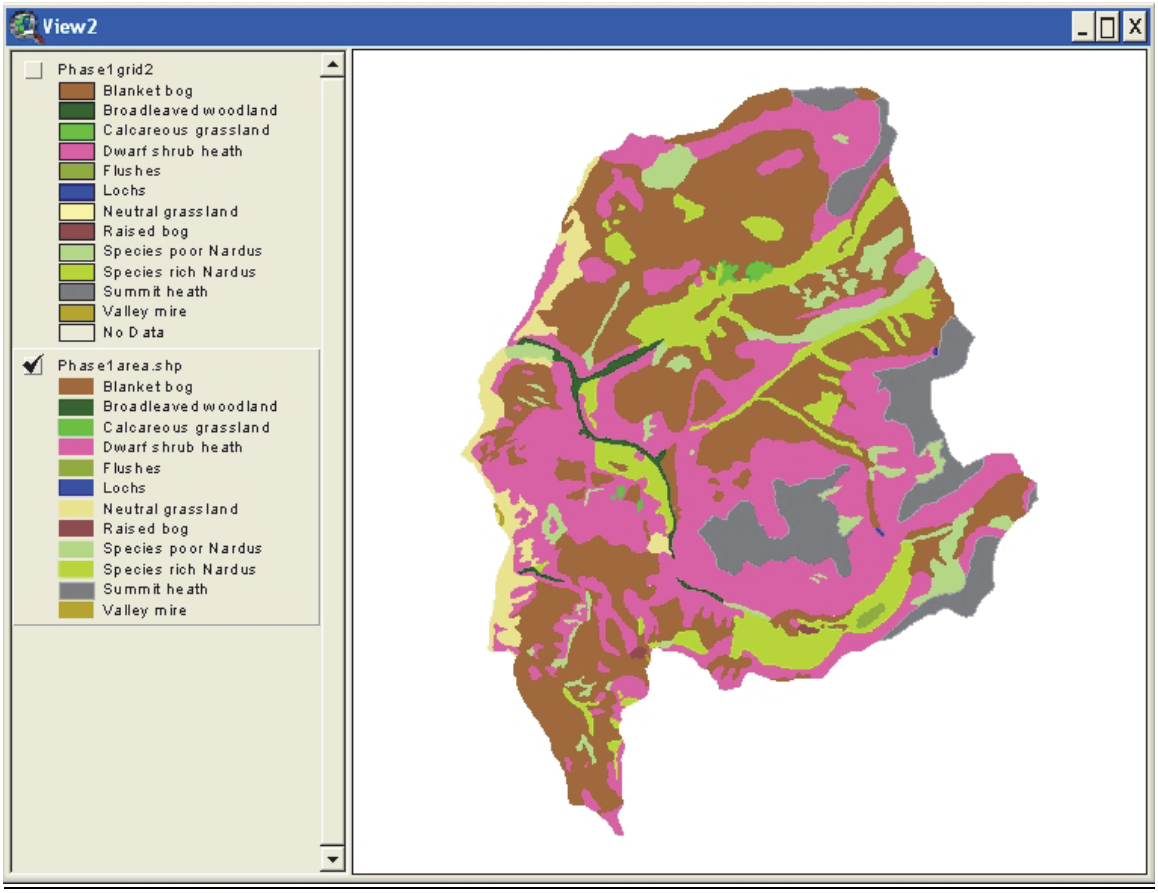


Figure 7. Area-class polygon map(Phase1 classification) for south Dee-Tilt watershed ((© SNH)

Pros:

- Works well for homogenous habitats with distinct boundaries i.e. field systems, plantation woodland. Fits well with supporting data for anthropogenic habitats (e.g. Scottish IACS agricultural database, the Rural Priorities programme, LA Planning data) is usually in polygon not grid form.
- Thematic accuracy for whole map relatively easy to assess using ground truthing data – results in one value which can be held in the metadata.
- Polylines obviously the best approach for certain linear habitats (e.g. rivers, the coast).

Cons:

- Does not work well for semi-natural habitats which exhibit fractal patchiness – the size of the patch is dependent on the scale of survey & scale of the output map

(Goodchild & Mark 1987). Large patches assigned a definite class can incorporate large thematic uncertainties. Most of the habitats SNH deal with are semi-natural, so this is an important point.

- Small patches make for over-detailed, cumbersome, datasets, and either require intensive (expensive) ground surveying or to be developed from remote sensing grids (in which case keeping the data in grid format can be considered).
- Very small patches such as flushes (which may be only a few square metres in size) can be incorporated – but the resulting polygons are so small that they will not be easy to view at the usual scale of use.
- Does not work well for 2 level habitats i.e. canopy & understory.
- The boundaries of the polygons for semi-natural habitats are, of necessity, human constructs – however, viewer interpretation has a tendency to over-emphasize the importance of boundaries in maps.

3.1.2 Area-class map with thematic accuracy (confidence) at polygon level.

Figures 8 & 9 below illustrate an area-class polygon map with thematic accuracy (confidence) at the feature (polygon) level, because it varies from one polygon to another.

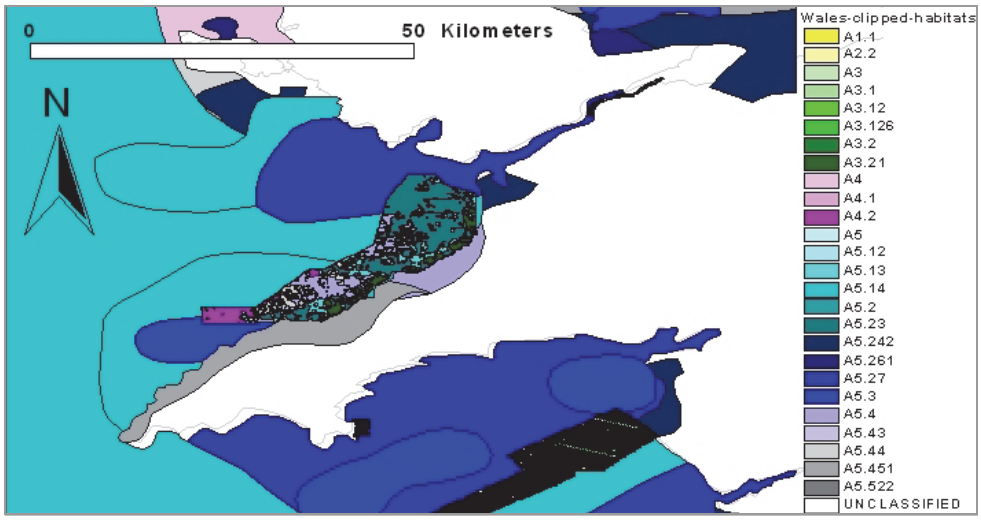


Figure 8. Predicted EUNIS habitats, courtesy of the MESH project (© JNCC)

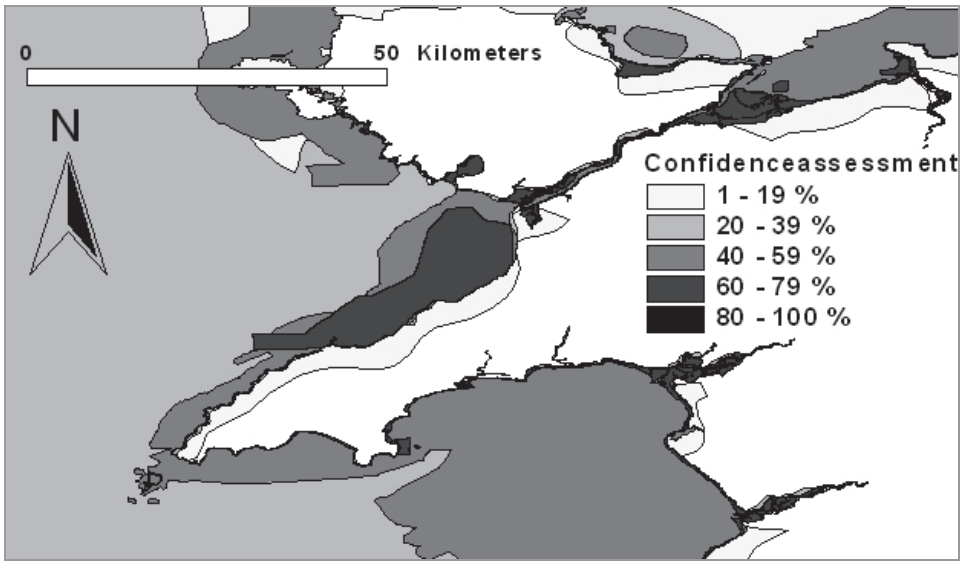


Figure 9. Confidence levels for predicted EUNIS habitats, courtesy of MESH (© JNCC)

Pros:

- Realistically the only areal way to deal with marine datasets (very few samples and much uncertainty).

Cons:

- Large polygon patches assigned a definite class will incorporate large thematic uncertainties. However, at least this is made clear by the confidence map.
- Small polygons make for over-detailed, cumbersome, datasets – however detailed marine surveys are relatively few.
- Not ideal for Article 17 Reporting – however, it is possible to do so, as the confidence assessment figures enable calculation of the best estimate plus range for overall habitat areas.
- Confidence levels tend not to have been assessed in SNH data (as per the Welsh example in Figs 8 & 9, from the JNCC MESH project). There would be a significant resource requirement involved in assessing confidence levels in SNH areal habitat extent data held in SNH.
- Marine – much wider spread of species, difficult to convert to biotopes – end up going very high up the EUNIS hierarchy. Possibly point-based would be best?

3.1.3 Area-class plus mosaics

This is the current SNH approach for much of its data, particularly the NVC classifications.

Figure 10 below illustrates some of the issues described in section 3.1.1, namely:

1. Patches too small to be recorded (A).
2. Canopy & understory (B)

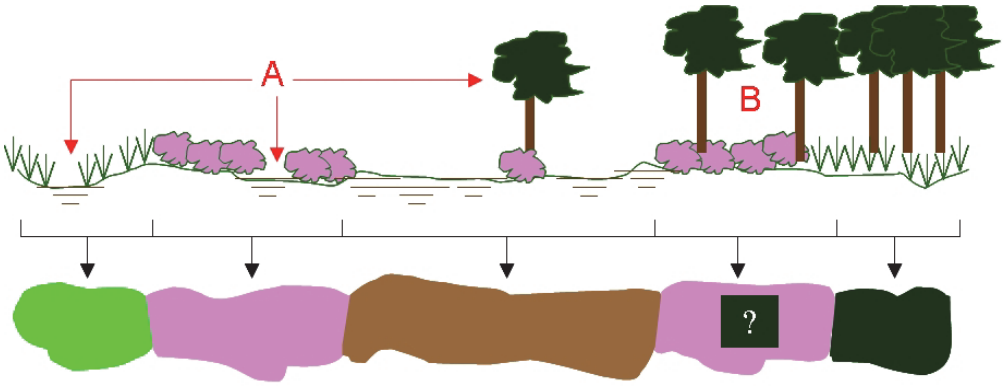


Figure 10. Schematic representation of Area-class map

Figure 11 below illustrates the current SNH data approach to these issues.

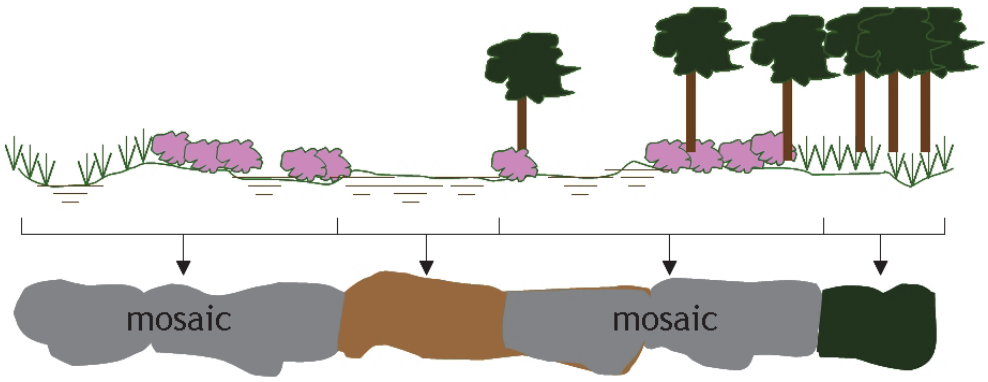


Figure 11. Schematic representation of Area-class map with mosaic

One resulting map, using real NVC data supplied to the author as a download shapefile, is shown in Figure 12. It can be seen that mosaics predominate in this map.

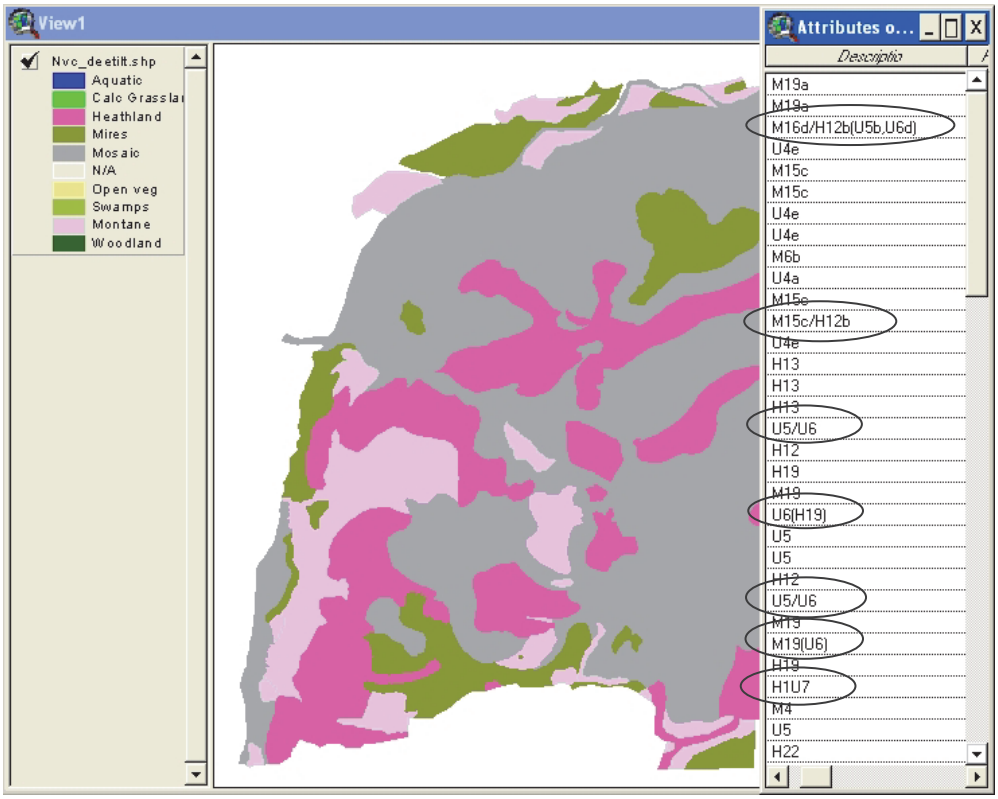


Figure 12. Area-class map with mosaics (NVC classification, mosaic descriptions in attribute table circled in grey) for north Dee-Tilt watershed (© SNH)

The strengths and weaknesses of this approach are as follows.

Pros:

- Addresses issue of semi-natural habitats.
- Allows very small habitats such as flushes (which may be only a few square metres in size) to be quantitatively included in the mosaic.
- In the current SNH internal set up each habitat code is held in a related table (i.e. there is a 1: many relationship between NVC polygon and habitats). The mosaic constituents are thus adequately described in the database in terms of % contribution to a given polygon i.e. 40% heath, 40% grassland, 20% bog – this is sufficient to enable Article 17 reporting.
- "*In Scotland, due to the extent of managed, semi-natural habitat, habitat mosaics are very much an issue we need to accommodate and deal with, or lose most natural heritage value in our data*" Susan Watt (Policy and Advice Officer Habitats Lead).
- The HB-DSv2.0 does allow "*to attribute one to many habitat types for one feature (object)*." – but there are certain issues which need addressed, see below.

Cons:

- External stakeholders viewing the WMS might not be able to view or query a specific habitat code, because so much of that habitat is 'hidden' under the mosaic code. This depends on whether the WMS/WFS is adequately linked to the 1:many relationship between NVC polygon and habitats.
- In the external download, the result is very different areas with the same community code, i.e. 'mosaic'. Note: There are more detailed habitat codes in the description

field, but in the sample dataset shown above these are string descriptions, NOT queryable items.

- Unless the mosaic % contribution information (from the 1:many relationship between NVC polygon and habitats) is somehow made available in the GML/KML/Shapefile data download, does not enable external re-use of data e.g. for EIA & SEA. **Note that when a sample was provided to the author, this % contribution information was not able to be included** – all that was obtained was the 'Description' text string and this is NOT queryable, nor did it contain % contribution.
- These three points are important outcomes for INSPIRE, therefore mosaics will not be allowed under the final Data Specifications UNLESS they can address these issues.

Requirement 5: If several habitat types are attributed to one feature (polygon or polyline), then a transformation & web service approach must be developed which enables the INSPIRE objectives of view, query and download for external stakeholders.

3.1.4 Area-class with overlaid polygons

This is the viewing solution to the above problem currently used by Natural England in their 'Nature on the Map' website http://www.natureonthemap.naturalengland.org.uk/. Screenshots are shown in Figure 13 and 14.

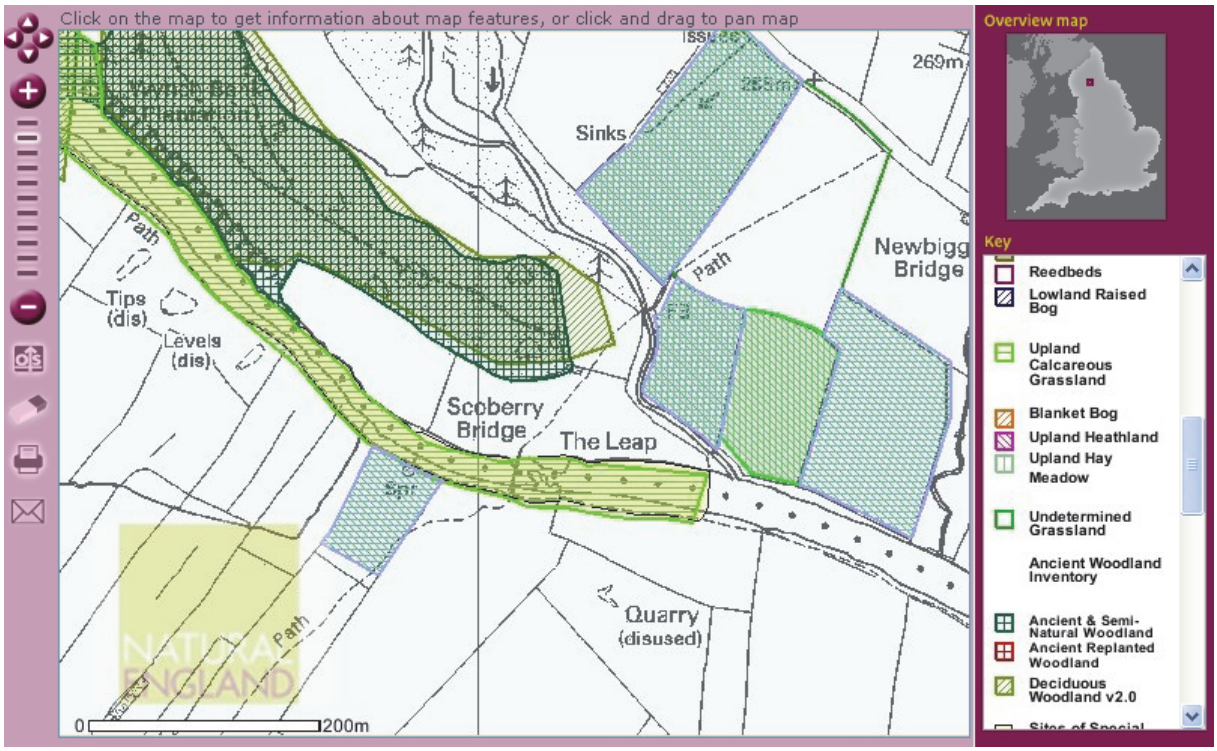


Figure 13. Area-class map with overlaid polygons- NE1

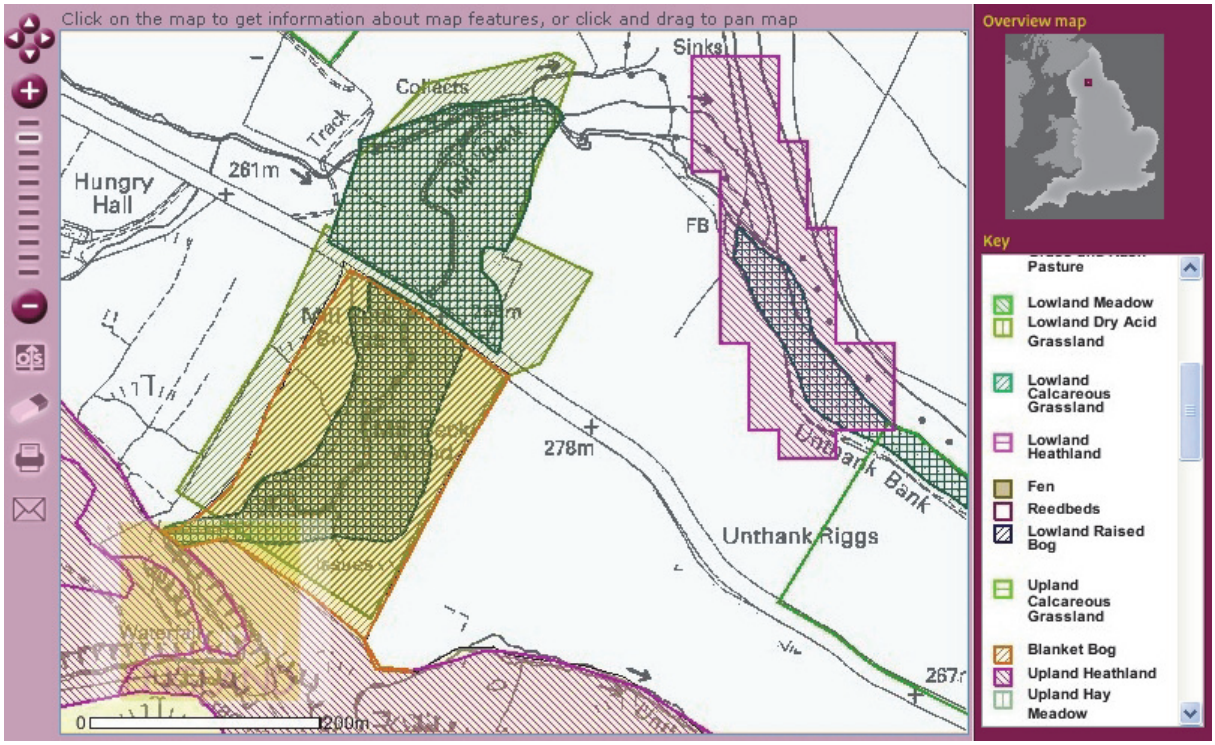


Figure 14. Area-class map with overlaid polygons –NE2

To do this, NE brought the granularity down to a minimum – 22 classes, reflecting broad priority habitats (which can be linked to the 78 habitats of the HD Annex I). Because there are so few classes, it was possible for NE to design a legend which enabled habitats to be visible when laid over each other. In Figure 13 there are fields with lowland meadow overlaid with upland hay meadow, and lowland meadow overlaid with purple moor grass pasture. In Figure 14 there is a field with overlays of deciduous woodland, ancient & semi-natural woodland, and blanket bog.

Pros: As for Area-class plus mosaics, plus:

- The WMS/WFS appears to be adequately linked to the 1:many relationship between NVC polygon and habitats, which has enabled the external view to function successfully.
- Opens up the data holding to public assessment, criticism and debate. The author is familiar with the area in Figures 13 and 14, and can identify a mis-match – well over 50% of the long, thin 'upland calcareous grassland' polygon in Figure 13 is, in fact, the River Tees (so not grassland at all, but under water).

Cons:

- Only works if granularity is kept to a minimum.
- The issue of granularity is of fundamental importance for SNH's statutory duties. "*This level of granularity is of little use to us for our main business drivers*" Susan Watt (Policy and Advice Officer - Habitats Lead)
- Can be tricky for viewer to work out which habitats are overlaid with which.
- Gets extremely tricky for viewer to work out if more than two habitats are overlaid. Note how 'untidy' the overlay of 3 habitats in Figure 14 appears.
- It should be noted that query by habitat code did not seem to be possible with the polygon dataset – rather, query by habitat code produced small-scale views with coverage aggregated over large (regional scale) areas.
- Without a feedback process to examine and, if necessary, to correct errors such as that described in the 'pros' above, could lead to a loss of public confidence in the data, which could affect the success of implementation of statutory duties.

Additional Requirement A: SNH should consider setting up such a feedback process, making use of 'citizen science' to correct errors. This would increase public confidence, and thus increase the success of implementation of statutory duties.

3.1.5 Area-class plus mosaics plus pie-charts

A solution to the above problem has been suggested by Gabor Barton (Geographic Systems and Data Officer). This would keep the current internal data structure, but would use WFS (Web Feature Service) to enable INSPIRE compliant external view & query. INSPIRE compliant download would be enabled by "On the fly" transformation to INSPIRE compliant GML 3.2.1. A simple flow chart illustration is shown in Figure 15.

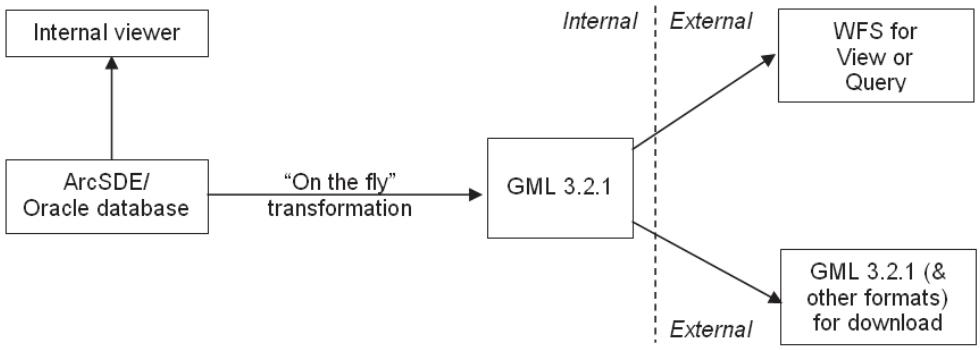
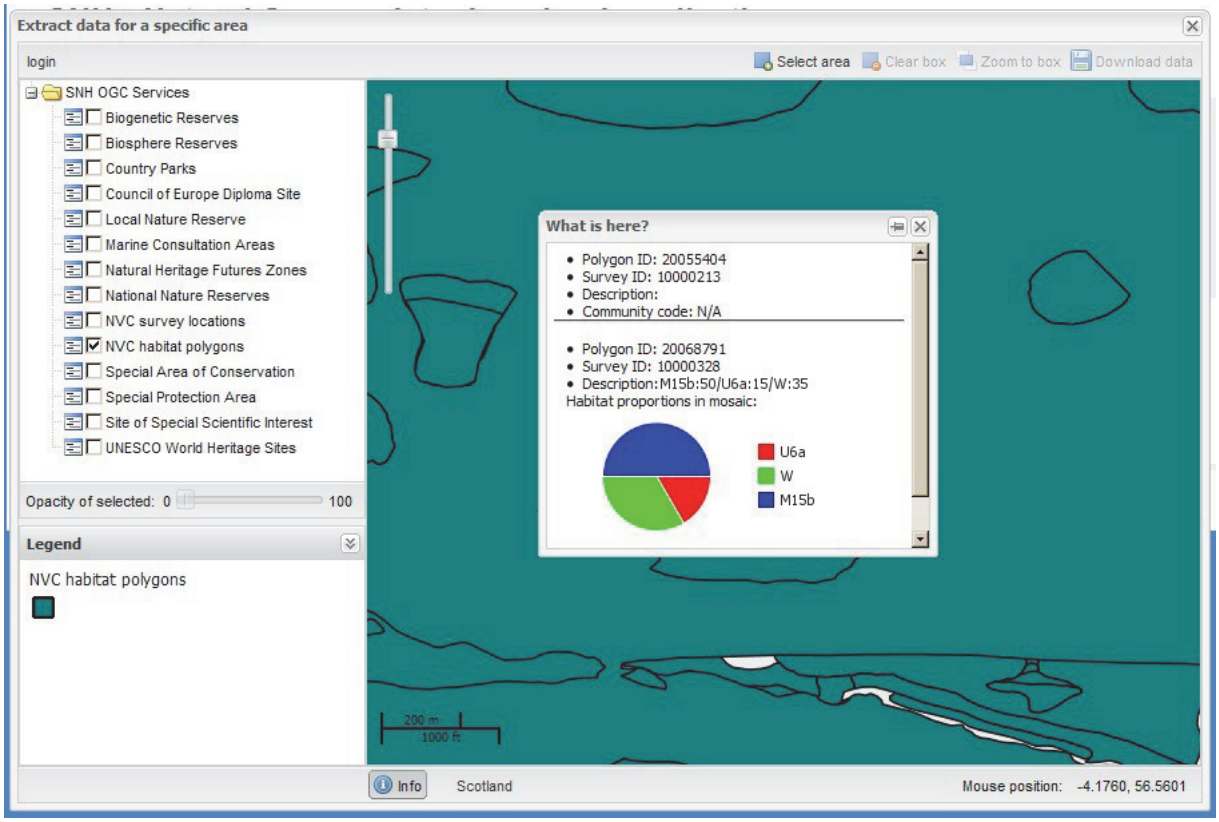


Figure 15. Flow chart of possible transformation system #1

The mosaic issue would be addressed by using pie-charts which would appear when the external user clicked on a particular mosaic polygon. An example is shown in Figure 16.



Pros: As for Area-class plus mosaics, plus:

- The WFS would be adequately linked to the 1:many relationship between NVC polygon and habitats.
- By adhering to good data principles (Moore *et al* 1993) of parsimony (not being more complex than need be), modesty (not claiming to do too much) and level of precision (not predicting more precisely than is justified), it reduces the exposure of the data holding to loss of public confidence.
- Allows detailed granularity of thematic classification to be retained.
- It should be possible to ensure that the mosaic % contribution information (from the 1:many relationship between NVC polygon and habitats) can be made available in the GML data download.

Cons:

- Difficult for viewer to get an overview of spread of one habitat within a region, since having to examine each mosaic polygon one at a time.
- Yet to be determined – whether external query by habitat code is possible with the polygon dataset.
- Not possible to provide the habitat data for download in Shapefile format (a 'flatfile' format which does not allow 1:many tables). Would need to be provided in GML3.2.1 (this would, however, meet INSPIRE requirements).

3.2 Individual habitat layers with % cover for each polygon

Defined as having only one habitat classifications in one layer.

Figures 17 to 19 below illustrates three separate polygon habitat layers for the same area (the north Dee-Tilt watershed) – grassland, heathland and blanket bog. Those polygons which were mosaics have had theoretical % cover values assigned to them (since the actual % cover values were not available to the author).

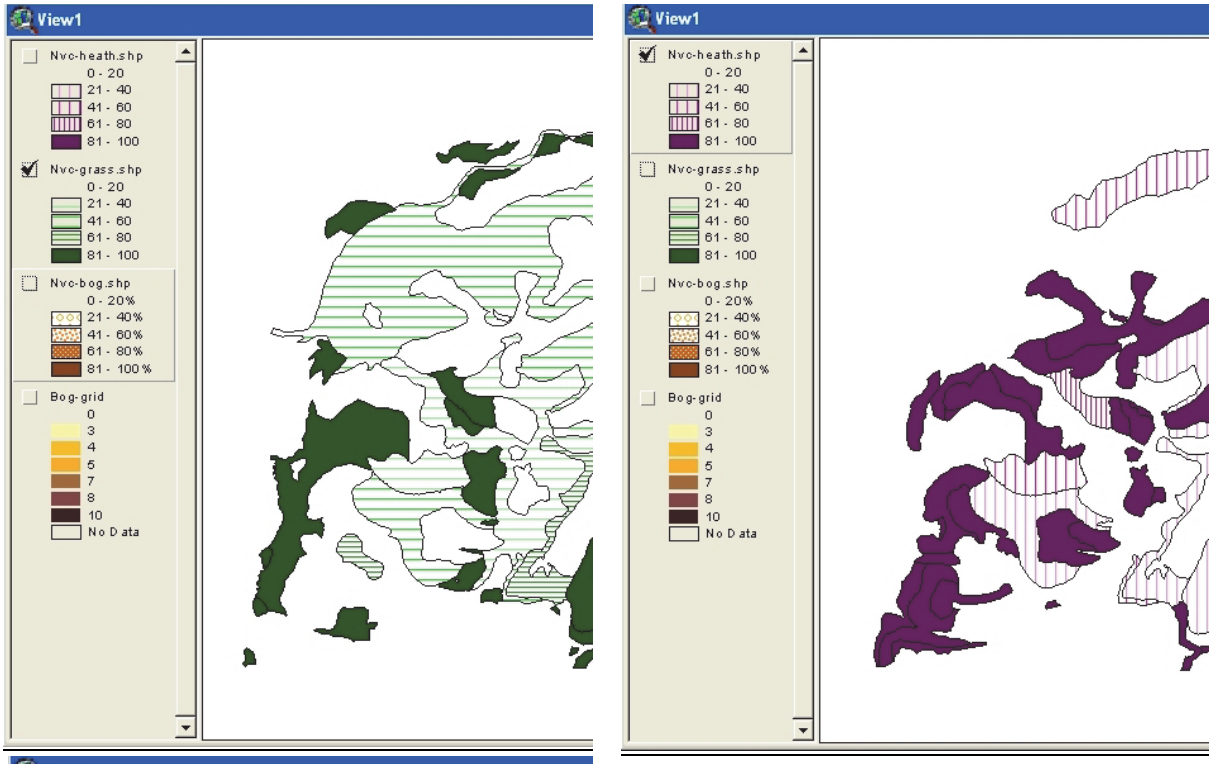
Pros:

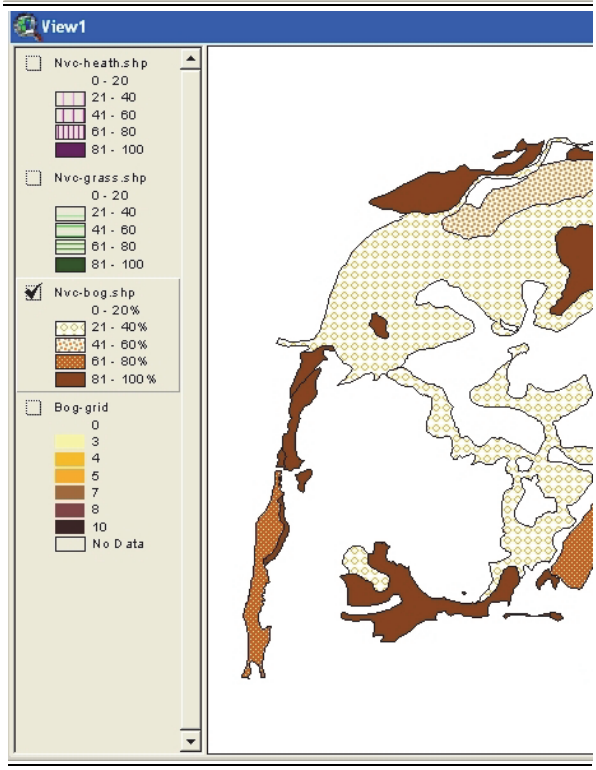
- Successfully addresses issue of semi-natural habitats.
- Works well for 2 level habitats i.e. canopy & understory, by having one separate layer for each.
- Makes Article 17 Reporting very straightforward for internal users, and transparent to external users.
- Easy for external users to view, query by habitat code and download (for use in EIA etc.)

Cons:

- Will end up with a lot of layers, rather than one habitat map – 78 listed UK HD habitats implies at least 78 habitat layers (although NE uses their limited set of 22 classes for download). Even more if EUNIS is used as the classification.

It should be noted that the "one habitat - one view – one download" approach appears to be the one used by many other countries (Carlisle & Green 2009). Natural England use a "one habitat – one download" approach for their data (though not, as of 2009, with % contribution).





Polygon habitat layers with % cover for north Dee-Tilt watershed (© SNH)

Figure 17 (top left): Grassland
Figure 18 (top right): Heathland
Figure 19 (bottom right): Bog

The Geographic Information Group within SNH noted that "*This is a possible approach and something we do already when producing 'feature maps' of a SSSI for condition monitoring. These can easily be generated from the [current] data structure so we may not want to store data this way. That said, we may end up holding some habitat layers separately*".

The above statement would indicate that the following flow diagram is possible:

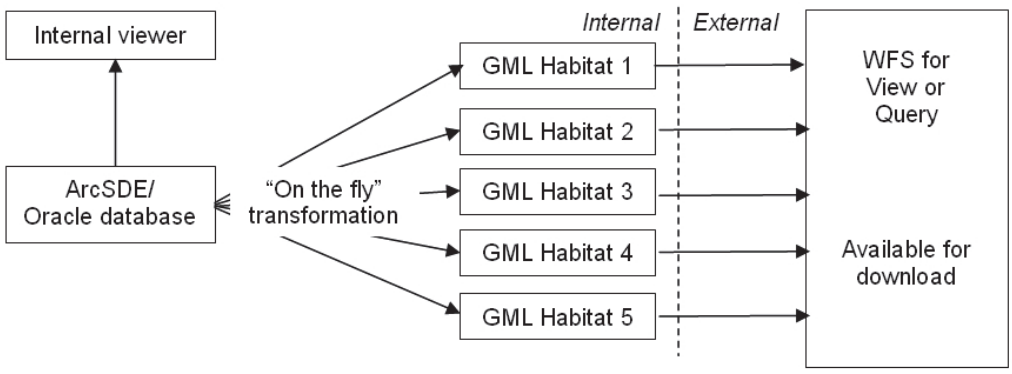


Figure 20. Flow chart of possible transformation system #2

3.3 Raster-class maps (also referred to as Grid-class maps)

Defined as having all the potential habitat classifications in one layer. This means that 100% of a cell is assigned to one class.

Pros:

- Works well for fractal patch semi-natural habitats – although only down to size of the grid cell (in the figure above this is 1 hectare, 100mx100m).
- The boundaries of the cells are more recognisably human constructs, and therefore less liable to over-emphasis – more suitable to semi-natural 'fuzzy' boundaries.
- Thematic accuracy for whole map relatively easy to assess using ground truthing data within a confusion matrix. Results in one value which can be held in the metadata.
- The most straightforward output resulting from the use of remotely sensed (RS) data.
- Habitat change detection straightforward using subsequent RS data – if the habitat can be accurately assessed thematically (see cons below).

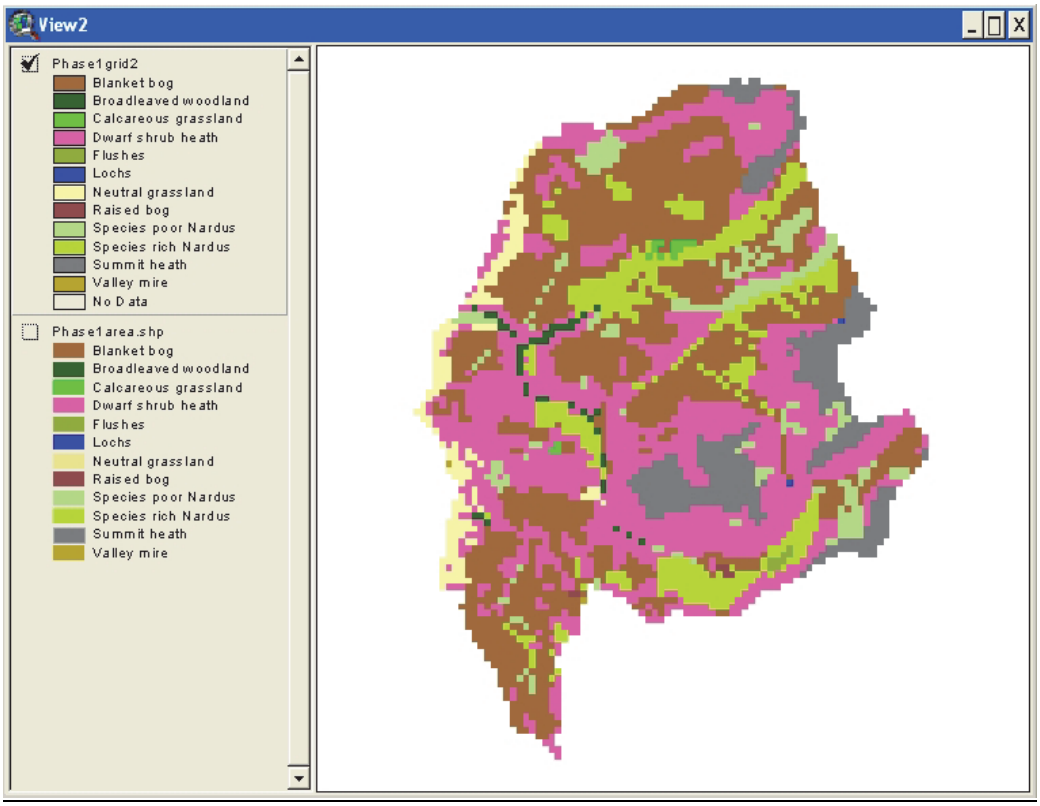


Figure 21. Raster map (Phase1 classification) for south Dee-Tilt watershed (© SNH)

Cons:

- When using RS, cells are assigned a definite class based on the spectral signal. This works very well for landcover (e.g. distinguishing between afforestation and blanket bog – for categories see CEH Landcover). Similarly, this works very well for habitats with a strong, unique, spectral signal – blanket bog is one such habitat. However, often the spectral resolution is not fine enough to match up with a useful level of thematic resolution (granularity) – for example, RS will usually distinguish between grassland and heathland very well, but less well within grassland types.
- Does not work well for homogenous habitats with distinct boundaries i.e. field systems, plantation woodland as end up with a large number of identical grid cells – also, supporting data for anthropogenic habitats (e.g. SIACS & Rural Priorities, LA Planning data) is usually in polygon not grid form.
- Effectively grid layers are sets of small patches, so still have the issue of over-detailed, cumbersome, datasets.
- Still does not work well for 2 level habitats i.e. canopy & understory.
- Cells are assigned a definite class based on the strongest signal – which, roughly speaking, correlates to whichever habitat constitutes the largest land area within that cell. Therefore thematic accuracy is a real issue This also leads to some habitats being under-reported, some over-reported – comparing Figures 7 & 21 it can be seen that the linear connectivity of the woodland strip has been lost in the grid map in comparison to the polygon map. Very small habitats such as flushes (which may be only a few square metres in size) are likely to be lost completely.
- More difficult to set up for stakeholder download? This is yet to be determined.
- Not useful for detailed site management - would not want a pixellated boundary if you needed to site a cycle path, for example.
- Raster/Grids might not be as useful for external users as polygons.

Note that conversion from raster/grids to polygons and vice versa is usually fairly straightforward, although there is always some loss of spatial precision in the process.

3.4 Individual habitat layers with % cover for each cell

See Figures 22 & 23.

Pros:

- Successfully addresses issue of mosaics.
- "Use cases describing reporting obligations on the Habitats Directive ask for grid distribution data on habitats, rather than area-class maps like in those classic biotope mapping programs." HB-DSv2.0 – so makes Article 17 Reporting very straightforward for internal users, and transparent to external users.
- Works well for 2 level habitats i.e. canopy & understory, by having one separate layer for each.
- The boundaries of the cells are more recognisably human constructs, and therefore less liable to over-emphasis – more suitable to semi-natural 'fuzzy' boundaries.

Cons:

- Will end up with a lot of layers, rather than one habitat map – 78 listed UK HD habitats implies at least 78 habitat layers. Even more if EUNIS is used as the classification.
- Not a straightforward output resulting from the use of remotely sensed data – actually derived using either % cover polygons, aggregating from finer resolution RS data, or statistical analysis.
- More difficult to set up for stakeholder download? This is yet to be determined.

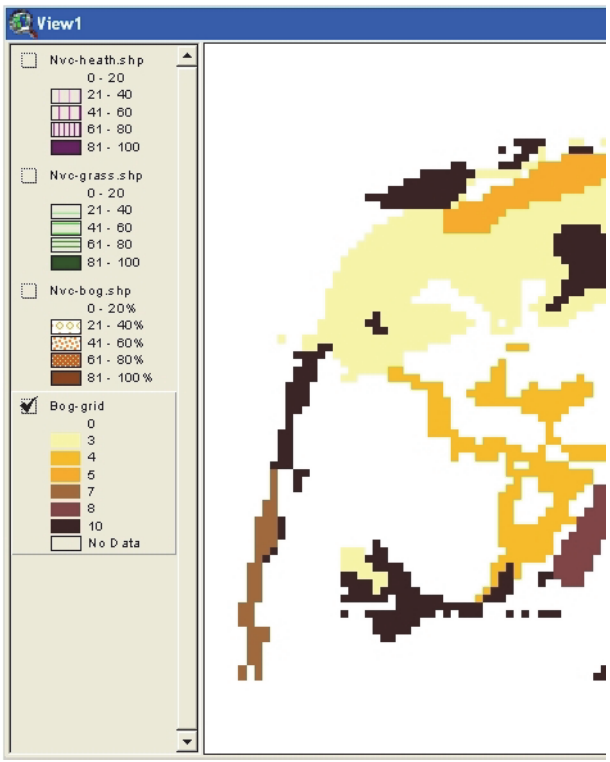


Figure 22: Raster habitat layers with % cover for Blanket Bog for north Dee-Tilt watershed (© SNH)

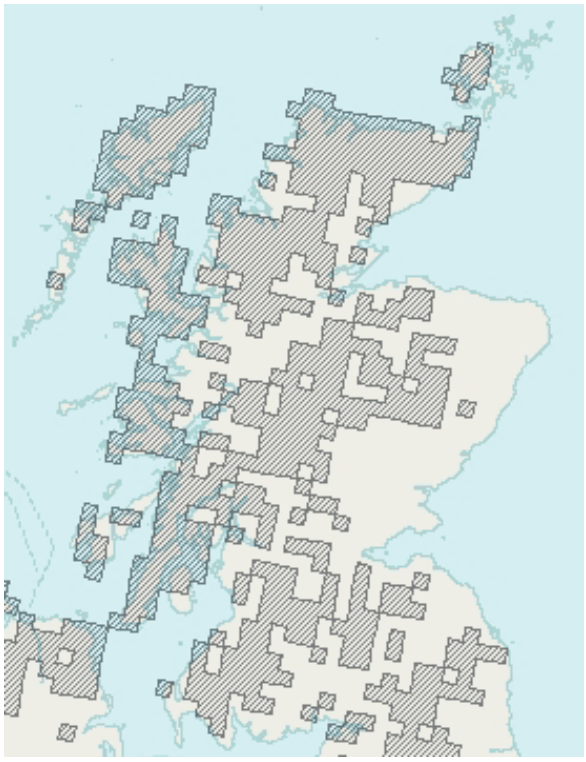


Figure 23: Close up of final output of Article 17 reporting (in this instance, the range of 10x10km grid cells which contain Blanket Bog – HD Annex I code 7130), available from EEA (see section 4.4)

3.5 Observations

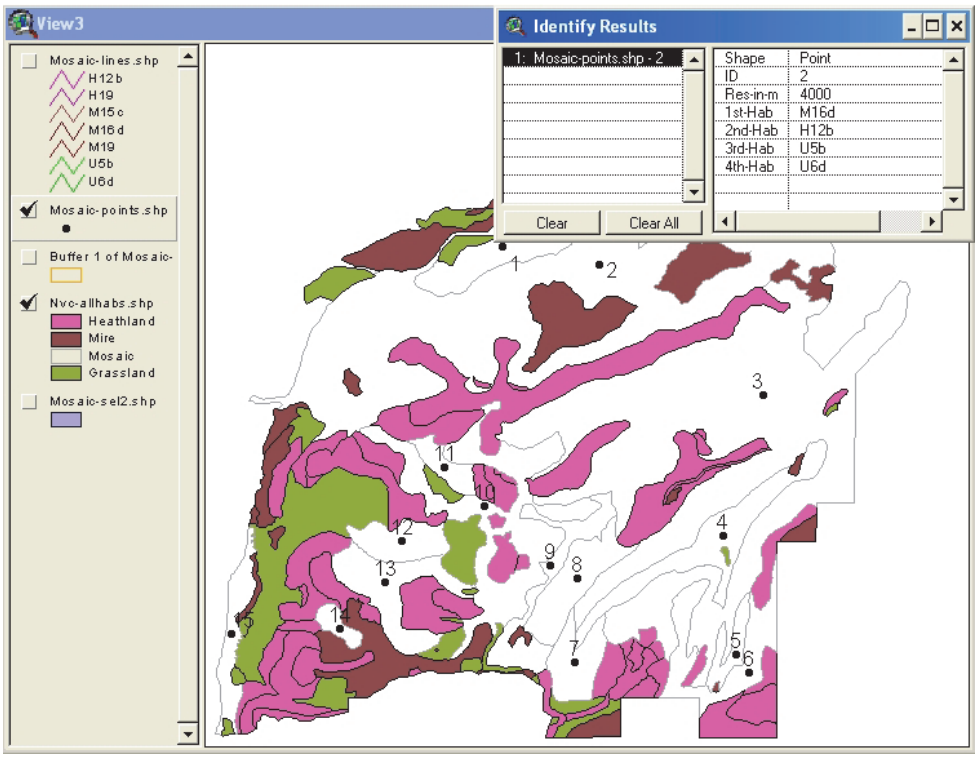


Figure 24. Theoretical point map (NVC observations) for north Dee-Tilt watershed (© SNH)

There exists the issue of polygons with multiple habitats which did not have the % contribution assessed by the surveyor. Estimation of "*the % amounts by the order in which the mosaic habitats have been documented*" is not recommended without substantial validation from independent ground surveys. This is because such an approach falls foul of the 'ecological fallacy', propagating large spatial errors, predicting more precisely than can be justified, and thus not adhering to good data principles (Rejeski 1993, Parrish *et al* 1993).

"*Even though uncertainties may be no more than an inconvenience to the scientific community, they may be the Achilles' heel of attempts to turn the results of science into public policy*" (Goodchild & Case 2001).

The author strongly recommends that, instead, an observations (points or polylines) approach should be taken (see Figures 24 & 25).

Pros:

- By adhering to good data principles (Moore *et al* 1993) of parsimony (not being more complex than need be), modesty (not claiming to do too much) and level of precision (not predicting more precisely than is justified), it reduces the exposure of the data holding to loss of public (& professional) confidence.
- Potentially a much better approach for marine data – much wider spread of species, difficult to convert to areal biotopes – can end up going very high up the EUNIS hierarchy for areal polygons. At the ground-truth (video/grab etc.) points it is not difficult to convert the faunal/floral species composition and sediment present to a biotope, usually to a reasonably detailed level in the hierarchy. The acoustic return at or near the sample point following interpolation, processing etc. determines the likely extent. This extent is likely to have fairly high uncertainties and fuzziness present (beyond immediate ground-truthing points), due to the sparsity of ground-truthing (due to cost) and heterogeneity in acoustic return (that might indicate categories no identified in ground-truthing). The drift up the EUNIS/biotope hierarchy for areal data reflects the level at which reasonable confidence can be given that the biological determination is sound. The actual point based habitat/biotope observations have some measure of confidence in respect of how well they fit the classification.
- For a designated site need very large scale (fine resolution) mapping to give precise locations, potentially best addressed by point data.
- Would answer some of the scaling issues, i.e. allow a minimum polygon/cell size to be set for practicality, with a second layer of points providing level of positional accuracy of smaller habitats needed for Site Condition Monitoring.

Cons:

- Will not provide a 'Habitat map for all Scotland'.

For new, as opposed to legacy, terrestrial data, consideration should be given to recording observations via polyline, i.e. replicating survey transects.

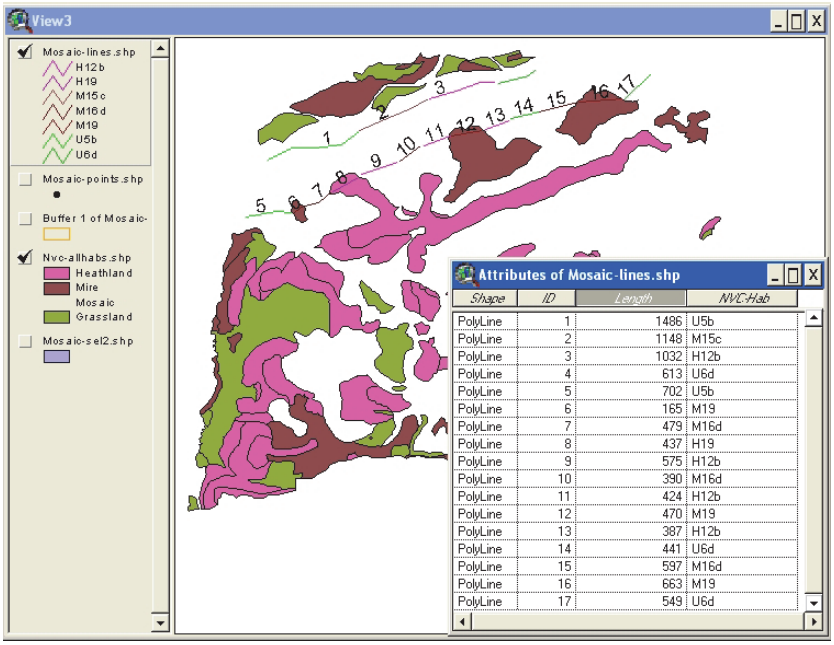


Figure 25. Theoretical polyline map(NVC transects) for north Dee-Tilt watershed (© SNH)

Note that **HB-DSv2.0** emphasises areal approaches (i.e. polygons & grids, although polylines are also encompassed) – but the important point to note here is that the Habitats & Biotopes specification is not intended for the original observations, but for the **geographic extent as derived from observations**. Observation data, therefore, do not come under the remit of the Habitats & Biotopes theme. They do come under Observations & Measurements (for which there are guidelines rather than rules), and also under Environmental Monitoring Facilities (human observers being considered as mobile EM facilities). The author examined both the requisite INSPIRE publications (**O&M-Gv1.0** and **EF-DSv2.0**, screenshots of which are shown in Figures 25 and 26), and concluded that this approach could be very useful for certain habitat data.

Additional Requirement B: SNH should consider the applicability of the themes Environmental Monitoring Facilities and Observations & Measurements for their applicability to SNH Habitat data, particularly for Site Monitoring Features and for some legacy data

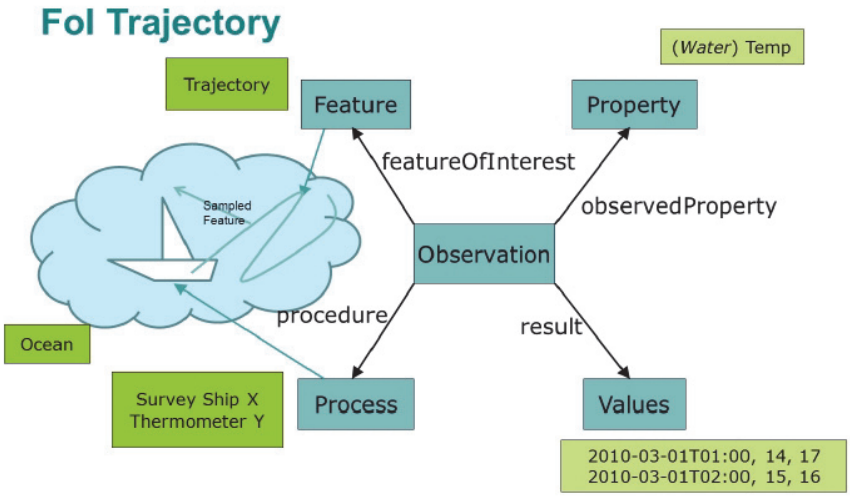


Figure 26. Observation & Measurement Design by Feature of Interest (from O&M-Gv1.0)

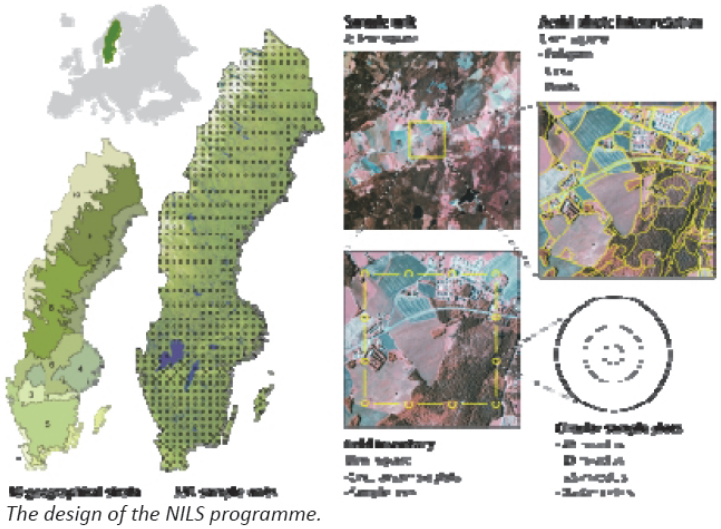


Figure 27. Environmental Monitoring Facilities: Use case for Swedish Landscape Assessment (from EF-DSv2.0)

3.6 SNH Decision Two

To conclude: SNH must decide which data structures to use for future data collection/storage/supply. Collected data should be readily transferable to an internal data structure. The internal data structure must satisfy Aarhus/INSPIRE requirements for external users via WMS/WFS/External-download. This decision must be made by 31st of Dec of 2014 (DEFRA 2009a).

Requirement 1: Habitats metadata must be INSPIRE compliant and available for discovery by **Dec 2013**. All new spatial data collected after Dec 2013 must be INSPIRE compliant and must speedily be made available for view, query and download, from **Dec 2014** onwards.

3.7 SNH Decision Three

To conclude: SNH must decide which data structure approach to use for legacy data. This decision must be made by 31st of Dec of 2019 (DEFRA 2009a).

Requirement 2: All legacy spatial data (collected before Dec 2013) should be transformed to become INSPIRE compliant, and then must be made available for view, query and download, from **2019** onwards.

Requirement 3: Any legacy habitat data which cannot be made INSPIRE compliant must be archived and not used for any statutory purpose from 2019 onwards.

Additional Requirement C: It was generally agreed at the workshop of 6th Feb 2012 that the decision for data structures for new data should take precedence

4. USE CASES

4.1 Summary of Use Case recommendations

"Use cases, stated simply, allow description of sequences of events that, taken together, lead to a system doing something useful" Use cases can be defined on different levels and one should distinguish high-level business use-cases (non-technical) from detailed system use cases. The latter is rather intended for defining system functionality from a technical point of view. Both types of use cases describe a set of interactions between actors and a system necessary to satisfy a certain goal" (Wawer & Tirry 2010).

Five SNH Use Cases are presented here: 1. Marine Protected Area designation (**MPA**); 2. Site Condition Monitoring (**SCM**); 3. Article 17 Reporting (**Art17**); 4. Casework Management (**CMS**); 5. Rural Priorities Scheme (**RP**).

Interviews were undertaken with SNH staff members for each Use Case. An information flow diagram was then drawn up and a narrative template completed for each Use Case, based on the interviews. The results are presented here in sub-sections 4.2 to 4.6. The Use Cases directly led to many recommendations, listed here and annotated in the Use Case diagrams:

4.1.1 Marine Data Requirements

The Scottish Government (Marine Scotland) are a sponsor of MEDIN (http:// http://www.oceannet.org/ Marine Environmental Data & Information Network), and have asked all Scottish agencies to ensure their marine data are MEDIN compliant.

Additional Requirement D: MEDIN requirements for marine data must be incorporated into all SNH internal debate regarding data management.

4.1.2 Staff resources

The author used SNH datasets (SSSI, SAC & SPA) and the ESRI supplied boundary for the UK to calculate in ArcView the % of Scottish land under one or more of these designations, and arrived at a value of 13.3%. The author was informed by staff members that SNH had habitat data for 70% of sites (not necessarily equivalent to 70% of the land area). SNH also holds unspecified amounts of habitat data for the 'wider countryside' (i.e. non-designated areas). Four staff members agreed with a suggested value of c.20% for % of Scottish landcover mapped for habitats. However one staff member, a member of the terrestrial Habitats team and therefore in a better informed position than others, estimated c.50%. But this would imply a data holding of c.40% of land area for the 'wider countryside', which is in conflict with the opinions of other staff members who thought that this holding was minimal.

Therefore there needs to be some clarification within SNH as to exactly how much terrestrial habitat data exist and how much of Scotland's land area is actually covered. This needs to be ascertained in order to be able to assess likely staff-time costs of making legacy data INSPIRE compliant. To this end the author downloaded the terrestrial NVC-polygons for all of Scotland from the Natural Spaces website and used this dataset to calculate the % of Scottish land under this mapping, and arrived at a value of just over 12%. This is a useful starting point – but note, it does not include other data such as the Aberdeenshire IHS survey or older Phase 1 surveys.

Recommendation 3: The coverage (i.e. the % of Scotland's land area) of terrestrial habitat data held by SNH needs to be calculated in order to be able to assess likely staff-time costs of making legacy data INSPIRE compliant.

For marine data the resource required for INSPIRE compliance is probably more likely to be aligned with the number of surveys done rather than the area they covered. INSPIRE compliance is likely to be more about standardising attribution to make layers interoperable.

SNH's Coastal and Marine Ecosystems Unit (CMEU) made an initial tentative assessment of the staff resources required. Considering the example of GIS based habitat point & polygon layers plus habitat information in Marine Recorder: It was estimated that taking these data and standardising structures, and merging to single polygon layer and single point layer, will take circa **2 person-months**. The wider process of migrating all data to corporate systems (some of which do not even exist at present) could be significantly longer. A very tentative assessment from CMEU as regards the wider marine data management task was a staff-resource requirement of **2 person-years**.

Additional Requirement E: The staff resources required to make data coherent and compliant should not be underestimated, and this issue should be incorporated into all SNH internal debate regarding data management.

4.1.3 Data from external parties

SNH already hold many 3rd party datasets, specifically in the marine sphere.

Additional Requirement F: 3rd party copyright issues for many of the marine datasets (those obtained via Marine Scotland, other datasets from developers/commercial interests, and other Statutory Nature Conservation Bodies) need to be clarified, documented and legitimised via licence agreements.

In the terrestrial sphere, the SNH-held habitat data is almost all SNH owned. However, there is the potential to incorporate survey data from developers within SNH's habitat data holding.

Recommendation 4: There is the potential to incorporate survey data from developers within SNH's terrestrial habitat data holding. It is recommended that SNH explore the possibilities for incorporating such external survey data.

However, the issues around copyright and IPR, which would be retained by the developer, are not trivial. Such issues might mean that copyright owners are unwilling to have the data available for view/query/download (for example, they may not wish competitors to be able to download it because it is of live commercial interest). If the data are deemed to be relevant to public projects, plans or programmes, however, then the Aarhus/INSPIRE directives comes into play. Currently SNH address this via releasing such data (principally marine GeMS data) only on receipt of an FOI request, with stringent conditions precluding re-use. A system of early drafting of formal exchange agreements will be required if SNH is to pursue a policy of incorporating 3rd party data.

Recommendation 5: A system of early drafting of formal exchange agreements will be required if SNH is to pursue a policy of incorporating 3rd party data.

Still in the terrestrial sphere, there are several habitats datasets held by other organisations and by citizen science – Local Authorities, Scottish Wildlife trust etc. It is strongly recommended that SNH should consider volunteering to become the prime Scottish LMO (Legally Mandated Organisation) for habitat data – i.e. to be the organisation who take others' habitat data and distributing them via WMS/WFS/download (in a similar way to the NBN taking SNH species data and distributing them, and MEDIN taking GeMS marine data

and distributing them). Copyright will still remain with the other organisations, but without the commercial/competition aspect this is likely to be less of an issue.

Recommendation 6: SNH should consider volunteering to become the prime Scottish LMO (Legally Mandated Organisation) for terrestrial habitat data – i.e. to be the organisation who take others' habitat data and distributing them via WMS/WFS/download

4.1.4 Data from other Govt. agencies

SNH already have a licence for use of CEH's Countryside Survey Landcover (LC) 2007. LC data are only useful for identifying a small subset of broad category habitats, principally woodland and blanket bog, but for these there may be potential for LC data to be used within habitat mapping.

Recommendation 7: If CEH Countryside Survey Landcover 2007 data are used as the basis for habitat mapping then SNH must draft an exchange agreement that will enable SNH to distribute the results via WMS/WFS/download.

The Scottish IACS system was previously used to support Common Agricultural Policy productivity payments – it is now used to support the Rural Priorities scheme. It contains farm audits of habitats & species, held in a non-GIS database with field identifiers, holding statements for what exists and what is planned for each field within an applicant farm. The S-IACS data is of particular interest because it is largely data for the wider countryside, i.e. outside the 13.3% of Scottish land that is under designation. Several SNH staff members have stated that SNH does not hold many data for the wider countryside (although in the light of Recommendation 3. this is by no means certain). In 2010 the author was informed by the University of Aberdeen's Professor Pete Smith that there was potentially future research being undertaken to investigate using the S-IACS data for habitat mapping.

It is suggested that SNH should contact Professor Smith to follow up on whether there is a current project converting Scottish IACS data to habitat mapping. If there is no such project, SNH should consider instigating one. Additionally, It should be assessed how much of the Scottish IACS resource is being used for SCM. If it is not – investigate the potential to use it. If is already is – formalise and record its use. Finally, The Article 17 information for condition/ pressures/ threats/ conservation measures is currently only taken from the SCM reports, which only cover 13.3% of Scotland's land area. However, the Scottish IACS database offers information for much of the 'wider countryside'. SNH should consider using S-IACS for this purpose.

The above can be considered as a re-iteration of Recommendation 6.

Recommendation 6: SNH should consider volunteering to become the prime Scottish LMO (Legally Mandated Organisation) for terrestrial habitat data – i.e. to be the organisation who take others' habitat data and distributing them via WMS/WFS/download

4.1.5 Level of use of terrestrial Habitat data within the Use Cases

It became apparent that Site Condition Monitoring SCM was the 'baseline' that all the other terrestrial Use Cases referred to. It also became apparent that within the SCM Use Case there was some uncertainty as to exactly how important the polygon habitat data are to the process.

Two SNH staff (Duncan Blake GIS Analysis Team Coordinator and Susan Watt Policy and Advice Officer – Habitats Lead) independently stated that they "*produce 'feature maps' of a*

SSSI for condition monitoring". However, the interviewee for the SCM Use Case (Brian Dickson SCM Data Manager) did not mention these feature maps, but emphasised the importance of the written records for Features within Site A: "*namely species, habitats & geology. Not mapped but a written record which might include GPS coordinates*".

Additional Requirement G: SNH should assess (via internal survey of all SCM assessors and SCM officers) how often habitat polygons are being used by SCM assessors (whether SSSI feature maps or the original NVC polygons), and how important these data are to the process. SNH should also assess how often SCM derived data are being fed into the spatial data holdings (both species & habitats).

Additional Requirement H: Reporting round 2 of SCM is just about to finish, round 3 just about to start. There is an opportunity here for SNH to instigate best practice, which should certainly include GPS recording for Site Features.

The author's overview resulting from these (necessarily) short interviews is that the only Use Case that appears to have a strong requirement for Habitat polygons is Article 17 reporting (because it is the only Use Case that needs a measure of areal extent). All the others, at least as described to the author, could be facilitated with an Observations (point-based) approach. This leads to a repeat of Additional Requirement B:

Additional Requirement B: SNH should consider the theme Environmental Monitoring Facilities and the guidelines for Observations & Measurements for their applicability to SNH Habitat data, particularly for Site Monitoring Features and for some legacy data

4.1.6 General level of use of Habitat data within the Use Cases

Regarding the information systems in general, the main issue is perceived as being a lack of capacity re. the skills to get the fullest use out of the data. It was perceived that there was a training issue – "*Apart from a brief initial introduction, have been left to own devices when it comes to using the spatial data system. Perhaps there is a need for coaching rather than training?*"

Recommendation 8: SNH should consider setting up a 'coaching' system to ensure that non-GIG officers are capable and confident of exploiting the available data to their fullest extent.

4.2 Use Case 1: Marine Protected Area (MPA) designation

Based on an interview with James Dargie (Marine Data Officer) & Ben James (Policy & advice manager – Marine Survey & Monitoring) on Thursday 22nd March 2012.

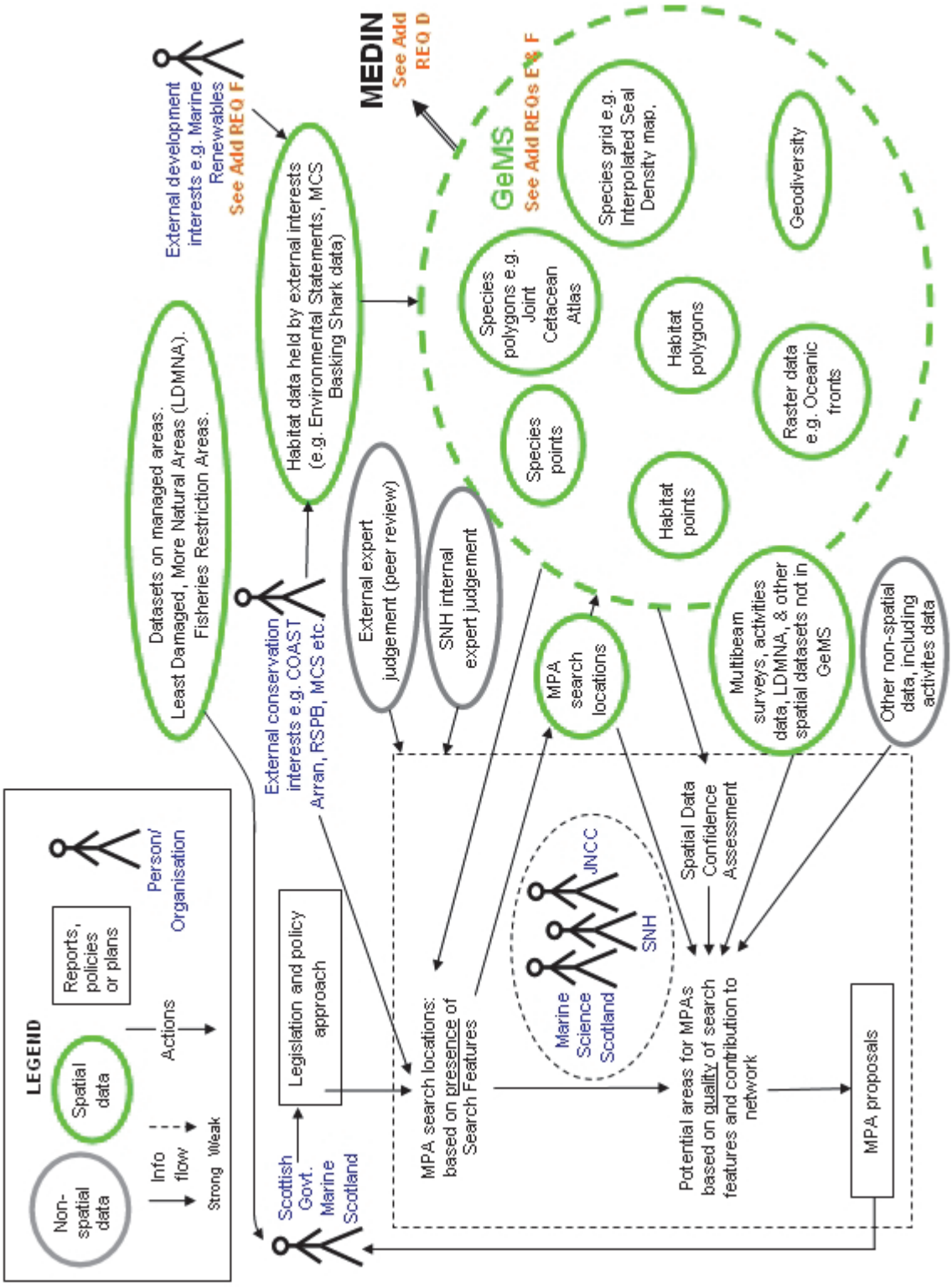


Figure 28: Info flow diagram for MPA Designation

Context for MPA designation Use Case

The issues around SNH's holding of marine data are complex, and are briefly described in the following narrative.

MEDIN (http://www.oceannet.org/ Marine Environmental Data & Information Network), are registered with INSPIRE as an SDIC (spatial data interest community). To achieve INSPIRE compatibility re. the output of marine surveys, MEDIN have set guidelines re. which data should be collected in surveys. MEDIN are also tasked with accrediting marine data archive centres (DACS). DASSH is the DAC that leads biodiversity, other DACs includes BGS, UKHO and the Met Office. Scottish agencies (inc. SNH) who collect marine data are required by Marine Scotland to provide their data to one of the DACs for public access. MEDIN have a working INSPIRE-compliant metadata portal and are developing INSPIRE-compliant view and download services.

The Scottish Government (as Marine Scotland) are a sponsor of MEDIN and have asked all Scottish agencies to ensure their marine data are MEDIN compliant. They have also asked all Scottish agencies to take on the duties of a MEDIN partner even if the agency is not a formal partner (this is the case for SNH). This means that SNH is required to undertake the following actions (see Additional Requirement D):

1. Follow MEDIN metadata standards (compatible with both INSPIRE and UK Gemini) and MEDIN survey data guidelines (which will presumably be developed to become compliant with INSPIRE Observations & Measurements, when the final version of this INSPIRE document is published).
2. Submit data to the relevant DAC (for biodiversity, this will be DASSH).

Regarding the first of these requirements: The SNH ArcGIS and the tool Gabor Barton (Geographic Systems and Data Officer) has built are not MEDIN metadata compatible. The former (based on ESRI functionality) is not strictly MEDIN or UKGEMINI or INSPIRE metadata compatible, the latter does not use the MEDIN designated vocabularies through live web services due to cross-site scripting vulnerabilities. SNH are currently building a Marine Survey Register to hold data from Marine Recorder and provide an index/link to all other Survey outputs – this will be MEDIN metadata and data guideline compatible and INSPIRE metadata compatible.

Regarding the second of these requirements: There is a provisional agreement from SNH-KIM (Knowledge & Information Management Unit) to provide DASSH with data. KIM are tasked with leading the drafting of the exchange agreement between SNH and DASSH.

A major task for SNH-Marine Management unit is to get the marine data off the current CD/DVD repository, and make them coherent and MEDIN compliant. The data are going first onto the Marine Share on the SAN and then into appropriate corporate systems as they are delivered. A subset of records that constitute Priority marine features and/or MPA search features are relevant to GeMS and are being incorporated into GeMS now if they are not already present. There is no dependency between these two discrete projects. The wider data management task is likely to be of the order of requiring staff resources of 24 person-months (see Additional Requirement E).

DEFRA have collected data for the purposes of designating Marine Conservation Zones under the DEFRA MB0102 project (DEFRA 2009b). The Scottish Govt. were a partner in this project, but SNH were not. These DEFRA data were for the use of project partners only – however, the Scottish Govt. have passed these data on to SNH and required that they be used for MPA designation. However, the 3rd party copyright issues have yet to be addressed – this dataset includes data from many providers, including commercial interests. Additionally, marine data have been supplied directly to SNH by commercial interests, often

from EIAs (environmental impact assessments) and the resulting ESs (environmental statements). For this reason the GeMS data are currently only accessible to members of the Marine Management Unit. These data can be released under FOI on a request-by-request basis, but only for information, not for re-use (see Additional Requirement F).

Use Case Description	
Name	Designation of Marine Protected Areas.
Priority	High
Description	SNH, JNCC, Marine Science Scotland (& Historic Scotland, though not for biodiversity) are the agencies tasked with the duty to provide the evidence base for MPA designation. SNH in particular is tasked with putting together the geodatabase containing the evidence – this is the Geodatabase for Marine features adjacent to Scotland GeMS.
Scope	Public service
Extent	Seaward limits of Scottish territorial waters (within the 12nm zone) This is the area for the Marine (Scotland) Act which defines MPAs – between 12nm and 200nm the Scottish Govt still has conservation duties, but this is under the UK Marine and Coastal Access Act and is about MCZs (Marine Conservation Zones) not MPAs.
Pre-condition	The Scottish Government (Marine Scotland) are a sponsor of MEDIN (http://www.oceannet.org/ Marine Environmental Data & Information Network), and have asked all Scottish agencies to ensure their marine data are MEDIN compliant.
Flow of Events – Basic Path	
Step 1	Marine Scotland has already defined the legislation and policy approach to be examined, using the following datasets: Existing Designations (SACs & MCAs). Least Damaged, More Natural Areas (LDMNA). Fisheries Restriction Areas The resulting broad search areas have been supplied to the three agencies (SNH, JNCC, Marine Science Scotland) plus Historic Scotland for archaeological input.
Step 2	The three agencies determine the MPA search locations: These are based on presence of Search Features (various species and habitats listed in Annex 3 of 'Marine Protected Areas in Scotland's Seas') within the Broad Search Areas. Additional MPA Search Locations can be submitted by external conservation interests (and, for archaeology, by Historic Scotland – not biodiversity info, so not shown in flow diagram)). The resulting output is the spatial dataset of the MPA search locations.
Step 3	Many of the data within GeMS are SNH's own data (so no copyright issues pertain). Many other data have been supplied by DEFRA (via the Scottish Govt.)., commercial interests (via EIA and Environmental Statements) and conservation interests. 3rd party use and copyright issues for these datasets need to be clarified, documented and legitimised
Step 4	SNH is subjecting the data within GeMS to Spatial Data Confidence Assessment – this is to ensure that evidence base for MPA designation is sound.
Step 5	The MPA search locations are assessed by the three agencies based on the biodiversity quality of the Search Features. All the datasets in GeMS are used, as well as multibeam surveys & other datasets that do not fit into GeMS. The resulting output are the MPA proposals.

4.3 Use Case 2: Site Condition Monitoring (SCM)

Based on an interview with Brian Dickson (SCM Data Manager) on Thursday 8th March 2012.

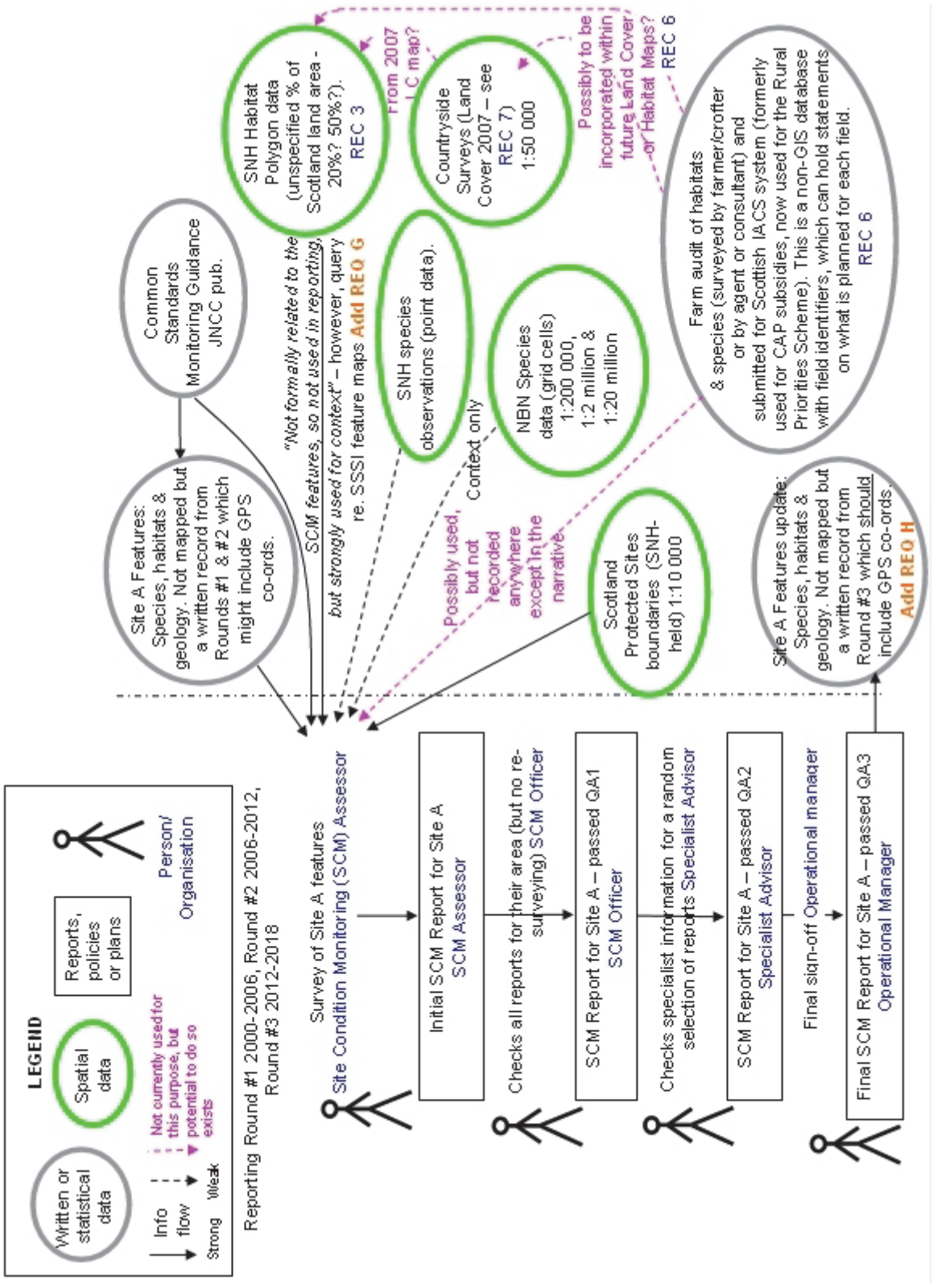


Figure 29: Info flow diagram for Site Condition Monitoring

Use Case Description	
Name	Monitoring of habitat features within designated Protected Sites (SACs & SPAs, also SSSIs)
Priority	High
Description	Article 17 of the Habitats Directive obliges Member States to report every six years about the condition of Natura 2000 designated sites. Reporting on the condition of SSSIs comes under the remit of the Nature Conservation (Scotland) Act 2004.
Scope	Monitoring, public service
Extent	National
Pre-condition	Biodiversity monitoring network being maintained. Reporting round #1 was 2000-2006. Round #2 was 2006-2012. Round #3 (2012-2018) is soon about to commence.
Flow of Events – Basic Path (for upcoming round, #3)	
Step 1	The SCM Assessor selects the info for the Site in question (Site A) from: • The Protected Sites boundary data (1:10,000 polygons) • The records for Features within Site A – namely species, habitats & geology. Not mapped but a written record which might include GPS coordinates. Should contain information from previous rounds (#1 & #2). • NVC polygon data for Site A – NVC data is not formally related to the features, so is not used statistically in reporting, but is thought to be strongly used for context. However, other SNH staff stated that they "*Produced 'feature maps' of a SSSI for condition monitoring*". **So there is some uncertainty as to exactly how vital polygon habitat data are to SCM.** There is minor use of other datasets: • NBN Species data would most probably only be used by the assessor for background information. However, sometimes get precise data from 3rd parties e.g. bird data from BTO and RSPB. There was some uncertainty as to exactly how important the SNH Species point data are to SCM. • There is potential to use Scottish IACS data, for those farms/crofts within designated Sites. Could be particularly useful for those habitats which require active human management e.g. H6170 which requires a certain amount of grazing.
Step 2	The SCM Assessor surveys the Site, using the Common Standards Monitoring Guidance to assess the condition of the listed Features. This provides a rulebook for methodology re. feature groupings. It contains an Annex Table of attributes & targets for each feature type e.g. must be a certain % of a certain vegetation type. These attributes & targets are fine-tuned into a bespoke set for each feature within Site A. For certain features a specialist assessor may be required e.g. for bryophytes.
Step 3	Once the initial SCM Report for Site A is prepared, it is passed on to the SCM Officer for first Quality Analysis (QA). The SCM Officer checks all report for their area.
Step 4	The second QA is undertaken by a Specialist Advisor, who checks specialist information within random selection of reports.
Step 5	The third and final QA is undertaken by the Operational Manager, who signs off the final report for Site A.
Step 6	The information in the final report / survey is incorporated as an update into the records for Features within Site A. A letter is sent to owner/occupiers to inform them. Two weeks later the public are informed via website update.
Step 7	The final report for Site A is incorporated into the submission to EEA for Article 17 reporting and to JNCC for Nature Conservation Act (2004) reporting.

4.4 Use Case 3: National reporting on Article 17 of Habitat Directive

Based on an interview with Dr Susan Watt (policy and Advice Officer – Habitats Lead) on Monday 12th March 2012.

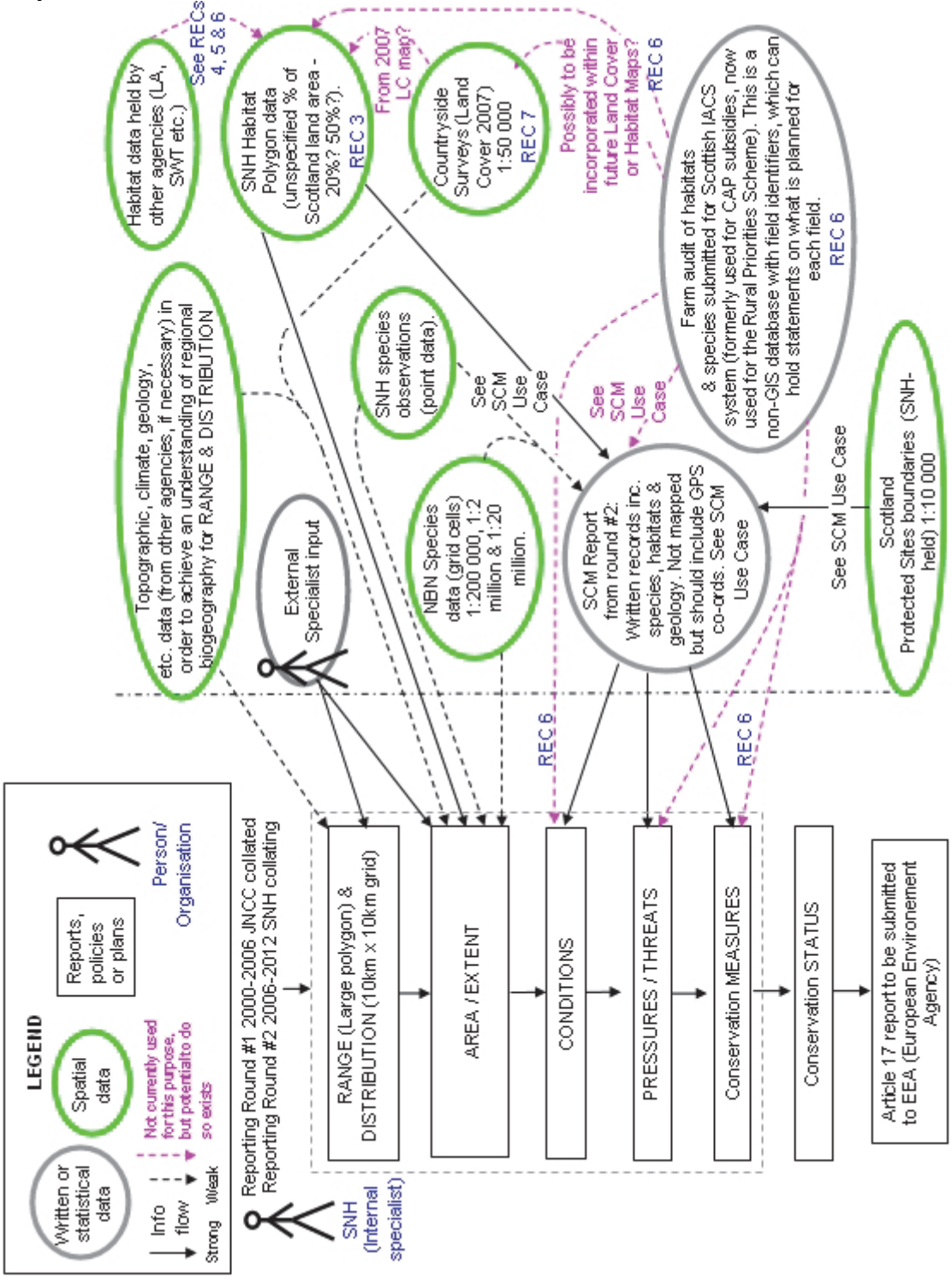


Figure 30: Info flow diagram for Article 17 reporting

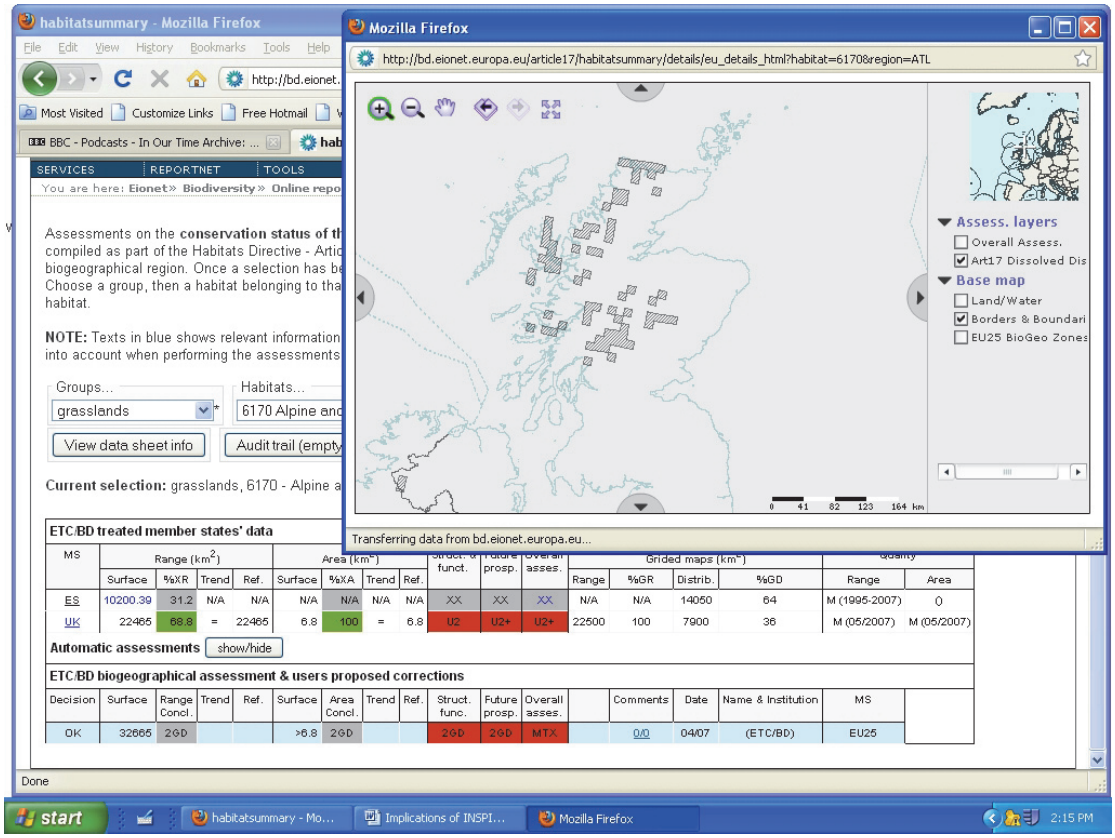


Figure 31: Final output of Article 17 reporting (in this instance for HD Annex I code 6170), available from EEA http://bd.eionet.europa.eu/article17/index_html

Use Case Description	
Name	National reporting on Article 17 of the Habitat Directive.
Priority	High
Description	Article 17 of the Habitat Directive obliges Member States to report every six years about the progress of the implementation of the directive. It is applicable for habitats and species for the entirety of the MS - both within and outside Natura 2000 network.
Scope	Monitoring, public service
Extent	National
Pre-condition	Biodiversity monitoring network being maintained. For reporting round #1 (2000-2006) the necessary information was collated by JNCC. For reporting round #2 (2006-2012) the necessary information is being collated by SNH. For reporting round #3 (2012-2018) the necessary information will be collated by SNH.
Flow of Events – Basic Path (for current reporting round, #2)	
Step 1	JNCC send SNH the RANGE & its subset DISTRIBUTION data from the last reporting round. The Range is a minimum convex polygon constructed using alpha hull software. The Distribution is the collection of 10x10-km squares of the National Grid showing the known and/or predicted occurrence of his habitat. The Range is essentially a mapping of regional biogeography– H6170 is "*almost entirely restricted to those upland areas in the central and north-western Highlands where base-rich rocks are found. Examples of the habitat at low altitude are very localised, being largely restricted to calcareous rocks in north-west mainland Scotland and on Skye*" (JNCC 2007). Biogeography does not, by definition, change quickly over time, but each round may be able to

	estimate the boundaries more precisely. The Distribution is essentially a presence/absence coarse scale grid. The round #1 mappings were mainly based on specialist expert judgement, although for H6170 JNCC also used the 1998 SNH Uplands Database. Expert judgement will also be the basis for round #2, but there is the potential to also use topographic, climate and geology spatial data.
Step 2	SNH determines the AREA (aka EXTENT) of H6170 – the actual hectarage this habitat occupies. This is determined by expert judgement from specialists for each habitat. These specialists are mainly SNH-in-house, but they connect with others in their field (i.e. external specialists). The principal spatial data these specialists use are the NVC habitat data. How much these data are used depends on the habitat in question. As noted elsewhere, it has not been possible to ascertain exactly how much of Scotland's land area is covered by NVC data – estimates range from 10% to 50%. It was agreed by all interviewees that the NVC data are very much concentrated on designated sites. So habitats that are well covered by designations are well mapped (e.g. some uplands habitats), but habitats that are principally in the wider countryside are not. Recently SNH have started addressing this by undertaking surveys for some wider-countryside habitats that were known to be poorly mapped, namely sand dunes, saltmarsh and shingle. There is minor use of other datasets: • Countryside survey landcover – very few habitats which can be strongly positively identified this way, really only blanket bog. However it could be informative as to where a habitat cannot exist if combined with biogeography, i.e. where there are base-rich rocks suitable for H6170 but the area is under tree cover. • Looking at Species data to see if these data can act as an indicator – SNH tried using NBN data to identify Caledonian woodland, but it did not work very effectively. The estimate of risk to H6170 as a whole (cf. Habitats Regulations 2009) is based on several elements, one of which is how much of the extent of the habitat is within designated sites and how much is outside (because more protected if within SACs or SSSIs).
Step 3	SNH determines the Condition, Pressure/threats, and Conservation measures for all known areas of H6170. This assessment is principally derived from the Site Condition Monitoring (SCM) reports for those designated sites which have H6170 features. However, this depends on the assumption that what is happening inside designated sites is also happening outside in the wider countryside. There is potential to use Scottish IACS data in conjunction with Land Registry polygons to ascertain what is happening in the wider countryside.
Step 4	The methods used are listed for all of the above, from the following selection: 3=complete survey, 2=estimate based on partial data with some extrapolation and/or modelling, 1=estimate based on expert opinion with no or minimal sampling, 0=absent data. This ordinal scale enables assessment of the confidence (accuracy) of the output.
Step 5	Penultimately, the CONSERVATION STATUS of a H6170 is assessed overall on a RAG (red-amber-green) scale.
Step 6	Finally, all of the above are collated into one report for H6170 to be submitted to the EEA (European Environment Agency). This information is disseminated to the public via the EEA website (see Figure x).

4.5 Use Case 4: Casework Management System (CMS)

Based on an interview with David Law (Senior Casework Manager) on Monday 12th March 2012.

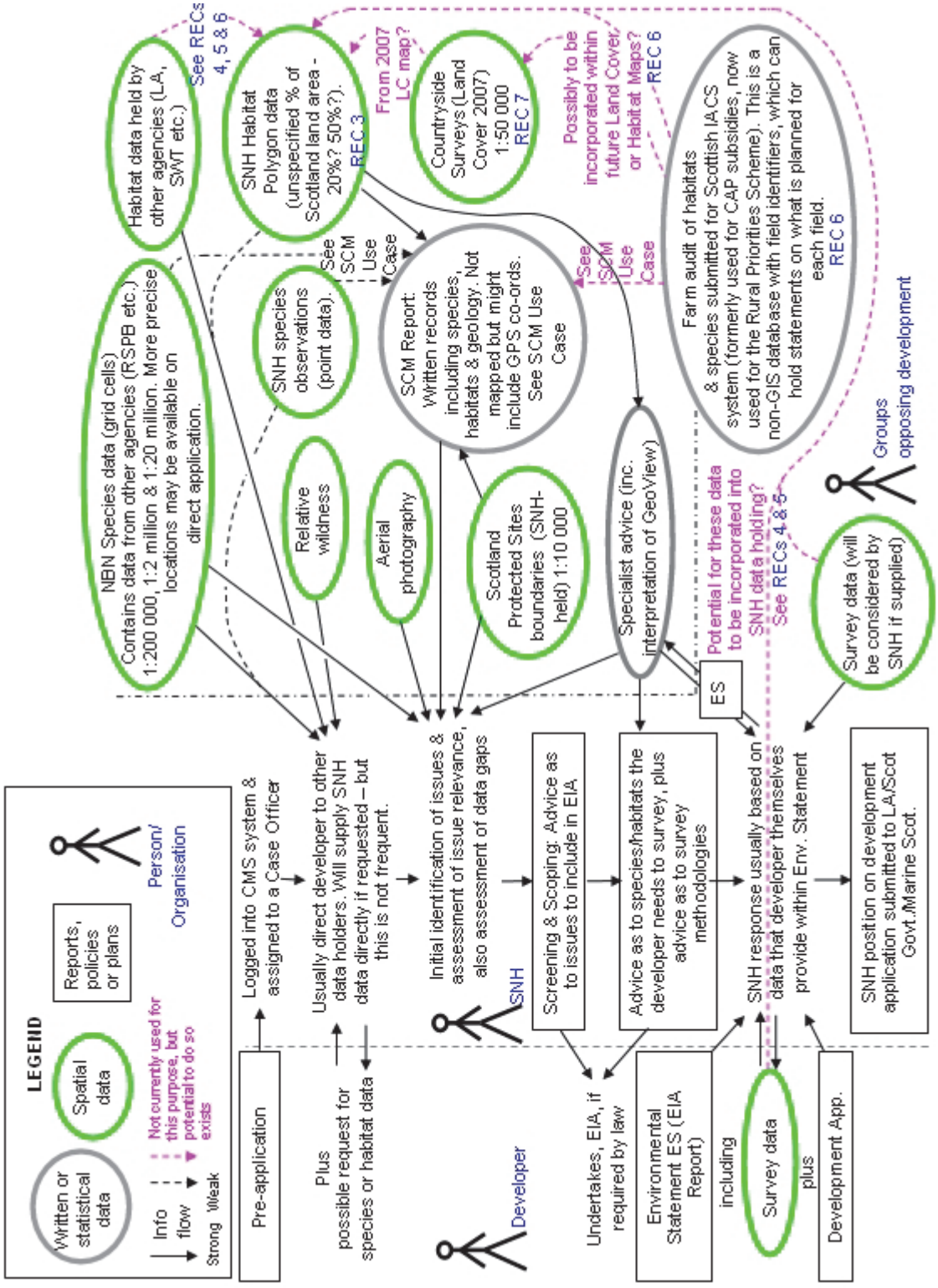


Figure 32: Info flow diagram Development Casework Management

Use Case Description	
Name	Input to development management using the Casework Management System (CMS).
Priority	High
Description	SNH is a statutory consultee for the EIA (Environmental Impact Assessment) and SEA (Strategic Environmental Assessment) processes – ultimate responsibilities for decisions within these processes rests with Local Authorities (LAs) and with the Scottish Government.
Scope	Public service
Extent	National
Pre-condition	Biodiversity monitoring network being maintained.

Flow of Events – Basic Path (for a hypothetical development)

Step 1 When a case comes in (a pre-application is usual), it is logged in the CMS and assigned to a Case Officer.

Step 2 A developer may request species or habitat data for the area under potential development. It is SNH policy to provide information to the developer as early as possible, so that they can become aware of any 'show-stopper' issues early on. The Case Officer thus would provide SNH held species and habitat data if available (under stringent conditions for protected species). However, most development is outside of Protected Sites (in the 'wider countryside'), and SNH unlikely to hold much data for that area. Therefore usually direct the developer to other data providers. Aberdeenshire Council have habitat data of their own, as do Cairngorm National Park – so for a development here, would probably refer developer to them for habitat data outside Protected Sites.
However would ask developers to look at the SNH 'Relative Wildness' map.

Step 3 As part of the pre-application process the developer will ask if SNH can identify any particular biodiversity issues and identify which surveys are required.

To this end the Case Officer undertakes initial identification of issues & assessment of issue relevance, also assessment of data gaps. This may involve overlaying the development onto a map view, but this is done 'by eye' as a drawing, not a true GIS polygon. Therefore the only spatial data within the CMS is indicative.

The Case Officer would use the following:

- Their own knowledge of the area.
- Aerial photography, if available, for context.
- If the development is within or near a Protected Site, they would look at the Site boundaries via GeoView, plus notified features, conservation issue & agreed management (i.e. the SCM reports). This is a broad-brush look at what the Site interests are.
- If not in a Protected Site, would probably look at NBN if no SNH species data in-house e.g. to see if Great Crested Newts are within 10km of the development.
- Would get specialist advice (in-house) if necessary. Note that there is much specialist info on GeoView which is not within the expertise of the Case Officers e.g. geomorphology. So the specialist advisor can refer to these data, which needs expertise to interpret. This also applies to species data – for e.g. was recently directed to seabird colony data (JNCC) by SNH specialist officer – so part of their job is to know about external data sources.

Step 4 The Case Officer offers advice to the developer re. screening & scoping (biodiversity issues to include in EIA). Also advice as to any species/habitat data the developer needs to survey, plus advice as to survey methodologies.

Step 5 The developer undertakes an EIA (if required), which will comprise part of the Development Application, which is submitted to the planning authority (LA / Scottish Govt./ Marine Scotland)

Step 6 The planning authority asks SNH for comments on the Environmental Statement resulting from the EIA process. The Case Officer would comment on the adequacy of the ES.

This feedback is based on data that the developer themselves provide – the Case Officer should not have to look at any other data sources. However, if an opposing group were to supply alternative survey info, then SNH would consider these data also.

The Case Officer would make a response based on these data – that response might be 'insufficient info, need a better survey' (although hopefully this would have been avoided by the developer accepting SNH advice as to survey requirements in the earlier stages).

In rare cases the response might be to reject the proposal – but again hopefully this would have been avoided by the developer accepting SNH advice as to 'show-stopper' issues in the earlier stages.

Finally, in very rare cases (one or two per year out of thousands) the case might go on to a public enquiry. The fact that this is such a low percentage demonstrates that the CMS functions as intended.

Further thoughts re. CMS Use Case

Regarding marine habitats & species:
Casework officers are aware that a great deal of work is being done re. marine data, but keeping up-to-date with all this is difficult. It is a rapidly changing area, and will become more important to CMS because of increased interest in marine renewables. Officers are still having to go to specialist advisers all the time – as noted in the MPA Use Case "*GeMS data are currently only accessible to members of the Coastal and Marine Ecosystems Unit*" for copyright and licensing reasons – so dealing with these issue (see Additional Requirement F) would greatly improve internal efficiency.

Regarding the information systems in general, the main issue is perceived as being a lack of capacity re. the skills to get the fullest use out of the data. David Law perceived that there was a training issue – "*Apart from a brief initial introduction, have been left to own devices when it comes to using the spatial data system. Perhaps there is a need for coaching rather than training?*" (see Recommendation 8)

4.6 Use Case 5: Rural Priorities Scheme

Based on several telephone interviews and email discussion with Stan Whitaker (Biodiversity Implementation Team Leader), Morag Milne (Natural Care, SRDP Policy and Advice Officer) and Tracey Robinson (Audit Response Task Force Project Manager) in 2009.

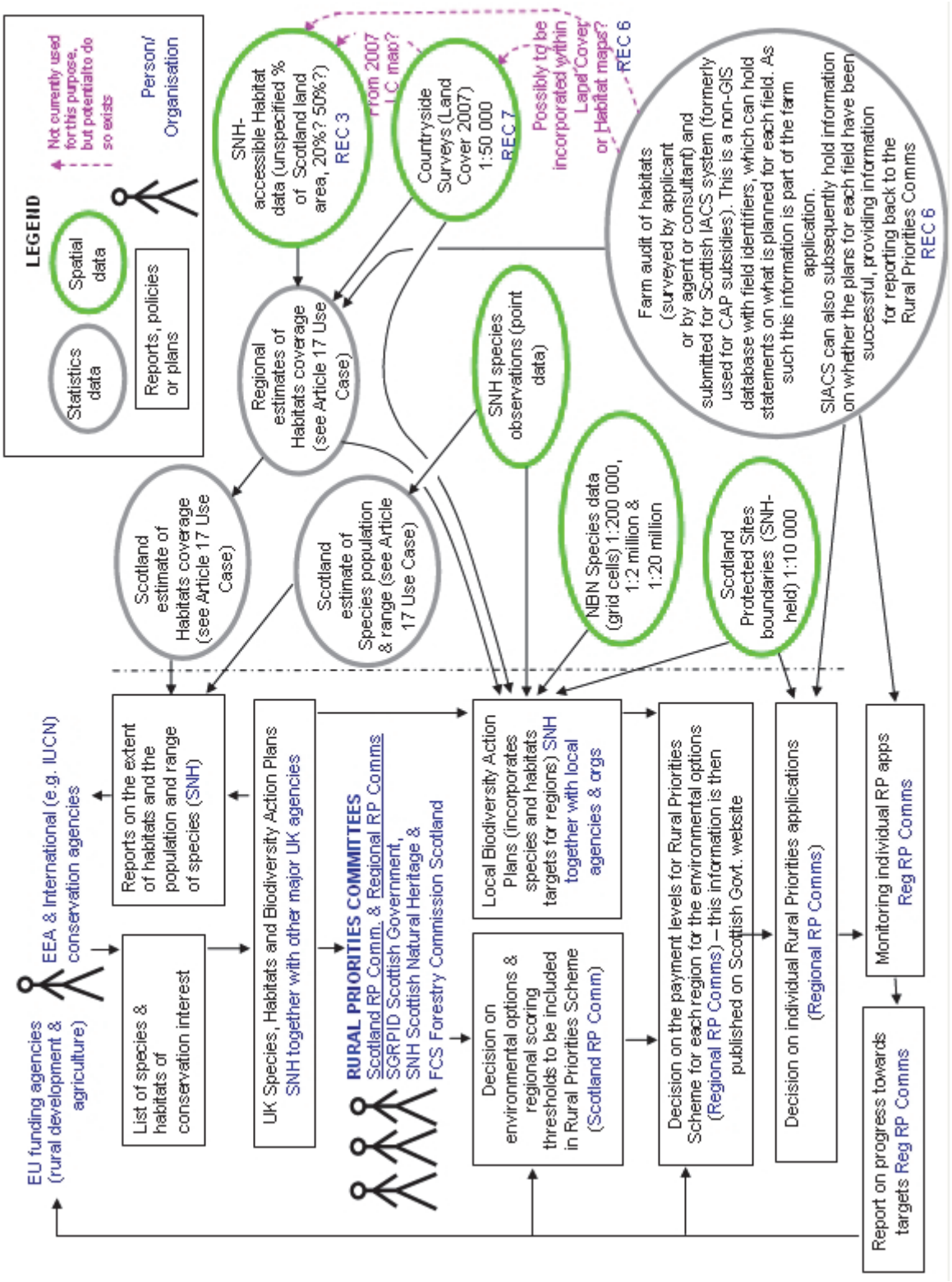


Figure 33: Info flow diagram Rural Priorities (SNH point of view)

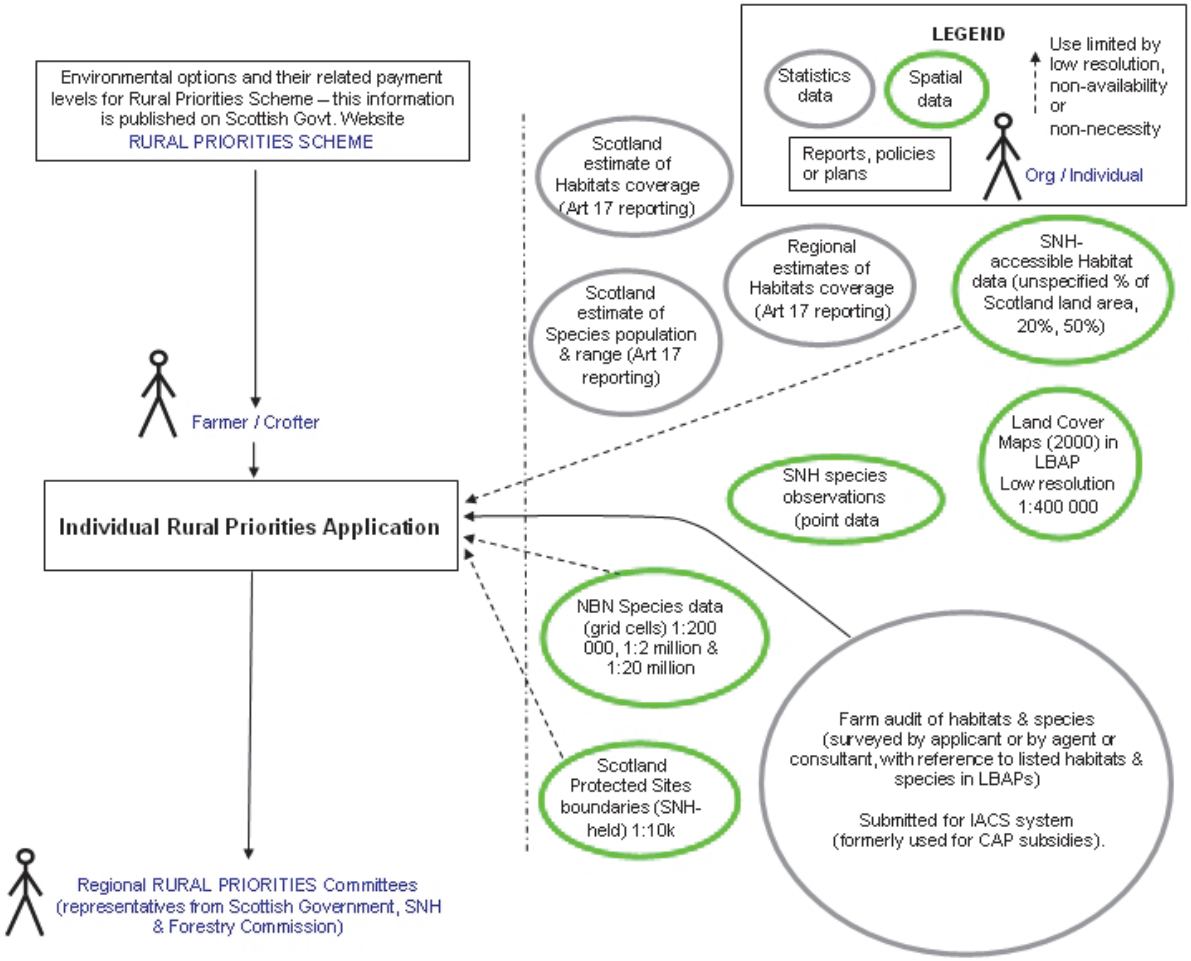


Figure 34: Info flow diagram Rural Priorities (farmer point of view)

Use Case Description	
Name	Scotland Rural Priorities Scheme (agri-environment scheme - agency DESIGN perspective) http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities
Priority	Medium (not a DIRECT legal obligation on the agency, but an important component of work towards fulfilling Natura 2000, which IS a direct legal obligation)
Description	Rural Development Contracts - Rural Priorities (RDC - RP) is an integrated funding mechanism which will deliver targeted environmental, social and economic benefits. It is a competitive mechanism to ensure that contracts are awarded for the proposals which are best able to deliver the agreed regional priorities, which include enhancing biodiversity. From a farmers/crofters perspective this scheme offers a financial incentive to pursue best environmental practice re. management of their land and choice of agricultural practices. The competition for grants is based on a points system - an area of land which has Protected Sites designation, or priority Habitats, or rare Species will have more 'points', and therefore an application to the scheme for this area of land will be at an advantage in the competition. This means that this scheme is particularly well suited to areas of non-intensive agriculture which are already relatively rich in biodiversity (e.g. the crofting areas of the Western Isles and Highlands).
Scope	Management.

Extent	Scotland
Pre-condition	Careful design of the scheme beforehand is required, particularly as regards the points system for existing biodiversity and the rewards system as regards the options. Currently there are 47 environmental options available, examples include: Conversion and Maintenance of Organic Farming, Mown Grassland for Corncrakes, Wardening for Golden Eagles, Control of Invasive Non-Native Species etc. etc.
Flow of Events – Basic Path	
Step 1	Article 17 reporting (see that Use Case)
Step 2	This information, together with that from other countries, enables EU & International conservation agencies to determine lists of species and habitats of conservation interest.
Step 3	These lists enable SNH, together with the other 3 UK agencies, to produce the three UK-wide Species, Habitats & Biodiversity Action Plans.
Step 4	At a regional level SNH, together with other local agencies and organisations, develops Local Biodiversity Action Plans. These LBAPs are developed with further reference to the available regional data for Species (spatial, from SNH & NBN) and Habitats (only 20-50% spatial data available within SNH, so most reference will be to statistical data). They are also developed with reference to Land Cover (100% coverage, but poorer spatial and thematic resolution), and Protected Sites.
Step 5	The Rural Priorities Scheme is jointly administered by three organisations - the Scottish Government Rural Payments & Inspections Directorate (SGRPID), SNH and the Forestry Commission Scotland (FCS). The Scotland level committee (NPAC) decides on the environmental options to be included in the Rural Priorities Scheme (with feedback from the EU agri-funding agencies) and the scoring thresholds for the Regional level committees (RPACs) to use.
Step 6	The regional level RP committees (RPACs) decide on the points system and payment levels for each environmental option for each region. These payment levels incorporate the LBAPs (which are, as noted above, very largely based on ecological spatial and statistical data).
Step7	The options and regional payment levels are published on the Scottish Government website.
Step 8	INDIVIDUAL RURAL PRIORITIES APPLICATIONS SUBMITTED. Each application is assessed on the points system - namely, which application offers the best value for EITHER conserving existing high biodiversity OR enhancing biodiversity. For example, an application will win more points if it contains "activities which will bring the notified special features of 95% of Scotland's nationally important nature sites (SSSIs, SACs, SPAs and Ramsar sites) into favourable condition, or maintain them in favourable condition". Each application should have a farm audit of habitats & species, which is submitted for the Scottish IACS system (formerly used for Common Agricultural Policy subsidies). S-IACS is a non-GIS database with field identifiers, holding statements for what exists and what is planned for each field.
Step 9	Grants are paid out to successful applicants.
Step 10	Applications are monitored, and reports on progress towards targets are submitted to the Scottish Government (who provide 66% of the funding) and the EU (34% funding).

5. DISCUSSION

Any dataset can be theoretically transformed to conform to the INSPIRE data specifications. However, considering cost-benefit issues, the crucial question relates to the feasibility of such transformation for SNH's holding of habitat data.

Transformation has constraints, problems and benefits.

The main constraint is the institutional one of limited capacity (see Add. Req. E and Rec. 3). The main resource cost will be capacity-building – the staff time taken to learn about INSPIRE, understand INSPIRE requirements, and apply INSPIRE specifications to the necessary datasets. Many European data providers have felt somewhat excluded by the complexity of the INSPIRE requirements (Carlisle & Green 2009, Hennig & Wallentin 2010). However, much of INSPIRE's exclusivity is due to "*the dilemma of standards: the need for systematic data handling versus the need for flexibility*" (De Man 2006).

A second constraint relates to data spatial and thematic resolutions (see Req. 4). Table 1 shows an assessment of effective linear and areal resolution for some common map scales.

Table 1: Resolution for some common map scales (after Goodchild 1993)

Minimum resolvable area	*Effective Linear Resolution*	*Equivalent vector scale (based on Goodchild 1993)*
100 km2	10 x 10 km	1: 20 million (**Article 17 Distribution Map scale** & NBN)
1 km2 (100 ha)	1 x 1 km	1: 2 million (CEH Landcover Map 2007 – free to use at this resolution)
1 ha	100 x 100 m	1: 200,000
2500 m2 (0.25 ha)	50 x 50 m	1: 100,000 (CORINE 2000 scale – free to use) **Also scale of SNH potential RS work**.
625 m2 (0.06ha)	25 x 25 m	1: 50,000 (CEH Landcover Map 2007 – currently charged for at this resolution)
100 m2	10 x 10 m	1: 20,000
25 m2	5m x 5m	1: 10,000 (NVC polygon scale & scale of Protected Sites maps used by **Site Condition Monitoring**)
1.56 m2	1.25 x 1.25 m	1: 2500 (first Land Registry scale)
1 m2	1 x 1 m	1: 2000
0.39 m2	0.625 x 0.625 m	1: 1250 (second Land Registry scale)

The Use Cases indicate that there are two scales that are important for SNH's statutory work – namely 1:20 million (Article 17 Distribution Map, namely the mapping of presence/absence on 10km x 10km grid squares) and 1:10,000 (Site Condition Monitoring, upon which two of the other Use Cases depend). Habitat data at these two scales should be made available for view/query/download (see Reqs 1, 2, 3 & 5, and Add. Reqs C & D).

It should be noted that NE have already taken this approach, at least as regards viewing, in the 'Nature on the Map' WMS. Examination of 'Nature on the Map', however, does throw up something of a 'viewing gap' in the middle of this scale range – the regional scale, where 1:20 million is too coarse and 1:10,000 too fine for informative viewing. SNH are currently investigating whether to have a programme of habitat mapping via remote sensing (RS) work, which would deliver minimum units of 0.25ha – or 1:100,000. These data would address the regional scale 'viewing gap' described above.

Granularity or Thematic resolution (the number of classes within a classification) is also a constraint. Firstly, it should be noted that other classifications have been available in the

recent past (Metzger *et al* 2005; Sheail and Bunce 2003; Bunce *et al* 2002; Bölöni *et al* 2007), and new ones may become established as best practice in the future. Again, this comes back to "*the dilemma of standards*" (De Man 2006), the need for methodical data handling versus the need for adaptability. In INSPIRE HB-DSv2.0 the classifications taken as standard are HD Annex I or EUNIS (see Req 4 and Recs. 1 & 2).

Coarse granularity such as that used by NE in their WMS 'Nature on the Map' allows for easy viewing (only 22 classes), but is of little use for serious internal (SCM, Art17, CSM) or external (EIA and LA statutory planning) work. Fine granularity (detailed EUNIS or NVC) is useful for these functions, but difficult to accommodate within a WMS/WFS viewer.

The foreseeable challenges fall into three areas: institutional, development and research.

The first institutional problem is that some data providers/distributors are not the data creators, who are often in different institutions or within academia or are commercial interests. This results in an issue as regards communication with data creators and negotiating who will take on the burden of achieving compliance as well as negotiating data exchange agreements (see Add. Reqs F, Recs. 4, 5, 6, 7, 8, 9, 10). How much of the onus is on SNH to do the work towards INSPIRE compliance, and how much should rest with the data originator? Obviously SNH does not want to end up in a position where they take on INSPIRE compliance responsibilities of other organisations where it is not needed, nor should SNH duplicate effort. Clearly dialogue with data suppliers is needed in order to avoid such unnecessary costs. However, where SNH collates and add value to a subset of habitat (or species) records (some from 3rd parties), to support the MPA process for example, SNH need to ensure that the collation itself is INSPIRE compliant.

Secondly, some data providers may not perceive there to be any great benefits resulting from achieving INSPIRE compliance, and will be undertaking the process because it will become a legal requirement to do so, rather than because of awareness of its importance for the principles of compatibility, accessibility and compliance. SNH are not excluded from this problem – while the author met with widespread enthusiasm for opening up the SNH data holding to public access, she also frequently encountered assumptions that the habitat data currently supplied for download as shapefiles were already fit-for-use by external stakeholders (reasons why they are not are given in section 3.1.3), presumably because SNH's internal set up (with a 1: many relationship between NVC polygon and habitats) is indeed fit-for-use (see Req. 5).

This finding indicates a lack of "*external awareness*" (Thellufsen *et al* 2009), i.e. not changing focus from "*data handling in isolation to service orientated delivery of land information to wider society*". INSPIRE is intended to address this (see Reqs 1, 2, 3 & 5).

The potential lack of recognition of any great benefits resulting from achieving INSPIRE compliance, particularly re. sustainable development (Musacchio 2009) is based on perceptions of saliency (relevance to decision-making) (see Add. Reqs B, G & H) and legitimacy (fair and unbiased information) (see Add. Req. A), in particular the perception that nature conservation SDI may be considered "*too complex, too prescriptive, too demanding of resources, or not flexible enough to support place-specific decisions*." (Nassauer and Opdam 2008).

The research problem is that of the reporting of data accuracy. It is now standard for any dataset to have a statement within its metadata describing its spatial resolution, which corresponds to its spatial precision. This value is usually taken corresponding to spatial accuracy – and for the spatial domain this is often enough the case to be allowed to pass.

However, thematic accuracy does not usually correspond to thematic precision (which is equivalent to thematic resolution or granularity). Additionally it is much less common for there to have been any assessment of thematic accuracy. As several authors have noted, the accuracy or uncertainty associated with spatial data is critical for ecology research (Shao and Wu 2008; Thompson and Gergel 2008; Gimona et al 2009). A data accuracy statement is also a vital component in the context of increasing spatial data exchange (Goodchild, 1995) if research is to have political and social legitimacy (Nassauer and Opdam 2008). See Add. Req. A. Such information may be difficult to identify retrospectively (see Add. Req. B and section 3.5).

However, the INSPIRE Directive was formulated on the basis that its implementation would bring many benefits, most of which would bring about cost reduction (Thellufsen *et al* 2009, Tuchyna 2006, Bunce *et al* 2008, Wu 2006; Fu *et al* 2008; Metzger 2008, Metzger *et al* 2008, Czúcz *et al* 2009, Rajabifard *et al* 2002, Smit *et al* 2008, Musacchio 2009). These benefits are listed below.

- Facilitating structural improvements in communications within organisations (see Add. Reqs D & E and Recs 1, 2 & 8).
- Facilitating structural improvements in communications between organisations (see Req. 5, Add. Reqs. D & F, and Recs. 4, 5, 6, 7 & 8).
- Enabling data-sharing (see Req. 5, Add. Reqs. D & F, and Recs. 4, 5, 6, 7 & 8).
- Identifying and addressing data gaps (see Add Req. E and Recs. 3, 4, 5, 6 & 8).
- Reducing duplication (see Add Req. E and Recs. 4, 5, 6 & 8).
- Enhance work-flows and time management (see Rec. 3 and Add. Reqs. B, E, G & H).
- Co-ordinating compatibility and facilitating cross-boundary management (see Add. Req. D).
- Increasing accessibility of the datasets to wider society (see Reqs. 1, 2, 3, 4 & 5, also Add. Req. A).
- Facilitating international modelling and analysis (see Req. 5 and section 3.5).
- Enabling transferability of local, regional or national research methodologies to other areas (see Req. 5).
- Enabling change analysis at the strategic level (see section 4.4, Article 17 reporting).
- Promoting the interdisciplinary approach to research sustainability issues (see Req. 5)
- Supporting strategic environmental assessment (SEA) and environmental impact assessment (EIA) (see Req. 5 and section 4.5, Casework Management).
- Reducing resource disputes (see section 4.5, Casework Management).
- Promoting consistency in marine species and habitat conservation (see Add. Reqs. D & F)
- Promoting consistency in terrestrial species and habitat conservation (see Add. Reqs. A, B, C, E, G & H and Recs. 3, 4, 5, 6 & 8)
- Facilitating management of all non-urban land areas, whether protected for conservation purposes or not (see Add. Reqs. A, B, C, E, G & H and Recs. 3, 4, 5, 6 & 8).

6. CONCLUSIONS

In conclusion, there are five priority requirements resulting from the INSPIRE and Aarhus Directives.

Requirement 1: Habitats metadata must be INSPIRE compliant and available for discovery by **Dec 2013**. All habitats spatial data collected after Dec 2013 must be INSPIRE compliant and must speedily be made available for view, query and download, from **Dec 2014** onwards.

Requirement 2: All legacy habitats spatial data (collected before Dec 2013) should be transformed to become INSPIRE compliant, and then must be made available for view, query and download, from **2019** onwards.

Requirement 3: Any legacy habitat data which cannot be made INSPIRE compliant must be archived and not used for any statutory purpose from 2019 onwards.

Requirement 4: All habitat data must be classified using at least one of the two current pan-European Habitats classifications – namely, Habitats Directive Annex I or EUNIS.

Requirement 5: If the current SNH data structure is retained, with several habitat types attributed to one feature (polygon or polyline), then a transformation & web service approach must be developed which enables the INSPIRE objectives of **view, query and download for external stakeholders.**

In addition to these there are eight additional requirements, which are essential to minimise resource costs. The three most important of these are:
Additional Requirement B: SNH should consider the applicability of the theme **Environmental Monitoring Facilities** and the guidelines for **Observations & Measurements** for their applicability to the SNH Habitat data holding.
Additional Requirement C: The decision for data structures for new data should take precedence over any decisions about legacy data.
Additional Requirement F: 3rd party copyright issues for many of the marine datasets need to be clarified, documented and legitimised via licence agreements.

There are five remaining additional requirements. Additionally there are eight recommendations, which are advisable to minimise resource costs. Out of this total of thirteen:

- Four of these address communication issues within SNH.
- Two of these address information issues within SNH
- One recommends coaching/training
- One recommends a best practice.
- The remaining five address the potential to use 3rd party data / information.

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All the following EU documents are available to view or download at http://eur-lex.europa.eu/en/index.htm. **Use the simple search, and select 'natural number'.**

Directive: year 1985, number 337
EIA Directive 85/337/EEC (including amendments 97/11/EC, 2003/35/EC & 2009/31/EC) – the Environmental Impact Assessment Directive

Directive: year 2001, number 42
SEA Directive 2001/42/EC –the Strategic Environmental Assessment Directive

Directive: 2003, number 4
Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC.

Directive: year 2005, number 1698
Rural Development Regulation 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

Directive: year 2007, number 2
Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

Directive: year 2008, number 56
Marine Strategy Framework Directive2008/56/EC

COM final: year 2000, number 547
COM (2000) 547 final Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management (ICZM): A Strategy for Europe – hereafter referred to as the ICZM Resolution.

COM final: year 2007, number 308
Evaluation of ICZM in Europe 18 August 2006 – hereafter referred to as the ICZM Evaluation

COM final: year 2007, number 575
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COM final: year 2009, number 469
COM(2009) 469 final: Report on the application and effectiveness of the SEA Directive

ANNEX 1: AARHUS DIRECTIVE

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0004:EN:HTML

Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on **public access to environmental information** and repealing Council Directive 90/313/EEC THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, Having regard to the Treaty establishing the European Community, and in particular Article 175(1) thereof, Having regard to the proposal from the Commission(1), Having regard to the opinion of the European Economic and Social Committee(2), Having regard to the opinion of the Committee of the Regions(3), Acting in accordance with the procedure laid down in Article 251 of the Treaty(4) in the light of the joint text approved by the Conciliation Committee on 8 November 2002,

Whereas:

(1) Increased public access to environmental information and the dissemination of such information contribute to a greater awareness of environmental matters, a free exchange of views, more effective participation by the public in environmental decision-making and, eventually, to a better environment.

(2) Council Directive 90/313/EEC of 7 June 1990 on the freedom of access to information on the environment(5) initiated a process of change in the manner in which public authorities approach the issue of openness and transparency, establishing measures for the exercise of the right of public access to environmental information which should be developed and continued. This Directive expands the existing access granted under Directive 90/313/EEC.

(3) Article 8 of that Directive requires Member States to report to the Commission on the experience gained, in the light of which the Commission is required to make a report to the European Parliament and to the Council together with any proposal for revision of the Directive which it may consider appropriate.

(4) The report produced under Article 8 of that Directive identifies concrete problems encountered in the practical application of the Directive.

(5) On 25 June 1998 the European Community signed the UN/ECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters ("the Aarhus Convention"). Provisions of Community law must be consistent with that Convention with a view to its conclusion by the European Community.

(6) It is appropriate in the interest of increased transparency to replace Directive 90/313/EEC rather than to amend it, so as to provide interested parties with a single, clear and coherent legislative text.

(7) Disparities between the laws in force in the Member States concerning access to environmental information held by public authorities can create inequality within the Community as regards access to such information or as regards conditions of competition.

(8) It is necessary to ensure that any natural and legal person has a right of access to environmental information held by or for public authorities without his having to state an interest.

(9) It is also necessary that public authorities make available and disseminate environmental information to the general public to the widest extent possible, in particular by using information and communication technologies. The future development of these technologies should be taken into account in the reporting on, and reviewing of, this Directive.

(10) The definition of environmental information should be clarified so as to encompass information in any form on the state of the environment, on factors, measures or activities affecting or likely to affect the environment or designed to protect it, on cost-benefit and economic analyses used within the framework of such measures or activities and also information on the state of human health and safety, including the contamination of the food

chain, conditions of human life, cultural sites and built structures in as much as they are, or may be, affected by any of those matters.

(11) To take account of the principle in Article 6 of the Treaty, that environmental protection requirements should be integrated into the definition and implementation of Community policies and activities, the definition of public authorities should be expanded so as to encompass government or other public administration at national, regional or local level whether or not they have specific responsibilities for the environment. The definition should likewise be expanded to include other persons or bodies performing public administrative functions in relation to the environment under national law, as well as other persons or bodies acting under their control and having public responsibilities or functions in relation to the environment.

(12) Environmental information which is physically held by other bodies on behalf of public authorities should also fall within the scope of this Directive.

(13) Environmental information should be made available to applicants as soon as possible and within a reasonable time and having regard to any timescale specified by the applicant.

(14) Public authorities should make environmental information available in the form or format requested by an applicant unless it is already publicly available in another form or format or it is reasonable to make it available in another form or format. In addition, public authorities should be required to make all reasonable efforts to maintain the environmental information held by or for them in forms or formats that are readily reproducible and accessible by electronic means.

(15) Member States should determine the practical arrangements under which such information is effectively made available. These arrangements shall guarantee that the information is effectively and easily accessible and progressively becomes available to the public through public telecommunications networks, including publicly accessible lists of public authorities and registers or lists of environmental information held by or for public authorities.

(16) The right to information means that the disclosure of information should be the general rule and that public authorities should be permitted to refuse a request for environmental information in specific and clearly defined cases. Grounds for refusal should be interpreted in a restrictive way, whereby the public interest served by disclosure should be weighed against the interest served by the refusal. The reasons for a refusal should be provided to the applicant within the time limit laid down in this Directive.

(17) Public authorities should make environmental information available in part where it is possible to separate out any information falling within the scope of the exceptions from the rest of the information requested.

(18) Public authorities should be able to make a charge for supplying environmental information but such a charge should be reasonable. This implies that, as a general rule, charges may not exceed actual costs of producing the material in question. Instances where advance payment will be required should be limited. In particular cases, where public authorities make available environmental information on a commercial basis, and where this is necessary in order to guarantee the continuation of collecting and publishing such information, a market-based charge is considered to be reasonable; an advance payment may be required. A schedule of charges should be published and made available to applicants together with information on the circumstances in which a charge may be levied or waived.

(19) Applicants should be able to seek an administrative or judicial review of the acts or omissions of a public authority in relation to a request.

(20) Public authorities should seek to guarantee that when environmental information is compiled by them or on their behalf, the information is comprehensible, accurate and comparable. As this is an important factor in assessing the quality of the information supplied the method used in compiling the information should also be disclosed upon request.

(21) In order to increase public awareness in environmental matters and to improve environmental protection, public authorities should, as appropriate, make available and

disseminate information on the environment which is relevant to their functions, in particular by means of computer telecommunication and/or electronic technology, where available.

(22) This Directive should be evaluated every four years, after its entry into force, in the light of experience and after submission of the relevant reports by the Member States, and be subject to revision on that basis. The Commission should submit an evaluation report to the European Parliament and the Council.

(23) Since the objectives of the proposed Directive cannot be sufficiently achieved by the Member States and can therefore be better achieved at Community level, the Community may adopt measures, in accordance with the principle of subsidiarity as set out in Article 5 of the Treaty. In accordance with the principle of proportionality, as set out in that Article, this Directive does not go beyond what is necessary in order to achieve those objectives.

(24) The provisions of this Directive shall not affect the right of a Member State to maintain or introduce measures providing for broader access to information than required by this Directive,

HAVE ADOPTED THIS DIRECTIVE:

Article 1
Objectives
The objectives of this Directive are:

(a) to guarantee the right of access to environmental information held by or for public authorities and to set out the basic terms and conditions of, and practical arrangements for, its exercise; and

(b) to ensure that, as a matter of course, environmental information is progressively made available and disseminated to the public in order to achieve the widest possible systematic availability and dissemination to the public of environmental information. To this end the use, in particular, of computer telecommunication and/or electronic technology, where available, shall be promoted.

Article 2
Definitions
For the purposes of this Directive:

1. "Environmental information" shall mean any information in written, visual, aural, electronic or any other material form on:

(a) the state of the elements of the environment, such as air and atmosphere, water, soil, land, landscape and natural sites including wetlands, coastal and marine areas, biological diversity and its components, including genetically modified organisms, and the interaction among these elements;

(b) factors, such as substances, energy, noise, radiation or waste, including radioactive waste, emissions, discharges and other releases into the environment, affecting or likely to affect the elements of the environment referred to in (a);

(c) measures (including administrative measures), such as policies, legislation, plans, programmes, environmental agreements, and activities affecting or likely to affect the elements and factors referred to in (a) and (b) as well as measures or activities designed to protect those elements;

(d) reports on the implementation of environmental legislation;

(e) cost-benefit and other economic analyses and assumptions used within the framework of the measures and activities referred to in (c); and

(f) the state of human health and safety, including the contamination of the food chain, where relevant, conditions of human life, cultural sites and built structures inasmuch as they are or may be affected by the state of the elements of the environment referred to in (a) or, through those elements, by any of the matters referred to in (b) and (c).

2. "Public authority" shall mean:

(a) government or other public administration, including public advisory bodies, at national, regional or local level;

(b) any natural or legal person performing public administrative functions under national law, including specific duties, activities or services in relation to the environment; and

(c) any natural or legal person having public responsibilities or functions, or providing public services, relating to the environment under the control of a body or person falling within (a) or (b).

Member States may provide that this definition shall not include bodies or institutions when acting in a judicial or legislative capacity. If their constitutional provisions at the date of adoption of this Directive make no provision for a review procedure within the meaning of Article 6, Member States may exclude those bodies or institutions from that definition.

3. "Information held by a public authority" shall mean environmental information in its possession which has been produced or received by that authority.

4. "Information held for a public authority" shall mean environmental information which is physically held by a natural or legal person on behalf of a public authority.

5. "Applicant" shall mean any natural or legal person requesting environmental information.

6. "Public" shall mean one or more natural or legal persons, and, in accordance with national legislation or practice, their associations, organisations or groups.

Article 3

Access to environmental information upon request

1. Member States shall ensure that public authorities are required, in accordance with the provisions of this Directive, to make available environmental information held by or for them to any applicant at his request and without his having to state an interest.

2. Subject to Article 4 and having regard to any timescale specified by the applicant, environmental information shall be made available to an applicant:

(a) as soon as possible or, at the latest, within one month after the receipt by the public authority referred to in paragraph 1 of the applicant's request; or

(b) within two months after the receipt of the request by the public authority if the volume and the complexity of the information is such that the one-month period referred to in (a) cannot be complied with. In such cases, the applicant shall be informed as soon as possible, and in any case before the end of that one-month period, of any such extension and of the reasons for it.

3. If a request is formulated in too general a manner, the public authority shall as soon as possible, and at the latest within the timeframe laid down in paragraph 2(a), ask the applicant to specify the request and shall assist the applicant in doing so, e.g. by providing information on the use of the public registers referred to in paragraph 5(c). The public authorities may, where they deem it appropriate, refuse the request under Article 4(1)(c).

4. Where an applicant requests a public authority to make environmental information available in a specific form or format (including in the form of copies), the public authority shall make it so available unless:

(a) it is already publicly available in another form or format, in particular under Article 7, which is easily accessible by applicants; or

(b) it is reasonable for the public authority to make it available in another form or format, in which case reasons shall be given for making it available in that form or format.

For the purposes of this paragraph, public authorities shall make all reasonable efforts to maintain environmental information held by or for them in forms or formats that are readily reproducible and accessible by computer telecommunications or by other electronic means.

The reasons for a refusal to make information available, in full or in part, in the form or format requested shall be provided to the applicant within the time limit referred to in paragraph 2(a).

5. For the purposes of this Article, Member States shall ensure that:

(a) officials are required to support the public in seeking access to information;

(b) lists of public authorities are publicly accessible; and

(c) the practical arrangements are defined for ensuring that the right of access to environmental information can be effectively exercised, such as:

- the designation of information officers;
- the establishment and maintenance of facilities for the examination of the information required,
- registers or lists of the environmental information held by public authorities or information points, with clear indications of where such information can be found.

Member States shall ensure that public authorities inform the public adequately of the rights they enjoy as a result of this Directive and to an appropriate extent provide information, guidance and advice to this end.

Article 4

Exceptions

1. Member States may provide for a request for environmental information to be refused if:

(a) the information requested is not held by or for the public authority to which the request is addressed. In such a case, where that public authority is aware that the information is held by or for another public authority, it shall, as soon as possible, transfer the request to that other authority and inform the applicant accordingly or inform the applicant of the public authority to which it believes it is possible to apply for the information requested;

(b) the request is manifestly unreasonable;

(c) the request is formulated in too general a manner, taking into account Article 3(3);

(d) the request concerns material in the course of completion or unfinished documents or data;

(e) the request concerns internal communications, taking into account the public interest served by disclosure.

Where a request is refused on the basis that it concerns material in the course of completion, the public authority shall state the name of the authority preparing the material and the estimated time needed for completion.

2. Member States may provide for a request for environmental information to be refused if disclosure of the information would adversely affect:

(a) the confidentiality of the proceedings of public authorities, where such confidentiality is provided for by law;

(b) international relations, public security or national defence;

(c) the course of justice, the ability of any person to receive a fair trial or the ability of a public authority to conduct an enquiry of a criminal or disciplinary nature;

(d) the confidentiality of commercial or industrial information where such confidentiality is provided for by national or Community law to protect a legitimate economic interest, including the public interest in maintaining statistical confidentiality and tax secrecy;

(e) intellectual property rights;

(f) the confidentiality of personal data and/or files relating to a natural person where that person has not consented to the disclosure of the information to the public, where such confidentiality is provided for by national or Community law;

(g) the interests or protection of any person who supplied the information requested on a voluntary basis without being under, or capable of being put under, a legal obligation to do so, unless that person has consented to the release of the information concerned;

(h) the protection of the environment to which such information relates, such as the location of rare species.

The grounds for refusal mentioned in paragraphs 1 and 2 shall be interpreted in a restrictive way, taking into account for the particular case the public interest served by disclosure. In every particular case, the public interest served by disclosure shall be weighed against the interest served by the refusal. Member States may not, by virtue of paragraph 2(a), (d), (f), (g) and (h), provide for a request to be refused where the request relates to information on emissions into the environment.

Within this framework, and for the purposes of the application of subparagraph (f), Member States shall ensure that the requirements of Directive 95/46/EC of the European

Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data are complied with(6).

3. Where a Member State provides for exceptions, it may draw up a publicly accessible list of criteria on the basis of which the authority concerned may decide how to handle requests.

4. Environmental information held by or for public authorities which has been requested by an applicant shall be made available in part where it is possible to separate out any information falling within the scope of paragraphs 1(d) and (e) or 2 from the rest of the information requested.

5. A refusal to make available all or part of the information requested shall be notified to the applicant in writing or electronically, if the request was in writing or if the applicant so requests, within the time limits referred to in Article 3(2)(a) or, as the case may be, (b). The notification shall state the reasons for the refusal and include information on the review procedure provided for in accordance with Article 6.

Article 5

Charges

1. Access to any public registers or lists established and maintained as mentioned in Article 3(5) and examination in situ of the information requested shall be free of charge.

2. Public authorities may make a charge for supplying any environmental information but such charge shall not exceed a reasonable amount.

3. Where charges are made, public authorities shall publish and make available to applicants a schedule of such charges as well as information on the circumstances in which a charge may be levied or waived.

Article 6

Access to justice

1. Member States shall ensure that any applicant who considers that his request for information has been ignored, wrongfully refused (whether in full or in part), inadequately answered or otherwise not dealt with in accordance with the provisions of Articles 3, 4 or 5, has access to a procedure in which the acts or omissions of the public authority concerned can be reconsidered by that or another public authority or reviewed administratively by an independent and impartial body established by law. Any such procedure shall be expeditious and either free of charge or inexpensive.

2. In addition to the review procedure referred to in paragraph 1, Member States shall ensure that an applicant has access to a review procedure before a court of law or another independent and impartial body established by law, in which the acts or omissions of the public authority concerned can be reviewed and whose decisions may become final. Member States may furthermore provide that third parties incriminated by the disclosure of information may also have access to legal recourse.

3. Final decisions under paragraph 2 shall be binding on the public authority holding the information. Reasons shall be stated in writing, at least where access to information is refused under this Article.

Article 7

Dissemination of environmental information

1. Member States shall take the necessary measures to ensure that public authorities organise the environmental information which is relevant to their functions and which is held by or for them, with a view to its active and systematic dissemination to the public, in particular by means of computer telecommunication and/or electronic technology, where available.

The information made available by means of computer telecommunication and/or electronic technology need not include information collected before the entry into force of this Directive unless it is already available in electronic form.

Member States shall ensure that environmental information progressively becomes available in electronic databases which are easily accessible to the public through public telecommunication networks.

2. The information to be made available and disseminated shall be updated as appropriate and shall include at least:

(a) texts of international treaties, conventions or agreements, and of Community, national, regional or local legislation, on the environment or relating to it;

(b) policies, plans and programmes relating to the environment;

(c) progress reports on the implementation of the items referred to in (a) and (b) when prepared or held in electronic form by public authorities;

(d) the reports on the state of the environment referred to in paragraph 3;

(e) data or summaries of data derived from the monitoring of activities affecting, or likely to affect, the environment;

(f) authorisations with a significant impact on the environment and environmental agreements or a reference to the place where such information can be requested or found in the framework of Article 3;

(g) environmental impact studies and risk assessments concerning the environmental elements referred to in Article 2(1)(a) or a reference to the place where the information can be requested or found in the framework of Article 3.

3. Without prejudice to any specific reporting obligations laid down by Community legislation, Member States shall take the necessary measures to ensure that national, and, where appropriate, regional or local reports on the state of the environment are published at regular intervals not exceeding four years; such reports shall include information on the quality of, and pressures on, the environment.

4. Without prejudice to any specific obligation laid down by Community legislation, Member States shall take the necessary measures to ensure that, in the event of an imminent threat to human health or the environment, whether caused by human activities or due to natural causes, all information held by or for public authorities which could enable the public likely to be affected to take measures to prevent or mitigate harm arising from the threat is disseminated, immediately and without delay.

5. The exceptions in Article 4(1) and (2) may apply in relation to the duties imposed by this Article.

6. Member States may satisfy the requirements of this Article by creating links to Internet sites where the information can be found.

Article 8

Quality of environmental information

1. Member States shall, so far as is within their power, ensure that any information that is compiled by them or on their behalf is up to date, accurate and comparable.

2. Upon request, public authorities shall reply to requests for information pursuant to Article 2(1)b, reporting to the applicant on the place where information, if available, can be found on the measurement procedures, including methods of analysis, sampling, and pre-treatment of samples, used in compiling the information, or referring to a standardised procedure used.

Article 9

Review procedure

1. Not later than 14 February 2009, Member States shall report on the experience gained in the application of this Directive.

They shall communicate the report to the Commission not later than 14 August 2009.

No later than 14 February 2004, the Commission shall forward to the Member States a guidance document setting out clearly the manner in which it wishes the Member States to report.

2. In the light of experience and taking into account developments in computer telecommunication and/or electronic technology, the Commission shall make a report to the

European Parliament and to the Council together with any proposal for revision, which it may consider appropriate.

Article 10
Implementation

Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 14 February 2005. They shall forthwith inform the Commission thereof.

When Member States adopt these measures, they shall contain a reference to this Directive or shall be accompanied by such reference on the occasion of their official publication. The methods of making such reference shall be laid down by Member States.

Article 11
Repeal

Directive 90/313/EEC is hereby repealed with effect from 14 February 2005.
References to the repealed Directive shall be construed as referring to this Directive and shall be read in accordance with the correlation table in the Annex.

Article 12
Entry into force

This Directive shall enter into force on the day of its publication in the Official Journal of the European Union.

Article 13
Addressees

This Directive is addressed to the Member States.

ANNEX 2: LEGAL CONTEXT

As noted in the Introdcution, INSPIRE enables determination of the level of compliance with the Aarhus Directive. The following quotes from the Aarhus Directive (Annex 1) are illustrative:

> "Participation…..in particular of NGOs, should be fostered, including *inter alia* by promoting environmental education of the public."
>
> "Provides for access to… procedures for challenging the substantive…. legality of decisions"
>
> Public access to "the decisions taken and the reasons and considerations upon which those decisions are based"

The following quotes are taken from the EU website summary of the Aarhus Convention (http://ec.europa.eu/environment/aarhus/):

- the right of everyone to receive environmental information that is held by public authorities ("**access to environmental information**"). This can include information on the state of the environment, but also on policies or measures taken, or on the state of human health and safety where this can be affected by the state of the environment. Applicants are entitled to obtain this information within one month of the request and without having to say why they require it. In addition, public authorities are obliged, under the Convention, to actively disseminate environmental information in their possession;
- the right to participate in environmental decision-making. Arrangements are to be made by public authorities to enable the public affected and environmental non-governmental organisations to comment on, for example, proposals for projects affecting the environment, or plans and programmes relating to the environment, these comments to be taken into due account in decision-making, and information to be provided on the final decisions and the reasons for it ("**public participation in environmental decision-making**");
- the right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general ("**access to justice**").

The need for further legislation to bring about determination of compliance with the Aarhus Directive (and all other environmental legislation) has been described by Farmer (2011):

> "The effectiveness of EU environmental policy depends upon its appropriate implementation. Most member states have had problems, and most EU environmental law has been affected. There are many reasons for this, including a lack of political will, real or deliberate misinterpretation of the law, and investment constraints. Where this happens, the EC should enforce member state obligations….. However, the ease with which implementation can be determined reflects the nature of the legal obligations.
>
> Compliance with specific performance standards (e.g. emission limits) or specific environmental standards (e.g. for air quality) is relatively easy to determine. Where the law requires significant levels of analysis to determine what needs practically to be done, compliance is much harder to determine."

Six legislative/policy instruments are quoted further here in relation to INSPIRE – namely the EIA & SEA Directives, the Marine Strategy Framework Directive, the SEIS Communication, the ICZM resolution and the Rural Development Regulation (re. current Agricultural Policy)

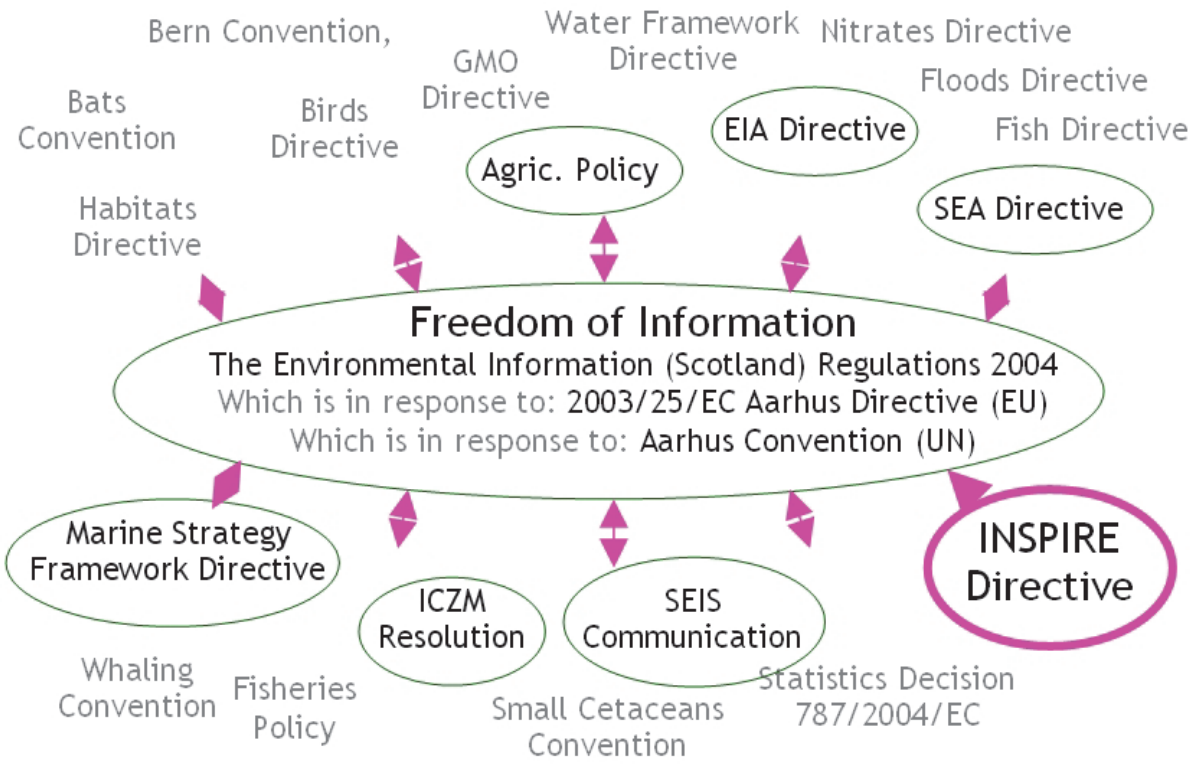

Figure 35:The relationship of environmental legislation and policies with the Aarhus & INSPIRE Directives (#2)

EIA Directive85/337/EEC (including amendments 97/11/EC, 2003/35/EC & 2009/31/EC) –the Environmental Impact Assessment Directive

"Affirm the need to take effects on the environment into account at the earliest possible stage in all the technical planning"

"The EIA shall identify….. the direct and indirect effects of a project on the following factors:…..fauna and flora"

"The information to be provided by the developer shall include at least: information on the site of the project; data required to identify and assess the main effects which the project is likely to have on the environment"

"The environmental sensitivity of geographical areas likely to be affected….. having regard, in particular, to: the relative abundance, quality and regenerative capacity of natural resources; the absorption capacity of the natural environment (inc. wetlands, mountain and forest areas)".

COM(2009) 378 final: Report on the application and effectiveness of the EIA Directives

"The report is well-timed ……. There are growing environmental challenges in the areas of climate change and biodiversity."

"The costs of preparing an EIA as a share of project costs typically range from 0.1% for large projects to 1.0% for small projects"

"Despite increasing public participation in the decision-making process there is still no standard practice across the EU…… in most cases, the public is consulted for the first time on the information gathered"

"Public participation is not effective when national arrangements are constricted e.g. when the EIA documention is only available for consultation at the offices of the competent authority"

"No major problems are reported with regard to coordination between the EIA Directive and other Directives and policies".

"MS have stablished both informal and formal links between the EIA Directive and the the Habitats and Birds Directives. Although no major problems have been reported, the Commission's implementation experience shows that the requirements… are not taken properly into account in the context of EIA procedures. Furthermore, EIA procedures focus on the impact on Natura 2000 sites, while the species protection provisions tend to be neglected. The EIA Directive does not make explicit reference to the concept of biodiversity (it only refers to fauna and flora). Many MS replied that the provisions of the EIA Directive already take sufficient account of the substance of the Biodiversity Action Plan (BAP) and that their national EIA systems are effective in preventing biodiversity loss. However, it appears highly unlikely that the EU will meet its 2010 target of halting biodiversity decline; intensive efforts will be required. In this regard, the biodiversity considerations could be expressly reflected within the text of the EIA Directive. In addition, a single assessment procedure for projects falling under the EIA Directive and Article 6(3)-(4) of the Habitats Directive could be established."

SEA Directive 2001/42/EC –the Strategic Environmental Assessment Directive

"Where the obligation to carry out assessments of the effects on the environment arises simultaneously from the Directive and other Community legislation, such as [the Birds and Habitats Directives], in order to avoid duplication of the assessment, MS may provide for coordinated or joint procedures fulfilling the requirements of the relevant Community legislation"

"MS shall monitor the significant environmental effects of the implementation of plans and programmes in order, inter alia, to identify at an early stage unforeseen adverse effects, and to be able to undertake appropriate remedial action. In order to comply with this, existing monitoring arrangements may be used if appropriate, with a view to avoiding duplication of monitoring"

COM(2009) 469 final: Report on the application and effectiveness of the SEA Directive

"Other difficulties reported by the MS are lack of good quality information, the time-consuming nature of data collection, the lack of homogenous criteria for the baseline analysis, and the absence of a standard set of environment and sustainability criteria against which to assess P&P (plans & programmes)."

The Directive provides for significant environemental effects of the implementation of P&P to be monitored….. very few MS report that they have established monitoring methods or drawn up national guidance on how to establish monitoring indicators.

The Directive has formal and explicit links with the Habitats and EIA Directives. Only a few MS report the existence of guidance for coordination of the joint procedures for fulfilling the requirements governing assessments under other directives."

"Regarding the Habitats Directive, and in particular Article 6(3) thereof providing for a special assessment in certain cases, MS take the view that there are no major problems to report concerning its relationship with Article 11(2) of the SEA Directive, which provides for co-coordinated or joint assessment procedures. Indeed, MS report that they have taken steps to avoid duplication and overlapping, mainly by means of a coordinated approach, which is preferred to a joint approach.

……It should be noted, however, that NGOs have raised concerns about this issue.

With regard to the BAP, many MS simply feel that the provisions of the SEA are sufficient and take its substance into account.

The 2008 mid-term Report on the implementation of the BAP, reveals that the EU is highly unlikely to meet its 2010 target of halting biodiversity decline. The report stresses the need for further progress in ensuring that SEA and EIA are systematically conducted in relation to environemntally sensitive interventions funded by MS and the EC."

General conclusion re. EIA & SEA Directives:

The EIA and SEA Directives are the major mechanism for development and planning decisions in the EU, and are particularly important for those areas which are not Natura 2000 sites (i.e. c. 80% of EU land territory – only 20% (very approximately) is designated under Natura 2000 or national law). It is via the mechanisms put in place by these Directives that nature conservation interests are able to be involved with decisions made on development plans, programmes and projects.

Marine Strategy FrameworkDirective2008/56/EC and

Maritime Strategy Communication *COM (2007) 575 final* *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on an Integrated Maritime Policy for the European Union*

> "This framework should…. foster the integration of environmental concerns into other policies, such as the Common Fisheries Policy, the Common Agricultural Policy and other relevant Community policies"
>
> "Provision should be made for the preparation at national level of an appropriate framework, including marine research and monitoring operations, for informed policymaking. At Community level, support for associated research should be continuously enshrined in research and development policies."
>
> "Provision should be made for the adoption of methodological standards for the assessment of the status of the marine environment, monitoring, environemntal targets and the adoption of technical formats for the purposes of transmission and processing of data in line with the INSPIRE Directive."
>
> "This Directive shall contribute to the integration of environmental concerns into the different policies, agreements and legislative measures which have an impact on the marine environment."
>
> "MS shall establish and implement coordinated monitoring programmes for the ongoing assessment of the environmental status…. compatible with relevant provisions for assessment and monitoring including the Habitats and Birds Directives…. monitoring methods are consistent across the marine region or subregion so as to facilitate comparability of monitoring results….. taking into account existing commitments and ensure comparability between monitoring and assessment results."
>
> "Availability and easy access to a wide range of natural and human-activity data on the oceans is the basis for strategic decision-making on maritime policy."
>
> "Marine and maritime research is expensive: inefficiencies cannot be afforded. For the best use to be made of Europe's resources a clear strategy needs to be drawn up that will link political and research priorities, address cross-sectoral challenges, maximise synergies, avoid duplication and improve dialogue between interested actors."

SEIS Communication *COM (2008) 46 final* *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions towards a Shared Environmental Information System (SEIS)*.

> "INSPIRE is based on similar principles to SEIS and successful implementation of this Directive will go a long way towards overcoming existing inefficiencies relating to the use and usability of spatial data stored by public authorities."
>
> "Examples of the need for cross-thematic co-ordination include in-situ monitoring of…. Biodiversity in an ecosystem context".

ICZM Resolution & ICZM Evaluation

COM (2000) 547 final *Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management (ICZM): A Strategy for*

Europe – ***hereafter referred to as the ICZM Resolution*** – and *Evaluation of ICZM in Europe 18 August 2006* – ***hereafter referred to as the ICZM Evaluation***.

> "Scientific research and data collection have been isolated from end-users"
> "uncoordinated sectoral policies tend to conflict and may even work at cross-purposes, resulting in policy gridlock
> "Integration of policies at the local and regional level is only possible if the higher levels of administration provide an integrated legal and institutional context"
> "Bottom-up initiatives involving the citizens and users of the coastal zones…. Are a corner-stone for integrated management"
> "Integration of policies, programmes and activities…. As a basis for resolving or avoiding specific problems. Good information provision is a basis to building understanding"
> "Collection and availability to decision-makers of appropriate data and relevant information"
> "Although the actual involvement of stakeholders is still unsatidfactory overall, successful local ICZM-based processes have created a strong pressure to increase paricipative elements in decision making."
> "Improve the knowledge basis for ICZM"

General conclusion:
These instruments are the major basis for management of marine areas in the EU, and are particularly important given that very few marine areas are designated under Natura 2000. These Directives feed into the EIA and SEA Directives, enabling nature conservation interests to be involved with decisions made in marine areas.

Rural Development Regulation 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

> "Support should continue to be granted to farmers to help address specific disadvantages in the areas concerned resulting from the implementation of the Birds and Habitats Directives in order to contribute to the effective management of Natura 2000 sites"
> "Agri-environmental payments should continue to play a prominent role…. In responding to society's increasing demand for environmental services".
> "Each national strategy plan shall include an evaluation of the environmental situation and the potential for development"
> "Main quantified objectives and the appropriate monitoring and evaluation indicators"
> "Support re conservation and upgrading of the rural heritage…. Shall cover the drawing up of protection and management plans relating to Natura 2000 sites and other places of high natural value…. Maintenance, restoration and upgrading of the natural heritage and with the development of high natural value sites"
> "The Managing Authority… shall carry out monitoring by means of financial, output and result indicators"

General conclusion:
Agriculture and forestry are the predominant land use for the majority of the EU land area, and particularly important for those areas which are not Natura 2000 sites. The EIA and SEA Directives (discussed earlier) are the mechanism with which negative impacts on the environment are controlled. The Rural Development Regulation, however, is becoming the mechanism by which positive impacts on the majority of the EU land area are encouraged.

ANNEX 3: GOVERNANCE & THEMES

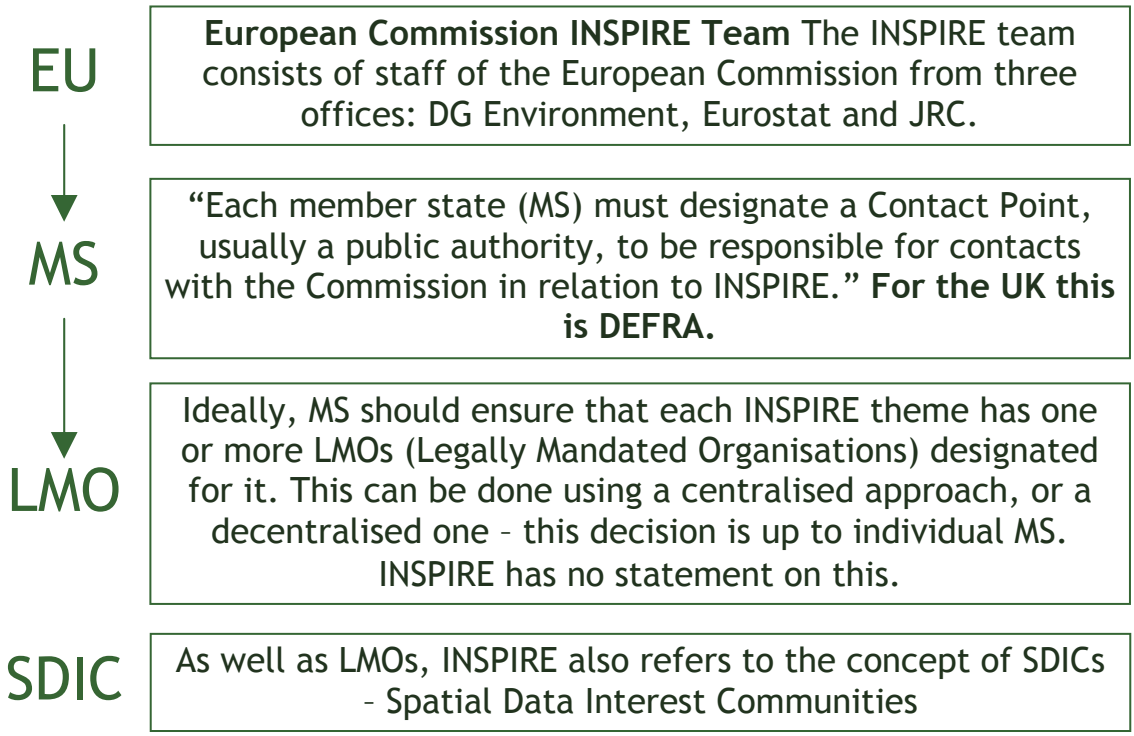

Figure 36: INSPIRE Governance Structures

ANNEX I Coordinate reference systems Geographical names Administrative units Addresses Cadastral parcels Transport networks Hydrography Protected sites	ANNEX III Statistical units Buildings Soil Land use Human health & safety Utility & governmental services ***Environmental monitoring facilities*** Production & industrial facilities Agricultural & aquaculture facilities Population distribution- demography Area management zones Natural risk zones Atmospheric conditions Meteorological geographical features Oceanographic geographical features Sea regions Bio-geographical regions ***Habitats & biotopes*** Species distribution Energy resources Mineral resources
ANNEX II Elevation Land cover Orthoimagery Geology	
Observations & Measurements Guidelines	

Figure 37: INSPIRE Themes

ANNEX 4: IMPLEMENTATION SCHEDULE

Background to the INSPIRE Directive

The INSPIRE Directive, first published in April 2007, aims to make it easy to find spatial data using the web through a 'discovery service' and to enable data to be used in a variety of ways. INSPIRE 'services' range from 'viewing' and 'downloading' to 'transforming'. To achieve these objectives, the Directive lays down the framework for a Spatial Data Infrastructure (SDI) and sets out obligations on what public authorities in Member States must do with the data they collect.

In summary, public authorities holding data covered by INSPIRE must:

- Share their data with other public authorities.
- Ensure that metadata are created for data and services corresponding to various themes listed in Annexes I, II and III of the Directive
- Maintain these metadata.
- Allow the public to view data for free
- Make the data available for download and use over the Internet
- Comply with technical implementing rules to improve data consistency.

Hence, INSPIRE has potential to generate new and significant demands on the infrastructure and resources required to both maintain and make available spatial data to defined INSPIRE standards.

What data are covered?

INSPIRE covers 34 spatial data themes. The details are laid down in 3 Annexes. Key points to note are that: Annex I includes '**Protected Sites**' ("*Areas designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives*"), whilst Annex III covers '**Bio-geographical regions**' (*areas of relatively homogenous ecological conditions and common characteristics*); '**Habitats and biotopes**'; and '**Species distribution**'.

The INSPIRE (Scotland) Regulations 2009

How will INSPIRE Work?

The Directive provides five sets of **Implementing Rules** (IRs) which set out how the various elements (metadata, data sharing, data specification, network services, monitoring and reporting) will operate.

What does this mean for SNH?

SNH is in a reasonable position with regard to the early stage Implementing Rules. Spatial data storage and management is centralised within the SNH Geographic Information Group and data is securely maintained in a series of Oracle geospatial data repositories (geo.Store). SNH was an early adopter of the UK Gemini metadata standard and so metadata is held for the vast majority of SNH's spatial data. SNH has also made good advantage of the web as a means of improving access to its spatial data, with applications such as *Natural Spaces* (data download facility) and *SiteLink* (Protected Sites data viewing facility) now well established and frequently cited as examples of best practice in the Scottish Public Sector.

A phased implementation

From a data publisher perspective (i.e.SNH), the implementation of the Directive is divided into two distinct phases:

- Phase 1 – publishing our data as it is now; and
- Phase 2 – publishing INSPIRE Annex I, II and III compliant data

What needs to happen and when in Phase 1

ID	Date	Milestone	Notes
1.1	December 2010	Compliant Discovery Metadata created (and available) for INSPIRE Annex I & II datasets	Member States are only required to provide the INSPIRE Discovery Service with initial operating capability by May 2011, and full operating capability by November 2011.
1.2	May 2011	View Services published for INSPIRE Annex I & II datasets (initial operating capability only).	Not required to meet INSPIRE Quality of service criteria
1.3	November 2011	Full View Services published for INSPIRE Annex I & II datasets	Required to meet INSPIRE Quality of Service criteria.
1.4	June 2012	Download Services published for INSPIRE Annex 1 and 11 datasets	Dependent on entry into force of EC regulation.
1.5	December 2013	Discovery Metadata published for INSPIRE Annex III datasets	
1.6	December 2013	View Services published for INSPIRE Annex III datasets	
1.7	December 2013	Download Services published for INSPIRE Annex III datasets	

What needs to happen and when in Phase 2

Phase 2 applies only to data that comes under an INSPIRE Theme, where what gets published needs to change, so that it complies with the INSPIRE Data specifications.

For Annex I, II and III datasets we must publish the following network services:

- Discovery Service, metadata about your published data and services
- View Service, a map (spatially referenced image) of your data
- Download Service, the retrieval of the dataset itself
- Coordinate Transformation Services, the conversion of your data to another INSPIRE specified Coordinate System

These published services must comply with the INSPIRE Network Services Regulations. For datasets that lie outside the INSPIRE Themes, you only need to provide Discovery and View Services, but any services provided must also comply with the INSPIRE Directive.

What needs to happen and when in Phase 2 (con't)

ID	Date	Milestone	Notes
2.1	June 2012	Publish newly collected INSPIRE Annex I compliant data	Dependent on entry into force of EC regulation.
2.2	Dec 2014 / January 2015	Publish newly collected INSPIRE Annex II and III compliant data	Dependent on entry into force of EC regulation.
2.3	June 2017	Publish legacy INSPIRE Annex I compliant data	Dependent on entry into force of EC regulation.
2.4	May 2019	Publish legacy (restructured) INSPIRE Annex II compliant data	Dependent on entry into force of EC regulation.
2.5	May 2019	Publish legacy (restructured) INSPIRE Annex III compliant data	Dependent on entry into force of EC regulation.

Implementation plan for phases 1 and 2

With this background in mind, we now identify the resource requirements for delivery against the specified timescales. Each of the milestones described above is broken down into as many supporting tasks as are required to deliver it. The following pages set out the requirement in detail.

Phase 1 Implementation plan

1.1 Compliant Discovery Metadata created (and available) for INSPIRE Annex I & II datasets - by December 2010

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.1.1	Tool for creating and updating metadata identified and obtained/created.		GIG	End Nov 2010	5 days	Green
1.1.2	Gemini 2.1 metadata created for Protected Sites datasets		GIG	03 Dec 2010	3 days	Green
1.1.3	Metadata tools refined to allow maintenance of metadata.		GIG	May 2011	3 days	Green
1.1.4	Gemini 2.1 metadata created for all other published datasets		GIG	May 2011	2 days	Green
1.1.5	Gemini 2.1 metadata created for all other geo.Store datasets		GIG			
1.1.6	Protected Sites metadata uploaded to SSDI		GIG	May 2011	1 day	Green
1.1.7	Process to ensure no spatial data commissioned without INSPIRE compliant metadata		KIM			

RR= **Resource requirement (person days or cost)**

1.2 View Services published for INSPIRE Annex I & II datasets (initial operating capability only) – by May 2011

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.2.1	WMS created containing Protected Sites layers		GIG	December 2010	3 days	Green
1.2.2	WMS data moved to new infrastructure	Infrastructure project	GIG	April 2011	5 days	Amber
1.2.3	Natural Spaces data working with new infrastructure		GIG	April 2011	2 days	
1.2.4	Interactive mapping data working with new infrastructure		GIG	April 2011	3 days	

1.2.5	WMS provided to SSDI		GIG	May 2011	2 days	Green

1.3 Full View Services published for INSPIRE Annex I & II datasets – by November 2011

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.3.1	Investigate compliance requirements		GIG/KIM	August 2011	3 days	Green
1.3.2	Assess performance metrics		GIG	October 2011	2 days	Green
1.3.3	Confirm governance		GIG/KIM	November 2011	1 day	Green
1.3.4						
1.3.5						
1.3.6						

1.4 Download Services published for INSPIRE Annex I and 11 datasets – by June 2012

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.4.1	Investigate INSPIRE download requirements		GIG	February 2012	1 day	Green
1.4.2	Create test WFS		GIG	March 2012	3 days	
1.4.3	Confirm INSPIRE format for WFS	Published guide (the cookbook)	GIG	May 2012	2 days	Amber
1.4.4	Create compliant WFS	1.4.3	GIG	June 2012	3 days	Amber
1.4.5						

1.5 Discovery Metadata published for INSPIRE Annex III datasets - by December 2013

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.5.1	Annex III datasets identified and agreed with Scottish Government		GIG		5 days	
1.5.2	Additional theme-specific fields identified and incorporated into metadata editing tools		GIG			
1.5.3	Metadata for Annex III datasets updated to be fully INSPIRE compliant		GIG			
1.5.4	Annex III metadata published		GIG			
1.5.5	Annex III metadata added to SSDI		GIG		1 day	

1.6 View Services published for INSPIRE Annex III datasets – by December 2013

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.6.1	Annex III data added to CAG	Infrastructure project	GIG			
1.6.2	WMS created containing Annex III data		GIG			
1.6.3	Annex III WMS published		GIG			
1.6.4	Annex III WMS added to SSDI		GIG			
1.6.5	Annex III data added to Natural Spaces		GIG			

1.7 Download Services published for INSPIRE Annex III datasets – by December 2013

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
1.7.1	Investigate INSPIRE download requirements		GIG			
1.7.2						
1.7.3						
1.7.4						
1.7.5						

Phase 2 Implementation plan

2.1 Publish newly collected INSPIRE Annex I compliant data – by June 2012

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
2.1.1	Assess if any data falls into this category		KIM			
2.1.2						
2.1.3						
2.1.4						
2.1.5						

2.2 Publish newly collected INSPIRE Annex II and III compliant data – by Dec 2014/January 2015

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
2.2.1	Metadata tools available to contractors and other data creators		GIG			
2.2.2	Data protocol documents updated		KIM			
2.2.3	Procedures for enforcement of protocols		KIM			
2.2.4						

2.2.5						

2.3 Publish legacy INSPIRE Annex I compliant Data – by June 2017

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
2.3.1	Identification of changes in Protected Sites data structures required for compliancy		GIG /KIM /PPU			
2.3.2	Submit ISIP bid for changes to MIDAS to incorporate data structure changes		KIM			
2.3.3	Make changes to MIDAS		KIM			
2.3.4	Make changes to script that pulls out MIDAS attributes and joins them with polys		GIG			
2.3.5	Incorporate new MIDAS fields into spatial datasets		GIG			
	Published updated WMS		GIG			

2.4 Publish legacy INSPIRE Annex II compliant data – May 2019

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
2.4.1						
2.4.2						
2.4.3						
2.4.4						
2.4.5						

2.5 Publish legacy INSPIRE Annex III compliant legacy data – May 2019

ID	What needs to be done	Dependency	Who	Timescale	RR	RAG rating
2.5.1						
2.5.2						
2.5.3						
2.5.4						
2.5.5						

ANNEX 5: HOW DATA SPECIFICATIONS ARE DEVELOPED

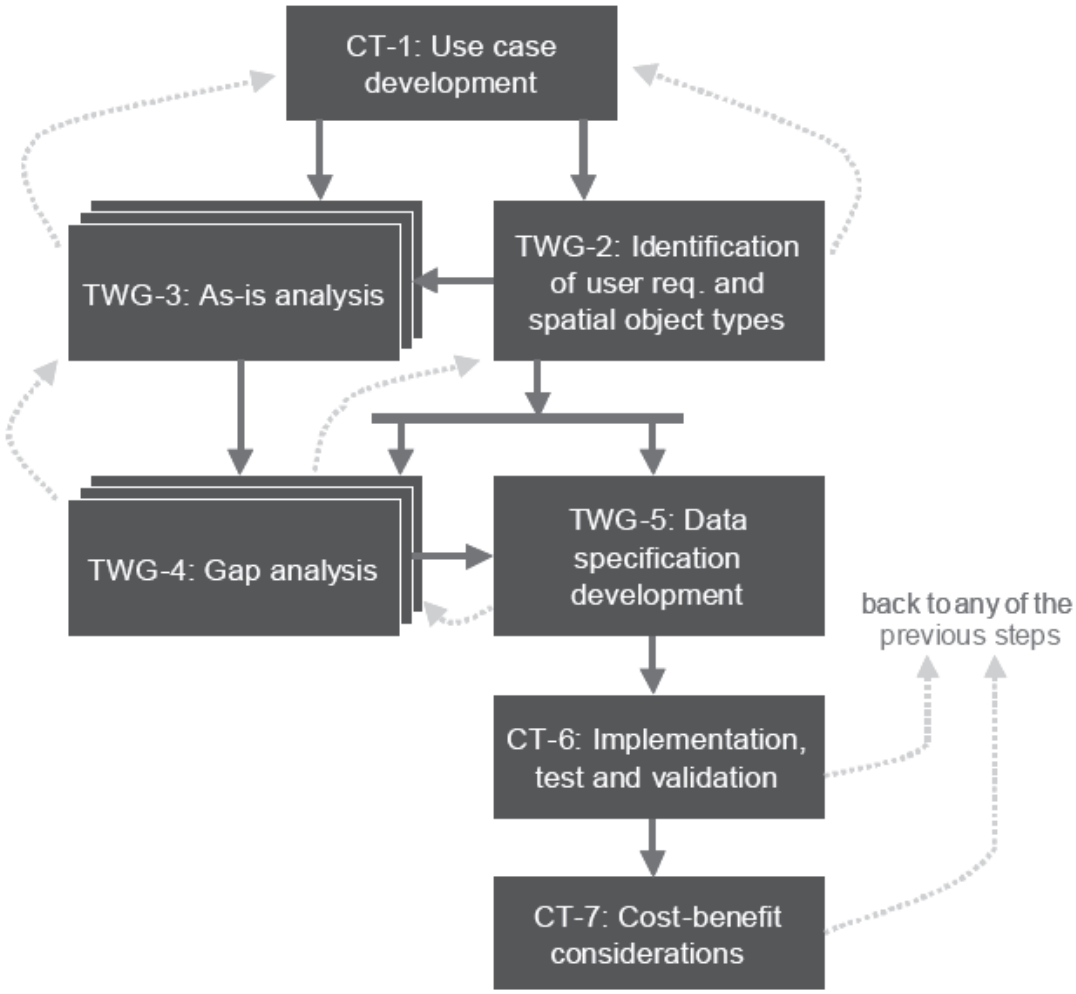

Figure 38: The process of developing INSPIRE data specifications. (INSPIRE D2.6v.3.0)

The consecutive steps in the development of an INSPIRE data specification for a theme are shown in Figure xx. This step-wise methodology proposed by the INSPIRE Drafting Team Data specifications is based on guidelines from OGC and the outcome of the RISE (Reference Information Specifications for Europe) project funded under the 6th Framework Programme (Wawer & Tirry 2010).

This was the methodology used by the Nature-SDIplus project (of which SNH is a network partner). All the reports herafter referrred to can be found on the Nature-SDI*plus* intranet (for which SNH have a username and password –contact Mark Robson in GIG for details). Looking at each step in turn.

Step CT-1
Use cases are an important step towards the creation of data specifications, as stated in the INSPIRE D2.6 document: Methodology for development of data specifications. According to Wawer & Tirry 2010, "Use cases, stated simply, allow description of sequences of events that, taken together, lead to a system doing something useful". Use cases can be defined on different levels and one should distinguish high-level **business use-cases** (non-technical) from detailed **system use cases**. The latter is rather intended for defining system

functionality from a technical point of view. Both types of use cases describe a set of interactions between actors and a system necessary to satisfy a certain goal. Within the framework of Nature-SDI*plus*, the focus was on the second type, **data-oriented approach** instead of a business or process-oriented approach. Nature-SDI*plus* finalised twenty use cases, which are described in detail in Annex 2 of *D3.4 NatureSDIplus Data Exchange Models* (R. Wawer & D. Tirry, 2010).

The same process has been undertaken here for SNH's business model – see Section 4 on Use Cases.

TWG-2: User survey

In order to get a broad view on actual user needs throughout Europe, the relevant use groups were identified as follows: EU authorities, Member State Authorities, Local & Regional Authorities, Public Data provider, Primary education, Secondary education, Universities/Colleges, Life long learning, Museums & comparable facilities, Research institutes, Engineering, Consulting, Planning & construction, Environmental management, Industrial companies, Nature conservation authorities, Protected sites personnel, Environemental NGOs, Citizens.

A comprehensive questionnaire was designed. This survey gathered the relevant information for implementing a user-centred SDI. The questionnaire was implemented as an online survey and disseminated to the target stakeholder groups throughout Europe via collaboration with the project partners. Results are described in detail in *D2.4 - Report assessing the user needs* (Hennig & Wallentin, 2010)

TWG-3&4: As-is & Gap analysis

Project partners from 17 EU countries provided information on 253 nature conservation datasets – 121 protected sites, 78 species, 43 habitats and 11 biogeography. These datasets were assessed for their attributes/databse fields, in particular how these compared to thematically developed feature lists. Results are described in detail in *D2.3 - Report on the project datasets and the feature lists* (Carlisle & Green, 2009) – one of many tables is reproduced below.

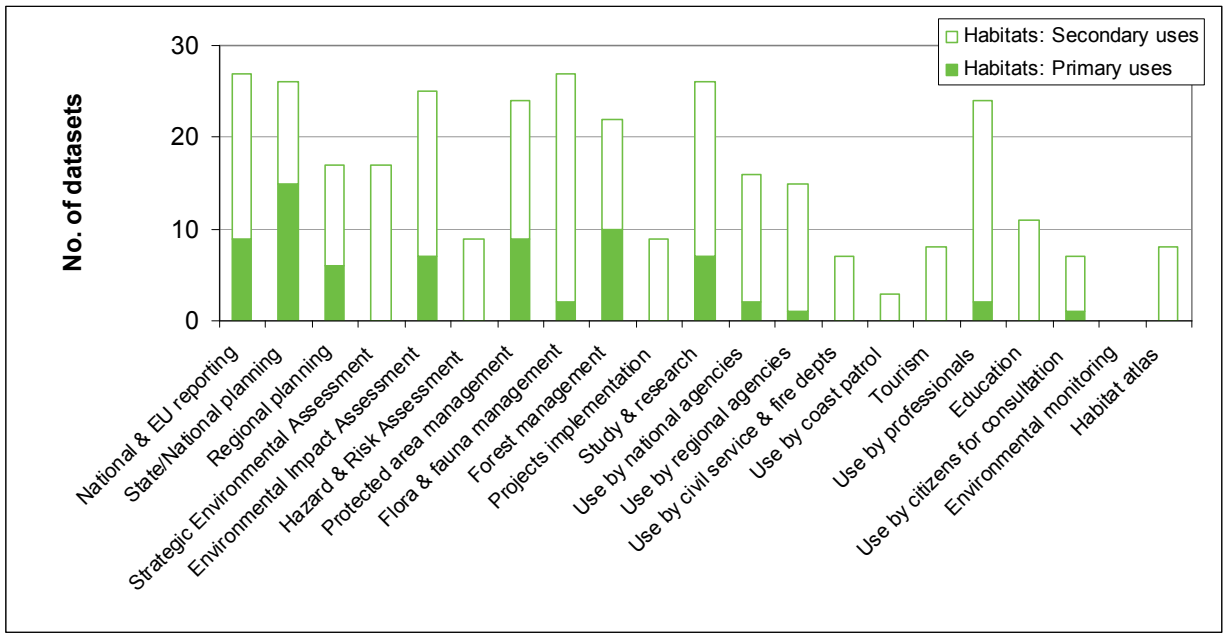

Figure 39. Primary & secondary purposes for which 43 Habitats datasets (from 14 EU countries) are maintained (multiple classifications).

TWG-5: Other material

Additional analysis was conducted on the raw survey results from TWG 2, 3 & 4 to prioritise and thematically aggregate candidate features and attributes. Additional reference material, especially focussing on European reporting obligations, was consulted. This process is described in detail in *D3.4 NatureSDIplus Data Exchange Models* (Wawer & Tirry, 2010).

The final Nature-SDI*plus* results – the Data Exchange Models – were supplied to the INSPIRE Thematic Working Group for Biogeographical Regions/Habitats and Biotopes/Species Distribution (the TWG-BR-HB-SD). ***The TWG-BR-HB-SD then went through the Data Specification methodology again, but using the Nature-SDIplus Data Exchange Models as the starting point.***

CT-6&7: Testing & Cost/Benefits

The work of the TWG-BR-HB-SD resulted in version 2 of the Habitats Data Specification – **HB-DSv2.0**. This was made available for testing by JRC (Joint Research Centre) in summer 2011. The JRC testing template contained questions for both the **Feasibility** and **Fitness-for-Purpose** parts of the testing.

The part for reporting on the feasibility testing contains comments on where a ***partner's data*** is missing something that is needed by the ***data specification***.

The part for reporting on the fitness-for-purpose testing includes comments on where the ***data specification*** is missing something required for a ***partner's data***.

The results for a selection of the Nature-SDIplus partners are shown below.

Table 2. HB-DSv2.0 testing results for the Nature-SDIplus partners

	Feasibility	Feasible?	Fitness-for-purpose	Fit?
UniAbdn & SNH UK	Semantic	Y	Tested	Partly
AGI Lithuania	Semantic	Y		
IGP & ICNB Portugal	Semantic	Y		
OeAW Austria	Semantic	Y	Tested	Y
RegPie Italy	Semantic	Y	Tested	Partly
SAZP Slovakia	Structural	Y		
TRACASA Spain	Structural	Y		

The third and final part of the testing was related to costs and benefits – namely the ***implementation costs*** of implementing the Data Specification over a partner's whole data holding, followed by the ***use benefits*** or ***use costs*** resulting from implementing the Data Specification over the same data holding.

The feasibility costs analysis indicated a range of values for the number of person-months required to transform the contributors entire data holding for each theme – the lowest value was less than 3 person months, the highest was 22 p.m. The fitness-for-purpose cost-benefit analysis found that software and hardware costs were an issue for small NGOs, but not for major organisations – for these, human resources were the most important issue.

Identified benefits included more efficient data management, improved data access, easier to integrate datasets across themes, increased ease of use for internal and external stakeholders, improved ability to use other's data, enabling better decision-making, better joined-up working, increased institutional effectiveness, wider use of data following (expensive) collection and decreased cost of IT (once legacy dataset issues are resolved).

This information was delivered back to the TWG-BR-HB-SD for consideration within version 3.0 of the Habitat Data Specifications (forthcoming).

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