European Forests and Protected Areas: Gap Analysis

TECHNICAL REPORT

Compiled by the

UNEP World Conservation Monitoring Centre
Cambridge, UK.

July 2000

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ACKNOWLEDGEMENTS

Many agencies and individuals responsible for managing protected area and forest data have contributed vital datasets to this study. A full list of these contributors is included in Annexes 1 and 3 of this document. The willingness of these contributors to provide data and comments is greatly appreciated. Thanks are due in particular to Dr. Udo Böhn (Bundesamt für Naturschutz) for permission to use the *Natural Vegetation Map of Europe* (1994), which underpins the entire study.

Funded by the World Wide Fund for Nature (WWF-International) under its European Forest Programme, this project follows on from an earlier pilot study undertaken by the World Conservation Monitoring Centre (WCMC) *Feasibility Study: Gap Analysis of Forest Protected Areas in Europe*, completed in November 1995. The terms of reference for this current study were discussed and agreed by Dr Michael Green (WCMC) and Per Rosenberg (WWF-International) in 1997.

The project was managed by Harriet Gillett (WCMC) working with many staff at WCMC. Corinna Ravilious was responsible for managing the forest vegetation data, under the guidance of Dr Valerie Kapos. Simon Blyth was responsible for managing protected areas boundary data, with input from Javier Beltrán, and Balzhan Zhimbiev. Igor Lysenko was responsible for managing the development of protected area datasets for Russia, the Ukraine and Belarus. Jonathan Rhind provided GIS technical supervision. Corinna Ravilious was responsible for the digital overlays of habitat and protected area data and the production of the underlying statistics. Simon Blyth completed the analysis on the number and size of protected forest areas and produced the final maps with support from Ian May. Gemma Smith produced the tables and figures included in the report and developed the user-friendly Excel file included on the CD-ROM (see below), under the guidance of Gerardo Fragoso. Edward Coney helped produce the final figures. Julie Reay and Lise Jackson were responsible for project administration. The final text was written by Gemma Smith and Harriet Gillett.

The project was managed in close collaboration with Harri Karjalainen (WWF International). Draft outputs of habitat and protected area maps were circulated to WWF national officers for review, and project progress was discussed at WWF European Forest Team meetings in 1998 (Latvia), January and September 1999 (Switzerland and Komi, Russia) and March 2000 (Switzerland).

CD-ROM

This document is accompanied by a CD-ROM that contains electronic outputs from the study. More specifically it contains an electronic copy of this report, an Excel file with original data from the digital overlay; summary statistics by country and forest type and gif-file maps of potential forest cover, current forest cover, and protected areas, that can be viewed as single or multiple layers. Forest cover maps were produced by Corinna Ravilious; protected area maps were produced by Simon Blyth and the CD-ROM was created by Phil Fox. The contents of the CD-ROM are also available on the internet at: http://www.unep-wcmc.org/forest/eu_gap

EXECUTIVE SUMMARY

This gap analysis of forest protected areas in Europe was designed to provide relevant information on the distribution and conservation status of European temperate forests, in support of the Pan-European Biological and Landscape Diversity Strategy and in particular WWF's Forest Strategy for Europe.

Digital pan-European forest cover maps of potential and current forest cover were compiled together with a digital map of Europe's protected areas. Digital overlays of these data were undertaken and statistics produced indicating the current state of protection of differing forest types, in respect to the location of these forests within legally gazetted areas.

The study indicates that 56% of Europe's forest has already been lost. Europe's potential forest cover was 7,395,440 km^2 and current forest cover is 3,255,680 km^2. Of this, 204,996 km^2 (6.3%) lie within protected areas (IUCN management categories I-IV).

The analyses were undertaken by country and by forest type at complex (66 forest types) and simplified (20 forest types) levels. At a national level forest protection (as a proportion of current forest cover) ranges from 11.7% in Belarus to less than 1 % in relatively large countries such as Bosnia Herzegovina (0.8%), United Kingdom (0.6%) and Belgium (0.2%).

The analysis of current forest cover using a simplified forest classification system (20 categories), found that forest protection varies from < 0.5% for spruce woodland amid hygrophilous birch tundra, to 18.5% for conifer forests in mires and bogs.

An indication of the wilderness quality of European forests is given by the analyses of protected forest by forest size. This shows that rather few (329) relatively large (>10,000 ha[1]) sites account for 67% of Europe's protected forests. Conversely, 95% of Europe's protected forest areas comprise fragments of less than 1,000ha. Together these fragments protect less than 10% of Europe's forests. Forty-five of the 50 largest protected forest areas occur in the Russian Federation and Fennoscandia, accounting to a large extent for the much greater proportion of Europe's protected forest that is found in northern Europe, compared to that found in the south.

Full details of the analyses and a series of maps illustrating the distribution of potential and current forest cover and protected areas are included in the CD-ROM that accompanies this report.

[1] Note: 1 km^2 = 100 hectares

1. INTRODUCTION

Many of the world's temperate forests exist in some of the wealthiest developed countries, where there is a tradition of forest protection and research. Paradoxically, public awareness and debate on forest conservation has focused almost exclusively on tropical forests and their highly diverse flora and fauna, while the protection of temperate forests and their equally important, albeit fewer, species has received much less attention (WWF, 1992).

In 1998 total global forest cover amounted to 38,966,548 km^2 (Commonwealth of Australia, 1999) of which 8.23% was protected under IUCN management categories I-VI. At a regional level, data available in 1996 indicated that 8% of European temperate forests (excluding Russia), lay within protected areas (IUCN categories I-VI) (Iremonger *et al.*, 1997).

In Europe, temperate forests are often highly fragmented, threatened ecosystems. An urgent need for geo-referenced information on the region's forests and protected areas was identified by Luxmoore and Drucker (1994), to provide the basis of a regional gap analysis and recovery plan for forests. Subsequently a project entitled *Feasibility study: Gap Analysis of Forest Protected Areas in Europe*, was undertaken by the World Conservation Monitoring Centre on behalf of WWF (WCMC, 1995), assessing the availability of relevant forest protected areas information. Following on from this a second phase of the project was agreed in 1997.

This current gap analysis forms the second phase of the project. It is designed to provide information on the distribution and conservation status of European temperate forests, in relation to potential and current forest cover. The project supports the Pan-European Biological and Landscape Diversity Strategy and more specifically WWF's Forest Strategy for Europe. In particular, information on the conservation status of different forest types will support implementation of Action Theme 9 on Forest Ecosystems of the Pan-European Biological and Landscape Diversity Strategy.

Gap analysis, in the sense used in this project, involves overlaying information on the distribution of forests with information on the distribution of protected areas, to identify the level of official protection afforded to differing forest types. Like other rapid appraisal methodologies, it should not be viewed as a substitute for full biological inventories, but as a coarse indicator of gaps. Such information is vital to policy-makers and planners in developing a European-wide network of ecologically representative protected forests.

1.1 PROJECT OBJECTIVES

The objectives of this project were as follows:

- To compile a digital pan-European forest cover map, classified, harmonised and at sufficiently high resolution for analysis at national and regional scales.
- To compile a digital map of European protected areas

- To assess quantitatively the extent of protection of forest types in relation to original and present forest cover and forested wilderness in Europe and identify major gaps in their protection.

- To identify regional priorities for conservation action and apply them within a national context.

2. METHODOLOGY

2.1 STUDY AREA

The countries that constitute Europe are not easily defined, as the region is contiguous with Asia and continues to undergo political change. Table 1 lists the 45 European countries that were selected to be included in this study. They cover the region between the Atlantic Ocean and the Ural Mountains, and extend as far south as southern Greece and northwards to the Barents Sea.

Table 1. European countries included in the study.

Albania	Greece	Poland
Andorra	Hungary	Portugal
Austria	Iceland	Romania
Belgium	Ireland	Russian Federation
Belarus	Italy	San Marino
Bosnia Herzegovina	Latvia	Serbia
Bulgaria	Liechtenstein	Slovakia
Croatia	Lithuania	Slovenia
Czech Republic	Luxembourg	Spain
Denmark	FYROM	Sweden
Estonia	Malta	Switzerland
Finland	Monaco	Ukraine
France	Moldova	United Kingdom
Germany	Netherlands	
Georgia	Norway	

2.2 FOREST DATA

2.2.1 Potential forest cover

Potential forest cover was taken from the map *Natural Vegetation of Europe* produced by Böhn and Neuhäusl in 1994 at a scale 1 : 2.5 million (referred to in this report as B & N). This map was designed to provide a unified view of Europe's potential vegetation types. The editors of the map envisaged that one of its principal uses would be to support the development of plans for the systematic protection of natural ecosystems in Europe (Bohn 1994). The B & N map has a hierarchical legend from which two levels were selected for this project. The simplified level divides European forest types into 20 categories (B & N 20) (see Map 1), whilst the detailed level divides them into 66 categories (B & N 60).

The vegetation map is based on climate, soil and historical records. The map presents the distribution of the main natural plant communities corresponding to the actual climatic and edaphic conditions, excluding, as far as possible, human impact. It seeks to show the most important features of latitudinal zone (i.e. vegetation zones and sub-zones), longitudinal (oceanic/continental gradients) and altitudinal variations (vegetation belts). In addition the main azonal vegetation types and their differentiation, as well as the floristic variations of the natural vegetation units resulting from different edaphic, florogenetic and climatic conditions are depicted. The construction of the potential vegetation level was based on existing remnants of natural ecosystems and their relation to specific site conditions (climate, soil, water regime, etc.). Recent large-scale changes of the abiotic environment resulting from man-made air and water pollution were not taken into consideration as the effects on potential natural vegetation could not be definitively determined (Bohn, 1994).

The final version of the map was compiled following review by experts from throughout Europe. Full details of the methodology followed in the compilation of the map are given in Bohn (1994, 1995) and Neuhäusl (1990).

2.2.2 Current forest cover

Forests have been estimated to cover approximately one third of Europe's total land area by FAO in their report: *State of the World's Forests* (FAO 1999). However, the figure depends upon the precise definition used to identify forest, and what is "other wooded land". The FAO Forest Resource Assessment defines forests as having at least 10% crown cover per area unit (FAO, 1995). In contrast CORINE land cover forest classes (which this project is based on) define forests as having 30% crown cover. Definitions of forest types also vary between countries and international organisations, frequently causing problems in assessing their state and trends.

The European Topic Centre on Land Cover (ETC/LC) is a consortium of 16 different organisations from all over Europe, contracted by the European Environment Agency (EEA). ETC/LC (led by Satellus) co-ordinates the CORINE landcover mapping programme (Co-ordination of Information on the Environment), which is the source for the majority of the current forest data used in this project. The CORINE programme began in 1985, with the aim to create a consistent, compatible and

updateable digital database on land cover across the whole of Europe. The CORINE data currently covers most of Western Europe and provides 250m resolution satellite data on the actual extent of coniferous forests, broad-leaved forests, mixed forests and sclerophyllous vegetation. These forest classes have been selected from a 44 class CORINE landcover nomenclature, and are described below.

- **Broad-leaved forest**

Vegetation formation composed principally of trees, including shrub and bush understories, where broad-leaved species predominate. Broad-leaved trees must represent more than three-quarters of the surface unit in this category, failing which the category is that of mixed forest. Young coppices and young plantations also belong to this category

- **Coniferous forest**

Vegetation formation composed principally of trees, including shrub and bush understudies, where coniferous species predominate. Surface planted with conifers must represent at least 75% of the total surface of the unit; otherwise, the unit is one of mixed forest.

- **Mixed forest**

Vegetation formation composed principally of trees, including shrub and bush understories, where neither broad-leaved nor coniferous species predominate. This category includes not only mixed forest in the strict silvicultural sense (single tree or clump mixtures), but also complex forest parcels comprising an intricate mosaic of broad-leaved and softwood species where no homogeneous stand of more than 25 ha can be distinguished.

- **Sclerophyllous vegetation**

Bushy sclerophyllous vegetation, including *maquis* and *garrigue*.

Maquis describes dense vegetation associations composed of numerous shrubs covering acid siliceous soils in Mediterranean areas. This formation generally consists of small oaks, oleasters, arbutus, lentiscus, junipers, briar wood and an understorey of cistus and low heathers.

Garrigue describes discontinuous bushy associations of the Mediterranean calcareous plateaus, often composed of kermes oak, lavender, thyme and white cistus. There may be a few isolated trees. Garrigue is found on a dry, filtering substrate (usually calcareous).

Bushy sclerophyllous vegetation describes a subforest formation often difficult to distinguish from Mediterranean forest (possibility of confusion between high maquis and sclerophyllous forest). Use of ancillary data (aerial photographs, forest inventory maps, vegetation index) is highly recommended.

Where CORINE forest data were unavailable, the best available alternative sources were used. In some cases this entailed using data at a scale of 1: 2,500,000 or at a resolution of 1km. A full list of the sources used in compiling the current forest data for this project can be found in Annex 1.

2.2.3 Production of detailed map of current forest cover

The basic current forest cover data only included information on the occurrence of these four forest classes. To increase the level of detail, these data were then overlaid with the B & N data. Thus data on the categories and extent of current forest cover were combined with data on potential forest cover to provide a more detailed classification of current forest cover.

Combining the two maps resulted in the identification of some areas that were problematic to resolve in terms of forest type as the current forest cover differed from the potential vegetation cover. The three anomalous situations that arose were treated as follows:

1 Current and potential forest cover differ in broad physiognomic type

In instances (178,340 km^2) where current and potential cover were both identified as forest, but differed in terms of broad physiognomic type (conifer, broad-leaved or mixed), the tentative conclusion was reached that the current forest cover was replacement vegetation. The most obvious example of this is where current coniferous forest occurs in areas identified as deciduous forest on the potential forest map. These areas were identified as "replacement forest" (see table 2, example 1 below) for this project. It is important to recognise that the original forest cover map is coarser in resolution than the current forest cover datasheets, so that disagreement between the two may not, in fact, indicate that the forest is a replacement type.

2 Current cover forest, potential cover clearly non-forest

In those instances (152,068 km^2) where current forest fell within a B & N class that was clearly only non-forest, the CORINE definition of the forest (i.e. coniferous, broad-leaved, sclerophyllous or mixed) has been kept, with the qualifier "from current" appended (see table 2, example 2 below).

3 Current cover forest, potential cover clearly non forest class with forest elements

In some instances an area identified as currently forested corresponded to a B & N category that was not *obviously* forest. The B & N legend has been reworded to account for these and to emphasise the forest component of the vegetation type (see table 2, example 3 below and Annex 2).

Full details of the B & N 66 classification, including the additional and re-worded classes are given in Annex 2 with a key to the corresponding simplified scheme of 20 B & N classes.

The maps of potential and current forest cover were circulated by Harri Karjalainen (WWF-International) to WWF national officers for review, following the WWF European Forest Programme Protected Areas team meeting in Gland, in January 1999.

Table 2. Examples of legend harmonisation between potential and current forest cover maps

Example	Potential (B & N)	Current (CORINE)	Project legend
1	Broad leafed	Coniferous	Replacement vegetation
2	Non forest	Coniferous	Coniferous (from current)
3	Non Forest In B & N source full definition was: Pannonian sand steppes (*Festuca beckeri, F. vaginata*) with *Dianthus polymorphus* var. *bessarabicus, Astragalus varius, Echinops ruthenicus, Anthemis ruthenica* alternating **with oak forests** (*Quercus robur*) with *Convallaria majalis*	Broad-leaved and mixed	Oak forests in Panonian sand steppes

2.3 PROTECTED AREAS DATA

WCMC maintains a global database of protected areas. This has been developed over many years in collaboration with IUCN's World Commission on Protected Areas (WCPA). In addition European protected area data are managed by WCMC, on behalf of the European Environment Agency (EEA) and other regional organisations. This subset of the global protected areas database is known as the Common Database of Designated Areas (CDDA). Digital data providing protected area boundary lines is included as part of this database as it becomes available. Under the current project, funding was provided for appropriate organisations in Russia and the Ukraine to digitise protected areas data and to make this available to WCMC. Similarly, data for Belarus were digitised at WCMC. These are countries for which relatively little data were previously available, but contain extensive areas of temperate forest.

Lists and maps of each country's protected areas were sent to the appropriate management authorities for review, with a request for further protected area information if it was available. Data were received by WCMC in a range of formats (electronic and hard copy). The data were then integrated into a standard format in WCMC's geographic information system (GIS). A full listing of the sources of protected areas data is given in Annex 3. A copy of the final digital protected area map is included on the CD-ROM that accompanies this report.

For this project it was agreed that only protected areas that fell within IUCN categories I-IV should be included in the study. Thus a further task involved in protected areas data management was to identify the appropriate IUCN category of each area, where this was not already known.

Details of IUCN protected area management categories are given in Annex 4. The best protected area boundary data available in 1999, were used for this project. However, it should be realised that the rapid growth in computer technology in recent years means that the quality and availability of protected areas digital data is continually improving and increasing.

Table 3 illustrates polygon and point data available to WCMC for each country included in the project, and more specifically provides an idea of the level of data quality. Countries with a high percentage of polygons are considered to have better

quality protected areas data. Thus, data for several countries including Ireland, Belgium, Albania, Romania, Moldova, Slovenia and the Netherlands could be even more accurate if polygon data were made available.

Table 3 Quality of protected area polygon data

Country	Points	Polygons	% Polygons
Albania	22	0	0
Andorra	0	0	0
Austria	30	13	30
Belarus	320	161	33
Belgium	26	0	0
Bosnia and Herzegovina	11	0	0
Bulgaria	45	0	0
Croatia	139	0	0
Czech Republic	1,742	0	0
Denmark	47	21	31
Estonia	9	48	84
Finland	14	4,163	100
France	143	2,653	95
Georgia	0	20	100
Germany	326	37	10
Greece	34	15	31
Hungary	69	67	49
Iceland	4	54	93
Ireland	54	0	0
Italy	53	305	85
Latvia	125	6	5
Liechtenstein	9	0	0
Lithuania	23	6	21
Luxembourg	15	0	0
FYROM	20	3	13
Malta	6	0	0
Moldova	43	0	0
Monaco	2	0	0
Netherlands	56	0	0
Norway	2	1,304	100
Poland	375	22	6
Portugal	2	20	91
Romania	52	0	0
Russian Federation	6,981	1,731	20
San Marino	0	0	0
Slovakia	31	7	18
Slovenia	3	0	0
Spain	100	192	66
Sweden	23	4,330	99
Switzerland	14	197	93
Ukraine	8	1,425	99
United Kingdom	0	2,995	100
Serbia	60	0	0

2.4 ANALYSES

2.4.1 Data preparation and procedure

The main aim of the analyses was to identify all forested land within IUCN protected areas management categories I - IV.

The analysis of potential and current forest data with protected areas was undertaken by overlaying the data layers within a GIS and calculating the size of corresponding areas. In some instances protected area boundary data were not available. In these cases the protected area was represented by a circle proportional to its area at its latitude/longitude position (where such information was available), rather than digitised boundaries. A total of 30,833 polygons were identified in the analysis - this included both boundaries and proportional circles. Of these, a total of 19,795 protected areas were digitised outlines and 11,038 were proportional circles. It should be noted that, in general, the proportional circle data tend to represent very small protected areas. Of the 11,038 proportional circles, 8,415 have an area of less than 1 km^2.

To analyse data in a GIS, all data layers must be in a common format ie. raster or vector. Raster data has a cellular data structure composed of rows and columns for storing images. Groups of cells with the same value represent features. Vector data has a co-ordinate based data structure. Each linear feature is represented by an ordered list of locations that are joined up to form lines and polygons. Polygons are boundaries that enclose areas that represent features.

The forest data were initially held electronically in a raster format. To perform the analyses the forest data were converted to vector format in order to maintain the detail and accuracy of the protected areas vector dataset. (Note: Data can also readily be converted from vector to raster format but the raster data storage in the form of cells of a pre-determined size has the effect of generalising the vector data. No such loss of detail occurs in a raster to vector conversion).

The overall accuracy of the analysis is defined by the scale of the original source information for both the forests and protected areas datasets. These vary in detail from country-to-country. Full source information is given in Annex 1 and Annex 3 for forest cover and protected areas data respectively.

2.4.2 Size analyses

Another aspect of the analyses was to identify the size distribution of Europe's protected forest areas. These analyses were undertaken at two levels:

Firstly, looking at protected forest areas as one general category and subsequently splitting the protected forest areas into the major B & N categories (20 classes).

The analysis was designed to identify individual pieces of forest which fall within either an individual protected area (figure 1) or combinations of adjacent protected areas (figure 2) of IUCN categories I - IV inclusive. This maintains the analysis of individual blocks of forest that occur across more than one protected area.

Only in the analysis of the 50 most forested protected areas were the individual boundaries of each protected area maintained. When several individual blocks of forest are protected by a single protected area, such individual blocks of forest are not added together in this analysis, hence it is important to recognise that the number of areas of protected forest will exceed the total number of protected areas.

Figure 3 illustrates the situation where one protected area crosses two forest types. When the analysis is irrespective of forest type, the result is one protected forest area. When the analysis considers forest type, then the result is two protected forest areas.

Diagrams to show the issues involved in counting forest protected areas.
(F = forest; PA = protected area)

Figure 1. Three protected forest areas
(one protected area containing three non-adjacent forest areas)

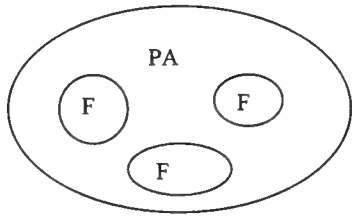


Figure 2. One protected forest area
(one forest area containing three adjacent protected areas)

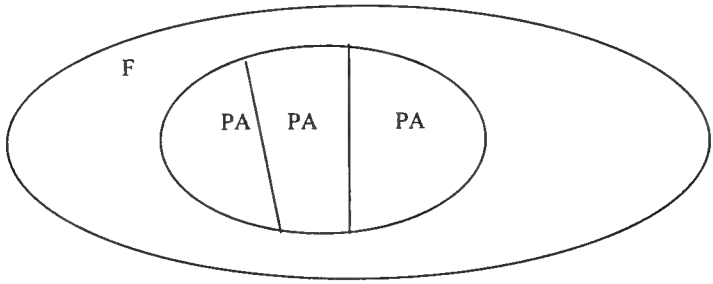
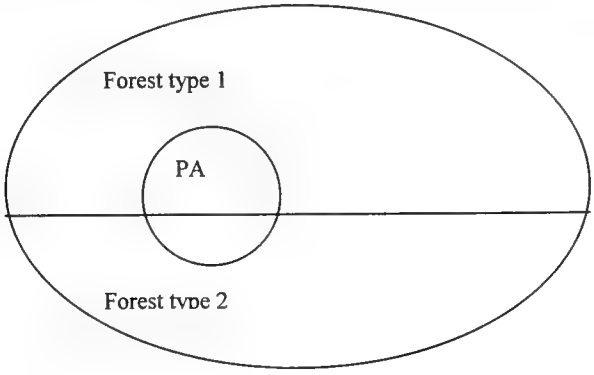


Figure 3. Two protected forest areas – when analysed by forest type
(one protected area comprising two forest types – when analysed irrespective of forest type, this example would give a count of one protected forest area)



3. RESULTS

Outputs produced as a result of this project include:

- Harmonised digital maps of potential and current European forest cover and protected areas
- Potential and current forest cover statistics
- Protected forest area statistics
- Technical report describing gap analysis methodologies, results and initial conclusions from the project

This information has been combined in a user-friendly format on a CD-ROM that accompanies this technical report. The contents of the CD-ROM are also available on the internet at: http://www.wcmc.org.uk/forest/eu_gap. Details of the contents of the CD-ROM are provided in Annex 6.

The analyses for the project were undertaken at two levels: detailed and simplified. The most detailed level involved analyses of forest data classified into 66 forest types, while a second analysis was undertaken classifying forest data into 20 simplified forest types. Annex 2 provides information on the 66 detailed and corresponding 20 simplified forest types.

3.1 ANALYSIS BY COUNTRY

3.1.1 Forest extent

Results indicate that total **potential forest** cover for all countries included in the study extends to 7,395,440 km^2. Analysed at a country-by-country level the data show that the Russian Federation has the largest potential forest area (2,469,520 km^2), while Monaco has the smallest potential forest area (8 km^2), (Annex 5, Table 1). Figure 1 in Annex 5 illustrates potential forest cover by country.

A further analysis of potential forest cover as a proportion of each country's total land area was made. Potential forest cover ranges from 100% in Luxembourg to 6.4% of land area in Iceland (Annex 5, Table 5). Twenty-seven of the 45 countries (60%) in the study had potential forest cover extending over 90-100% of their total land area (see table 4).

Table 4. Countries with potential forest cover > 90%

Rank	Country	Potential Forest Area as % of Land Area
1	Luxembourg	100.0
2	Bosnia Herzegovina	99.8
3	Belgium	99.5
4	Czech Republic	99.3
5	Slovakia	99.1
6	Lithuania	98.8
7	Poland	98.8
8	Germany	98.6
9	Latvia	98.4
10	San Marino	98.3
11	Netherlands	97.8
12	France	97.8
13	Slovenia	97.4
14	Spain	97.4
15	Albania	97.0
16	Greece	96.9
17	FYROM	96.5
18	Italy	95.9
19	Serbia	95.4
20	Bulgaria	95.1
21	Liechtenstein	93.9
22	Belarus	93.6
23	Portugal	93.3
24	Finland	92.9
25	Estonia	92.8
26	Croatia	92.8
27	Sweden	91.6

Current forest cover for all countries included in the study stands at 3,255,680 km^2 (Annex 5, Table 2). Analysed at a country-by-country level, the data show that the Russian Federation has the largest current forest cover area (1,539,947 km^2), while Monaco has the smallest area of current forest of less than 1 km^2. Figure 2 in Annex 5 illustrates current forest cover for all countries included in the analysis.

When analysed as a proportion of each country's total land area, current forest coverage ranges from 55.5% in Finland to 1.2% of land area in Iceland (Annex 5, Table 6).

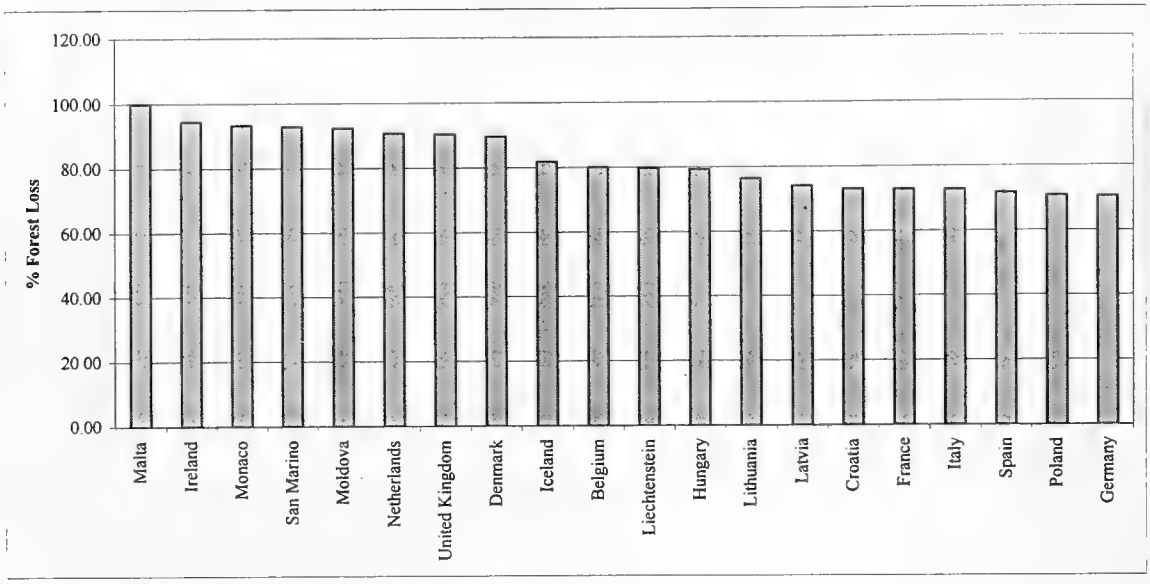
3.1.2 Forest loss

Total forest loss (potential forest cover – current forest cover) for all countries in the study amounted to 4,139,759 km^2, a decline of 56% of potential forest area. Note that

this is an estimate due to the necessarily different methodologies employed in quantifying potential and current forest cover.

Figure 4 illustrates the top 20 countries ranked in order of relative loss of forest area (km^2). Data on the area (km^2) of forest lost and forest loss in relation to potential forest cover at a country-by-country level are given in Annex 5, Table 3.

Figure 4: Top 20 countries ranked by forest loss (relative terms)



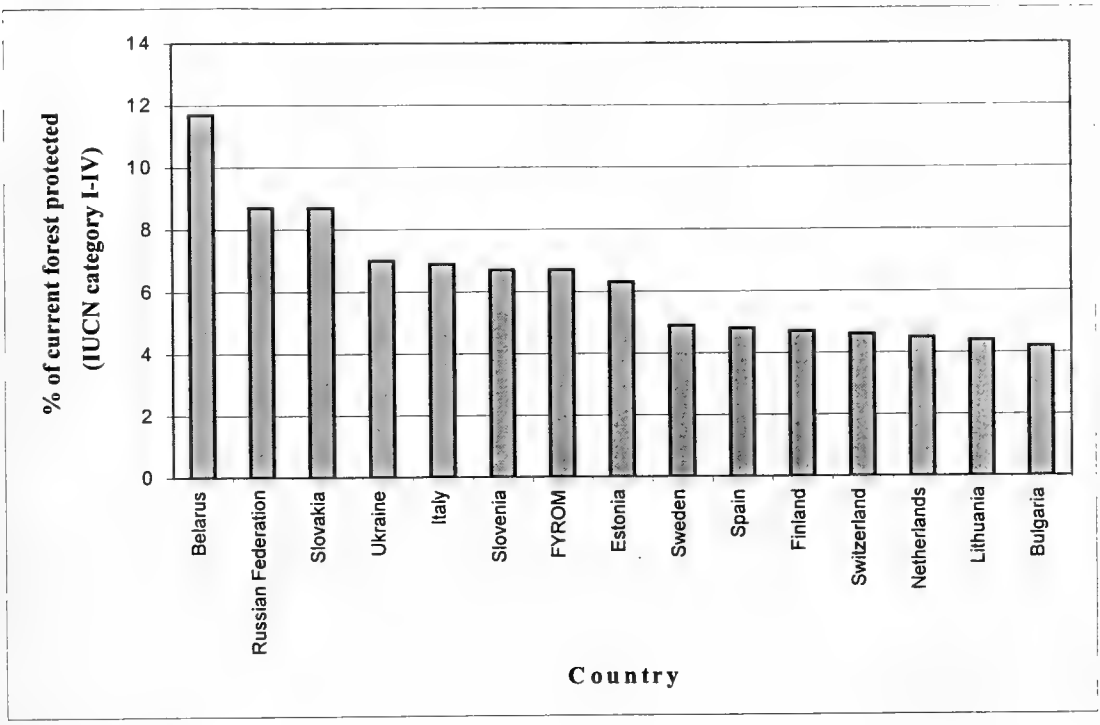
When forest loss is measured in relation to potential forest cover, the situation is very different. Nationally, forest loss ranges from 38% (Russian Federation) to 100% (Malta) of potential forest area (Annex 5, Table 3). The Russian Federation, ranks top in terms of *area* of forest loss, but ranks at the bottom in terms of *percent* of forest loss.

3.1.3 Forest protection

At a regional scale, 204,996 km^2 (6.3%) of current forest is protected. Levels of protection (km^2) range from 11.7% of current forest area in Belarus, to 0% of current forest area in Andorra, Monaco and San Marino (Annex 5, Table 4). These three are small countries so this absence of protected forest has negligible impact on the overall European situation. Nations with a greater land area, that also have low quantities of protected forest (IUCN categories I-IV) include the United Kingdom (0.6%), Portugal (1.2%) and France (1.2%). Figure 5 illustrates the top 15 countries ranked according to the largest proportion of current forest protected (IUCN categories I-IV).

Figures for current forest protection as a proportion of national land area are given in Annex 5, Table 7. Protected forest accounts for between 0% (Andorra) and 3.49% (Slovakia) of each country's land area.

Figure 5: Top 15 countries ranked according to proportion of forest protected



3.1.4 Forest diversity

Forest type diversity was analysed at a national level, following the most detailed forest classification data (B & N 66). Results indicate that diversity ranges from a minimum of 1 (San Marino and Monaco) to 33 (Russian Federation) forest types in any one country, with a mean value of 11 types (Annex 5, Table 8).

3.2 ANALYSIS BY SPECIFIC FOREST TYPE (B & N 66)

3.2.1 Potential and current forest cover

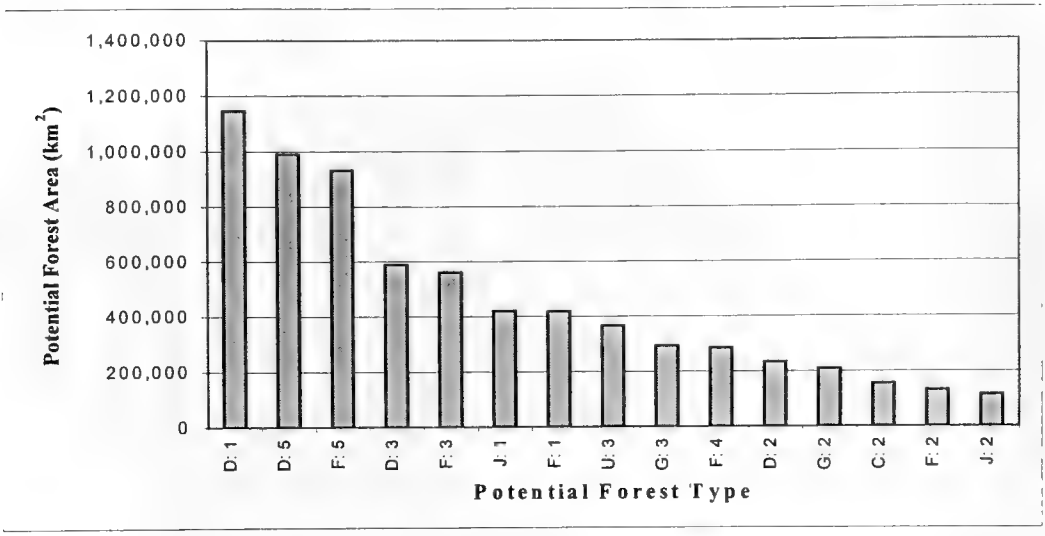
Data were first analysed at a detailed level, with 66 forest categories defined (see Annex 2). The extent of **potential forest** cover according to the detailed B & N classifications is given in figure 6 .The most predominant forest types are identified as:

- D:1 (Western boreal spruce (*Picea abies*, *P. obovata, P. abies x* P. obovata), partly with *Pinus sylvestris*, locally with birch (*Betula czerepanovii, B. pendula, B. pubescens*), alder (*Alnus incana*) or mixed forests (1,147,593 km^2).

- D:5 (Boreal and hemiboreal pine forests (*Pinus sylvestris*), partly with *Betula czerepanovii*, *B. pubescens*, *Picea obovata*, *P. abies*) and F:5 (Beech and mixed beech *forests (Fagus sylvatica*, partly *F. moesiaca*, *Abies alba*) (990,858 km^2).

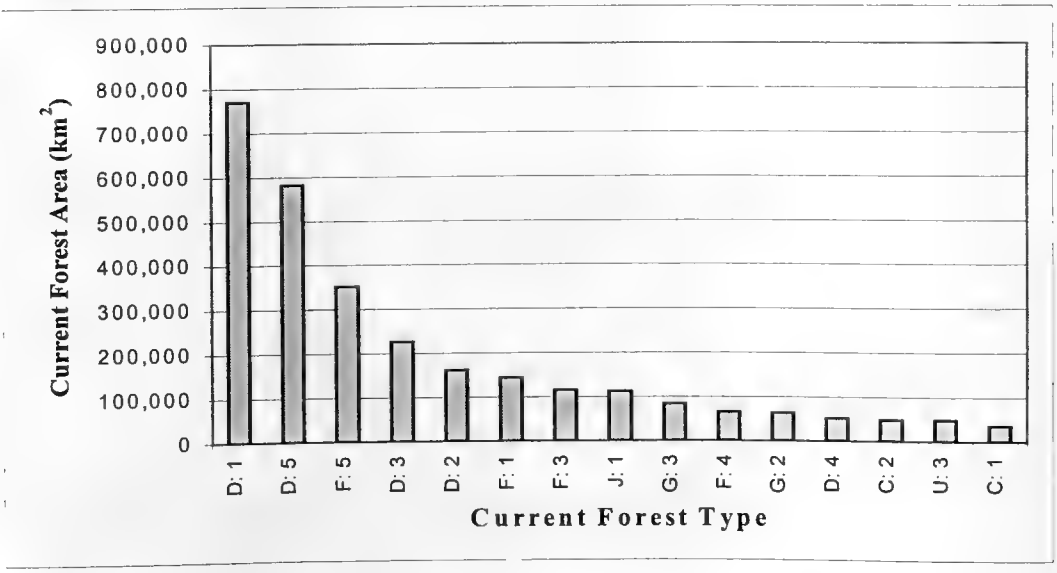
In contrast, minerotrophic mires (S:3), vegetation of marine sand dunes and sea shores (P:1), Juniper and cypress woodlands and scrub (*Juniperus thurifera, J. excelsa, J. foetidissima, J. polycarpos, Cupressus sempervirens*) (K:3), meso- and supramediterranean fir forests (*Abies pinsapo, A. cephalonica*) (K:2) and humid thermophytic mixed broad-leaved forests (H: Hu) are uncommon (Annex 5, table 10). All of these categories have a potential extent of less than 9,300 km^2.

Figure 6. Top 15 Potential forest types ranked by area (B & N 66 classification)



The extent of current forest cover according to the detailed B & N classification (B & N 66) is given in Annex 5, Table 10. The top 15 current forest types by current area are illustrated in Figure 7.

Figure 7. Top 15 current forest types by current area (B & N 66 classification)



The data reveal a similar pattern to that shown by potential cover, with predominant classes (D:1, D:5 and F:5) remaining in the same rank order, although reduced in extent (770,775 km^2, 581,470km^2 and 309,702 km^2 respectively). Forest types with very small current areas are listed in table 5.

Table 5. Current forest types with area <250 km^2

Current Forest Type Description	Current Area (km^2)
Riverine forest	248
Central European raised bogs wooded with *Pinus rotundata* (S: Ce)	181
Quercus pubescens forests in Crimean herb-grass steppes (L: Qu)	181
Pre-Ural Spruce woodland amid hygrophilous birch tundra (B: Pr)	145
Birch swamp forests amid Icelandic coastal heaths (E:Bi)	74
Continental willow alluvial forests (*Populus nigra, P. alba, Salix alba)* and tamarisk alluvial scrub (*Tamarix ramosissima*) (U: 5)	71
Greek evergreen scrub (C: Gr)	33
Juniperus foetidissima forest (C: Ju)	28
Orocantabrian *juniperus sibirica* scrub (C: Or)	2
Apenine mountain pine scrub (*Pinus mugo*) (C: Ap)	1

3.2.2 Forest loss

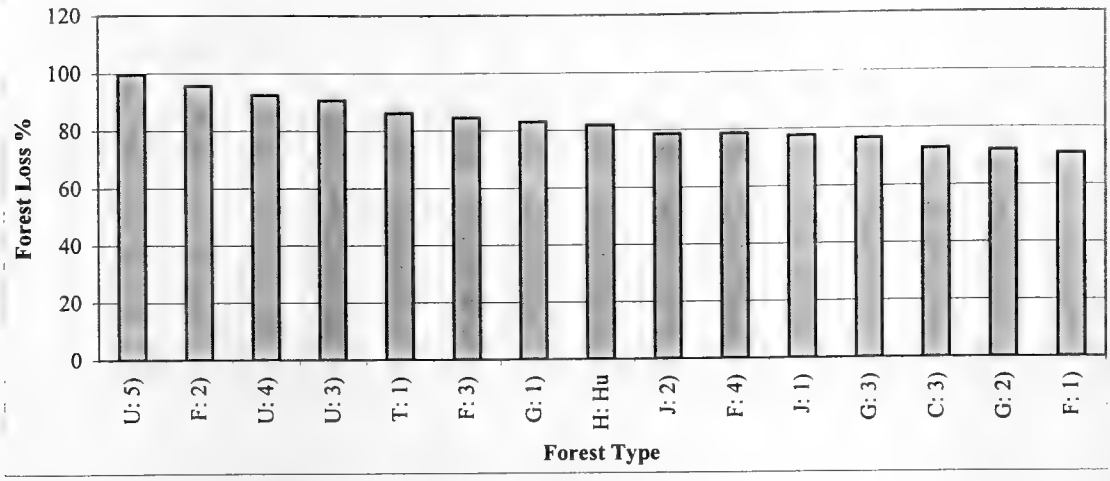
Total forest loss amounts to 4,139,759 km^2 . Further analysis of the data allowed the forest types (B &N 66) that have declined the most (in absolute terms) to be identified (Annex 5, Table 13). The top four of these forest types are:

- (F:5): Beech and mixed beech forests (*Fagus sylvatica*, partly *F. moesiaca*, *Abies alba*)
- (F:3): Mixed oak-hornbeam forests (*Carpinus betulus*, *Quercus robur, Q. petraea*, *Tilia cordata*),
- (D:5): Boreal and hemiboreal pine forests (*Pinus sylvestris*), partly with *Betula czerepanovii, B. pubescens, Picea obovata, P. abies*
- (D:1): Western boreal spruce (*Picea abies, P. obovata, P. abies x P. obovata*), partly with *Pinus sylvestris*, locally with birch (*Betula czerepanovii, B. pendula, B. pubescens*), alder *(Alnus incana*) or mixed forests

When these figures are analysed as a percentage of potential forest cover, thus providing *relative* forest loss data, the picture is somewhat different (see Figure 8 and Annex 5, Table 14).

Forest loss ranges from 99.5% (Continental willow alluvial forests (*Populus nigra, P. alba, Salix alba*) and tamarisk alluvial scrub (*Tamarix ramosissima*), to 19.3% (coastal vegetation). Three categories of alluvial forest (U:5, U:4 and U:3) appear to have suffered greatest proportional loss (>90%). Other forest classes that have suffered relatively high levels of decline include those of Mediterranean origin (J:1, J:2, G:1, G:2, G:3).

Figure 8. Top 15 detailed forest types (B&N) 66 that have suffered the greatest relative forest loss



3.2.3 Forest protection

Protected current forest figures (in *absolute* terms) range from 42,904 km^2 (D: 5) to no protection (B: Sp; B: Pr) (Annex 5, Table 11). With the exception of two forest types with minimal current forest areas that are largely protected (56% and 100%) and that both lie within the Russian Federation, protection (as a proportion of current forest area) ranges from zero to 36% (Annex 5, Table 12). Two forest types have areas greater than 1,000 km^2 and receive more than 20% protection. These occur in North-east Europe (Poland, Russian Federation and the Ukraine) (S: PisC) and in Romania and the Ukraine (C: So).

Five forest types extend to at least 1,000 km^2 but receive less than 2% protection. These forests occur in Russian Federation (B: Sp); Fennoscandia (S: PisS); Central and Eastern Europe (G:1); Hungary (H: Hu) and the Mediterranean (J:1). Other forest types receiving less than 2% protection but that cover very small areas comprise: B:Pr (Russian Federation); E:Bi (Norway); L: OaS (Hungary, Romania and Serbia): and P1 (France).

3.3 ANALYSIS BY GENERALISED FOREST TYPE (B & N 20)

3.3.1 Potential and current forest cover

Data on **potential forest** area, for simplified forest categories are illustrated in table 6. Results support findings in the detailed analysis. Predominant forest types include:

- *Mesophytic and Hygromesophytic coniferous and broadleaf forests* (type: D)
- *Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests* (type E)
- *Thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests* (type: G)

Humid Thermophytic mixed broad-leaved forests (type: H) *conifer forests in mires and bogs* (type:S) and *coastal vegetation* (type: P) remain under-represented.

Table 6. Potential forest type ranked by area (B & N 20 classification)

Forest Type	Description	Potential Forest Area (km^2)
D	Mesophytic and Hygromesophytic coniferous and broadleaf forests	3,051,980
F	Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests	2,406,552
G	Thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests	581,416
J	Mediterranean broad-leaved sclerophyllous forests and scrub	537,597
U	Alluvial forests	438,722
C	Subarctic, boreal and nemoral-montane birch woodlands and forests	287,014
T	Swamp and fen forests	50,790
K	Xerophytic coniferous forests, woodlands and scrub	32,562
H	Humid Thermophytic mixed broad-leaved forests	5,584
S	Conifer forests in mires and bogs	2,289
P	Coastal vegetation	934
B	Spruce woodland amid hygrophilous birch tundra	0
Broadleaf (from current)	Broadleaf (from current)	0
Coniferous (from current)	Coniferous (from current)	0
L	Deciduous broad-leaved forests amid steppes	0
Mixed (from current)	Mixed (from current)	0
Plantation	Plantation	0
Replacement vegetation	Replacement vegetation	0
Sclerophyllous (from current)	Sclerophyllous (from current)	0
Unclassified (from current)	Unclassified	0
Total		**7,395,440**

Table 7 provides comparable information to that shown by the detailed classification, for the extent of **current forest** cover. Again, results suggest a similar theme to that of potential forest cover, with *Mesophytic and Hygromesophytic coniferous and broadleaf forest* and *Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests* remaining predominant.

As a result of forest loss due to human and natural environmental influences, current forest area for most types declines. The exceptions to this are *deciduous broad-leaved forests amid steppes* (type: L) and *Spruce woodland amid hydrophillous birch tundra* (type: B). The area of these two types increases.

Table 7. Current forest extent and ranked by extent (B & N 20 classification)

Forest Type Abbreviation	Forest Type Description	Current Forest Area (km^2)
D	Mesophytic and Hygromesophytic coniferous and broadleaf forests	1,796,260
F	Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests	624,537
Replacement vegetation	Replacement vegetation	178,340
G	Thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests	141,285
J	Mediterranean broad-leaved sclerophyllous forests and scrub	119,542
C	Subarctic, boreal and nemoral-montane birch woodlands and forests	102,490
Coniferous (from current)	Coniferous (from current)	90,168
Broadleaf (from current)	Broadleaf (from current)	48,304
U	Alluvial Forests	46,588
L	Deciduous broad-leaved forests amid steppes	24,841
Unclassified (from current)	Unclassified (from current)	20,854
K	Xerophytic coniferous forests, woodlands and scrub	15,207
Mixed (from current)	Mixed (from current)	11,778
S	Conifer forests in mires and bogs	10,857
T	Swamp and fen forests	9,538
Plantation	Plantation	8,097
B	Spruce woodland amid hygrophilous birch tundra	3,404
Sclerophyllous (from current)	Sclerophyllous (from current)	1,818
H	Humid Thermophytic mixed broad-leaved forests	1,018
P	Coastal vegetation	754
Total		**3,255,680**

3.3.2 Forest loss

Figure 9 illustrates *absolute* forest loss, and identifies that the greatest decline has occurred to:

- (F): mesophytic deciduous broad-leaved and coniferous-broad-leaved forests (1.782,015 km^2)
- (D): mesophytic and hygromesophytic coniferous and broadleaf forests (1,255,643 km^2)
- (G): thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests (440,131 km^2)
- (J): Mediterranean broad-leaved sclerophyllous forests and scrub (417,825 km^2)

As a proportion of potential forest cover, forest loss figures by type range from 88.8% (alluvial forest) to 19.4% (coastal vegetation) (Annex 5, Table 15).

Figure 10 illustrates relative forest loss. Three of the four forest types that rank highest in this figure comprise wetland forests: U Alluvial forests; S Conifer forests in mires and bogs; T Swamp and fen forests.

Figure 9. Simplified forest type (B & N 20) ranked according to greatest forest loss (km^2)

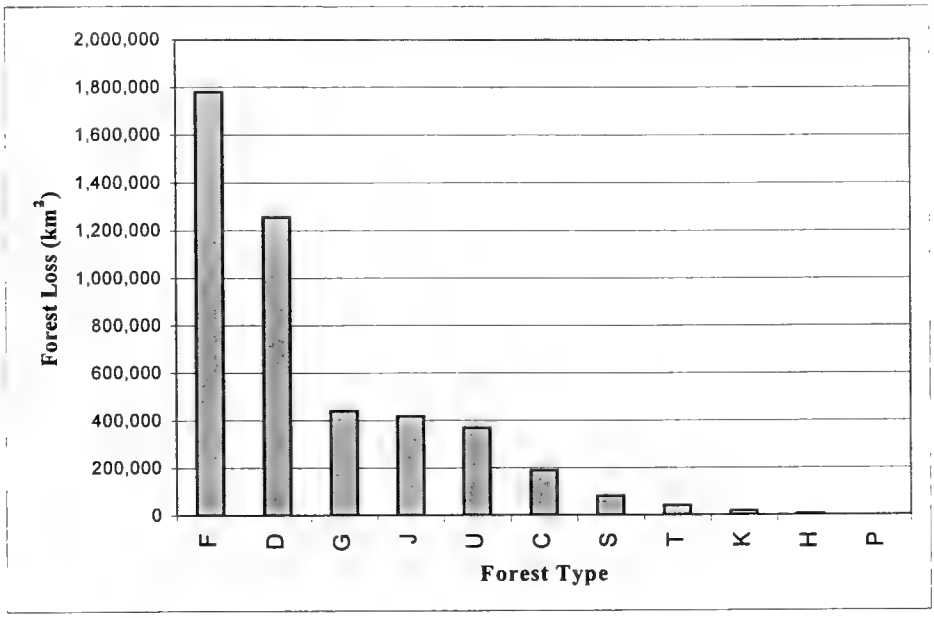
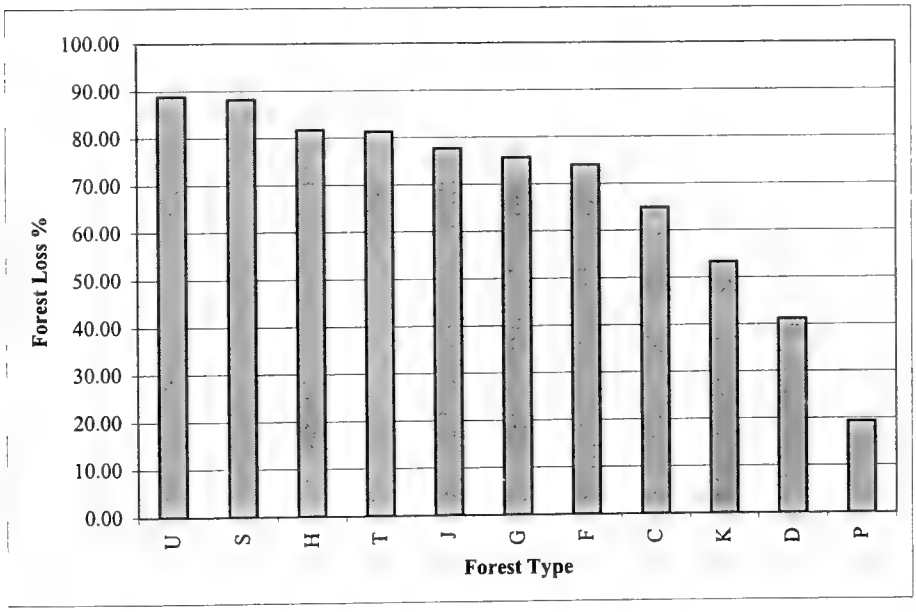


Figure 10. Simplified forest type (B & N 20) ranked according to greatest relative forest loss.



3.3.3 Forest protection

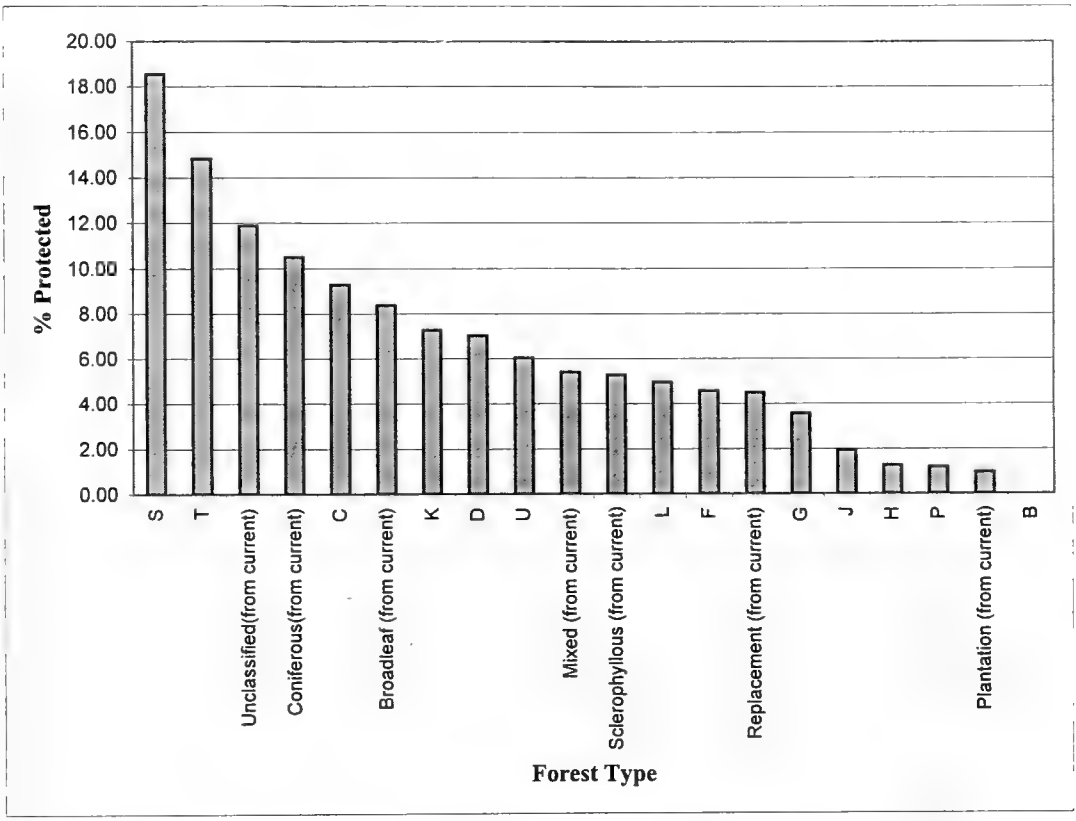
The results of the analysis identifying the quantity and proportion of current forest (by simplified forest type), that is protected (IUCN category I-IV) are presented in table 8. As a proportion of the current forest type they represent, the most protected forest types include: *conifer forests in mires and bogs* (type: S) (18.5%) and *swamp fen forest* and (type: T) (14.8%). In contrast, *spruce woodland amid hygrophilous birch tundra* (type: B) appear to be the least protected (0%).

Table 8. Current forest protection: B & N 20 simplified classification (ranked by area protected)

Simplified Forest Type Abbreviation	Simplified Forest Type Description	Protected Forest Area (km^2)	% Forest Type Protected
D	Mesophytic and Hygromesophytic coniferous and broadleaf forests	126,082	7.0
F	Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests	28,615	4.6
C	Subarctic, boreal and nemoral-montane birch woodlands and forests	9,515	9.3
Coniferous (from current)	Coniferous (from current)	9,475	10.5
Replacement vegetation	Replacement vegetation	8,020	4.5
G	Thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests	5,045	3.6
Broadleaf (from current)	Broadleaf (from current)	4,049	8.4
U	Alluvial forests	2,812	6.0
Unclassified (from current)	Unclassified (from current)	2,481	11.9
J	Mediterranean broad-leaved sclerophyllous forests and scrub	2,313	1.9
S	Conifer forests in mires and bogs	2,013	18.5
T	Swamp and fen forests	1,404	14.8
L	Deciduous broad-leaved forests amid steppes	1,233	5.0
K	Xerophytic coniferous forests, woodlands and scrub	1,106	7.3
Mixed (from current)	Mixed (from current)	637	5.4
Sclerophyllous (from current)	Sclerophyllous (from current)	96	5.3
Plantation	Plantation	78	1.0
H	Humid Thermophytic mixed broad-leaved forests	13	1.3
P	Coastal vegetation	9	1.2
B	Spruce woodland amid hygrophilous birch tundra	1	0.0
TOTAL		204,996	6.3

Figure 11 illustrates the proportion of each forest type that is protected, ranked in order of decreasing levels of protection.

Figure 11: Percentage of forest currently protected (B & N 20 classification)



3.4 SIZE AND DISTRIBUTION OF PROTECTED FOREST AREAS

3.4.1 Size

Table 9 illustrates the size distribution of European protected forest.

Table 9. Size distribution of protected forest areas

Size class (ha)	Number of protected forest areas	Area protected (ha)	Area protected (% of total area protected)
>100,000	20	5,621,173	27
50,000-99,999	34	2,448,497	12
10,000-49,999	275	5,747,235	28
1,000-9,999	1,497	4,717,163	23
<1,000	36,025	1,965,525	10
Total	**37,851**	**20,499,593**	

A total of 37,851 areas were identified when the analysis was made with all forest considered as one type. Rather few (329) relatively large (>10,000 ha) sites account for 67% of Europe's protected forests. Conversely, 95% of Europe's protected forest areas comprise fragments of less than 1,000 ha. Together these fragments protect less than 10% of Europe's forests.

Forest protected areas were further analysed by forest type and size category (according to the simplified forest categories). This analysis showed that the number of separate pieces of protected forest frequently increased, as one forest protected area often comprises more than one type of forest. Hence one protected area containing two types of forest would give a count of two forest protected areas when analysed by forest type. Details of the number and area of each category of protected forest are included in the Excel sheet on the accompanying CD-ROM. In summary mesophytic and hygromesophytic coniferous and broadleaf forests represent the most protected forest type (12,603,428 ha) with the greatest number of protected areas (14,814). In contrast, forest types that occur over a smaller area and in fewer numbers include:

- Spruce woodland amid hygrophilous birch tundra (1 protected forest, 56 ha)
- Humid thermophytic mixed broad-leaved forests (5 protected forests, 1,297 ha)
- Coastal vegetation (16 protected forests, 920 ha)

3.4.2 Distribution

Further analysis of forest and protected area data enabled the top 50 largest protected forest areas (IUCN categories I-IV) to be identified. Most of these areas occur in Russia (39 out of 50), with the remaining areas occurring in Finland (2), Sweden (3), Italy (2), Slovenia (1), Slovakia (1), Norway (1) and Spain (1). The largest forested protected area is Ugyd-Va National Park in Russia (1,138,401 ha). This protected area constitutes part of the Virgin Forests of Komi; a UNESCO World Heritage site. The predominance of these large protected areas in northern Europe to a large extent accounts for the much greater extent of protected forest that is found in this region compared to the south.

Full details of all forest data for each country included in this study are available in the Excel file included on the CD-ROM that accompanies this report.

4. DISCUSSION

The results of this Gap Analysis provide a baseline illustrating the extent of European current forest cover and relative forest protection status in 2000. The study identifies the extent and type of forest cover that exists and the current level of legal protection. Used in conjunction with the Excel file on the CD-ROM accompanying this document, the analyses also allow each country to assess the state of protection of each forest type within their country, compared to Europe as a whole.

It would appear that Europe's forests (IUCN categories I-IV) have low levels of protection (only 6.3% of current forest is protected), and that there is a need to press policymakers to increase these levels, to ensure valuable forest habitats and ecosystems are maintained.

It is interesting to compare the data on forest loss as a proportion of potential forest cover, with data on existing levels of protection, at the national level (Annex 5, Tables 3 and 4). These tables appear to show a regional bias within Europe. Countries of western Europe have suffered greatest forest loss, yet they have the lowest current levels of protection. For example Ireland and the UK rank high (4 and 9) in terms of forest loss, yet low (27 and 36) in terms of protection. Conversely, countries of northern Europe that have suffered lower levels of forest loss rank amongst the top in terms of current levels of protection. The Russian Federation and Finland rank 45 and 44 in terms of forest loss (i.e. the lowest), yet they rank high (2 and 11) in terms of protection. The picture for Mediterranean countries and eastern Europe is more variable, with less extreme variations in ranking between forest loss and forest protection. These figures appear to indicate that those countries that still have a relatively high proportion of their potential forest remaining, value this as a resource, and that they are prepared to invest in establishing protection measures. The data could also indicate that protection measures in place are effective in helping halt forest loss. The situation for western Europe, where the little forest that remains receives some of the lowest levels of protection suggests that action is urgently needed if the remaining fragments are to be preserved.

The analyses of levels of protection by forest type clearly relate to the distribution of these forest types within Europe, with forest types occurring in those countries that ranked high in the country analyses predominating. Protection levels for *conifer forests in mires and bogs* and *swamp and fen forests* are relatively high (18.5% and 14.8% respectively), but these two forests together only comprise 1% of Europe's protected forests. The majority (60%) of Europe's protected forests comprises *mesophytic and hygromesophytic coniferous and broadleaf forests; mesophytic deciduous broad-leaved and coniferous-broad-leaved forests.* This reflects the predominance of this forest type, which stands at 55% of current forest cover.

There appear to be 'gaps' in protection for three of the least common forest types: *coastal vegetation; humid thermophytic mixed broad-leaved forest; spruce woodland and hygrophilous birch tundra.* Less than 1.5% of each of these three forest types is currently protected. Another forest type with low (<2%) protection is *Mediterranean broad-leaved sclerophyllous forests and scrub.*

Initial investigations into the concept of 'wilderness' (in this study based on the size distribution of protected forest areas), indicate that there are few areas of large wilderness in Europe (20 forests over 100,000 ha). However, these are very unevenly distributed within Europe, with the majority located in the north, predominantly in the north-east of Russia. Conversely, only four of the 50 largest areas occur in the south, indicating that the forests that remain are only protected as fragments and that a pressing need exists to protect larger individual areas. It should be noted that this is quite a coarse classification of wilderness. A more accurate and detailed analysis requires further study.

5. CONCLUSION AND RECOMMENDATIONS

Gap analysis, in the sense used in this project, involves overlaying information on the distribution of forests with information on the distribution of protected areas to identify the level of official protection afforded to differing forest types. Like other

rapid appraisal methodologies, it should not be viewed as a substitute for full biological inventories, but rather as a coarse indicator of gaps. Such information is vital to policy-makers and planners, in developing a European-wide network of ecologically representative protected forest areas.

As well as identifying the current extent and types of European forest, the analyses presented in this study provide two indications of the state of protection of Europe's forests: the area of forest that is currently afforded legal protection; and the relative size of the pieces of protected forest. However it should be noted that no attempt has been made to address other issues that impact the state of protection. Additionally forest condition and threats to forest protection have not been analysed.

The collation of protected areas data remains an on-going task. Any analyses will inevitably date, as more data become available. However the analyses provide as accurate a view as possible for the status of Europe's protected forests for the year 2000.

Obtaining harmonised vegetation data across the entire area of interest of a project, classified according to a readily understood scheme is critical to any study. While this has been attempted for this analysis, it has been an immensely difficult task. Any subsequent analysis would need to ensure that this is again achieved. As with the collation of protected areas data, the gathering of up-to-date forest data is an ongoing task. Once again, this project provides as accurate a picture as possible for the year 2000, given the financial resources available for the project.

When analysing the data provided in this study, these factors should be taken into consideration, in order to provide a balanced well informed strategic plan, for improving the network of protected forest areas.

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Full details of the sources of protected area and forest data used in these analyses are included in Annexes 1 and 3.

MAP 1: SIMPLIFIED FOREST COVER

UNEP

WCMC

WWF®

European Forest Cover: 2000

According to Bohn and Neuhäusl simplified forest classification: 20 forest categories

Legend

- B Spruce woodland amid hygrophilous birch tundra
- C Subarctic, boreal and nemoral-montane birch woodlands and forests
- D Mesophytic and hygromesophytic coniferous and broad-leaved coniferous forests
- F Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests
- G Thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests
- H Humid thermophytic mixed broad-leaved forests
- J Mediterranean broad-leaved sclerophyllous forests and scrub
- K Xerophytic coniferous forests, woodlands and scrub
- L Deciduous broad-leaved forests amid steppes
- P Coastal vegetation
- S Conifer forests in mires and bogs
- T Swamp and fen forests
- U Alluvial Forests
- Broadleaf (from current)
- Coniferous (from current)
- Mixed (from current)
- Unclassified (from current)
- plantation
- Replacement vegetation
- Sclerophyl (from current)
- Non forest

Compiled by S. Blyth
Date: April 2000
Projection: Lambert Azimuthal

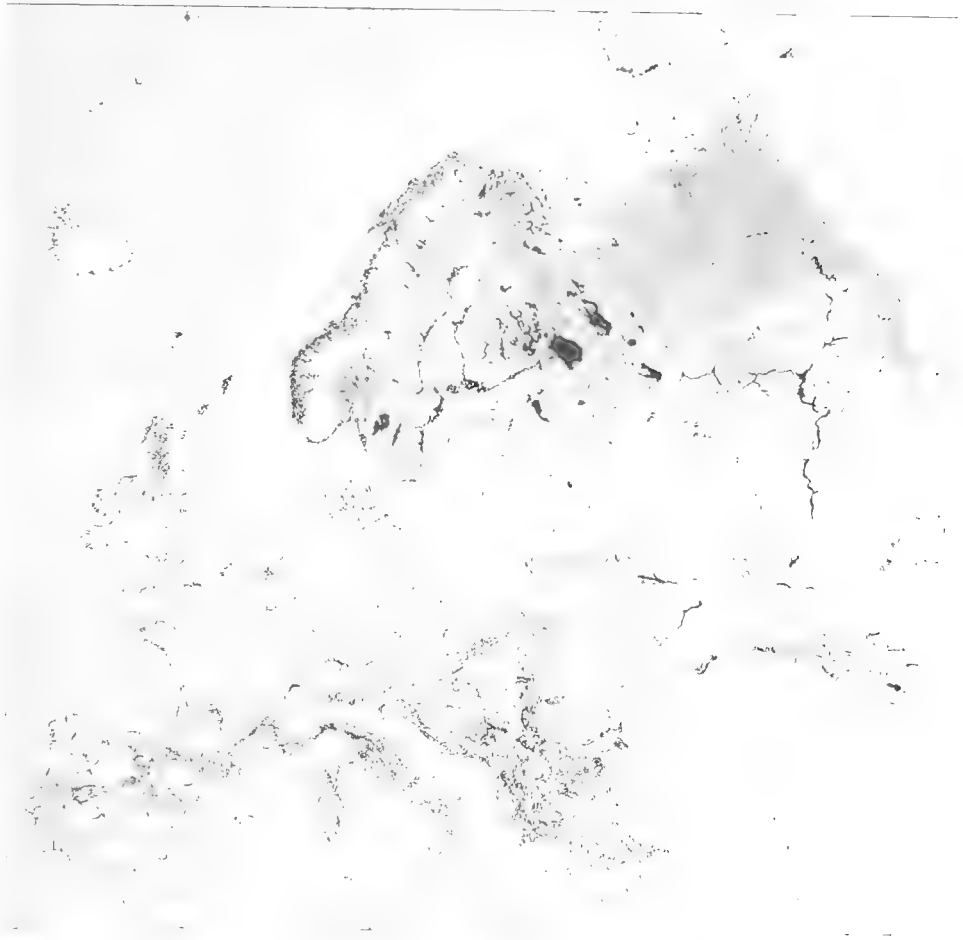
UNEP

WCMC

WWF

European Forest Cover: 2000

According to Bohn and Neuhäusl simplified forest classification: 20 forest categories



The geographical designations in this map do not imply the expression of any opinion whatsoever on the part of WCMC concerning the legal status of any country, territory, or area or concerning the delimitation of its frontiers or boundaries

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Date: April 2000
Projection: Lambert Azimutha
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ANNEX 1: FOREST DATA SOURCES

Summary of Current Forest Data Sources:

Albania, Bosnia-Herzegovina, Croatia, Liechtenstein, FYROM, Norway, Yugoslavia:
Stockholm Environment Institute. (1996). The forests of Europe. 1: 2,500,000.

Andorra, Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Monaco, Netherlands, Northern Ireland, Poland, Portugal, Romania, San Marino, Slovak Republic, Sweden (unclassified), Spain:
European Topic Centre on Land Cover (ETC/LC) (Satellus). (1999). CORINE Land Cover Version 6. 250m.

Great Britain (England, Scotland, Wales):
I. T. E. (1996). Land Cover Map of Great Britain. 1km.

Belarus, Estonia, Georgia, Latvia, Lithuania, Moldova, Russian Federation:
Isaev, A. C. State Committee of the USSR. (1990). Forests of the USSR. 1:2,500,000.

Iceland:
Iceland Forest Service, unpublished data. Scale unknown.

Switzerland:
Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). (1985). Dominant Tree Species. 1km.

Ukraine:
Yu. M. Voznyi, T. V. Medyna, A.O. Tkachev (1999). Forests of the Ukraine - Digital Map. Department of National Nature Parks and Reserves, Ministry of the Environment, Ukraine. 1:250,000.

Annex 2: Detailed and simplified Bohn and Neuhäusl derived forest categories (66 or 20 forest types)

Note: The original description provided by Bohn and Neuhäusl has been modified for this project for categories marked "#", to take account of current forest cover identified by CORINE data (see Table 2, example 3 in the main text).

Category (B & N 66)		Detailed forest description	Simplified forest description	Simplified category (B & N 20)	
1	B: SP	Spruce woodland amid hygrophilous dwarf birch tundra and cotton grass-sedge mires #	Spruce woodland and hygrophilous birch tundra	B	1
2	B: Pr	Pre-Ural Spruce woodland amid hygrophilous birch tundra #			
3	C:1	Eastboreal woodlands and forests (*Betula czerepanovii, Picea obovata, Pinus sylvestris*)	Subarctic, boreal and nemoral-montane birch woodlands and forest	C	2
4	C:2	Westboreal and nemoral-montane birch forests, partly with pine forests (*Betula czerepanovii, B. pubescens, Pinus sylvestris*)			
5	C: 3	Subalpine and oro-Mediterranean vegetation (woodlands, scrub and dwarf shrub communities in combination with grasslands and tall-herb communities)			
6	C: Ap	Apenine mountain pine scrub (*Pinus mugo*) #			
7	C: Ba	Balkan Krummholz scrub (*Pinus mugo, Alnus viridis, Salix waldsteniana, Juniperus communis*) #			
8	C: Di	Dinarian mountain pine scrub #			
9	C: Gr	Greek evergreen scrub #			
10	C: Ib	Iberian oro-mediterranean scrub with *Juniperus siberica* #			
11	C: Ju	*Juniperus foetidissima* forest #			
12	C: Or	Orocantabrian *Juniperus sibirica* scrub #			
13	C: Rh	Rhododendron - mountain pine scrub in the Alps #			
14	C: So	South Carpathian and Balkan mountain pine (*Pinus mugo*) scrub #			
15	D: 1	Western boreal spruce (*Picea abies, P. obovata, P. abies x P. obovata*), partly with *Pinus sylvestris*, locally with *birch (Betula czerepanovii, B. pendula, B. pubescens*), alder (*Alnus incana*) or mixed forests	Mesophytic and hygromesophytic coniferous and broadleaf forest	D	3
16	D: 2	Eastern boreal pine-spruce- (*Picea obovata, Pinus sibirica*) and fir-spruce forests (*Picea obovata, Abies sibirica*), partly with *Betula czerepanovii, Larix sibirica*			

Category (B & N 66)		Detailed forest description	Simplified forest description	Simplified category (B & N 20)	
17	D: 3	Hemiboreal spruce (*Picea abies, P. abies x P. obovata, P. obovata*) and fir-spruce forests (*Picea obovata, P. abies x P. obovata, Abies sibirica*) with broad-leaved trees (*Quercus robur, Tilia cordata, Ulmus glabra, Acer platanoides* etc.)			
18	D: 4	Montane to altimontane, partly submontane fir (*Abies alba, A. nordmanniana*) and spruce forests (*Picea abies, P. omorica, P. orientalis*) in the nemoral zone	Mesophytic and hygromesophytic coniferous and broadleaf forest (continued)	D	3
19	D: 5	Boreal and hemiboreal pine forests (*Pinus sylvestris*), partly *with Betula czerepanovii, B. pubescens, Picea obovata, P. abies*	Mesophytic and hygromesophytic coniferous and broadleaf forest (continued)	D	3
20	D: 6	Montane to altimontane (subalpine) pine forests *(Pinus peuce, P. kochiana, P. sylvestris*) in the nemoral zone			
21	E: Bi	Birch swamp forests amid Icelandic coastal heaths #	Swamp and fen forests	T	13
22	F: 1	Acidophilous oak and mixed oak forests, poor in species, (*Quercus robur, Q. petraea, Q. pyrenaica, Pinus sylvestris, Betula pendula, B. pubescens, B. celtiberica, Castanea sativa*)	Mesophytic deciduous broad-leaved and coniferous-broad-leaved forests	F	4
23	F: 2	Mixed oak-ash forests (*Fraxinus excelsior, F. angustifolia, Quercus robur, Ulmus glabra, Quercus petraea*)			
24	F: 3	Mixed oak-hornbeam forests (*Carpinus betulus, Quercus robur, Q. petraea, Tilia cordata)*			
25	F: 4	Lime-pedunculate oak forests (*Quercus robur, Tilia cordata*)			
26	F: 5	Beech and mixed beech forests (*Fagus sylvatica, F. moesiaca, Abies alba*)			
27	F: 6	Oriental beech forests (*Fagus orientalis*) and hornbeam-Oriental beech forests (*Fagus orientalis, Carpinus betulus, C. caucasica*)			
28	F: 7	Mixed Caucasian hornbeam-oak forests (*Quercus robur, Q. petraea, Q. iberica, Carpinus caucasica* etc.)			
29	G: 1	Subcontinental, thermophilous pedunculate oak and sessile oak forests as well as mixed forests (*Quercus robur, Q. petraea, Q. dalechampii, Pinus sylvestris*)	Thermophilous deciduous broad-leaved forests and mixed coniferous broad-leaved forests.	G	5
30	G: 2	Subcontinental thermophilous and supra-Mediterranean sessile oak, bitter oak and Balkan oak forests as well as mixed forests (*Quercus petraea, Q. cerris, Q. frainetto, Q. polycarpa, Q. pedunculiflora, Q. dalechampii, Q. hartwissiana, Q. pubescens*)			

Category (B & N 66)		Detailed forest description	Simplified forest description	Simplified category (B & N 20)	
31	G: 3	Sub-Mediterranean and supra-Mediterranean downy oak forests (and forests of other southern oak species) as well as mixed forests (*Quercus pubescens, Q. pyrenaica, Q. faginea, Q. broteroi, Q. canariensis, Q. virgiliana, Q. trojana, Q. congesta*)			
32	H: Hu	Humid thermophytic mixed broad-leaved forests	Humid thermophytic mixed broad-leaved forests	H	6
33	J: 1	Meso- and supra-Mediterranean and relict broad-leaved sclerophyllous forests (*Quercus ilex, Q. rotundifolia, Q. calliprinos, Q. coccifera, Q. suber, Pistacia lentiscus*)	Mediterranean broad-leaved sclerophyllous forests and scrub	J	7
34	J: 2	Thermo-Mediterranean broad-leaved sclerophyllous forests and xerophilous scrub (*Quercus suber, Q. rotundifolia, Olea europaea, Ceratonia siliqua, Periploca angustifolia, Rhamnus lycioides*)			
35	K: 1	Pine forests and woodlands (*Pinus sylvestris, P. nigra, P. pinea, P. halepensis, P. brutia, P. pityusa, P. heldreichii*)	Xerophytic coniferous forests, woodland and scrub	K	8
36	K: 2	Meso- and supramediterranean fir forests (*Abies pinsapo, A. cephalonica*)			
37	K: 3	Juniper and cypress woodlands and scrub (*Juniperus thurifera, J. excelsa, J. foetidissima, J. polycarpos, Cupressus sempervirens*)			
38	L: As	Ash-Oak forests in Danubian delta sand steppes #	Deciduous broad-leaved forests and steppes	L	9
39	L: Asm	Ash oak forest in meadow steppe #			
40	L: Ho	Hornbeam-Oak forests in Moldavian-Ukrainian meadow-steppes #			
41	L: Li	Lime-Oak and lime forests in Transkama-Transvolgian meadow steppe #			
42	L: OaV	Oak and beech forests within Volyn-Podolian meadow steppes #			
43	L: OaD	Oak forests in Danubian herb-grass steppes #			
44	L: OaP	Oak forests in Panonian sand steppes #			
45	L: OaS	Oak forests in South Pannonian herb-grass steppes #			
46	L: Qu	*Quercus pubescens* forests in Crimean herb-grass steppes #			

Category (B & N 66)		Detailed forest description	Simplified forest description	Simplified category (B & N 20)	
47	P: 1	Vegetation of marine sand dunes and sea shores, often in combination with halophytic vegetation of rocky shores	Coastal vegetation	P	10
48	R:	Riverine forests #	Alluvial forests	U	11
49	S: 3	Minerotrophic mires (fens)	Conifer forests in mires and bogs	S	12
50	S: Ce	Central European raised bogs wooded with Pinus rotundata #			
51	S: Pim	*Pinus mugo* in subatlantic Central European raised bogs #			
52	S: PisC	*Pinus sylvestris* in Central-East European raised bogs #			
53	S: PisS	*Pinus sylvestris* in raised bogs (central Scandinavia-west Finland) #			
54	T: 1	Alder carrs and swamp forests (*Alnus glutinosa, A. barbata*)	Swamp and fen forests	T	13
55	T: 2	Birch carrs and swamp forests (*Betula pubescens* s. l.) incl. vegetation complexes of degraded lowland raised bogs			
56	U: 2	Boreal alluvial forests	Alluvial forests	U	11
57	U:3	Alluvial and moist lowland forests in the nemoral zone			
58	U:4	Mediterranean wet lowland and alluvial forests and scrub (*Fraxinus angustifolia s.l., F. oxycarpa, F. pallisae, Platanus orientalis, Phoenix theophrasti, Nerium oleander, Tamarix* spec. div.)			
59	U: 5	Continental willow alluvial forests (*Populus nigra, P. alba, Salix alba*) and tamarisk alluvial scrub (*Tamarix ramosissima*)	Alluvial forests	U	11
60	Broadleaf (from current)	Broadleaf (from current)	Broadleaf (from current)	Broadleaf (from current)	14
61	Coniferous (from current)	Coniferous (from current)	Coniferous (from current)	Coniferous (from current)	15
62	Mixed (from current)	Mixed (from current)	Mixed (from current)	Mixed (from current)	16
63	Sclerophyllous (from current)	Sclerophyllous (from current)	Sclerophyllous (from current)	Sclerophyllous (from current)	17
64	Unclassified (from current)	Unclassified	Unclassified	Unclassified (from current)	18
65	Replacement	Replacement vegetation	Replacement vegetation	Replacement	19
66	Plantation	Plantation	Plantation	Plantation	20

ANNEX 3: PROTECTED AREA DATA SOURCES

The pages that follow provide information on the protected areas data sources used in this Gap Analysis project. In addition to new protected areas data that were gathered during 1998-1999, existing protected areas data held in the WCMC Protected Areas Database were also used.

Country: Albania
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Andorra
Title: None given
Source: Govern, MI (Eds)
Publisher: Consellaria de Serveis Publics
Date: 1987
Scale: 1: 50000

Country: Austria
Title: Evaluation of Austria's protected area system and IUCN's contribution to improve this system
Source: Mang, J
Publisher: IUCN
Date: 1990
Scale: None given

Country: Austria
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Belgium
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Belarus
Title: Republic of Belarus
Source: Map produced for the Department of Environment and Protection
Publisher: Belgeadezia
Date: 1996
Scale: 1: 500000

Country: Bosnia Herzegovina
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Bulgaria
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Croatia
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Czech Republic
Most protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Czech Republic
Title: Chanena Uzemi Priody Ceske
Source: Unknown
Publisher: Laket Cartography Computer Drawing
Date: 1993
Scale: 1: 500000

Country: Denmark
Approximately half of the protected areas polygon data is represented by polygon outlines from a sketch map (source unknown). The remaining protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Estonia
Title: Nature Conservation in Estonia
Source: Unknown
Publisher: REGIO, LKU
Date: 1996
Scale: Unknown

Country: Finland
Title: Oulanka National Park, Finland
Source: Finnish Forest and Park Service
Publisher: (same as source)
Date: 1995
Scale: 1: 50000

Country: Finland
Title: Finnish National Parks
Source: Finnish Forest Research Institute
Publisher: (same as source)
Date: Unknown
Scale: 1: 40000

Country: Finland
Title: Wilderness and Nature Conservation Area in Northern Finland
Source: Ministry of Environment, Environment Protection Dept.
Publisher: Pohjaartta, Karttakeskus, Helsinki
Date: 1993
Scale: Unknown

Country: Finland
Title: Pyhatunturi National Park
Source: Finnish Forest Research Institute
Publisher: Same as source
Date: Unknown
Scale: 1: 40000

Country: Finland
Title: Protected Areas of Finland
Source: Yrjo Sucksdorff, Finnish Environment Institute / GIS and Remote Sensing Unit, PO Box 140, FIN-00251, Helsinki, Finland
Publisher: Same as source
Date: 1998
Scale: 1: 30000; 1 : 50000; 1 : 60000; 1: 100000; 1: 200000; 1: 250000; 1: 400000; unknown

Country: France
Title: Unknown
Source: Espaces Naturels Proteges (1996)
Publisher: Unknown
Date: Unknown
Scale: 1: 500000

Country: France
Title: Les Zones Naturelles d'Interet Ecologique, Faunistique, Floristique de la Region Midi-Pyrenées
Source: Le Ministère de L'Environnement (1991)
Publisher: (Same as source)
Date: Unknown
Scale: 1: 250000

Country: France
Title: Protected Areas of France
Source: Museum National d'Histoire Naturelle, 57 Rue Cuvier, PARIS 75231 (via Dominique Richard)
Publisher: Same as source
Date: 1999
Scale: Unknown

Country: France
Title: Mont Perdu Patrimoine Mondial
Source: Documentation on World Heritage Properties (Natural) October 1998
Publisher: IUCN
Date: 1997
Scale: Unknown

Country: Georgia
All data in the form of polygon outlines from a sketch map (source unknown)

Country: Germany
Title: Protected Areas of Germany
Source: Bundesamt fur Naturschutz
Publisher: Same as source
Date: Unknown
Scale: Unknown

Country: Greece
Title: World Directory
Source: Unknown
Publisher: Hellenic Military Geographical Service
Date: 1985
Scale: 1: 1000000

Country: Hungary
Title: National Parks, Landscape Protection Reserves and Nature Conservation Areas in Hungary (1983)
Source: Unknown
Publisher: Unknown
Date: 1983
Scale: 1: 500000

Country: Iceland
Title:
Source: UNEP GRID, Arendal, Norway
Publisher:
Date: Unknown
Scale: Not given

Country: Iceland
Title: Fridlyst Svaedi og Adrar Natturuminjar
Source: Nature Conservation Council of Iceland 1991
Publisher: Same as source
Date: 1991
Scale: 1: 750000

Country: Ireland
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Ireland
Title: Killarney National Park
Source: Office of Public Works, Ireland (1990)
Publisher: Unknown
Date: 1990
Scale: Unknown

Country: Italy
Title: Carta Delle Aree Protette in Italia (1991)
Source: Ministero Dell'Ambiente
Publisher: (Same as source)
Date: 1991
Scale: 1: 1500000

Country: Italy
Title: Protected Areas of Italy
Source: Italian Environment Ministry
Publisher: Same as source
Date: Unknown
Scale: Unknown

Country: Latvia
Title: European Travel Map of Latvia (1996)
Source: Bartholomew
Publisher: Bartholomew
Date: (1995)
Scale: 1: 400000

Country: Leichtenstein
Title: Inventar der Natyrvorrangflachen
Source: Mario F. Broggi
Publisher: Buro fur Umweltplanung
Date: Unknown
Scale: 1: 25000

Country: Lithuania
Most protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Lithuania
Title: Lithuania (1985)
Source: Unknown
Publisher: Unknown
Date: 1985
Scale: 1: 600000

Country: Luxembourg
Title: Grand Duchy of Luxembourg, Programme CORINE/Project Land Cover
Source: EC, CORINE, Ministre de l'Amengement du territoire et de l'Environnement and WALPHOT
Publisher:
Date: Unknown
Scale: 1: 100000

Country: FYROM
Title: European Travel Map, Macedonia
Source: Bartholomew
Publisher: Bartholomew
Date: 1996
Scale: Unknown

Country: Netherlands
Title: Carte Touristique - Parcs Nationaux des Pays de l'Entente (1984)
Source: Institute Geographic National and Conseil de l'Entente, Abijan
Publisher:
Date: 1984
Scale: Unknown

Country: Netherlands
Title:
Source: C. Magin pers. 1992
Publisher:
Date: 1992
Scale: Unknown

Country: Norway
Title:
Source: UNEP GRID, Arendal Norway
Publisher:
Date:
Scale:

Country: Norway
Title: Protected Areas of Norway
Source: Torstein Olsen, Statens kartverk Miljoenheten, Postboks 1608, Myrene, 4801 Arendal
Publisher: Same as source
Date: 1999
Scale: Unknown

Country: Poland
Title: Polska Mapa Ochrony Pryzyrody - Conservation of Nature (1992)
Source: Istytut Ochrony Srodowiska and Polskie Przedseibiorstwo Wydawnictw Kartograficzynch and provided by Dr. Cjanusz Radziejowksi, Deputy Director, Institute for Environmental Protection
Publisher: Known
Date: 1992
Scale: 1: 750000

Country: Poland
Title: Wigierski Park Narodowy
Source: Polish Mapa turystycznz (1990)
Publisher: Same as source
Date: (1990)
Scale: 1: 46000

Country: Poland
Title: Kampinoski Park Narodowy
Source: Polish Mapa turystycznz (1987)
Publisher: Same as source
Date: 1987
Scale: 1: 60000

Country: Poland
Title: Biesczcady
Source: Polish Mapa turystycznz (1982)
Publisher: Same as source
Date: (1982)
Scale: 1: 75000

Country: Poland
Source: UNEP/GRID Warsaw
Scale: 1: 4000000

Country: Poland
Title: Kardonoski National Park
Source: Polish Mapa turystycznz (1985)
Publisher: Same as source
Date: (1985)
Scale: 1: 30000

Country: Poland
Title: Protected Areas of Poland
Source: The state information on nature conservation in Poland (produced by Ministry of Environment)
Publisher: Institute of Geodesy and Cartography (Warsaw) and Institute of Nature Conservation PAS (Cracow)
Date: 1998
Scale:

Country: Portugal
Title: Areas Protegidas
Source: Serviso Nacional de Parques, Reservas e Conservacao da Natureza
Publisher:
Date:
Scale: 1: 3000000

Country: Portugal
Title: Unknown at present
Source: Source of the dataset has been requested. Data provided by the Instituto de Consevacao de Natureza, Lisbon, Portugal.
Publisher:
Date:
Scale: 1: 1000000

Country: Russia
Title: Protection of Nature in the USSR (1985)
Source: Moscow State University
Publisher:
Date: 1985
Scale: 1: 4000000

Country: Russia
Title:
Source: V. Nikiforov, Deputy Director, Great Arctic Reserve
Publisher:
Date:
Scale:

Country: Russia
Source: Ministry of Nature Protection
Scale: 1: 1000000

Country: Russia
Title: Meshchera Wetland National Park
Source: Gary Hill - Univ. of Hertfordshire
Publisher:
Date:
Scale: 1: 200000

Country: Russia
Title:
Source: State Committee for the Environment Protection of the Russian Federation
Publisher:
Date:
Scale:

Country: Russia
Title: The Golden Mountains of Altai
Source: Documentation on World Heritage Properties (Natural) October 1998
Publisher: IUCN
Date: 1998
Scale: Unknown

Country: Serbia
All protected areas polygon data buffered from points using official 'size' and location information held in the WCMC Protected Areas Database.

Country: Slovakia
Title: Protected Areas of Slovakia (1991)
Source: Jozef Kramarik
Publisher: Unknown
Date: 1991
Scale: 1: 500000

Country: Slovenia
Title: Slovenija
Source: Marko Zeovnik
Publisher: Unknown
Date: Unknown
Scale: 1: 300000

Country: Spain
Title: Donana National Park - guide map
Source: Ministerio de Agricultura Pesca y Alimetacion
Publisher: Instituto Geografico Nacional
Date: Unknown
Scale: 1: 50000

Country: Spain
Title: Espacios naturales protegidos del Estado Espanol (Natural Protected Areas of Spain)
Source: Federacion de Parques Nacionales y Naturales de Europa, Fernandez Sanudo, P & de Lucio, J.V., 1994
Publisher:
Date: 1995
Scale:

Country: Spain
Title: Mont Perdu Patrimoine Mondial
Source: Documentation on World Heritage Properties (Natural) October 1998
Publisher: IUCN
Date: 1997
Scale: Unknown

Country: Sweden
Title: Areas of National Importance to Outdoor Recreation (Sweden)
Source:
Publisher:
Date:
Scale: 1: 2500000

Country: Sweden
Title: Areas of National Importance to Nature Conservation (Sweden)
Source:
Publisher:
Date:
Scale: 1: 2500000

Country: Sweden
Title: GSD-Naturvårdsobjekt database digitised at scales of 1:10,000, 1:20000, 1:50,000 and 1:100,000
Source: Swedish Environmental Protection Agency
Publisher: Same as source
Date: 1998
Scale:

Country: Switzerland
Title: Protected Areas of Switzerland
Source: Swiss Agency for the Environment, Forests and Landscape
Publisher: Swiss Agency for the Environment, Forests and Landscape
Date: 1998
Scale:

Country: Ukraine
Title: Protected Areas of the Ukraine
Source: Main Department of National Nature Parks and Reserves, Ministry of the Environment, Ukraine.
Publisher: Same as source
Date: 1999
Scale: 1: 250000

Country: United Kingdom
Title: Protected Areas in the United Kingdom
Source: Countryside Commission
Publisher: Same as source
Date: 1990
Scale:

Country: United Kingdom
Title: SSSI and other Statutory Sites in Cambridgeshire
Source: English Nature
Publisher:
Date:
Scale: 1: 150000

Country: United Kingdom
Title: English National Parks & Areas of Outstanding Natural Beauty
Source: Countryside Commission (Bob Monks) - Department of Environment Transport and the Regions supplied the data.
Publisher: Same as source
Date:
Scale:

Country: United Kingdom
Title: English National Nature Reserves
Source: English Nature, Geographic Information Unit, Northminster House, Peterborough PE1 1UA
Publisher: Same as source
Date: 1998
Scale: 1: 10000

Country: United Kingdom
Title: Northern Ireland (National Nature Reserves and Areas of Special Scientific Interest)
Source: Environment and Heritage Service, Belfast.
Publisher: Environment and Heritage Service, Commonwealth House, 35 Castle Street, Belfast BT1 1GU
Date:
Scale:

Country: United Kingdom
Title: Scotland National Nature Reserves
Source: Scottish Natural Heritage, Edinburgh.
Publisher: Scottish Natural Heritage, 12 Hope Terrace, Edinburgh, EH9 2AS
Date: 1998
Scale: 1: 10000

Country: United Kingdom
Title: Protected Areas of Wales
Source: Countryside Council for Wales
Publisher: Countryside Council for Wales, Plas Penrhos, Bangor, Gwynedd LL57
Date: 1998
Scale:

ANNEX 4: IUCN PROTECTED AREA MANAGEMENT CATEGORIES I – VI

Ia Strict nature reserve: protected area managed mainly for science.

Ib Wilderness Area: protected area managed mainly for wilderness protection.

II National Park: protected area managed mainly for ecosystem protection and recreation.

III Natural Monument: protected area managed mainly for the conservation of specific natural features.

IV Habitat/Species management area: protected area managed mainly for conservation through management intervention.

V Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation.

VI Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems.

The analyses in this project are based on protected area management categories I-IV. For additional information on IUCN management categories, readers should consult:

IUCN. 1994. *Guidelines for Protected Area Management Categories.* WCPA with the assistance of WCMC. IUCN, Gland, Switzerland and Cambridge, UK. X +261pp

Extracts of this publication may be found at: http://iucn.org/themes/wcpa/iucncategories-english.pdf

ANNEX 5: FOREST COVER BY COUNTRY

Figure 1 Potential forest cover by country
Figure 2 Current forest cover by country
Tables 1-14 Forest cover, loss and protection

Figure 1. Potential forest cover by country (excluding Russian Federation)

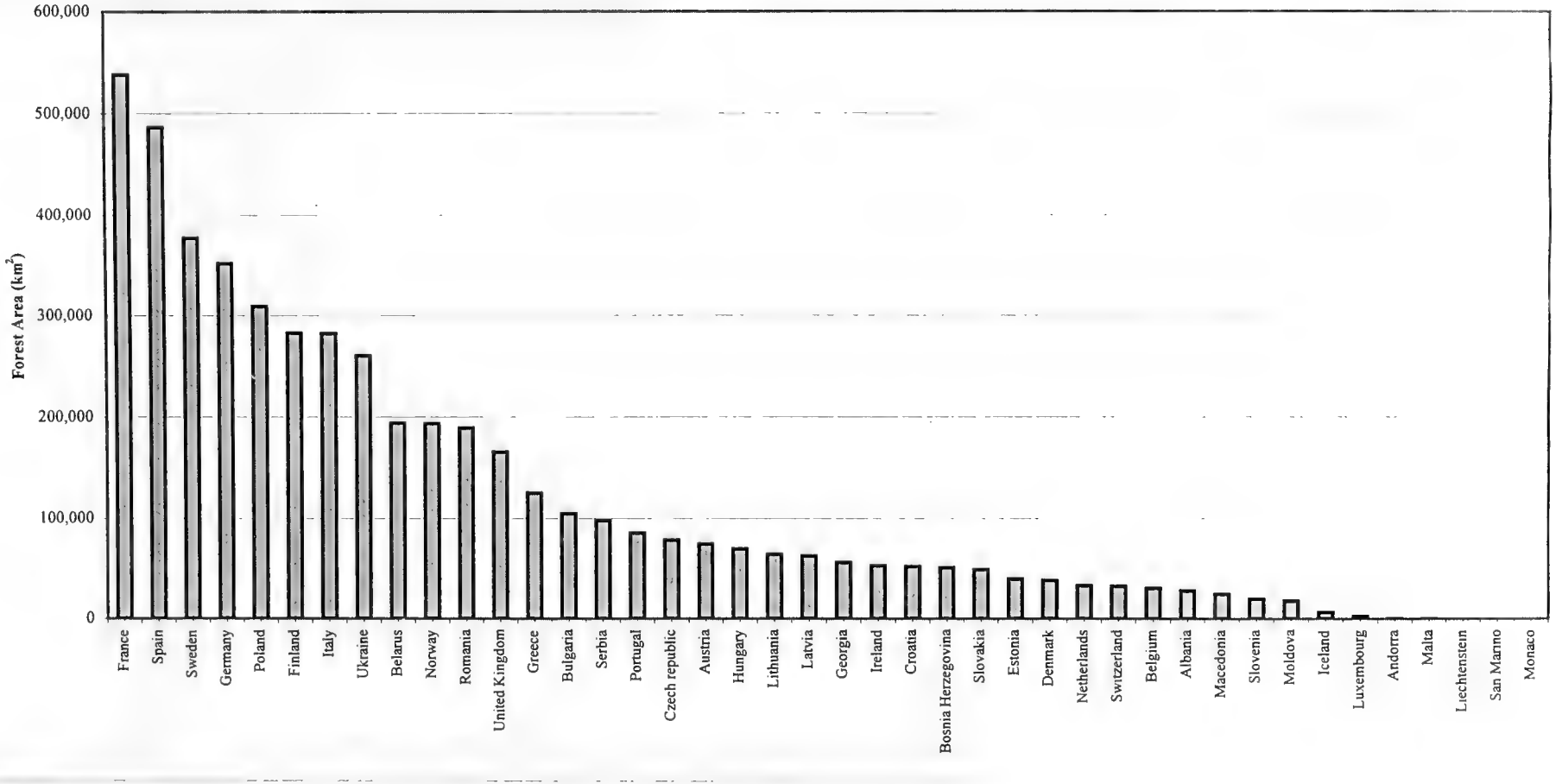

Figure 2. Current forest cover by country (excluding Russian Federation)

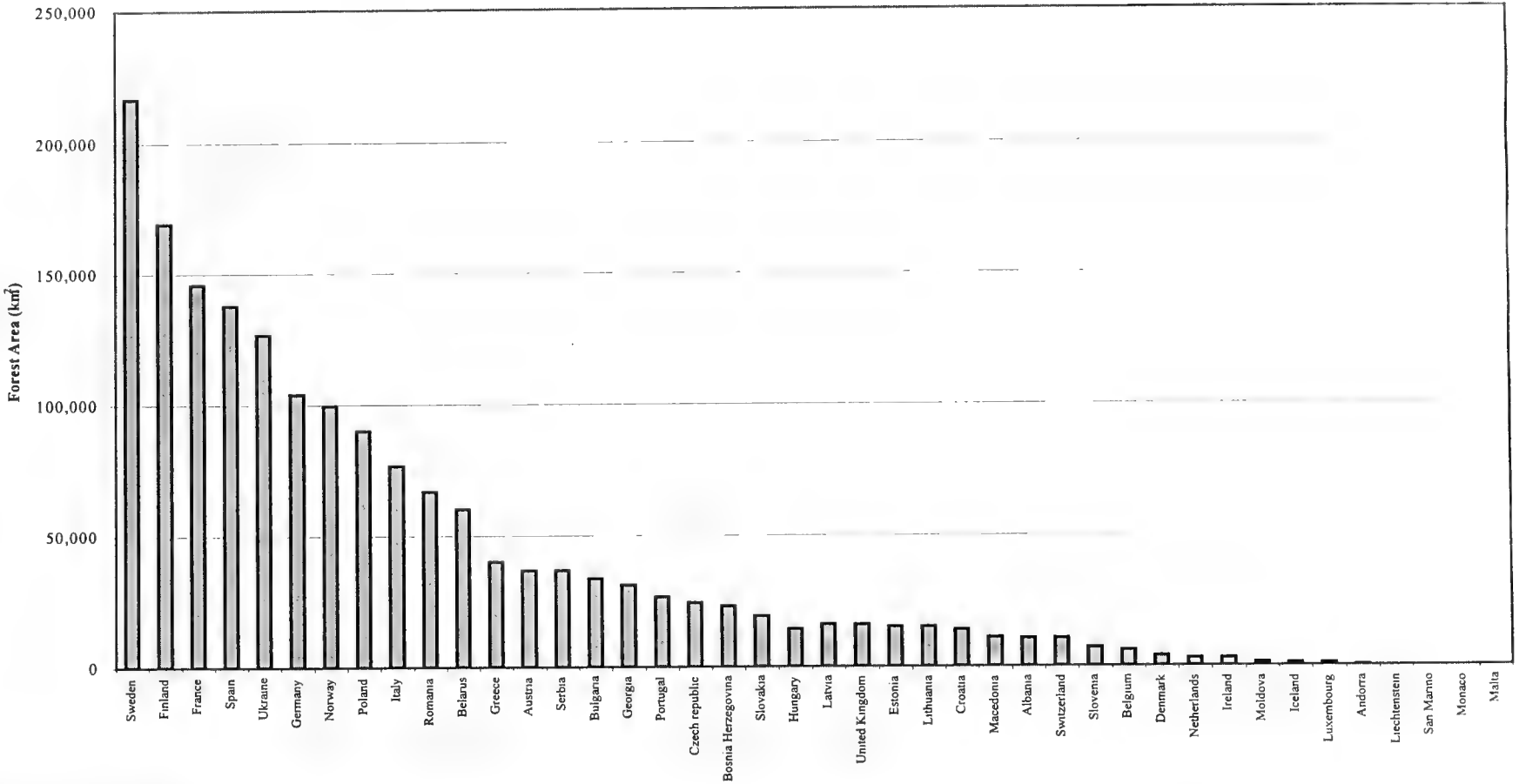

Table 1. Potential forest cover (km^2) by country

Rank	Country	Potential Forest Area (km^2)
1	Russian Federation	2,469,520
2	France	538,096
3	Spain	486,609
4	Sweden	376,920
5	Germany	351,767
6	Poland	308,850
7	Finland	282,884
8	Italy	282,155
9	Ukraine	260,142
10	Belarus	194,121
11	Norway	194,019
12	Romania	189,596
13	United Kingdom	166,103
14	Greece	124,880
15	Bulgaria	105,159
16	Serbia	97,349
17	Portugal	85,417
18	Czech Republic	78,327
19	Austria	74,306
20	Hungary	69,758
21	Lithuania	64,022
22	Latvia	62,654
23	Georgia	55,920
24	Ireland	52,847
25	Croatia	51,879
26	Bosnia Herzegovina	50,905
27	Slovakia	48,617
28	Estonia	39,246
29	Denmark	38,152
30	Netherlands	33,180
31	Switzerland	32,309
32	Belgium	30,377
33	Albania	27,900
34	FYROM	24,531
35	Slovenia	19,605
36	Moldova	17,513
37	Iceland	6,427
38	Luxembourg	2,613
39	Andorra	324
40	Malta	226
41	Liechtenstein	150
42	San Marino	60
43	Monaco	8
	Total	**7,395,440**

Table 2. Current forest cover (km^2) by country

Rank	Country	Current Forest Area (km^2)
1	Russian Federation	1,539,947
2	Sweden	216,631
3	Finland	169,157
4	France	145,856
5	Spain	137,796
6	Ukraine	126,764
7	Germany	103,930
8	Norway	99,668
9	Poland	90,187
10	Italy	76,779
11	Romania	66,909
12	Belarus	60,353
13	Greece	40,114
14	Austria	36,813
15	Serbia	36,802
16	Bulgaria	33,626
17	Georgia	31,076
18	Portugal	26,563
19	Czech Republic	24,465
20	Bosnia Herzegovina	23,031
21	Slovakia	19,356
22	Hungary	14,412
23	Latvia	16,249
24	United Kingdom	15,917
25	Estonia	15,214
26	Lithuania	15,106
27	Croatia	13,964
28	FYROM	10,958
29	Albania	10,684
30	Switzerland	10,633
31	Slovenia	7,128
32	Belgium	6,041
33	Denmark	3,953
34	Netherlands	3,051
35	Ireland	2,914
36	Moldova	1,327
37	Iceland	1,167
38	Luxembourg	960
39	Andorra	142
40	Liechtenstein	30
41	San Marino	4
42	Monaco	1
43	Malta	0
	Total	**3,255,680**

Annex 5 continued

Table 3. Forest loss by country

Rank	Country	Forest Loss (km^2)	Forest loss as % of Potential Forest Area
1	Malta	226	100.0
2	Ireland	49,933	94.5
3	Monaco	8	93.3
4	San Marino	56	92.9
5	Moldova	16,186	92.4
6	Netherlands	30,129	90.8
7	United Kingdom	150,181	90.4
8	Denmark	34,199	89.6
9	Iceland	5,259	81.8
10	Belgium	24,336	80.1
11	Liechtenstein	120	79.9
12	Hungary	55,346	76.9
13	Lithuania	48,916	76.4
14	Latvia	46,405	74.1
15	Croatia	37,915	73.1
16	France	392,240	72.9
17	Italy	205,376	72.8
18	Spain	348,813	71.7
19	Poland	218,662	70.8
20	Germany	247,837	70.5
21	Belarus	133,768	68.9
22	Portugal	58,853	68.9
23	Czech Republic	53,861	68.8
24	Bulgaria	71,533	68.0
25	Greece	84,766	67.9
26	Switzerland	21,676	67.1
27	Romania	122,688	64.7
28	Slovenia	12,477	63.6
29	Luxembourg	1,652	63.2
30	Serbia	60,546	62.2
31	Albania	17,216	61.7
32	Estonia	24,031	61.2
33	Slovakia	29,261	60.2
34	Andorra	182	56.1
35	FYROM	13,573	55.3
36	Bosnia Herzegovina	27,874	54.8
37	Ukraine	133,377	51.3
38	Austria	37,492	50.5
39	Norway	94,351	48.6
40	Georgia	24,844	44.4
41	Sweden	160,289	42.5
42	Finland	113,727	40.2
43	Russian Federation	929,573	37.6
	Total	**4,139,759**	

Annex 5 continued

Table 4. Current Forest Protected (km^2)

Country	Current forest protected (km^2)	% Current Forest Protected
Belarus	7,044	11.7
Russian Federation	134,466	8.7
Slovakia	1,678	8.7
Ukraine	8,928	7.0
Italy	5,304	6.9
Slovenia	480	6.7
FYROM	733	6.7
Estonia	955	6.3
Sweden	10,609	4.9
Spain	6,623	4.8
Finland	7,933	4.7
Switzerland	488	4.6
Netherlands	136	4.5
Lithuania	664	4.4
Bulgaria	627	4.2
Iceland	1,427	4.1
Hungary	48	4.1
Austria	1,390	3.8
Georgia	1,070	3.4
Denmark	132	3.3
Latvia	535	3.3
Serbia	1,157	3.1
Romania	2,089	3.1
Czech Republic	758	3.1
Greece	1,098	2.7
Moldova	34	2.6
Ireland	65	2.3
Germany	2,264	2.2
Norway	2,036	2.0
Croatia	262	1.9
Poland	1,479	1.6
Albania	157	1.5
France	1,724	1.2
Portugal	308	1.2
Bosnia Herzegovina	179	0.8
United Kingdom	101	0.6
Luxembourg	4	0.5
Belgium	12	0.2
Liechtenstein	0	0.0
Andorra	0	0.0
Malta	0	0.0
Monaco	0	0.0
San Marino	0	0.0
Total	**204,996**	**6.3**

Annex 5 continued

Table 5. Potential forest as % of land area by area by country

Country	Potential Forest Area as % of land area
Luxembourg	100.0
Bosnia Herzegovina	99.8
Belgium	99.5
Czech Republic	99.3
Slovakia	99.1
Lithuania	98.8
Poland	98.8
Germany	98.6
Latvia	98.4
San Marino	98.3
Netherlands	97.8
France	97.8
Slovenia	97.4
Spain	97.4
Albania	97.0
Greece	96.9
FYROM	96.5
Italy	96.0
Serbia	95.4
Bulgaria	95.1
Liechtenstein	93.9
Belarus	93.6
Portugal	93.4
Finland	92.9
Estonia	92.8
Croatia	92.8
Sweden	91.6
Denmark	89.9
Austria	89.8
Romania	82.3
Switzerland	81.7
Georgia	80.2
Ireland	76.7
Hungary	75.5
Andorra	72.0
Malta	70.6
United Kingdom	69.5
Norway	63.2
Moldova	53.1
Ukraine	44.9
Monaco	44.1
Russian Federation	14.6
Iceland	6.4

Table 6. Current forest as % of land area by country country

Rank	Country	Current Forest Area as % of land area
1	Finland	55.5
2	Sweden	52.6
3	Bosnia Herzegovina	45.2
4	Georgia	44.6
5	Austria	44.5
6	FYROM	43.1
7	Slovakia	40.3
8	Albania	39.0
9	Luxembourg	37.1
10	Serbia	36.1
11	Estonia	36.0
12	Slovenia	35.4
13	Norway	32.5
14	Czech Republic	31.7
15	Andorra	31.6
16	Greece	31.1
17	Bulgaria	30.4
18	Germany	29.8
19	Poland	29.6
20	Belarus	29.1
21	Romania	29.0
22	Portugal	29.0
23	Spain	27.6
24	Switzerland	26.9
25	France	26.5
26	Latvia	26.2
27	Italy	26.1
28	Croatia	25.0
29	Lithuania	23.3
30	Ukraine	21.9
31	Belgium	19.8
32	Liechtenstein	18.8
33	Hungary	15.6
34	Denmark	9.3
35	Russian Federation	9.1
36	Netherlands	9.0
37	San Marino	7.0
38	United Kingdom	6.7
39	Ireland	4.2
40	Moldova	4.0
41	Monaco	3.0
42	Iceland	1.2
43	Malta	0.0

Annex 5 continued

Table 7. Current forest protected as % of land area by country

Country	Current Forest Protected as % of land area
Slovakia	3.5
Belarus	3.4
FYROM	2.9
Finland	2.6
Sweden	2.6
Slovenia	2.4
Estonia	2.3
Italy	1.8
Austria	1.7
Ukraine	1.5
Georgia	1.5
Spain	1.3
Bulgaria	1.3
Switzerland	1.2
Serbia	1.1
Lithuania	1.0
Czech Republic	1.0
Romania	0.9
Latvia	0.9
Greece	0.9
Russian Federation	0.8
Hungary	0.7
Norway	0.7
Germany	0.6
Albania	0.6
Poland	0.5
Croatia	0.5
Netherlands	0.4
Bosnia Herzegovina	0.4
Portugal	0.3
France	0.3
Denmark	0.3
Luxembourg	0.2
Moldova	0.1
Ireland	0.1
Iceland	0.0
United Kingdom	0.0
Belgium	0.0
Andorra	0.0
Liechtenstein	0.0
Malta	0.0
Monaco	0.0
San Marino	0.0

Table 8. Current forest type diversity ranked by country

Country	Number of forest types (B & N 66)
Russian Federation	33
Ukraine	26
Italy	21
Greece	20
Romania	20
France	19
Spain	19
Germany	17
Serbia	17
Bulgaria	16
Belarus	15
Norway	15
Albania	14
Austria	14
Poland	14
Croatia	13
Czech Republic	13
Bosnia Herzegovina	12
Georgia	12
Sweden	12
Slovenia	11
Switzerland	11
United Kingdom	11
Hungary	10
Lithuania	10
FYROM	10
Denmark	9
Finland	9
Netherlands	9
Slovakia	9
Estonia	8
Ireland	8
Latvia	8
Moldova	8
Portugal	8
Belgium	6
Andorra	3
Liechtenstein	3
Iceland	2
Luxembourg	2
Monaco	1
San Marino	1
Malta	0

Annex 5 continued

Detailed forest type (B &N 66)

Table 9. Potential Forest Area (km^2)

Potential Forest Type	Current Forest Type	Total Area
D: 1)	D: 1)	1,147,593
D: 5)	D: 5)	990,858
F: 5)	F: 5)	931,575
D: 3)	D: 3)	590,422
F: 3)	F: 3)	562,909
J: 1)	J: 1)	422,131
F: 1)	F: 1)	419,084
U: 3)	Non f	364,652
G: 3)	G: 3)	294,030
F: 4)	F: 4)	286,009
D: 2)	D: 2)	234,785
G: 2)	G: 2)	209,791
C: 2)	C: 2)	156,587
F: 2)	F: 2)	132,098
J: 2)	J: 2)	115,467
D: 4)	D: 4)	81,279
G: 1)	G: 1)	77,596
C: 1)	C: 1)	70,759
C: 3)	C: 3)	59,665
F: 7)	F: 7)	49,320
U: 4)	U: 4)	41,763
T: 1)	Fores	35,341
F: 6)	F: 6)	25,557
U: 2)	U: 2)	19,223
K: 1)	K: 1)	19,080
T: 2)	Non f	15,449
U: 5)	U: 5)	13,084
K: 3)	K: 3)	9,249
D: 6)	D: 6)	7,043
H: Hu	H: Hu	5,584
K: 2)	K: 2)	4,233
S: 3)	S: 3)	2,289
P: 1)	P: 1)	934
Total:		7,395,440

Table 10. Current Forest Area (km^2)

Current Forest Type	Total Area
D: 1)	770,775
D: 5)	581,470
F: 5)	309,702
D: 3)	226,169
Replacement vegetation	178,340
D: 2)	161,810
F: 1)	122,374
J: 1)	94,885
Coniferous (from current)	90,168
F: 3)	87,509
G: 3)	69,267
F: 4)	61,152
G: 2)	58,781
D: 4)	51,646
Broadleaf (from current)	48,304
C: 2)	45,918
C: 1)	36,234
U: 3)	34,332
J: 2)	24,656
F: 7)	23,426
Unclassified (from current)	20,854
C: 3)	16,295
F: 6)	14,664
G: 1)	13,237
Mixed (from current)	11,778
K: 1)	9,554
U: 2)	8,801
L: Li	8,459
Plantation	8,097
L: Asm	8,032
F: 2)	5,710
S: 3)	5,044
T: 1)	4,928
L: Ho	4,811
T: 2)	4,537
D: 6)	4,390
S: PisC	4,351
K: 3)	3,584
B: Sp	3,259
U: 4)	3,137
K: 2)	2,068
Sclerophyllous (from current)	1,818
C: Rh	1,549
L: QaV	1,548
C: So	1,161
S: PisS	1,144
H: Hu	1,018
L: QaD	878
L: QaP	769
P: 1)	754
C: Ba	698
C: Di	300
C: Ib	272
Riverine	248
S: Ce	239
L: Qu	181
L: QaS	148
B: Pr	146
S: Pim	77
E: Bi	74
U: 5)	71
C: Gr	33
C: Ju	28
L: As	16
C: Or	2
C: Ap	1
Total:	3,255,680

Annex 5 continued

Table 11. Protected Forest Area (km^2)

Current Forest Type	Protected Area
D: 5)	42,904
D: 1)	40,666
D: 2)	23,225
D: 3)	13,677
F: 5)	12,162
Coniferous (from current)	9,475
Replacement vegetation	8,020
F: 4)	6,045
C: 2)	5,116
D: 4)	5,022
Broadleaf (from current)	4,049
F: 1)	3,897
G: 3)	3,591
F: 3)	2,600
Unclassified (from current)	2,481
U: 3)	2,302
C: 1)	1,978
F: 7)	1,856
F: 6)	1,786
J: 1)	1,744
C: 3)	1,686
S: PisC	1,315
G: 2)	1,303
T: 2)	820
K: 1)	778
S: 3)	675
Mixed (from current)	637
D: 6)	590
T: 1)	584
J: 2)	569
L: Li	529
L: Asm	374
U: 2)	341
F: 2)	271
C: So	263
C: Ba	246
K: 3)	223
G: 1)	151
C: Rh	150
K: 2)	105
L: Ho	101
U: 4)	97
Sclerophyllous (from current)	96
L: OaV	78
Plantation	78
L: Qu	66
L: OaD	47
U: 5)	40
L: OaP	34
Rivenne	32
C: Ib	30
C: Di	24
H: Hu	13
C: Gr	11
C: Ju	10
P: 1)	9
S: PisS	9
S: Pim	8
S: Ce	6
L: As	3
L: OaS	1
C: Ap	1
C: Or	0
E: Bi	0
B: Sp	0
B: Pr	0
Total:	**204,997**

Annex 5 continued

Table 12. Protected forest area as a percentage of current forest area

Current Forest Type	Current Forest Area (km2)	% of current forest area
C: Ap	1	100 00
U: 5)	71	56.49
L: Qu	181	36.23
C: Ba	698	35.22
C: Ju	28	35.01
C: Gr	33	33.50
S: PisC	4,351	30.21
C: So	1,161	22.63
L: As	16	19 90
T: 2)	4,537	18 08
D: 2)	161,810	14 35
D: 6)	4,390	13.44
S: 3)	5,044	13.39
C: Or	2	13 33
Riverine	248	12.72
F: 6)	14,664	12.18
Unclassified (from current)	20,854	11.90
T: 1)	4,928	11.85
C: Ib	272	11.21
C: 2)	45,918	11.14
S: Pim	77	10.90
Coniferous (from current)	90,168	10.51
C: 3)	16,295	10.35
F: 4)	61,152	9.89
D: 4)	51,646	9.72
C: Rh	1,549	9.66
Broadleaf (from current)	48,304	8.38
K: 1)	9,554	8.14
C: Di	300	7.92
F: 7)	23,426	7.92
D: 5)	581,470	7.38
U 3)	34,332	6.70
L: Li	8,459	6.26
K: 3)	3,584	6.22
D: 3)	226,169	6.05
C: 1)	36,234	5.46
Mixed (from current)	11,778	5.41
L: OaD	878	5.33
Sclerophyllous (from current)	1,818	5.28
D: 1)	770,775	5.28
G: 3)	69,267	5.18
K: 2)	2,068	5.07
L: OaV	1,548	5.05
F 2)	5,710	4.74
L Asm	8,032	4.65
Replacement vegetation	178,340	4.50
L: OaP	769	4.42
F: 5)	309,702	3.93
U 2)	8,801	3.87
F: 1)	122,374	3.18
U: 4)	3,137	3.09
F 3)	87,509	2.97
S: Ce	239	2.42
J: 2)	24,656	2.31
G: 2)	58,781	2.22
L: Ho	4,811	2.10
J: 1)	94,885	1.84
H: Hu	1,018	1.27
P: 1)	754	1.22
G: 1)	13,237	1.14
Plantation	8,097	0 96
L: OaS	148	0.83
S: PisS	1,144	0.77
E: Bi	74	0.30
B: Sp	3,259	0.00
B: Pr	146	0 00

Annex 5 continued

Table 13. Forest loss (km^2)

Current Forest Type	Forest loss (km^2)
F 5)	621,873
F. 3)	475,401
D: 5)	409,388
D: 1)	376,818
D 3)	364,253
U: 3)	330,320
J: 1)	327,246
F: 1)	296,709
F: 4)	224,857
G 3)	224,763
G. 2)	151,010
F 2)	126,389
C: 2)	110,669
J: 2)	90,810
D: 2)	72,975
G: 1)	64,358
C: 3)	43,370
U: 4)	38,626
C: 1)	34,526
T 1)	30,414
D: 4)	29,633
F 7)	25,894
U: 5)	13,013
T: 2)	10,913
F 6)	10,892
U: 2)	10,422
K: 1)	9,525
K: 3)	5,666
H: Hu	4,566
D. 6)	2,653
K: 2)	2,165
P: 1)	180
B: Pr	0
B: Sp	0
Broadleaf (from current)	0
C: Ap	0
C: Ba	0
C: Di	0
C: Gr	0
C: Ib	0
C: Ju	0
C: Or	0
C: Rh	0
C: So	0
Coniferous (from current)	0
E: Bi	0
L: As	0
L. Ho	0
L. Li	0
L: Asm	0
L. Qu	0
Mixed (from current)	0
Plantation	0
Replacement vegetation	0
Riverine	0
S: 3)	0
S: Ce	0
S. Pim	0
Sclerophyllous (from current)	0
Unclassified (from current)	0
S: PisS	0
L: OaP	0
L: OaS	0
S: PisC	0
L. OaV	0
L: OaD	0

Annex 5 continued

Table 14. Forest type ranked according to percent forest loss

Current Forest Type	% of Potential forest
U: 5)	99.46
F: 2)	95.68
U: 4)	92.49
U 3)	90.59
T: 1)	86 06
F. 3)	84 45
G. 1)	82.94
H. Hu	81.77
J: 2)	78.65
F: 4)	78 62
J: 1)	77.52
G: 3)	76 44
C 3)	72.69
G: 2)	71.98
F: 1)	70.80
C: 2)	70 68
T: 2)	70.64
F: 5)	66.76
D: 3)	61.69
K. 3)	61.25
U: 2)	54.22
F: 7)	52 50
K. 2)	51.14
K: 1)	49.92
C: 1)	48.79
F: 6)	42.62
D: 5)	41.32
D: 6)	37 67
D: 4)	36.46
D. 1)	32 84
D: 2)	31.08
P 1)	19.31
B: Pr	0.00
B: Sp	0.00
Broadleaf (from current)	0 00
C: Ap	0 00
C: Ba	0 00
C: Di	0 00
C Gr	0 00
C Ib	0.00
C: Ju	0.00
C Or	0 00
C: Rh	0 00
C: So	0 00
Coniferous (from current)	0 00
E. Bi	0.00
L: As	0 00
L: Ho	0.00
L Li	0.00
L. Asm	0.00
L: Qu	0 00
Mixed (from current)	0 00
Plantation	0.00
Replacement vegetation	0 00
Riverine	0 00
S: Ce	0.00
S: Pim	0 00
Sclerophyllous (from current)	0.00
Unclassified (from current)	0 00
S. 3)	0 00
S PisS	0 00
L OaP	0 00
L. OaS	0 00
S. PisC	0.00
L OaV	0 00
L: OaD	0.00

Annex 5 continued

Simplified forest type (B & N 20)

Table 15. Forest loss as a percent of potential forest

Rank	Potential forest type	% Forest Loss
1	U	88.8
2	S	88.2
3	H	81.8
4	T	81.3
5	J	77.8
6	G	75.7
7	F	74.0
8	C	56.1
9	K	53.3
10	D	41.1
11	P	19.4
12	B	0.0
13	L	0.0
14	Coniferous (from current)	0.0
15	Broadleaf (from current)	0.0
16	Mixed (from current)	0.0
17	Sclerophyllous (from current)	0.0
18	Replacement(from current)	0.0
19	Plantation (from current)	0.0
20	Unclassified	0.0

ANNEX: 6 CONTENTS OF THE CD-ROM

Details are given at a country-by-country level and for the region as a whole.

Users can view the following:

- Potential forest cover
- Current forest cover
- Protected forest (IUCN categories I-IV)
- Protected forest as a proportion of potential forest cover
- Protected forest as a proportion of current forest cover

Additional statistics that are provided include:

- Top 50 largest forest protected areas
- A summary of protected forest areas by size category
- A summary of protected forest areas by forest type & size
- Ranked potential and current forest cover by forest type
- Ranked protected current forest cover by type
- Countries ranked in terms of potential & current forest area, percent of current forest protected, and absolute forest loss

Digital maps of regional forest cover and protected areas, as described in the project objectives, are also available on the on the CD-ROM that accompanies this report, or at http://www.unep-wcmc.org/forest/eu_gap. The results that follow assess the analysis firstly at a national level and then by forest type, at regional level.


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