Conversion of European habitat data sources into common standards

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Abstract

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In Austria, Sweden and Great Britain protocols are being used to produce data which can be integrated at the environmentall stratum level. The national protocols for habitat monitoring in Great Britain, Sweden and Austria have been converted into a common format based on General Habitat Categories (GHCs). The conversion tables enable full integration of the datasets. This makes it possible to use national data in estimates for European comparisons and the production European habitat extent. Without common protocols it would be impossible to carry out comparisons between environmental zones and biogeographical regions.

Keywords: Habitat, national databases, European standards

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Summary

It is important to develop protocols for harmonisation in order to convert habitat categories recorded in monitoring projects in Europe into a format that enables datasets to be integrated. This deliverable demonstrates the success of the procedures for most available projects. The present document delivers conversion tables and summarises the conclusions, which can be drawn from them, including comments on their integration with satellite imagery. In Austria, Sweden and Great Britain the protocols are now being used to produce data which can be integrated at the environmental stratum level. In Spain the work in EBONE has shown that additional survey at the right level of detail will be required.

The national protocols for habitat monitoring in Great Britain, Sweden and Austria have been converted into a common format based on General Habitat Categories (GHCs). The conversion tables enable full integration. This makes it possible to use national data in estimates for European comparisons and the production European habitat extent. Without common protocols it would be impossible to carry out comparisons between environmental zones and biogeographical regions.

Although conversion at a high level will be possible with the Spanish SISPARES the scale of the Minimum Mappable Units does not fit the detail of the other projects. Further data therefore needs to be collected in the Spanish SISPARES sites to provide detailed mapping for integration. An additional conclusion reached during the preparation of protocols for the Countryside Survey of Great Britain, was that further divisions of the GHCs will be required to improve the relationship with Remote Sensing. These divisions are being made using ancillary data that are available in all existing projects as well as from the EBONE field records. The divisions will also provide more ecological details in grassland habitats.

Other national and regional projects are expected to fit this approach. For example the categories of the Northern Ireland Countryside Survey are included as an example how additional datasets can be converted into CHG's.

The conclusion to be drawn from the results presented in this Deliverable is that for projects at the national or regional level within Europe, except SISPARES, the Minimum Mappable Units are comparable with the EBONE approach. Minimum standards for data collection have been achieved in order to make European harmonisation possible. In addition, previous work in SINUS has shown that GHCs can be used to detect habitat change over a period of years.

1 Introduction

A key activity in the development of a monitoring system for Europe is the utilisation of extant data. When assessing habitat extent and change in Europe it is essential to use what is available and to integrate the data into a harmonised system. Inevitably some of the detail of the data sources will be omitted. In other cases further detail may need to be added to the current national observation systems.

The first stage of the harmonisation of habitat data is to develop protocols to convert the categories recorded in the major field habitat monitoring projects in Europe into the General Habitat Categories (GHCs) to be used in EBONE. These projects are:

- The Countryside Survey of Great Britain (CS), (Bunce et al., 1996)
- The National Inventory of landscapes (NILS) in Sweden, (Esseen et al., 2003)
- Northern Ireland Countryside survey (NICS), (Cooper and McCann, 2000)
- Spanish Rural Landscape Monitoring Systems (SISPARES) in Spain (Elena-Rosselló, 2003)
- Spatial Indices for land-use sustainability (SINUS) in Austria (Wrbka et al., 2004)
- Step-less models for regional environmental variation in Norway (Bakkestuen et al., 2008)

The latter monitoring system will be created shortly, so is not included here. The present report delivers the conversion tables and presents the main conclusions. In Austria, Sweden and Great Britain (GB) the protocols have now been converted into a common data structure, which can then be integrated in due course at the environmental stratum level. In Spain work in EBONE has shown that additional survey at the right level of detail is required. The only worked example of integration between surveys in different countries or regions carried out to date is that between Northern Ireland and GB (England, Scotland, Wales), although the sampling squares were 0.25 km^2 and 1 km^2 respectively. Different categories were used in the field but protocols similar to those in the present report were used to integrate the dataset, as described by Bunce (1999). The integration was reported by Haines Young et al. (2000).

1.1 Scope and objectives of the report

This report covers the following EBONE objectives:

- Identification of appropriate habitat data sources for integration with remotely sensed data.
- Development of protocols for recording data sets.

The scope of these objectives is to allow the comparison and integration of existing datasets between countries. The spatial data from the various databases can be converted from the original categories into GHC's in order to make analyses of the relationship between field observation data and remote sensed data. Without common protocols it would be impossible to carry out such comparisons, either between environmental zones or biogeographical regions.

2 Identification of appropriate data sources

The main datasets which had been identified within the consortium were SISPARES, the Countryside Survey, the Swedish NILS project and SINUS. Initially within WP5 these were identified as the key datasets, which were already available and could be used to be linked to the available satellite imagery. The protocols for these projects are presented in this document. In this document the conversion is presented between categories in these approaches and General Habitat Categories (GHC) as developed in the BioHab project (Bunce et al., 2005) and further elaborated in the EBONE project. The BioHab report is downloadable from www.alterra.wur.nl/UK/publications/Alterra+Reports/ under report number 1219. An updated description of the GHCs including desert categories as qualifiers has been published within the EBONE project and is downloadable from the same website under nr. 2154 (Bunce et al., 2011). An overview table is presented in Annex 1.

Subsequently, liaison with the University of Coleraine has enabled protocols for the Northern Irish Countryside Survey (NICS) to convert data into GHCs Agreement has also been reached to include the converted NICS data into the EBONE project. Test data have already been included.

Agreement has been reached with scientists from Northern Italy and Flanders to include their data as test sites for WP5. These data sets are already in the EBONE format, no protocols for translation are required. EBONE has also collaborated in field training with the University of Porto (Portugal). Data from North Portugal will be made available when the survey is completed in 2010.

3 Database conversion protocols

3.1 SISPARES, Spain

There is broad agreement between the SISPARES (www.sispares.com/) land cover units and the GHC's as developed in BioHab (Bunce et al., 2007) and elaborated and applied in EBONE (Table 1). However, in some cases there is considerable overlap in the GHCs because the national data have more detail, while the SISPARES classes are more general. Nevertheless, summary figures could eventually be compared between SISPARES sites and subsequent EBONE estimates. However, they can only be treated in a general way as the categories do not match exactly. SISPARES categories are broader and contain combinations of GHCs. Other categories, e.g. dehesas, do not match exactly and need further database management.

Table 1
Types of land cover detected by interpretation of aerial photographs in SISPARES and their correspondence with GHCs.

Type of land cover	GHCs	Explanation
Forest	All FPH and mixtures	This includes pure forest categories and mixtures. Some areas of *Juniperus oxycedrus* may not be included as forest in SISPARES
Matorral	SCH + LPH + MPH + TPH	Probably mainly taller grasses and almost certainly including a significant area of CHE
Dehesa	FPH /EVR	Subscripted with agro forestry. There are problems in this class concerning the extent of tree cover that is required to be called Dehesa
Forest plantation	LPH + MPH + TPH + FPH	Subscripted with under ten years
Pastures	CHE/LHE + LHE/CHE and mixtures with THE	Especially in central and northern Spain. This class will contain a very wide variety of grassland types. Pastures may also include patches of LHE and EHY + SHY + HEL
Crops	WOC + CRO + mixtures.	Woody and annual crops. There are problems with crops between trees and the borderline with Dehesa
Riparian woodland	FPH/DEC + TPH/DEC + MPH/DEC	Mask along riversides
Rock	TER	There will be confusion with GHCs such as DCH and HCH
Water body	AQU + EHY + SHY	There will be problems with estuaries and tidal areas
Urban and industrial use	All urban categories	URB/GRA (recreational grass) may not be included

The main reason for the difficulties in comparing SISPARES with GHCs is in the scale differences between the approaches. The critical point is that the Minimal Mappable Unit (MMU) for SISPARES was 1ha, whereas EBONE uses 400 m^2. These contrasting levels of detail mean that it is not possible to use SISPARES data to overlay with remote sensed information in support the intercalibration exercise to be carried out in WP5. As a result sample km-squares of SISPARES structure are being resurveyed using the EBONE methodology. A brief comparison of the parcel outlines in SISPARES and those from the subsequent EBONE mapping shows that all small patches were inevitably not covered. It is still valid however to use the SISPARES data in WP3 of EBONE in order to test stratification.

In SISPARES additional codes are included in the recording procedure. For example, water bodies are divided into marshland, wet areas, lakes, natural lagoons and reservoirs. How this information can be used to further divide the principal division is exemplified in Table 2, which represents one of the SISPARES sites near Madrid. Some of the additional data could also be utilised e.g. Lavendula stoechas is SCH/EVR and Cistus ladanifer is MPH/EVR.

Whilst it would be technically feasible to extend this exercise throughout the whole sample series, the difference in MMU makes this exercise not useful at present. However, the SISPARES data can be used later in the planning of test sites or for inclusion of particular issues. Because they incorporate habitat data at the strategic level (Ortega et al., 2008) as shown in the analysis of SISPARES data for the whole of Spain. These analyses show how stratified samples can be used to estimate changes in habitats and land cover patterns at the national scale of countries of the size of Spain. The spatial data that will be eventually available in the EBONE database will enable similar analyses to be carried out.

Table 2

Square Name: Centroid 1x1km 37: NAVALUENGA (NAVALMORAL)[1].

Code	**Field 1**	**Field 2**	**Field 3**	**Field 4**	**Field 5**				**Observations**
α	General Habitat Category	Global/ Environmental Qualifier	Site Qualifier	Management Qualifier	Life Form/Species				SISPARES % cover (1998)
					Life Form	%	Species	%	
A--1292	TPH/ CON	6.2	137/163	313	TPH	70	Jun oxy	60	B3 (Sp 1.Jun.Oxy, Sp 2 Que ile)+M, (Sp1 Lav sto Sp 2 Cis lad)
							Que ile	40	
					LPH/EVR	30	Lav sto	60	
							Cis lad	40	
B--1293	THE/CHE	6 2	137/163		THE	80			
					LPH/EVR	20	Cis lad	60	
							Lav sto	40	
C--1294	LPH/ EVR	6 2	137/163		LPH	70	Lav sto	60	M3 (Sp1 Lav sto Esp 2.Thy mas) + A (Sp 1.Jun.oxy Sp 2 Que ile) + L
							Thy mas	40	
					TPH	30	Jun oxy	60	

[1] Codes as given in the EBONE Field manual (Bunce et al., 2011). Further information see Annex 1 and www.ebone.wur.nl

							Que ile	40	
D—1295	WOC	SCA	0	323	517				
E--1296	LPH/ EVR	6 2	137/163		LPH	30	Lav sto	60	M1 (Sp1 Lav sto Sp 2.Thy mas) + P
							Thy mas	40	
					HERCHE/THE)	70			
F--1297	FPH/ EVR	6 2	137/163	318	FPH	30	Que ile	60	B1 (Sp1: Que ile Sp2: Jun oxy) + M (Sp1: Cis lad. Sp2: Lav sto)
							Jun oxy	40	
					LPH	70	Cis lad	60	
							Lav sto	40	
G--1298	WOC	SCA	0	323	517				
H--1299	THE /CHE	6 2	137/163	321	HER	60			XPMC (50 25 25) Mosaic
					LPH	20			
					CUL	20			
I--1300	FPH/ EVR	6 2	137/163	318	FPH	70	Que ile	60	B3 (Sp1: Que ile, Sp2: Jun ox) +M (Sp1: Lav sto, Sp2: Thy mas)
							Jun oxy	40	
					LPH	30	Lav sto	60	
							Thy mas	40	

3.2 Countryside Survey of Great Britain (CS)

In the British Countryside Survey (www.countrysidesurvey.org.uk/) Broad Habitat Codes have been used (BH, Haines Young et al., 2000). These have been converted directly into GHCs as shown in Table 3. During this work it became apparent that further information would be required than solely the Broad Habitats for two reasons:

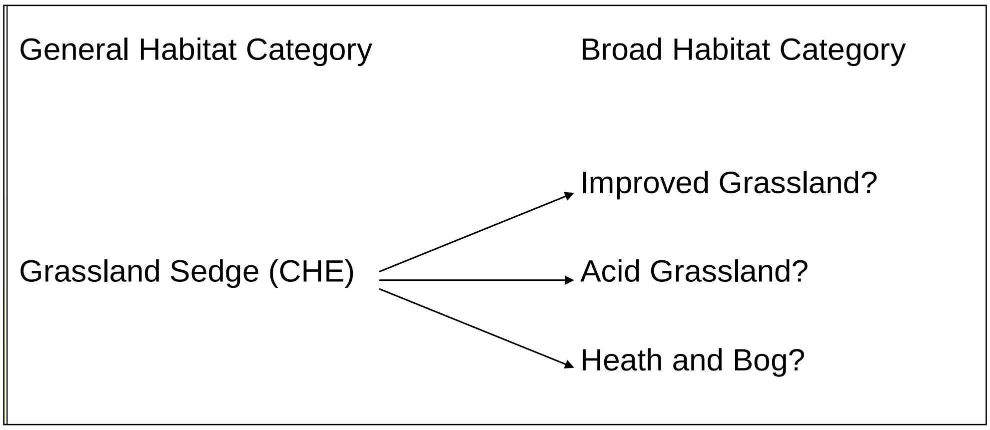
1) The relationship with RS will probably improve if the GHCs were divided further.
2) Subdivision of GHCs, especially the grassland categories will add to the ecological value as habitats and their relationship with Annex 1.

This information relates to the moisture and soil reaction data as well as species information. This information is recorded in the field procedure of the Countryside Survey as well as in NILS and SINUS. This conclusion is a key finding in the EBONE project and will be transferred to all the other comparisons between in-situ data and remotely sensed data. The initial overlaying carried out between CS data and remotely sensed images will use this procedure and will be reported in WP5. An example of subdivisions of GHCs is given in Figure 1. However, currently in the construction of the databases for WP5 only GHCs have been used.

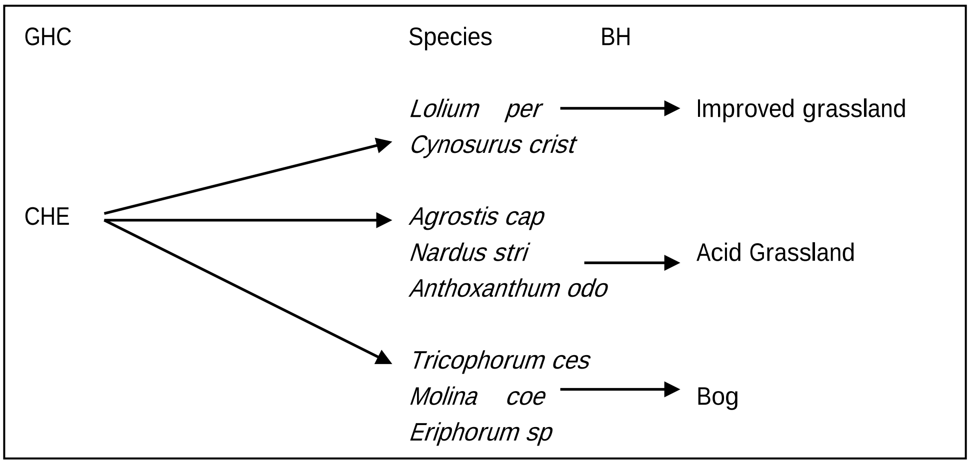
Table 3
Conversion of Great Britain Broad Habitat codes into GHCs.

Broad Habitat codes	**GHC**
Acid grassland	CHE
Arable and horticulture	CRO
Bogs	SCH/EVR
Boundary and linear features	NULL
Broadleaved, mixed +yew woodland	FPH/DEC/CON
Forest Phanaerophytes Deciduous	FPH/DEC
Calcareous grassland	CHE/LHE
Coniferous woodland	FPH/CON
Continental Shelf slope	SEA
Dwarf Shrub Heath	LPH/EVR
Fen Marsh Swamp	CHE/LHE
Improved Grassland	CHE
Inland Rock	SPV/TER
Inshore sublittoral rock	SPV/TER
Inshore sublittoral sediment	SPV/TER
Littoral rock	SPV/TER
Littoral sediment	SPV/TER
Neutral grassland	CHE/LHE
Offshore shelf sediment	n a
Rivers and streams	SPV/AQU
Standing open water and canals	SPV/AQU
Supralittoral rock	SEA
Supralittoral sediment	SEA

In the discussions held in EBONE work for the development of the Manual and the databases it became clear, that it is essential to extract further levels of detail within GHC's in order to get the best correspondence with satellite images. All the surveys considered in this report have sufficient ancillary information, which can be used to develop a variety of transformation of the national categories into subdivisions of GHCs. These subdivisions will also contain more ecological detail, especially in grasslands, that will be important in assessing the biodiversity composition of sample squares.



A



B

Figure 1
A Mapping EBONE General Habitat Categories (GHCs) to GB-Broad Habitats (BH) is not always straightforward. B: Species information can be used to link EBONE General Habitat Categories (GHC) and GB-Broad Habitats (BH).

3.3 Countryside Survey for Northern Ireland (NICS)

The Northern Ireland Countryside Survey (NICS, www.doeni.gov.uk/niea/biodiversity/nh-research/nicountrysidesurvey-2.htm) covers over 200 squares of 0.25 km^2 in the province, stratified according to an environmental stratification (Cooper and McCann, 2000).The procedure is comparable to that used in Great Britain. There are, however, more categories than in CS, which makes it easier for the conversion into GHC's.

Haines Young et al. (2000) have demonstrated how the datasets from Great Britain and Northern Ireland can be integrated into UK figures. This publication provides the first example of integration between separate surveys using different sampling intensities, recording categories and environmental strata. However, the protocols written by Bunce (1999) were used to convert the NICS categories into the broad habitats of CS and they are now also converted into GHC's (Table 4).

Many GHC's do not occur in Northern Ireland, eg. all summer deciduous categories, other GHC's occur in such small patches that they are not be recorded, eg. dwarf chamaephytes and herbaceous chamaephytes. Whilst all the NICS rural categories have direct correspondence with GHC's, the urban categories are not separated in the NICS protocol. Figures will therefore only be produced for the urban area in total.

Table 4
Conversion table of Northern Ireland habitat categories into GHCs. In some GHCs an environmental qualifier has been added.

Code		Primary habitat	GHC and subdivisions
A	01	Wheat	CRO
A	02	Barley	CRO
A	03	Oats	CRO
A	04	Potatoes	CRO
A	05	Brassica	CRO
A	06	Legumes	CRO
A	08	Rye grass	CHE + mesic neutral
A	09	Mixed species, agricultural grassland	CHE + mesic neutral
A	10	Ploughed land	SPA
A	11	Other agricultural grassland	CHE + mesic neutral
A	13	Soft fruit	CRO
A	14	Vegetables	CRO
A	15	Flowers	CRO
A	35	Maize	CRO
A	39	Root crops	CRO
B			Lines only
L	01	Urban area	ART
L	02	Industrial/commercial building	ART
L	03	Agricultural building	ART
L	04	Domestic building	ART
L	05	Amenity grassland	GRA
L	06 1	Vegetated verge	GRA
L	06 2	Hard verge	ART
L	10	Road track	ART
L	11	Railway	ART
L	15	Landfill	NON
L	15	Coastal/landfill	NON
L	16 1	Coastal/bare mineral soil, mud	TER
L	16 1	Bare mineral soil, mud	TER
L	16 2	Bare peat	TER
L	16 2	Coastal/bare peat	TER
L	17 1	Sand	TER
L	17 1	Coastal sand	TER
L	17 2	Gravel, pebble, shingle	TER
L	17 2	Coastal/gravel	TER
L	18 1	Boulders	TER
L	18 1	Coastal/Boulders	TER
L	18 2	Scree	TER
L	18 2	Coastal/scree	n a
L	19	Rock	TER
L	19	Coastal/Rock	TER
L	20	Lough/small water body	AQU
L	20 1	Open water, ditch	AQU
L	20 2	Canal	AQU

Code		Primary habitat	GHC and subdivisions
L	21	Reservoir	AQU
L	22	River	AQU
L	23	Stream	AQU
S	01	Species rich dry grassland	CHE/LHE + mesic neutral
S	02	Species rich wet grassland	LHE/CHE + wet neutral
S	03	Bent/fescue grassland	CHE/LHE + mesic acid
S	04	Mat grass, hill pasture	CHE + mesic acid
S	05	Molinia grassland	CHE + waterlogged acid
S	06	Calcareous grassland	CHE/LHE + mesic calcareous
S	07	Gorse heath	SCH/NLE
S	09	Dry heath	LPH/EVR
S	10	Wet heath	SCH/EVR + waterlogged acid
S	14	Wet bog	SCH/EVR + waterlogged acid
S	15	Dry bog	CHE + wet acid
S	16	Poor fen	CHE + wet acid
S	17	Reed beds	EHY
S	18	Fen	HEL + waterlogged basic
S	19	Freshwater vegetation	SHY
S	21	Upper salt marsh	LHE/CHE + mesic, moderately saline
S	22	Shingle-gravel vegetation	THE/LHE
S	23	Strandline	THE/LHE
S	24	Fore-dune	TER
S	25	Dune grassland	CHE/LHE + mesic neutral
S	28	Coastal cliff	LHE/CHE + mesic basic
S	29	Inland cliff	CHE/LHE + mesic neutral
S	32	Bracken	LHE + mesic acid
S	34	Tall herb ruderals	LHE + mesic neutral
S	57 1	Dry mixed heath	LPH
S	57 2	Wet mixed heath	SCH/EVR + wet acid
S	65	Fen meadow	LHE/CHE + wet acid
S	66	Swamp	EHY
S	68	Water inundation	HEL
W	01	Broadleaved woodland	FPH/DEC
W	02	Mixed broadleaved conifer	FPH/DEC/CON
W	03	Conifer woodland	FPH/CON
W	07	Scrub	TPH/DEC
W	09	Parkland	CHE + FPH/DEC < 30%
W	12	Orchard	WOC
W	47	Bog woodland	FPH/DEC + waterlogged acid
W	48	Fen carr	FPH/DEC + waterlogged basic

3.4 National Survey of the Swedish Landscape (NILS)

The NILS team has made a comprehensive protocol for conversion of the NILS data into GHCs. For each of the NILS classes a code has been written to convert them into GHCs. This code is written in the form of SQL queries and these are completed for each class to be converted. It is not useful therefore to present them in the format used for the Countryside Survey (Table 3). Rather they are comparable to second stage which is described in Section 3.2 where ancillary information is used to further expand the basic codes

All variables and combination of variables have been put together in the algorithm. The next stage in the procedure is to determine how many of the polygons have met the criteria and subsequent procedures to identify which categories have to be used or merged, since they cannot be distinguished by interpretation of Colour Infra-Red (CIR) aerial photographs. Other GHCs are not applicable, e g. summer deciduous which do not occur in Sweden. Previous work in the BioHab project has shown that the CIR interpretation plus the ground control carried out in NILS has produced comparable levels of mapping details. The MMU was also comparable. Databases have been constructed using these procedures and an example of the conversion is given in Figure 2

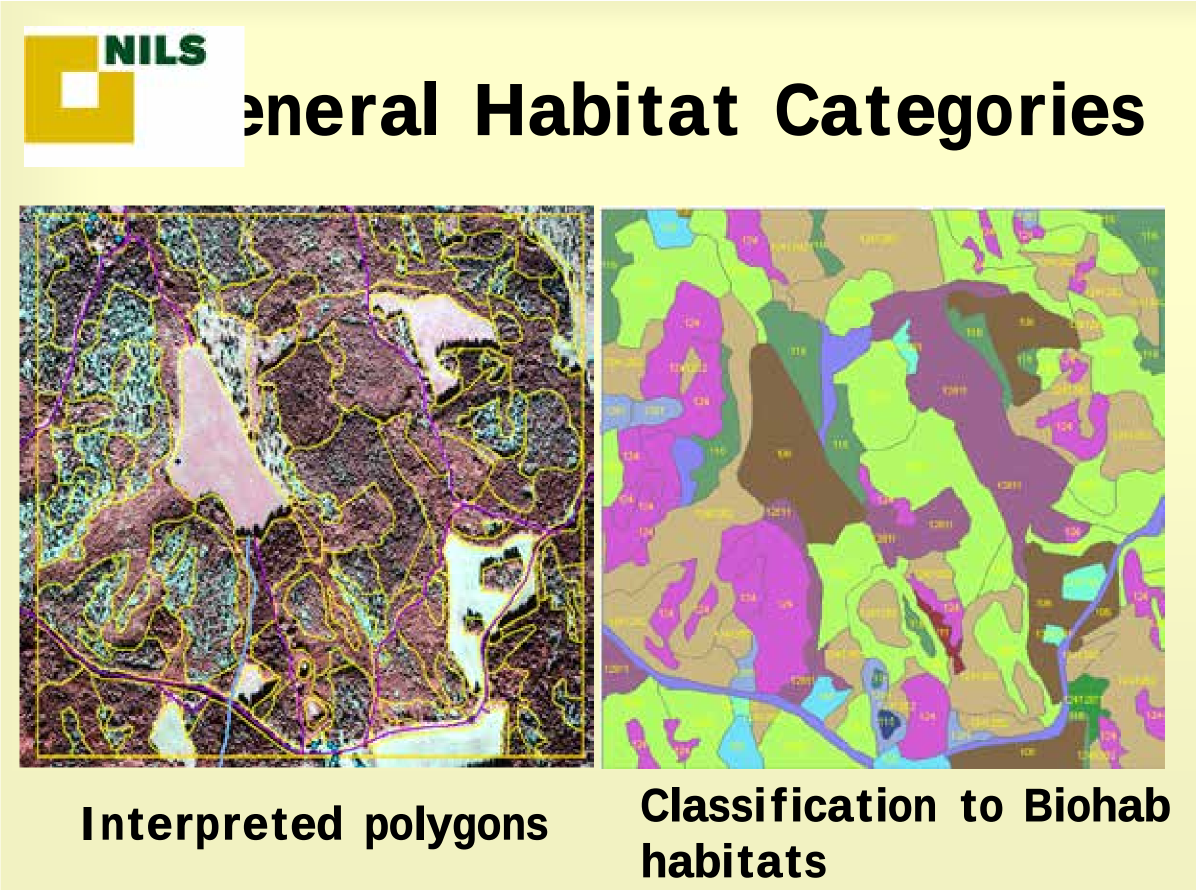


Figure 2
Conversion of interpreted polygons from NILS into EBONE (GHCs)

NILS is a national project with a greater detail than proposed in EBONE, which is designed to harmonise data at a European level. Table 5 describes the background of the decision making and shows that the conversion process is generally without difficulties. Only minor problems need to be solved. This table will be published in future reports, where relevant, so that any differences are explicit and any merges are clearly understood.

Table 5

Relationship between General Habitat Categories and NILS variables and classes.

	Feature	General Habitat Categories	NILS Variables and classes	Easy conversion Yes/No
	Features recorded	**Categories and qualifiers**	**Variables and classes**	
Area	**Area size**	400 m²	100 m²	Yes
	Polygon width	5 m	10 m	Y/N Linear elements make up
	Uncertain boundaries	Codes for arbitrary lines or for transitions zones	No uncertainty allowed in the variable and class system	Yes, but with caution
	Urban codes	Single boundary, nothing recorded inside. Not individual buildings as an area. If a group of three or more buildings is large enough, they can be one coded area	Single boundary or individual buildings as an area, if large enough for an MME	Yes
		Glass house or polytunnels marked as agricultural	Glass house or polytunnels marked as industrial	No
		Water bodies are included in urban codes	Water bodies are stand-alone features	Yes, but with GIS analysis
		Recreational areas in and around towns are recorded as urban ground	Forest areas around towns are recorded as forestry	Yes, but with GIS analysis. Something to think about in NILS, help data can be obtained from cadastral maps
	Cultivation codes	Individual crop species are recorded	Groups of crops are recorded together	Yes, but will have to be merged in the deeper levels of crops for conversion
		Bare ground recorded, where no crops have been planted or otherwise being kept bare. Except for herbaceous crops	No bare ground recorded for cultivated fields. Cultivation where the ground is bare, e g. under orange trees, is not applicable in Sweden	No bare cultivated ground will be merged with other cultivated ground
		Woody crops recorded specially	Woody crops recorded, but in groups	Yes, but will have to be merged in the deeper levels of crops for conversion
		Abandonment of woody crops recorded within five years	Abandonment within five years not seen in aerial photos, but will be recorded when evidence of decay has set in	Yes, but with time difference
		Cover is recorded for all crops, except woody crops, where the rule is 20 trees/bushes per ha	Cover is not recorded in cultivated ground	Yes, but with caution
	Sparsely vegetated codes	Sea below mean water mark is recorded	Such ground is not usually applicable in NILS, and is not distinguished with good accuracy in aerial photos	No

	Feature	General Habitat Categories	NILS Variables and classes	Easy conversion Yes/No
		Tidal zone areas are recorded.	Tidal zone areas are not occurring in Sweden	Not applicable
		Water is only recorded if cover of vegetation is less than 30%	Submerged and emergent hydrophytes are recorded as aquatic with vegetation in four classes but without percentages	Yes, but some codes will have to be merged in both systems. A given percentage for recording would be an improvement in NILS
	Herbaceous	Broad leaved herbaceous species and grasses/ sedges are single codes. Based on 70% or more of one type	Broad leaved herbaceous species and grasses/sedges are recorded in one group and by dominance. In this code is also the field/bottom layer dwarf shrub of grass type"' included. At twelve single points per square percentages are recorded in field	Yes but the two codes LHE and CHE will have to be merged. EBONE records for 70% and NILS for above or below 50%
		Therophytes (plants that survive as seeds under unfavourable seasons) are recorded	Therophytes as habitat or vegetation cover do not occur in Sweden	Not applicable
		Succulent chamaephytes are recorded	Succulents do not occur in areas large enough to be mapped	Not applicable
		Geophytes are recorded	Geophytes are not possible to distinguish in the aerial photos	Not applicable
		Cryptogams are recorded	Cryptogams occur in wetlands and in the mountainous areas. In forests the trees take precedence	Yes
		Herbaceous chamaephytes are recorded	Herbaceous chamaephytes do not occur in Sweden	Not applicable
	Shrubs and trees	Dwarf and Shrubby chamaephytes (< 0.05 m and 0.05 - 0.3 m) are recorded as single life forms	Bottom and field layer below 0.03 m are recorded merged together	Yes but the two codes DHC and SCH will have to be merged
		Low and Mid phanerophytes (0.3 – 0.6 m and 0.6 – 2.0 m) are recorded as single life forms	All phanerophytes below 30 m are recorded as one code. And mean stand height is not recorded under this limit, except for mountain birches	Yes, but LPH and MPH will have to be merged. And the difference of 1m higher in NILS will have to be noted. For the mountain birches that make up the zone up to the mountain timber line, NILS has the limit of 2m for recording phanerophytes as trees

	Feature	General Habitat Categories	NILS Variables and classes	Easy conversion Yes/No
		Tall and Forest phanerophytes (0.3 – 0.6 m and 0.6 – 2.0 m) are recorded as single life forms	All phanerophytes above 3.0 m are recorded as one code. But in this code, the mean tree height is recorded for the forest stand. The decision of distinguishing between 3.0 - 5.0m and everything above 5m is not clearly viable and is abandoned	Yes, but the two codes TPH and FPH will have to be merged
			In the expression 'Pine' the Larch and Lodgepole pine species are included	
	Shrubs and trees, Level II and III	Winter deciduous and Conifers are recorded as single codes	Winter deciduous and Conifers are recorded as single codes	Yes. BUT there is much overlap and have to be done manually, at this stage
	Exotic trees, to Swedish conditions	Evergreen trees, Non-Leafy evergreen and Summer deciduous are recorded as single codes. Codes are: EVR, NLE and SPI	These categories are not viable in Sweden	Not applicable
Lines	**Linear objects**	30m	20m	Yes
	Always record linear features	No	Yes	Yes
	Fences, walls etc.	Included in urban codes, not recorded in urban	Stand-alone features	Yes
	Roads	Always recorded	Always recorded	Yes
Points	**Point objects**	Single or in groups	Always single points	Yes
	Point objects recorded	Decided for each survey, and differ	Fixed list	No
Other	**Inventory outside square**	Yes	No	Not important for conversion
	Species	'Indicator species' used as identifiers, no list	Fixed list, although only in the field work	No
	Slope angle, aspect, height	Data	Terrain model	Possible, not Easy
	Level II in classification	Qualifiers	Management or land use in 46 classes	Yes
	Total cover of vegetation	Vertical perspective	Vertical perspective	Yes
	Land surface	100%	100%	Yes
	Multiple layers in forest	Not recorded	Two-story forests, multiple in field data	Yes
	Single GHC	Over 70% of one life form	Continuous cover percentage	Yes
	Combination of two GHC	Relation of 40 - 60%	Continuous cover percentage	Yes, but will have to be 31 - 69%

	Feature	General Habitat Categories	NILS Variables and classes	Easy conversion Yes/No
	More than 40% bare ground + >2 Life forms		Continuous cover percentage	Yes, but will have to be from 31% and in certain combinations
	Life form < 10 %	Not recorded	Continuous cover percentage	Yes
	Single species > 30%	Recorded	Field layer classes	Yes, but species are recorded as groups
	Complex elements	Dominant GHCs recorded	Dominant land cover and three extra	Yes, but with one dominant land cover and three subdominant
	Ecotone, any	Mapping code	Inferred from Variables	No

3.5 SINUS Austria

The Austrian SINUS project used disaggregated codes based on the GB-Countryside Survey principles. In order to demonstrate the ability of these disaggregated codes to be translated into European habitats the SINUS team developed a protocol for conversion of codes into GHCs. This protocol is given in Table 6.The SINUS team successfully showed that the changes that they had observed could be converted into changes in GHCs.

Table 6
Conversion of SINUS codes. Ntyp code: Austrian Code Name; Ntyp_eng: English translation of the German SINUS type name.

Ntyp_code	Ntyp_eng	GHC	Description
SONK	artificial special biotopes	ART	Urban-Artificial
ALLA	avenue with old trees	FPH/DEC	Forest phanerophytes (> 5m) winter deciduous
ALLJ	avenue with young trees	FPH/DEC	Forest phanerophytes (> 5m) winter deciduous
BZV	blocks	ART	Urban-artificial
FKA	built up element	ART	Urban-artificial
LKA	built up element linear	ART	Urban-artificial
PKA	built up element point	ART	Urban-artificial
AE	corn fields extensive	CRO	Crops-cultivated herbaceous crops
AI	corn fields intensive	CRO	Crops-cultivated herbaceous crops
AMI	corn fields medium intensive	CRO	Crops-cultivated herbaceous crops
DEP	deposition, land fill	ART	Urban-artificial
EIG	detached houses	GRA	Urban-herbaceous
EIGV	detached houses paved	ART	Urban-artificial
EIGA	detached houses veg	GRA	Urban-herbaceous
VW	dirt roads	NON	Urban-non-vegetated
FR	field margin	LHE	Vegetated herbaceous leafy hemicryptophytes

Ntyp_code	Ntyp_eng	GHC	Description
AFF	forage crops	CRO	Vegetated herbaceous leafy hemicryptophytes
PG	gardens, parks	VEG	Urban-vegetables
HS	hedgerow of shrubs	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
HB	hedgerow of trees	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
IGV	industrial sites paved	ART	Urban-artificial
IGA	industrial sites veg	ART	Urban-artificial
STK	lake artificial	NON	Urban-non vegetated
STL	lake natural	AQU	Sparsely vegetated-aquatic
STN	lake semi-natural	AQU	Sparsely vegetated-aquatic
WIE	meadow extensive	CHE	Vegetated herbaceous caespitose hemicryptophytes
WII	meadow intensive	CHE	Vegetated herbaceous caespitose hemicryptophytes
WMI	meadow medium intensive	CHE	Vegetated herbaceous caespitose hemicryptophytes
WN	natural forest	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
SONN	natural special biotopes	CHE	Vegetated herbaceous caespitose hemicryptophytes
BG	old fallow land with shrubs	TPH/DEC	Tall phanerophytes (2-5 m) winter deciduous
BS	old fallow land with tall herbs	LHE	Vegetated herbaceous leafy hemicryptophytes
EBA	old solitary tree	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
EIH	one-family houses	ART	Urban-artificial
EIHA	one-family houses veg	GRA	Urban-herbaceous
BWA	orchard old	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
BWJ	orchard young	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
VS	other paved areas	ART	Urban-artificial
WS	other unpaved areas	ART	Urban-artificial
WEE	pasture extensive	CHE	Vegetated herbaceous caespitose hemicryptophytes
WEI	pasture intensive	CHE	Vegetated herbaceous caespitose hemicryptophytes
WEMI	pasture medium intensive	CHE	Vegetated herbaceous caespitose hemicryptophytes
BWEJ	pasture with young trees	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
BWEA	pasture with old trees	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
VV	paved roads	NON	Urban-non-vegetated
PFK	periodic stream artificial	NON	Urban-non-vegetated
PFN	periodic stream natural	NON	Urban-non-vegetated
VB	roads vegetated	VEG	Urban-vegetables
AHE	root crop extensive	CRO	Crops-cultivated herbaceous crops
AHI	root crop intensive	CRO	Crops-cultivated herbaceous crops
AHM	root crop medium intensive	CRO	Crops-cultivated herbaceous crops
WMN	semi-natural forest	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous

Ntyp_code	Ntyp_eng	GHC	Description
SV	settlements paved	ART	Urban-artificial
SG	settlements, vegetated	GRA	Urban-herbaceous
FG	small woodlot	FPH/DEC	Forest phanerophytes (> 5 m) winter deciduous
GV	stream artificial	AQU	Sparsely vegetated-aquatic
GN	stream natural	AQU	Sparsely vegetated-aquatic
GMN	stream semi-natural	AQU	Sparsely vegetated-aquatic
DFR	suburban	GRA	Urban-herbaceous
DFRA	suburb vegetated	GRA	Urban-herbaceous
WFA	timber plantation old	FPH/CON	Forest phanerophytes (> 5 m) coniferous
WFJ	timber plantation young	FPH/CON	Forest phanerophytes (> 5 m) coniferous
DFKA	village vegetated	ART	Urban-artificial
WGI	vineyard intensive	WOC	Crops-woody crops
WGM	vineyard medium intensive	WOC	Crops-woody crops
BJ	young fallow land	LHE	Vegetated herbaceous leafy hemicryptophytes
EBJ	young solitary tree	FPH/DEC	Forest phanerophytes (>5 m) winter deciduous

The categories have been applied in some squares to show the applicability. Figure 3 shows the generalisation of SINUS-categories converted into GHCs for the km-square 'Annatsberg'. Figure 4 displays the landscape change of the same square 'Annatsberg' based on GHCs.

Figure 3
Generalisation of categories from SINUS to GHC.

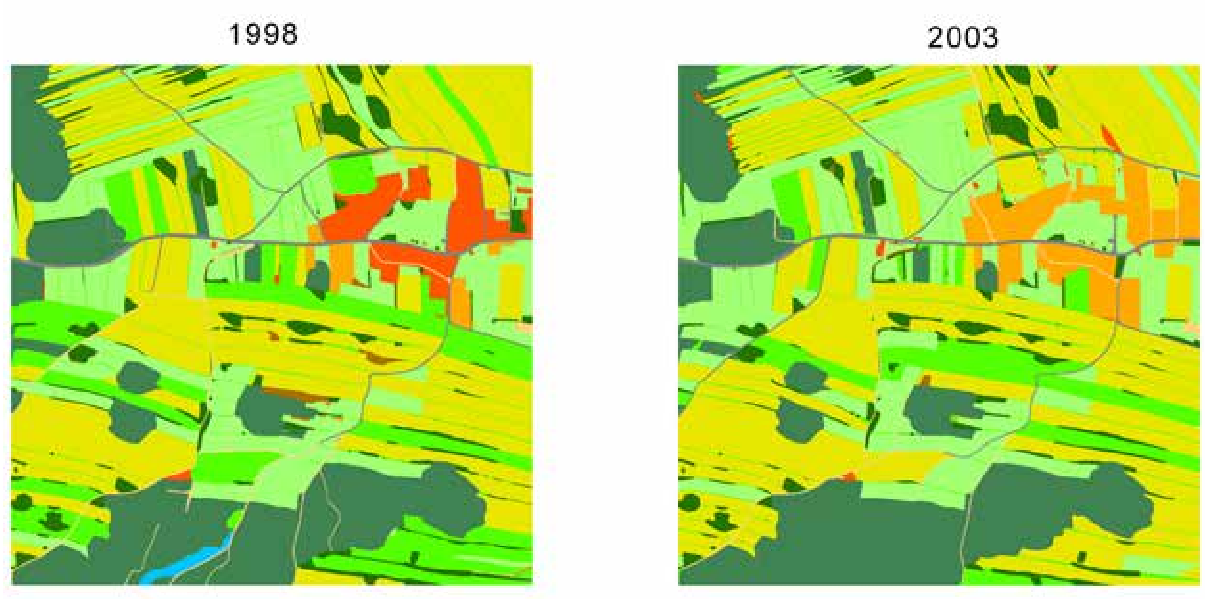


Figure 4
Land cover change between 1998 and 2003 using GHCs.

4 Validation of protocols

The protocols included in the present document have been produced as described in the Description of Work and are comprehensive for the various surveys. However, in some cases minor problems have been identified that need to be sorted out before the final integrated analysis is carried out. This is partly due to lack of experience with the full detail of the GHC's and partly due to interpretation differences between persons. For example, forage crops in SINUS were first coded LHE/CHE, but as sown crops the correct attribution was CRO. Also, in the CS several problems were detected with the database, which required attention.

The conclusion is that for all conversion tables done now as well as in the future an independent validation process is needed to ensure that the database is as accurate as possible.

A further part of validation is quality assurance (checking the reliability of the field recording) and quality control (providing initial training in recording and subsequent field visits). An example of the former is provided by Bunce et al. (2008) and the latter is an integral feature of the EBONE field recording procedure.

5 Proposed subdivisions of grasslands

It is proposed to subdivide the CHE and LHE/CHE categories for the following reasons:

1. To improve relationships with reflectance, because of the greater variability of structure and colour in grasslands than other GHC's.
2. To increase the information on biodiversity in grasslands.

The latter will anyway be recorded in the field because the handbook instructions require them to be mapped if there are significant differences in qualifiers. An instruction will be added to the vegetation recording procedure that plots should not only be placed in CHE and LHE/CHE categories, but also in the subdivisions. In most Km squares there are likely only two or three extra plots to be recorded. LHE alone is not included because such patches are rare and are likely to be markedly different anyway. The division given in Table 7 are taken from the EBONE handbook (Bunce et al., 2011) except that eutrophic is excluded for similar reasons as LHE.

Table 7
Environmental qualifiers for CHE and LHE.

	waterlogged	seasonally wet	wet	mesic	dry	very dry	xeric
Acid	2 2	3 2	4 2	5 2	6 2	7 2	8 2
Neutral	2 3	3 3	4 3	5 3	6 3	7 3	8 3
Basic	2 4	3 4	4 4	5 4	6 4	7 4	8 4
Saline	2 5	3 5	4 5	5 5	6 5	7 5	8 5

Therefore there will be 28 subdivisions in both CHE and LHE giving a total of 58 classes. It is proposed to call the subdivisions of General Habitat Codes (SGHC's). Apart from grasslands the other habitat class likely to cause problems are bogs. The CHE and LHE/CHE classes will be identified as waterlogged acid but the SCH/EVR and possibly LPH/EVR will need to be extracted separately.
Discussions have been held with the NILS and CS team on the time required for such manipulation. The NICS protocol already includes the necessary relationships.

6 Conclusions

The national protocols for habitat monitoring in Great Britain, Sweden, Austria and Northern Ireland have been converted into a common format based on GHCs. The Northern Ireland conversion table also allows for integration. This makes it possible to use them in European comparisons and for eventual European reporting on habitats.

The MMU of the Spanish SISPARES project does not fit with the other projects. The data of the Spanish SISPARES project therefore need further survey for conversion.

Further division of the GHCs for potential improvement of the relationship with remote sensing will enable harmonisation and the eventual production of EU-wide estimates of habitat extent. This will require ancillary data, which is generally available. The subdivision will also provide further detail for the assessment of biodiversity.

Other national and regional projects are expected to fit this approach as well as most have approaches at a local to regional scale. The Northern Ireland Countryside Survey has used a similar approach and others will follow, eg. France, Portugal and Estonia. Other countries are approached to link their data at the European level into a common database.

The conclusion to be drawn from the comparison between the Spanish data and the other datasets in this report is that for projects at the national or regional level within Europe it is important to utilise Minimum Mapping Units comparable with or below the EBONE approach. Minimum standards for data collection re also required to make European harmonisation possible. However, the protocols produced to date have already been included into the database being constructed in WP7 to produce figures for environmental strata, which can eventually be integrated into European estimates. A final stage of validation is also required to sort out minor problems that have been identified in the protocol procedure.

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Annex 1 List of General Habitat Categories

GHC (vernacular name)	Primary code
URBAN	URB
Artificial	ART
Non Vegetated	NON
Crops	VEG
Herbaceous	GRA
Woody vegetation	TRE
Artificial / Non-Vegetated	ART/NON
Artificial / Crops	ART/VEG
Artificial / Herbaceous	ART/GRA
Artificial / Woody	ART/TRE
Non Vegetated / Crops	NON/VEG
Non Vegetated / Herbaceous	NON/GRA
Non Vegetated / Woody	NON/TRE
Crops / Herbaceous	VEG/GRA
Crops / Woody	VEG/TRE
Herbaceous / Woody	GRA/TRE
CULTIVATED	CUL
Bare Ground	SPA
Herbaceous Crops	CRO
Woody Crops	WOC
Herbaceous/Woody Crops	CRO/WOC
SPARSELY VEGETATED	SPV
Sea	SEA
Tidal	TID
Aquatic	AQU
Ice and Snow	ICE
Terrestrial	TER
Sea/Tidal	SEA/TID
Sea/Ice	SEA/ICE
Sea/Terrestrial	SEA/TER
Tidal/Aquatic	TID/AQU
Tidal/ Terrestrial	TID/TER
Aquatic/Terrestrial	AQU/TER
TERRESTRIAL	TER
Bare Rock	ROC
Boulders	BOU
Stones	STO
Gravel	GRV
Sand	SAN
Earth, Mud	EAR
Rock/Boulders	ROC/BOU
Rock/Stones	ROC/STO
Rock/Gravel	ROC/GRV
Rock/Sand	ROC/SAN
Rock/Earth	ROC/EAR

GHC (vernacular name)	Primary code
Boulders/Stones	BOU/STO
Boulders/Gravel	BOU/GRV
Boulders/Sand	BOU/GRV
Boulders/Earth	BOU/EAR
Stones/Gravel	STO/GRV
Stones/Sand	STO/SAN
Stones/Earth	STO/EAR
Gravel/Sand	GRV/SAN
Gravel/Earth	GRV/EAR
Sand/Earth	SAN/EAR
HERBACEOUS WETLAND	HER
Submerged Hydrophytes	SHY
Emergent Hydrophytes	EHY
Helophytes	HEL
Submerged Hydrophytes / Emergent Hydrophytes	SHY/EHY
Submerged Hydrophytes / Helophytes	SHY/HEL
Emergent Hydrophytes / Helophytes	EHY/HEL
HERBACEOUS	HER
Leafy Hemicryptophytes	LHE
Caespitose Hemicryptophytes	CHE
Therophytes	THE
Geophytes	GEO
Chamaephytes	HCH
Cryptogams	CRY
Leafy Hemicryptophytes / Caespitose Hemicryptophytes	LHE/CHE
Leafy Hemicryptophytes / Therophytes	LHE/THE
Leafy Hemicryptophytes / Geophytes	LHE/GEO
Leafy Hemicryptophytes / Herbaceous Chamaephytes	LHE/HCH
Leafy Hemicryptophytes / Cryptogams	LHE/CRY
Caespitose Hemicryptophytes / Therophytes	CHE/THE
Caespitose Hemicryptophytes / Geophytes	CHE/GEO
Caespitose Hemicryptophytes / Herbaceous Chamaephytes	CHE/HCH
Caespitose Hemicryptophytes / Cryptogams	CHE/CRY
Therophytes / Geophytes	THE/GEO
Therophytes / Herbaceous Chamaephytes	THE/HCH
Therophytes / Cryptogams	THE/CRY
Geophytes / Herbaceous Chamaephytes	GEO/HCH
Geophytes / Cryptogams	GEO/CRY
Chamaephytes / Cryptogams	HCH/CRY
TREES/SHRUBS	TRS
Dwarf Chamaephytes Winter Deciduous	DCH/DEC
Dwarf Chamaephytes Evergreen	DCH/EVR
Dwarf Chamaephytes Coniferous	DCH/CON
Dwarf Chamaephytes Winter Deciduous / Evergreen	DCH/DEC/EVR
Dwarf Chamaephytes Winter Deciduous / Coniferous	DCH/DEC/CON
Dwarf Chamaephytes Evergreen / Coniferous	DCH/EVR/CON
Shrubby Chamaephytes Winter Deciduous	SCH/DEC
Shrubby Chamaephytes Evergreen	SCH/EVR
Shrubby Chamaephytes Coniferous	SCH/CON
Shrubby Chamaephytes Non-Leafy Evergreen	SCH/NLE
Shrubby Chamaephytes Summer Deciduous and/or Spiny Cushion	SCH/SUM
Shrubby Chamaephytes Winter Deciduous / Evergreen	SCH/DEC/EVR

GHC (vernacular name)	Primary code
Shrubby Chamaephytes Winter Deciduous / Coniferous	SCH/DEC/CON
Shrubby Chamaephytes Winter Deciduous / Non-Leafy Evergreen	SCH/DEC/NLE
Shrubby Chamaephytes Winter Deciduous / Summer Deciduous	SCH/DEC/SUM
Shrubby Chamaephytes Evergreen / Coniferous	SCH/ EVR/CON
Shrubby Chamaephytes Evergreen / Non-Leafy Evergreen	SCH/EVR/NLE
Shrubby Chamaephytes Evergreen / Summer Deciduous	SCH/EVR/SUM
Shrubby Chamaephytes Coniferous / Non-Leafy Evergreen	SCH/CON/NLE
Shrubby Chamaephytes Coniferous / Summer Deciduous	SCH/CON/SUM
Shrubby Chamaephytes Non-Leafy Evergreen / Summer Deciduous	SCH/NLE/SUM
Low Phanerophytes Winter Deciduous	LPH/DEC
Low Phanerophytes Evergreen	LPH/EVR
Low Phanerophytes Coniferous	LPH/CON
Low Phanerophytes Non-Leafy Evergreen	LPH/NLE
Low Phanerophytes Summer Deciduous	LPH/SUM
Low Phanerophytes Winter deciduous / Evergreen	LPH/DEC/EVR
Low Phanerophytes Winter deciduous / Coniferous	LPH/DEC/CON
Low Phanerophytes Winter deciduous / Non-Leafy Evergreen	LPH/DEC/NLE
Low Phanerophytes Winter Deciduous Summer	LPH/DEC/SUM
Low Phanerophytes Evergreen / Coniferous	LPH/ EVR/CON
Low Phanerophytes Evergreen / Non-Leafy Evergreen	LPH/EVR/NLE
Low Phanerophytes Evergreen / Summer Deciduous	LPH/EVR/SUM
Low Phanerophytes Coniferous / Non-Leafy Evergreen	LPH/CON/NLE
Low Phanerophytes Coniferous / Summer Deciduous	LPH/CON/SUM
Low Phanerophytes Non-Leafy Evergreen / Summer Deciduous	LPH/NLE/SUM
Mid Phanerophytes Winter Deciduous	MPH/DEC
Mid Phanerophytes Evergreen	MPH/EVR
Mid Phanerophytes Coniferous	MPH/CON
Mid Phanerophytes Non Leafy Evergreen	MPH/NLE
Mid Phanerophytes Summer Deciduous and/or Spiny Cushion	MPH/SUM
Mid Phanerophytes Winter Deciduous / Evergreen	MPH/DEC/EVR
Mid Phanerophytes Winter Deciduous / Coniferous	MPH/DEC/CON
Mid Phanerophytes Winter Deciduous / Non-Leafy Evergreen	MPH/DEC/NLE
Mid Phanerophytes Winter Deciduous / Summer Deciduous	MPH/DEC/SUM
Mid Phanerophytes Evergreen / Coniferous	MPH/EVR/CON
Mid Phanerophytes Evergreen / Non-Leafy Evergreen	MPH/EVR/NLE
Mid Phanerophytes Evergreen / Broadleaved / Summer Deciduous	MPH/EVR/SUM
Mid Phanerophytes Coniferous / Non-Leafy Evergreen	MPH/CON/NLE
Mid Phanerophytes Coniferous / Summer Deciduous	MPH/CON/SUM
Mid Phanerophytes Non-Leafy Evergreen / Summer Deciduous	MPH/NLE/SUM
Tall Phanerophytes Winter Deciduous	TPH/DEC
Tall Phanerophytes Evergreen	TPH/EVR
Tall Phanerophytes Coniferous	TPH/CON
Tall Phanerophytes Non-Leafy Evergreen	TPH/NLE
Tall Phanerophytes Summer Deciduous	TPH/SUM
Tall Phanerophytes Winter Deciduous / Evergreen	TPH/DEC/EVR
Tall Phanerophytes Winter Deciduous / Coniferous	TPH/DEC/CON
Tall Phanerophytes Winter Deciduous / Non-Leafy Evergreen	TPH/DEC/NLE
Tall Phanerophytes Evergreen / Coniferous	TPH/EVR/CON
Tall Phanerophytes Evergreen / Non-Leafy Evergreen	TPH/EVR/NLE
Tall Phanerophytes Evergreen / Summer Deciduous	TPH/EVR/SUM
Tall Phanerophytes Coniferous / Non-Leafy Evergreen	TPH/CON/NLE
Tall Phanerophytes Coniferous / Summer Deciduous	TPH/CON/SUM

GHC (vernacular name)	Primary code
Forest Phanerophytes Winter Deciduous	FPH/DEC
Forest Phanerophytes Evergreen	FPH/EVR
Forest Phanerophytes Coniferous	FPH/CON
Forest Phanerophytes Summer Deciduous	FPH/SUM
Forest Phanerophytes Winter Deciduous / Evergreen	FPH/DEC/EVR
Forest Phanerophytes Winter Deciduous / Coniferous	FPH/DEC/CON
Forest Phanerophytes Evergreen / Coniferous	FPH/EVR/CON
Forest Phanerophytes Evergreen / Summer Deciduous	FPH/EVR/SUM
Forest Phanerophytes Coniferous/ Summer Deciduous	FPH/CON/SUM
Mega Forest Phanerophytes Deciduous	GPH/DEC
Mega Forest Phanerophytes Evergreen	GPH/EVR
Mega Forest Phanerophytes Conifer	GPH/CON
Mega Forest Phanerophytes Summer deciduous	GPH/SUM
Mega Forest Phanerophytes Winter Deciduous / Evergreen	GPH/DEC/EVR
Mega Forest Phanerophytes Winter Deciduous / Coniferous	GPH/DEC/CON
Mega Forest Phanerophytes Evergreen / Coniferous	GPH/EVR/CON
Mega Forest Phanerophytes Evergreen /Summer Deciduous	GPH/EVR/SUM
Mega Forest Phanerophytes Conifer /Summer Deciduous	GPH/CON/SUM

ALTERRA
WAGENINGEN UR

Conversion of European habitat data sources into common standards

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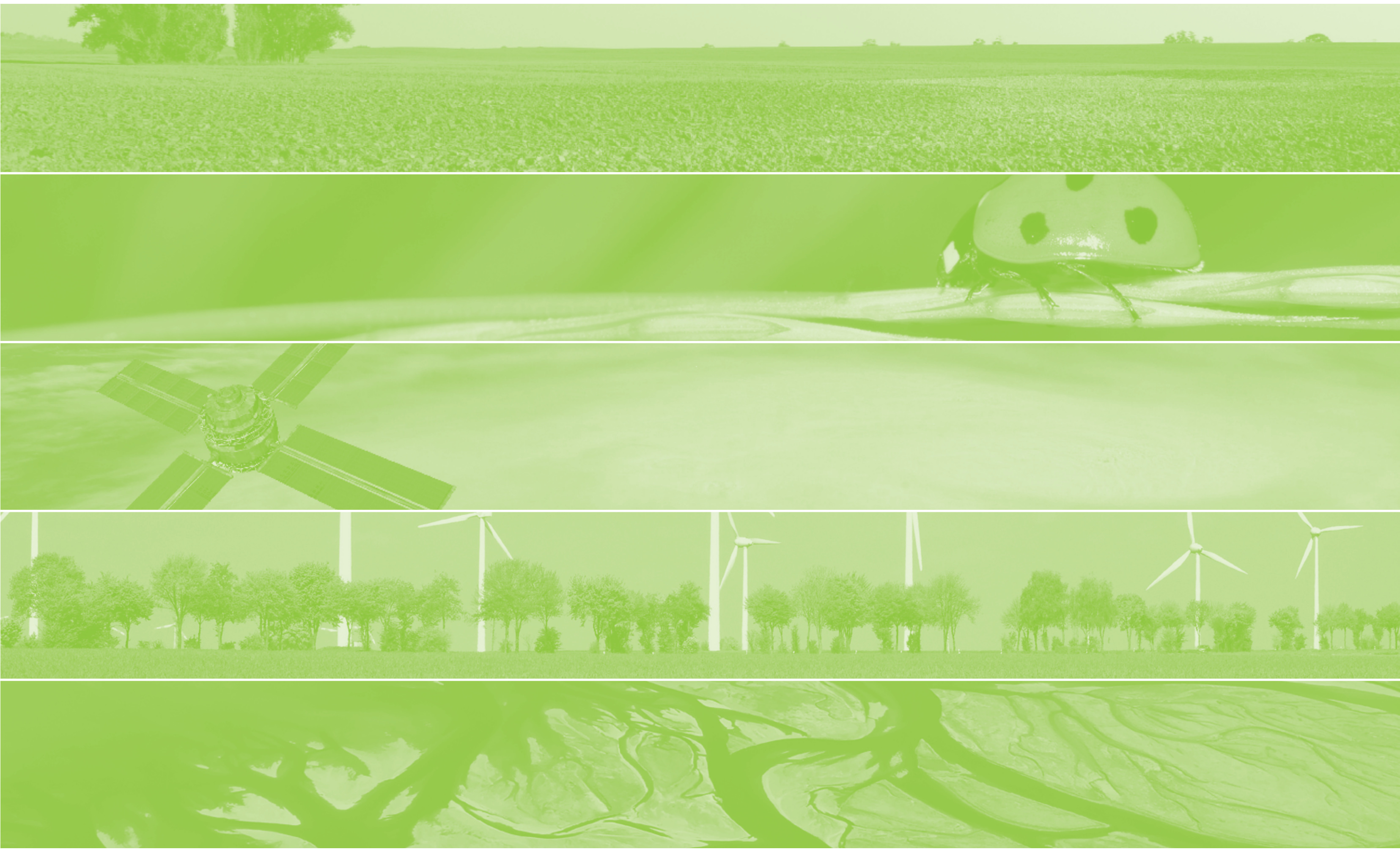
ALTERRA WAGENINGEN UR | SEVENTH FRAMEWORK PROGRAMME | EBONE EUROPEAN BIODIVERSITY OBSERVATION NETWORK



Alterra is part of the international expertise organisation Wageningen UR (University & Research centre). Our mission is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine research institutes – both specialised and applied – have joined forces with Wageningen University and Van Hall Larenstein University of Applied Sciences to help answer the most important questions in the domain of healthy food and living environment. With approximately 40 locations (in the Netherlands, Brazil and China), 6,500 members of staff and 10,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the exact sciences and the technological and social disciplines are at the heart of the Wageningen Approach.

Alterra is the research institute for our green living environment. We offer a combination of practical and scientific research in a multitude of disciplines related to the green world around us and the sustainable use of our living environment, such as flora and fauna, soil, water, the environment, geo-information and remote sensing, landscape and spatial planning, man and society.

More information: www.alterra.wur.nl/uk