

The **RUBICODE** Project

Rationalising Biodiversity Conservation in Dynamic Ecosystems

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Web report comparing indicators targeting habitat area

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Policy background

Over centuries human societies have modified natural habitats through a variety of land and water-use practices. The world's major biomes have been affected to different degrees by large scale conversion of natural habitats into production or waste lands, resulting in the reduction and fragmentation of natural habitat (e.g. Jongman, 2002; EEA, 2007). The reduction in size of natural biomes, ecosystems and habitats, as a result of land use change, has led to a reduction in ecosystem diversity, species richness and ecosystem services. Therefore, since the signature of the UN Convention on Biological Diversity (CBD) in 1992, concern for biodiversity was awarded a higher political profile. In 1995, a pan-European response to the CBD was issued through the endorsement of the *Pan-European Biological and Landscape Diversity Strategy* by more than 50 countries covered by the United Nations Economic Commission for Europe. Being embedded in the ministerial process 'Environment for Europe', this strategy provided the only platform for pan-European cooperation addressing biodiversity loss. Similarly, at the European Union level, the EC Biodiversity Conservation Strategy (ECBS) was adopted in 1998, and provided a comprehensive response to the many requirements of the CBD. The objective of “managing natural resources more responsibly: to protect and restore habitats and natural systems and

halt the loss of biodiversity by 2010” was first adopted by the EU in its Strategy for Sustainable Development (European Council: Gothenburg, 2001). The 2010 target was also assumed by the World Summit on Sustainable Development (WSSD), held in Johannesburg in 2002, which was designed as a framework for action to implement the commitments originally agreed at the Rio Conference. In line with these initiatives, the 6th Conference of the Parties (COP) to the Convention on Biological Diversity (the Hague, 2002) adopted a Strategic Plan for the CBD (Decision VI/26) including the 2010 target “to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level”.

CBD and SEBI 2010 headline indicators targeting habitat area

Following the adoption of the CBD Strategic Plan, the Conference of the Parties developed a framework to enhance the evaluation of achievements and progress toward its implementation (paragraph 1 of decision VII/30) in order to accomplish the 2010 Biodiversity Target. This framework comprises 26 indicators grouped into 15 headline indicators and allocated to 7 CBD focal areas (EEA, 2007). The main goal of the first focal area, “Status and trends of the components of biological diversity”, is “reducing the rate of loss of the components of biodiversity, including: (i) biomes, habitats and ecosystems; (ii) species and populations; and (iii) genetic diversity”. Accordingly, the EU headline indicators “Trends in extent of selected biomes, ecosystems and habitats” and “Coverage of protected areas” provide a direct measure of changes in ecosystem coverage. The information about trends in the extent of biomes, ecosystems, and habitat-types on a global scale is a crucial part of understanding the state and trends of biodiversity as a whole, and determining the extent to which the 2010 target is being met (EEA, 2003).

The CBD Framework was adapted to European and pan-European contexts (EC ‘Message from Malahide’, 2004; PEBLDS Council, 2005). A pan-European initiative, *Streamlining European 2010 Biodiversity Indicators* (SEBI 2010), was launched in 2004 in order to oversee and revise CBD focal areas and also to develop and propose a set of specific indicators to assess and inform progress towards the European 2010 target. Thus, SEBI 2010 proposed four specific indicators related to the headline indicators “Trends in extent of selected biomes, ecosystems and habitats” and “Coverage of protected areas”. “Ecosystem coverage” addresses changes in major ecosystems in Europe since 1990, providing a complete picture of their distribution. This is a key indicator as a particular ecosystem will comprise several habitats that support a characteristic set of species. If the

ecosystem is encroached upon and decreases in area, the species and habitats it supports may be put at risk and may not be able to sustain viable population levels (EEA, 2007). The other proposed indicators are “Habitats of European interest”, “Nationally designated protected areas” and “Sites designated under the EU Habitats and Birds Directives”. These indicators are central to the CBD and are closely linked to the species indicators. In fact, data on trends in the extent of biomes, ecosystems, and habitats is essential for assessing the status of threatened species, and may also be used as a surrogate or to help model assessments of populations. To make a global assessment of the rate of loss of biomes, ecosystems and habitats, it is important to obtain complete coverage of all major types of biomes/ecosystems, even if data quality varies. For some biome/ecosystem types, the identified datasets will yield sufficient datapoints to give trend information relevant to the 2010 target assessment. For others, appropriate global datasets are yet to be identified or need to be acquired (UNEP/CBD/SBSTTA/10, 2004). Moreover, habitat area indicators can be assessed globally using remote sensing information. These tools are efficient and very cost-effective, and do not necessarily require time-consuming field-based monitoring.

The establishment and management of protected areas is a direct response to concerns over biodiversity loss and reflect measures taken to safeguard biodiversity. Information on the distribution and status of species and ecosystems can provide valuable insight into the effectiveness of protected area networks, and the status of conservation response to pressures on species and ecosystems. Protected areas are therefore the cornerstones of all national and regional biodiversity conservation strategies. As comprehensive data on officially designated areas are regularly compiled and stored, the indicator on nationally designated protected areas illustrates the rate of growth in protected areas over time. In this way, protected area coverage can serve as an indicator of the efforts made at national, regional, global or biogeographic levels to maintain biodiversity. For the EU, the indicator on sites designated under the Habitats and Birds Directives will present an assessment of completeness of the EU network. Article 8(a) of the Convention on Biological Diversity (CBD) enjoins parties to establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity (UNEP/CBD/SBSTTA/10, 2004). Therefore, these sites are likely to cover the full range of biodiversity within any given geographical region, and that the protected areas will meet a number of different conservation-related objectives (decision33 VII/28).

Data sources for assessing habitat area indicators

Data sources are available systematically for selected biomes, ecosystems and habitats, such as forests, shrubs and grasslands, agro-ecosystems, aquatic ecosystems, wetlands and soils (Figure 1). Available data sources, their quality and the periodicity of assessments vary among ecosystems. For several biomes/ecosystem types, satellite imagery is the main source of information. The different classification systems used, different algorithms and varying levels of ground truthing create difficulties in comparing land cover data from different sources. Amongst a plethora of available methods to provide data on habitat area, the Corine Land Cover database (CLC) has been the data source most widely used to cover large areas of the main ecosystem types of Europe in a harmonised way (EEA, 2007). A few other data sources (e.g. GLC2000; MODLAND) also cover all ecosystem types (Figure 1).

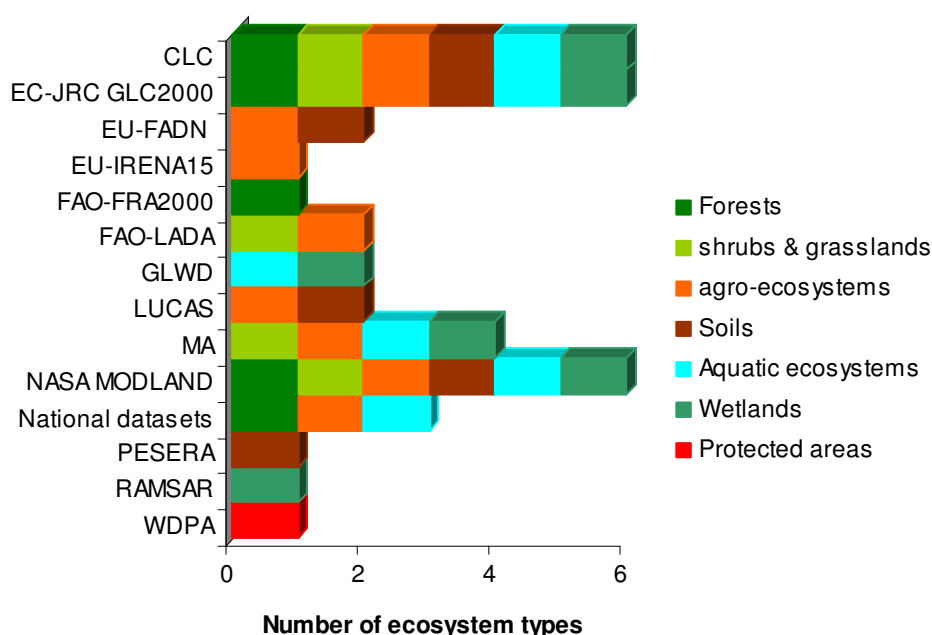


Figure 1. Data sources for assessing trends in major biomes, ecosystems and habitats (CLC – Corine Land Cover; EC-JRC GLC2000 – Global Land Cover from Joint Research Centre of the European Commission; EU-FADN - Farm Accountancy data network of the European Union; EU-IRENA15 - Indicator reporting on the integration of environmental concerns into the agriculture policy of the European Union; FAO-FRA2000 - FAO’s Forest Resources Assessment; FAO-LADA - FAO’s Land Degradation Assessment in drylands; GLWD - Global Lakes and Wetlands Database; LUCAS - Land use/cover area frame statistical survey; MA - Millennium Ecosystem Assessment; NASA-MODLAND - Moderate resolution Imaging Spectroradiometer (MODIS) Land Discipline Group of NASA; PESERA

- pan-European soil erosion risk assessment; RAMSAR - Convention on cooperation for the conservation and wise use of wetlands and their resources; WDPA - World Database on Protected Areas (compiled by IUCN and UNEP-WCMC).

The CLC is based on photo interpretation of satellite images (Landsat 7) by national teams of participating countries. The resulting national land cover inventories are integrated into a European database based on standard methodology and nomenclature with 44 land cover classes aggregated into 13 ecosystem types. At present, data are available from 23 countries providing CLC data in 1990 and 2000 and changes between 1990 and 2000 (EEA, 2006). The changes in land cover from 1990 to 2000 are given in the change database created for this specific purpose. In the Land Cover change database, change is calculated on a standard polygon size of 5 hectares in response to user needs. However, the accuracy of this information is determined by the CLC minimum polygon size, which is 25 hectares. These data have been processed and turned into a readily accessible spreadsheet file called Land Cover and Ecosystem Accounts (LEAC) created and managed by the EEA (EEA, 2007). An update of the CLC has been underway since 2006 and this should provide a third data point for tracking trends prior to 2010. As the CLC methodology is widely accepted, more countries are expected to provide CLC data in the future thereby expanding the data coverage of indicators targeting habitat area.

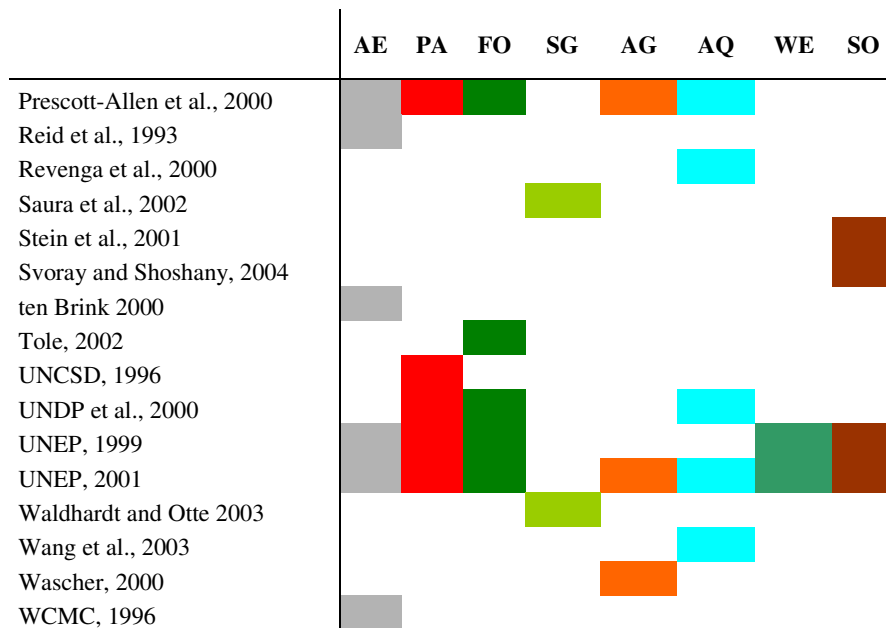
Comparison of habitat area indicators among terrestrial ecosystems types

Based on the “Ecosystem coverage” data sources and on the designated areas under international conventions and initiatives, habitat area indicators have been developed to track changes in the extent of biomes, ecosystems and habitats, in order to allow a view of global ecosystems as broad as possible. In decision VII/30 the COP established a process for testing and developing the indicators, with inputs from expert working groups (UNEP/CBD/SBSTTA/10, 2004), for assessing progress towards the 2010 biodiversity target. In fact, assessing progress towards targets 1.1 and 1.2 of decision VII/30, i.e. the effective conservation of “at least 10% of each of the world's ecological regions” and the protection of “areas of particular importance to biodiversity”, rely strongly on the development and implementation of suitable habitat area indicators. Therefore, several habitat area indicators have currently been proposed, developed, tested and implemented by various European and international initiatives and by ad-hoc groups (e.g. Table 1). As a result, based on the data

collected from the references shown in the Table 1, we found more than 270 habitat area indicators that up to now have been developed and/or implemented (see Appendix).

Table 1. List of references (in alphabetical order) addressing habitat area indication in major terrestrial ecosystem types (AE – all ecosystems; PA – protected areas; FO – forests; SG – shrubs and grasslands; AG – agro-ecosystems; AQ – aquatic ecosystems; WE – wetlands; SO – soils).

	AE	PA	FO	SG	AG	AQ	WE	SO
Alcaraz et al., 2006						■		
Ares et al., 2001					■			
Bailey et al. 2007					■			
Bär and Löffler, 2007							■	
BEF, 2000		■	■		■			
Belanger and Grenier, 2002			■					
Billeter et al. (submitted)		■	■		■		■	
Bosch & Söderbäck, 1997	■	■	■		■		■	
Buchs, 2003					■			
Chaves and Alipaz, 2007						■		
Donohue et al., 2006						■		
Dumanski and Pieri 2000								■
EC, 2000					■			
EC, 2001					■			
ECWFD						■		
EEA, 2000								■
EEA, 2001		■		■				
EEA, 2002		■	■	■	■	■	■	■
EEA, 2007			■		■	■		
EU, 2002								■
Eurostat, 2001	■	■			■		■	■
Focardi et al., 2006						■		
Franklin et al., 2000			■					
Gergel et al., 2002						■		
Gobin et al, 2004								■
Griffith, 2002						■		
Hannah, 1994a,b	■							
Heath and Rayment, 2001	■	■						
Helm et al., 2006				■				
Kohv and Liira, 2005			■					
Ludwig et al., 2007								■
Maestre, 2004				■				
MCPFE, 2001 ^a			■					
MCPFE, 2001b			■					
Munafo et al., 2005						■		
Nagler et al., 2001					■	■		
Neave et al., 2000					■			
OECD, 2001					■			
Pantus and Dennison, 2005						■		
Petit and Firbank, 2006				■				



At the global scale, 90% of indicators specifically address the EU Headline Indicator “Trends in extent of selected biomes, ecosystems and habitats”, whereas about 10% comprise specific indicators of “Coverage of protected areas” (Figure 2). Regarding the different terrestrial ecosystem types, forest indicators constitute almost one third of all existing indicators (84 indicators: 31%). Agro-ecosystems also cover a high number of indicators targeting habitat area (53 indicators: 20%). Both ecosystem types encompassed a higher number of indicators when compared with indicators of habitat area non-specific of a particular ecosystem type (43 indicators: 16%). Thirty-one habitat area indicators (~12% of the total indicators found) were developed for aquatic ecosystems, 17 (6%) of which exclusively refer to rivers (Figure 2).

Regarding soils, wetlands, and shrubs and grasslands, these ecosystem types presented lower relative numbers of habitat area indicators (5%, 4% and ~3%, respectively). These results are partly a consequence of the currently most comprehensive and easily accessible datasets that are available for the extent of forest cover, namely the trends of forest area based on FAO data (Global Forest Resources Assessment 2000 - FRA2000). In fact, CBD habitat area indicators have particularly focused on global forests, including mangroves and tropical forests, not giving information on other ecosystem types (UNEP/CBD/SBSTTA/10, 2004).

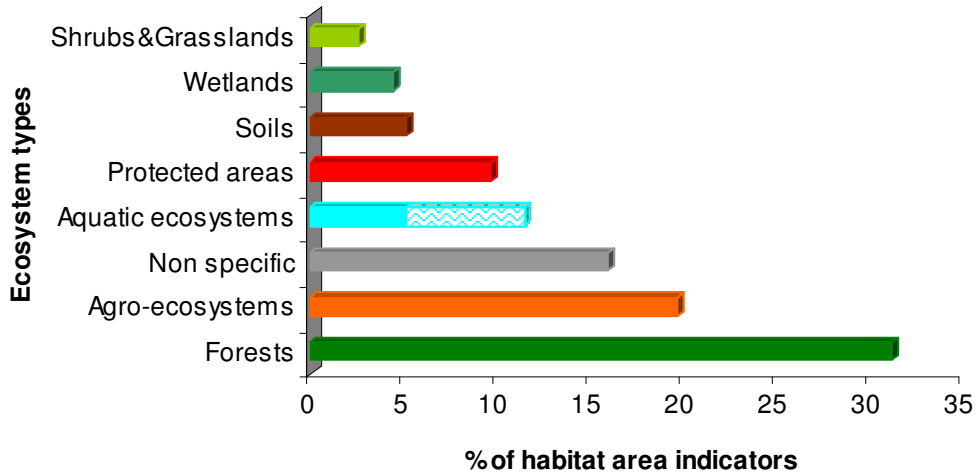


Figure 2. Relative proportion (%) of habitat area indicators developed and/or implemented in different ecosystem types (“blue waves’ bar” comprise indicators exclusively from rivers).

Concerning European, pan-European and international political contexts, the main driving forces behind the development and implementation of forest indicators have been the Ministerial Conference on the Protection of Forests in Europe (MCPFE), the United Nations Development Programme (UNDP) and the United Nations Environmental Programme (UNEP) (Figure 3). The pan-European MCPFE have mainly worked on indicators for sustainable forest management, while the UNEP developed global and European biodiversity indicators that have been considered for the focal area on status and trends of the components of biological diversity.

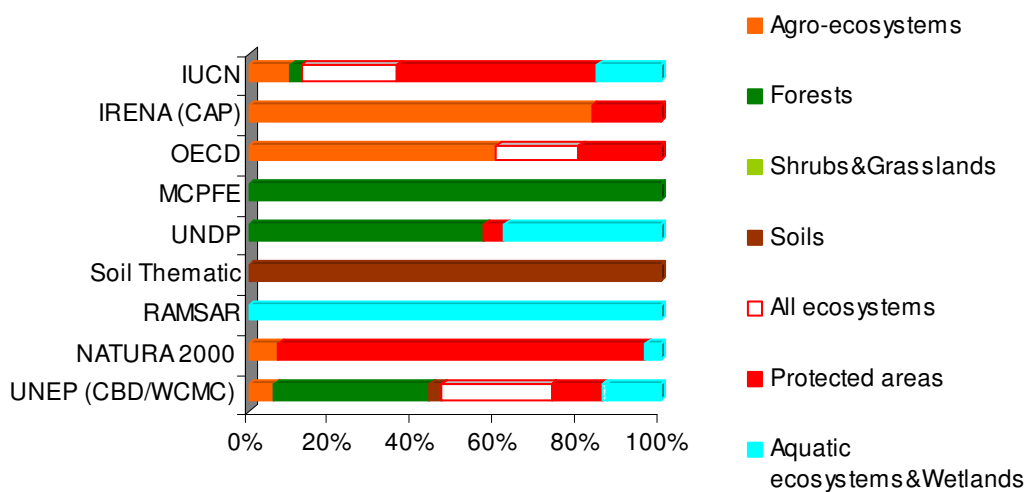


Figure 3. Relative proportion (%) of habitat area indicators developed under the most relevant policies for indication in the different ecosystem types.

The main habitat area indicators developed for agro-ecosystems are based on the indicators for environmental integration in the Common Agriculture Policy (IRENA) and on the Organisation for Economic Co-operation and Development (OECD) wildlife and agriculture indicators. Habitat area indicators for aquatic ecosystems and wetlands are basically supported by the RAMSAR convention, besides UNDP initiatives, whereas soil indicators are mainly based on the threats identified by the Thematic Strategy for Soil Protection. Regarding the coverage of protected areas, these are directly based on the indicators of current status of implementation and effective designation of sites under the IUCN (nationally protected areas), as well as the EU Habitats and Birds Directives.

The majority of indicators targeting habitat area are related to the assessment of habitat management (43%) (Figure 4), namely land cover change and habitat disturbance, e.g. area used for intensive arable agriculture, percentage of forest area affected by anthropogenic effects, extent and degree of water pollution, and extent of total soil loss by soil erosion.

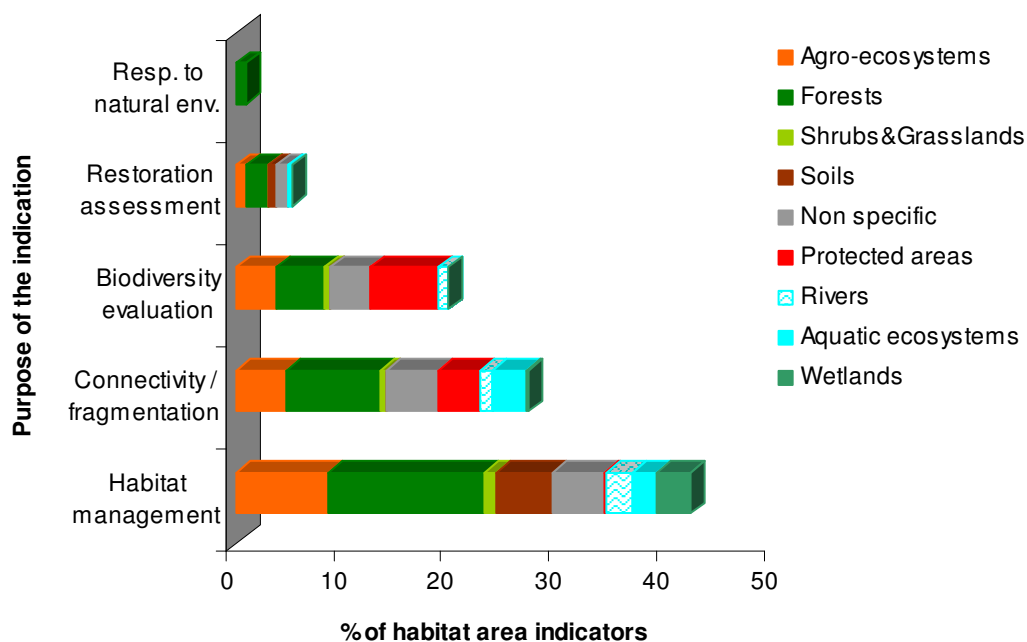


Figure 4. Relative proportion (%) of habitat area indicators under different indication purposes (“blue waves’ bars” comprise aquatic indicators exclusively from rivers).

Nevertheless, 23% of habitat area indicators are linked to connectivity/fragmentation assessment, e.g. edge to area ratio of agriculture field margins, forest physical fragmentation index, area of protected areas by vegetation type as percentage of total area, and river fragmentation index. Last but not least, 21% of the habitat area indicators are also connected with biodiversity evaluations as, according to CBD definition, ecosystems and habitats are a major component of biological diversity (UNEP, 1992; UNEP/CBD/COP/7/INF/22, 2003). Therefore, a reduction in area of the natural and semi natural habitats can be interpreted as a potential biodiversity loss, whereas an increase indicates that loss is reversed. Moreover, a particular habitat supports a particular set of species. If a habitat drastically decreases in area it will have a negative influence on the species which the habitat encloses (EEA, 2007). This indicator is particularly important for specialist species and endemic species that are dependent on particular habitats in one ecosystem and cannot survive in other ecosystems (EEA, 2007).

Conclusions

Habitat area indicators are highly relevant for the CBD focal area on 'Status and trends of the components of biological diversity' and for the 2010 target, as they are easy to understand and give a simple and clear overview of trends in ecosystems. Nevertheless, the assessment of trends should be feasible at a high resolution for areas of utmost importance to global biodiversity (e.g. a particular habitat holding specialist and/or endemic species) but the use of remote sensing data implies that some degree of detail is lost. For instance, the Corine Land Cover data set is based on a minimal unit of 25 hectares and this implies that smaller areas of certain habitat types and linear features may not be adequately detected (EEA, 2007). Moreover, other data sets (e.g. from national offices reporting for forests, crop and grassland areas) cannot be combined with CLC calculations because different definitions and different frequencies in updating will produce incomparable trends (UNEP/CBD/SBSTTA/10, 2004). Therefore, CLC and national inventories need to be converted to a common definition and baseline. Data source quality could be improved by promoting the standardization of sampling and aggregation of information, combining the systematic use of satellite images with field verification and expert interpretation for all ecosystem types. Moreover, even habitat area indicators developed for forests are based on data sources which provide little information about ecosystem quality (e.g. FAO's Forest Resources Assessment), particularly information on biodiversity in forests. Information on ecosystem/habitat extent needs to be considered in conjunction with information on

ecosystem/habitat quality provided through other indicators (such as species diversity and trophic integrity) to give a more complete picture of biodiversity trends, trends in threatened species or the occurrence of invasive alien species (UNEP/CBD/COP/7/INF/33, 2004). Additionally, links between indicators of habitat area (including also complementary indicators of fragmentation/connectivity) and biodiversity have to be further validated for different ecosystems. The relation of biodiversity data at different spatial scales with landscape information should be further studied in order to improve the utility and broaden the use of habitat area indicators for the evaluation of certain segments of biodiversity.

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Appendix. Habitat area indicators collected from the list of references shown in Table 1 vs ecosystem types, relevant policies and major purposes of indication.

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP		
Agricultural area (intensively farmed, semi-intensively farmed and uncultivated)							1	1					1																							
Agricultural area by crops (cereals, oil crops, forage, woodlands)							1	1					1																							
Agriculture intensity: area used for intensive arable agriculture							1	1														1				1		1								
Area and percentage of farmland subject to restrictions (due to Natura 2000 or by voluntary agreements), classified by type of farmland							1	1									1					1														
Area of 'natural' forest converted to agricultural use							1	1		1																								1		
Area of farmland covered by the agri-environmental programmes under Regulation 1257/99 classified by type of activity							1	1														1														
Area of high nature value							1	1														1														
Area under agri-environment support: Trends in the agricultural area enrolled in agri-environmental measures and share of the total agricultural area.							1	1														1						1					1			
Area under agri-environmental management contracts							1	1														1						1								
Area under nature protection: Proportion of Natura 2000 sites covered by targeted habitats that depend on a continuation of extensive farming practices.							1	1									1																		1	
Area under organic farming:							1	1														1						1								

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEP	OECD	IRENA	CAP	
Trends in organic farming area and in the share of organic farming area in the total utilised agricultural area (UAA).																																			
Availability of wildlife habitat on farmland								1		1																									
Boundaries between patches								1			1																								
Change in area of agricultural land area (conversion to or from agriculture)								1	1					1																					
Change in traditional land-use practice								1	1														1							1					
Changes in area of heathland, fallowland and hedgerows								1			1																								
Classification and distribution of valuable pasture lands								1		1																									
Current area of the major land ecosystems/habitats.																																			
Percentage unconverted/converted to cultivation/converted to infrastructure — 3 variants								1		1																									
Edge to area ratio of field margins								1			1																								
Extent and degree of soil degradation								1		1																									
Extent of habitats associated with agricultural land management								1		1																									
Extent of natural habitats as part of agricultural land								1			1																								
Field size								1		1																									
Fragmentation of arable land								1			1																								
Hedgerow length in farms < 2ha /tot. UAA								1			1																								
Hedgerow length in farms > 50 ha/tot. UAA								1			1																								

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP		
Intensification and extensification of agricultural land use								1	1					1																						
Land cover change: Area of the entries and exits to and from agricultural and forest/semi-natural land between 1990 and 2000.								1		1																									1	
Land cover change: Net land cover changes for arable land and permanent crop and pasture between 1990 and 2000								1		1																									1	
Land use change: Area of land use change from agriculture to artificial surfaces between 1990 and 2000								1	1																										1	
Landcover destruction								1	1															1												
Length and quality of field margins								1		1																										
NDVI resistance / resilience								1	1	1																										
Net area of aquatic ecosystems converted to agricultural use								1		1	1																								1	
Percentage area with intensive cropping of total agricultural land								1	1																											
Percentage environmentally managed land of total agricultural land								1	1																											
Percentage of agricultural land under exploitation								1	1					1																						
Preservation of high nature and culture value landscapes								1		1														1												
Preservation of semi-natural habitats								1		1														1												
Proportion of cropped to uncropped land								1	1																											
Several landscape metrics at different levels of thematic resolution								1		1																										

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP									
Share of agricultural area covered by semi-natural agricultural habitats								1	1																																		
Share of each crop in the total agricultural area								1	1																																		
Share of habitat use units for which habitat area increased, decreased or remained constant								1			1																																
Share of irrigated agricultural land								1	1																																		
Share of organic agriculture in the total agricultural area								1	1																																		
Share of semi-natural habitat (species- % of area relationship)								1		1																																	
Sown area								1	1																																		
Trends: intensification/extensification, specialisation								1	1														1																				
UAA to crop varieties with genetic resistance to pathogen and pest species								1	1																																		
UAA with higher genetic diversity/tot. UAA								1			1																																
UAA with lower genetic diversity/tot. UAA								1			1																																
Landscape metrics (FRAGSTATS)								1			1																																
Ecosystem quality: conversion of coastal areas																																											
Length of artificial coral reef																																											
Protected coastal area																																											
Annual rate of mangrove conversion	1											1		1																													
Annual volume and area of timber harvested — indigenous and plantation	1								1					1																													

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP	
Area and extent of degraded lands reclaimed through forest operations	1								1					1																					
Area and percentage of forest area affected by anthropogenic effects (logging, harvesting for subsistence)	1								1					1																					
Area and percentage of forest area affected by natural disasters (insect attack, disease, fire and flooding)	1								1			1	1																						
Area and percentage of forests managed for catchment protection	1								1					1																					
Area of forest rebuilding stands	1											1		1																					
Area of managed forest with special environmental values	1								1	1				1																					
Area of seed forest stands	1								1		1		1																						
Average annual % change of forests 1990–95	1								1																1										
Average annual % change of natural forests 1990–95	1								1																1										
Average annual % change of plantations 1990–95	1								1																1										
Burnt forest area per year	1								1			1	1																						
Change in land use, conversion of forest land to other land uses (deforestation rate)	1								1					1																					
Changes in the area of forests protected by special management regime	1								1								1											1							
Changes in the area of natural and ancient semi-natural forest types	1								1	1																		1							
Changes in the area of strictly protected forest reserves	1								1								1											1							

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP		
Changes in the proportion of mixed stands of 2–3 tree species	1								1	1																										
Changes in the proportion of stands managed for the conservation and utilisation of forest genetic resources	1								1	1			1																							
Extent mixed forests certified with FSC label	1							1																	1											
Extent natural forest 1990	1							1																	1											
Extent natural forest 1995	1							1																	1											
Extent natural forests certified with FSC label	1							1																	1											
Extent of area by forest type and by age class or successional stage	1							1	1				1																							
Extent of area by forest type in protected area categories as defined by IUCN or other classification systems	1								1				1	1																						
Extent of area by forest type relative to total forest area	1									1				1																						
Extent of mixed stands	1							1						1																						
Extent plantations 1990	1							1																	1											
Extent plantations 1995	1							1																	1											
Extent plantations certified with FSC label	1							1																	1											
Forest area change by forest type (primary, secondary or plantation)	1								1					1																						
Forest area with revitalisation or ecological sites	1											1		1																						
Forest conversion affecting rare ecosystems by area	1								1					1																						
Forest extent 1990	1							1																	1											
Forest extent 1995	1							1																	1											
Forest fragmentation	1							1		1																										
Forest physical fragmentation (index)	1							1		1																										

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNGSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP		
Forest stands older than 100 years and distribution of dominant tree species in these stands	1								1																										1	
Fragmentation of forest types	1								1	1			1																							
Mangrove forest (km2)	1								1				1																							
Mangrove percentage of total land	1									1			1																							
Number of dead trees more than 10 cm in diameter/ha in cut forest areas	1								1																											
Number of fires/areas burnt per year	1								1				1	1																						
Number of large trees per ha in young forests	1								1	1																										
Number of trees more than 30 cm in diameter/ha in young forests	1								1	1																										
Percentage area young coniferous forests with more than 20 % deciduous trees	1									1																										
Percentage mono-specific forests of total forest area	1									1																										
Percentage of forest cover by forest type (primary, secondary or plantation)	1									1			1																							
Percentage of forest land managed for recreation and tourism to total forest area	1								1				1																							
Percentage of forest managed for wood production	1								1				1																							
Percentage of forest protected areas by forest type by age, class, and successional stage)	1									1		1	1					1																		
Percentage of forest used by people for subsistence	1								1			1	1																							
Percentage of protected area of total forest area	1									1		1	1					1																		

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP
Percentage of protected productive forest area of total productive area	1								1	1			1				1																	
Proportion of annual area of natural regeneration in relation to total area regenerated	1								1																									
Proportion of deciduous trees in coniferous forests	1										1																							
Reforested and afforested areas	1										1		1																					
Revegetated areas by species or genus in hectares per annum and reasons thereof	1											1	1																					
Total area and changes in area of forest and other wooded land by various layers by forest type	1										1																							1
Total area and changes in area of forest and OWL classified by number of main tree species occurring in stands and by main forest types	1										1																							1
Total area and changes in area of regeneration, by regeneration type	1											1																						1
Total area and changes in area of tree stands managed for the conservation and utilisation of tree/forest genetic resources (in situ and ex situ gene conservation)	1										1																							1
Total area and changes in the area of forests and OWL which is undisturbed by man, natural or ancient semi-natural managed forest and OWL	1										1																							1
Total area of drained forest land & total length of forest ditches	1								1																									

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEP	OECD	IRENA	CAP	
Protected forests: Area of forest and other wooded land protected to conserve biodiversity, landscapes and specific natural according to MCPFE Assessment Guidelines	1								1								1											1							
Protective forests – infrastructure and managed natural resources: Area of forest and other wooded land designated to protect infrastructure and managed natural resources against natural hazards, part of MCPFE Class “Protective Functions”	1								1																			1							
Protective forests – soil, water and other ecosystem functions: Area of forest and other wooded land designated to prevent soil erosion, to preserve water resources, or to maintain other forest ecosystem functions, part of MCPFE Class “Protective Functions”	1								1																			1							
Road density	1									1		1																							
Regeneration: Area of regeneration within even-aged stands and uneven-aged stands, classified by regeneration type	1							1		1																		1							
Canopy cover class	1									1		1																							
Satellite remote sensing data	1							1																											
% habitat managed for production	1	1	1	1	1	1	1	1	1																										
% special habitat remaining	1	1	1	1	1	1	1	1	1		1																								
Area and length and numbers of biological corridors	1	1	1	1	1	1	1	1		1																									
Area and state of indigenous vegetation	1	1	1	1	1	1	1	1	1																										

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP
Area of degraded ecosystem undergoing rehabilitation or restoration/has been rehabilitated or restored. Percentage of total area of degraded ecosystem	1	1	1	1	1	1	1	1				1																						
Benefit by a given sector or use per unit of stress on the ecosystem	1	1	1	1	1	1	1	1																										
Benefits from on-site resources by tourism services, total and by biodiversity component	1	1	1	1	1	1	1	1		1																								
Change in average width of break in an identified habitat corridor	1	1	1	1	1	1	1	1		1			1																					
Change in cover of land-use types	1	1	1	1	1	1	1	1	1																									
Change in habitat boundaries	1	1	1	1	1	1	1	1		1				1																				
Change in land use 1950–99 (30 land-use types)	1	1	1	1	1	1	1	1	1														1				1							
Change in mean nearest distance between blocks of a particular habitat type	1	1	1	1	1	1	1	1		1			1																					
Changes in average size of a particular habitat type	1	1	1	1	1	1	1	1	1		1			1																				
Changes in largest block of a particular habitat type	1	1	1	1	1	1	1	1	1		1			1																				
Degree of fragmentation of the unconverted portion of each land ecosystem — 2 variants	1	1	1	1	1	1	1	1		1																								
Difference in total area of a particular habitat type	1	1	1	1	1	1	1	1		1				1																				
Ecosystem area	1	1	1	1	1	1	1	1	1											1														
Ecosystem quality	1	1	1	1	1	1	1	1	1											1														
Ecosystem quality: native vegetation fragmentation	1	1	1	1	1	1	1	1		1			1																					
Ecosystem quantity: man-made habitat	1	1	1	1	1	1	1	1	1					1																				

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Ecosystem quantity: self-regenerating habitat	1	1	1	1	1	1	1	1				1	1																					
Habitat index	1	1	1	1	1	1	1	1		1	1																							
Habitat loss by km2 through human activities, and through natural causes	1	1	1	1	1	1	1	1	1									1																
Habitat loss through habitat fragmentation	1	1	1	1	1	1	1	1			1							1																
Main human stresses on each land ecosystem or habitat. Percentage contribution of each stress to ecosystem/habitat concerned	1	1	1	1	1	1	1	1	1																									
Natural capital index: NCI = ecosystem quantity * ecosystem quality	1	1	1	1	1	1	1	1	1																									
Number and extent of invasive species	1	1	1	1	1	1	1	1		1								1																
Number of ecosystems/communities/species/populations considered being sustainable. Percentage of total number assessed	1	1	1	1	1	1	1	1		1																								
Original/potential land area of major land ecosystems and habitats	1	1	1	1	1	1	1	1		1																								
Percentage (extent) of area (province/nation/ecoregion) dominated by non-domesticated species occurring in patches greater than 1 000 km2	1	1	1	1	1	1	1	1		1																								
Percentage (extent) of area (province/nation/ecoregion) dominated structurally by non-domesticated species	1	1	1	1	1	1	1	1		1																								
Percentage (extent) of area (province/nation/ecoregion/community type) in strictly protected status	1	1	1	1	1	1	1	1		1																								

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Percentage of area dominated by non-domesticated species	1	1	1	1	1	1	1	1	1					1																					
Percentage of area dominated by non-domesticated species occurring in patches greater than 1 000 km2	1	1	1	1	1	1	1	1	1	1				1																					
Percentage of habitat colonised by invasive species	1	1	1	1	1	1	1	1	1	1				1																					
Self-generating area as a percentage of total area	1	1	1	1	1	1	1	1	1			1		1																					
Self-generating area per habitat type	1	1	1	1	1	1	1	1	1			1		1																					
Size of selected (threatened) ecosystem	1	1	1	1	1	1	1	1	1																										
Spatial differences in the number of rare vs. common species	1	1	1	1	1	1	1	1	1	1																									
Spatial differences in the restricted vs. wide-range species	1	1	1	1	1	1	1	1	1	1																									
Status and trend of ecological communities within each land ecosystem (communities at risk as a percentage of all communities in that ecosystem)	1	1	1	1	1	1	1	1	1	1																									
Surface displacement	1	1	1	1	1	1	1	1	1	1				1																					
Total stress on biodiversity due to habitat destruction due to ecosystem conversion/habitat destruction due to modification of unconverted ecosystem/stock depletion/pollution and poisoning/translocation of species	1	1	1	1	1	1	1	1	1	1																									
Area size		1	1						1																										
Red-Green-Blue color tonal values from false-color infrared aerial photographs		1	1						1																										
Change in area and use of grasslands	1	1						1															1											1	

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP	
Protection of grasslands	1	1						1	1						1			1					1												
Bare soil percentage – Vegetation cover		1	1						1																										
Habitat area and fragmenta- tion/connectivity		1	1								1																								
Vegetation patchiness											1																								
% habitat protected as IUCN classes I–III	1	1	1	1	1	1	1	1	1					1	1																				
% habitat protected as IUCN classes IV–V	1	1	1	1	1	1	1	1	1					1	1																				
% special habitat protected	1	1	1	1	1	1	1	1	1					1	1																				
Area of protected areas by vegetation type as percent- age of total area	1	1	1	1	1	1	1	1		1				1	1																				
Area under nature protec- tion: Proportion of Natura 2000 sites covered by targ- eted habitats that depend on a continuation of exten- sive farming practices.	1	1	1	1	1	1	1	1	1									1																1	
Change in overlap of IBAs with national and interna- tional protected areas	1	1	1	1	1	1	1	1	1								1	1																	
Change in presence of man- agement plans for IBAs	1	1	1	1	1	1	1	1	1								1	1																	
Corine Land Cover (CLC)1990 and 2000	1	1	1	1	1	1	1	1	1														1												
Designation of SPAs	1	1	1	1	1	1	1	1	1								1	1					1						1						
Nationally designated pro- tected areas (trends in na- tional establishment of protected areas)	1	1	1	1	1	1	1	1	1						1																				
Number and extent of pro- tected areas	1	1	1	1	1	1	1	1	1	1				1			1									1									
Number of SACs (Special Areas of Conservation: Habitats Directive)	1	1	1	1	1	1	1	1	1	1						1		1																	
Percent area in strictly pro- tected status	1	1	1	1	1	1	1	1	1	1				1	1																				

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP			
Percentage area of biotopes important for biodiversity of total area	1	1	1	1	1	1	1	1	1	1					1	1		1																			
Percentage of protected area colonised by invasive species	1	1	1	1	1	1	1	1	1	1				1	1																						
Percentage of protected area of different ecosystem types	1	1	1	1	1	1	1	1	1	1	1			1	1	1		1																			
Percentage of protected area to total area	1	1	1	1	1	1	1	1	1	1	1			1	1			1																			
Percentage of protected area with clearly defined boundaries	1	1	1	1	1	1	1	1	1	1	1			1	1			1																			
Protected area as a percentage of total area	1	1	1	1	1	1	1	1	1	1	1				1		1										1										
Protected area, loss, damage and defragmentation	1	1	1	1	1	1	1	1	1	1	1				1		1						1				1										
Protected areas according to IUCN category 1A and 1B	1	1	1	1	1	1	1	1	1	1	1				1		1																		1		
Protected areas according to national law	1	1	1	1	1	1	1	1	1	1	1				1		1																		1		
Size and distribution of protected areas	1	1	1	1	1	1	1	1	1	1	1			1	1		1																				
System of protected areas established	1	1	1	1	1	1	1	1	1	1	1				1		1																				
Total area of protected areas (using IUCN definition of protected areas)	1	1	1	1	1	1	1	1	1	1	1			1	1																						
Total number and area of communal interest habitats. Identification of priorities	1	1	1	1	1	1	1	1	1	1	1			1	1	1		1																			
Annual integral (NDVI-I), as a surrogate of primary production = integrative indicator of ecosystem functioning					1					1																											1
Ecosystem Health Index					1					1																											1
Flood Damage China's Changjiang River (Yangtze River)					1					1																											1

	Forests	Shrubs	Grasslands	Wetlands	Rivers	Lakes	Soils	Agro-ecosystems	Habitat management	Biodiversity evaluation	Connectivity/fragmentation	Restoration (success) as-	Response to natural envi-	CBD/UNEP	IUCN	EU Habitats Directive	EU Birds Directive	NATURA 2000 Network	EU WFD	WCMC	Soil Thematic Strategy	National Nature Protection	National Water Quality	EC	ECNC	UNDP	UNCSD	Eurostat	MCPFE	EEA	BEF	OECD	IRENA	CAP		
Imagery-derived normalized difference vegetation index (NDVI) and vegetation phenological metrics derived from time-series NDVI data					1				1										1																	
Land use and chemistry as stream indicators in Ireland					1				1										1																	
Landscape indicators of human impacts to riverine systems					1				1										1																	
Non-point Pollution Index					1				1										1																	
Normalized difference vegetation index (NDVI) and leaf area index (LAI) for riparian areas					1				1	1									1																	
The watershed sustainability index (WSI)					1				1										1																	
Degree of river fragmentation					1					1									1						1											
River Fragmentation Index (227 rivers worldwide)					1					1									1																	
Riverine forest (km2)					1				1				1						1																	
Riverine percentage of total land					1					1			1						1																	
Rivers with good quality according to biotic indexes					1				1				1						1																	
Current area of major aquatic ecosystems/habitats.																																				
Percentage unconverted/converted to infrastructure					1	1				1									1																	
Degree of fragmentation of unconverted portion of each aquatic ecosystem					1	1				1									1																	
Extent and degree of water pollution					1	1			1										1																	
Main human stresses on each aquatic ecosystem or habitat. Percentage contribution of each stress to ecosystem/habitat concerned					1	1			1										1																	

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Original/potential area of major aquatic ecosystems and habitats				1	1			1											1																
Percentage of each aquatic ecosystem (unconverted portion) natural/modified				1	1					1									1																
Percentage of watershed that is arid area				1	1					1									1						1										
Percentage of watershed that is built-up area				1	1					1									1						1										
Percentage of watershed that is cropland				1	1					1									1						1										
Percentage of watershed that is forest				1	1					1									1						1										
Percentage of watershed that is grassland				1	1					1									1						1										
Percentage of watershed that is irrigated area				1	1					1									1						1										
Percentage of watershed that is wetland				1	1					1									1						1										
Remote sensing and pollution monitoring tool				1	1			1		1									1																
Area and state of water per habitat, i.e. riverine areas and wetlands				1	1			1					1						1																
Rate of destruction of water habitats by types of activities				1	1			1					1						1																
Reservoir that has eutrophication				1	1			1					1						1																
Land degradation: soil erosion (12 land-use types)							1	1												1		1					1								
Soil quality							1	1					1							1															
LQI (land quality indicators)							1	1												1															
Extent of area affected by soil erosion							1	1												1		1							1						
Area of bare land or exposed soil surface							1	1												1		1					1								
Area of set-aside							1	1												1															

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Percentage of area affected to soil erosion per region							1	1													1															
Extent of total soil loss by soil erosion							1	1													1															
Conservation practices							1	1													1	1					1									
Remote sensing data as a contamination monitoring tool							1	1		1											1															
Remote sensing data as an erosion monitoring tool							1	1		1											1															
Soil sealing							1	1													1	1					1									
Land use and management							1	1													1	1					1									
Land cover, type and changes							1	1													1	1					1									
Ecosystem quality: wetland drainage and filling			1					1					1																							
Extent of wetland drainage and filling			1					1					1																							
Percentage of wetland area of total area			1					1																												
Percentage of wet forest land			1					1																												
Rate of destruction of water habitats per annum			1					1					1																							
Total area of wetlands			1					1																												
Wetland area			1					1					1																							
Wetland loss			1					1														1					1									
Area and state of water per habitat, i.e. riverine areas and wetlands			1					1					1																							
Rate of destruction of water habitats by types of activities			1					1					1																							
Reservoir that has eutrophication			1					1					1																							