COST

Technical Committee on Forests and Forestry Products

European cooperation in the field of scientific and technical research

European Commission

COST Action E4

FOREST RESERVES RESEARCH NETWORK IN EUROPE

Mission, Goals, Outputs, Linkages, Recommendations and Partners

Final Report

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COST Action E4

Forest Reserves Research Network in Europe

1 Preface

This newsletter is a summary of the COST Action E4: **Forest Reserves Research Network in Europe**, which was initiated in 1995 and ended in November 1999. Over 100 scientists and nature conservation administrators from 19 participating COST member countries, in addition to 8 Central and Eastern European countries and Russia participated in the Action. The objectives and tasks outlined in 1995 at the onset of the Action were achieved and in some cases extended and modified as a result of increasing interest from forest policy makers in this Action as it developed. The main outputs of the Action are: (1) the publication of country reports on protected forests and research in natural forests; (2) the analysis of strictly protected forest areas and related categories of protected forests in Europe; (3) a review of the methods and traits used for describing the structure of natural forests and (4) an electronic databank for strict forest reserves.

The importance of nature conservation in forests has increased because of the impact of sustainability and forest certification issues. Strict forest reserves play an important role on two fronts: they are important protection sites in their own right, and they provide the necessary reference data for nature-based silviculture in production forests. The term 'strict' reserve is interpreted very differently in the respective countries: in many cases game and fire control, and intervention to remove invading exotic species are permissible. The ideal non-intervention scenario is unrealistic in Europe. Human impact and fragmentation result in some degree of intervention in most cases. It is evident that more research and scientific analysis is needed to clarify and harmonise European protected forest definitions and terminology.

Despite considerable variation between countries in relation to topics studied, goals, methodologies and constraints on scientific research, there is also considerable overlap and similarity in the scientific approach to forest reserves. Transboundary co-operation is also evident, and needs further promotion. For this purpose, an electronic database on strict reserves -which can be consulted through the Internet at **www.efi.fi/Database_Gateway/FRRN** has been constructed within the framework of the COST Action. Judging from the number of visits to-date, it is apparent that it should prove to be an important tool for future scientific co-operation.

Joensuu, January 2000

Jari Parviainen
Chairman of the COST Action E4
The Finnish Forest Research Institute

Photo Tomaž Hartman

Figure 1. Fir and beech virgin forest Rajhenavski Rog, Kocevje, Slovenia 1998

2 What is COST?

COST is a framework for scientific and technical co-operation, allowing the co-ordination of national programmes on a European level. Within this framework, financial support is given for the organisation of meetings, specific co-ordination tasks and for Short Term Scientific Missions. The research to be co-ordinated is funded nationally.

3 Goals of the COST Action E4

The COST Action E4: **Forest Reserves Research Network** was established by the COST Commission in 1995 in order to promote the research of "natural" forests. The objectives were to create a European network of forest reserves, to collect ongoing research, to standardise research methodology and to create an accessible central data bank. Results are important for the application of ecologically-oriented silviculture and for forest protection network planning. The duration of the action was 4 years, ending in November 1999.

Goals of the Action

- *to survey and analyse current information on forest reserves and research in Europe*
- *to compile an overview of the published research reports on natural forests and forest reserves*
- *to develop and harmonise research methodology for monitoring forest structure*
- *to promote the establishment of a permanent sampling plot system*
- *to create a data bank for gathering the information on forest reserves*
- *to achieve a common consensus on terminology and management approach for forest reserves and other categories of forest protection*

4 The structure of working

Management Committee*
(consisting of country delegates)

Chairman: Jari Parviainen, Finland

Vice-chairman: Konstantinos Kassioumis, Greece

Working Group I **Greation of network**	Working Group II **Research Methodology**	Working Group III **Data bank**
Winfried Bücking, Germany	*Eduard Hochbichler, Austria*	*Risto Päivinen, European Forest Institute, Finland*
- definitions and terminology of protection areas - characteristics of existing reserves - the creation of a bibliograhpy	- parameters for measuring forest stands, structure and regeneration - design of the sampling plot system in forest reserves	- creation of a common electronic data base for forest reserves - standardisation of data collection

** List of Management Committee and Working Group members as well as other participants are presented on the pages 25-27.*

Figure 2. The Action is structured around three Working Groups.

5 COST E4 Management Committee Meetings

- ***1st** Management Committee meeting (formal initiation) in Brussels, **Belgium**, 4 March 1996*
- ***2nd** Management Committee and Working Group (WG) 1&2 joint meeting in Fountainebleue, **France**, 12-14 September 1996, with an excursion to the forests and forest reserves of Fountainebleue*
- ***3rd** Management Committee and WG 1&2 joint meeting in Pallas-Ounastunturi National Park and Joensuu, **Finland,** 30 July - 3 August 1997, with a scientific excursion to boreal forest reserves in Finnish Lapland and the Carelian Republic of **Russia** (Vuokkiniemi and Kostamuksha)*
- ***4th** Management Committee and WG 1&2 joint meeting in Brussels, **Belgium**, 24-25 November 1997, with an excursion to Zonienwoud*
- ***5th** Management Committee and WG 1&2 joint meeting in **Slovenia**, April 1998 with an excursion to the Rajhenavski Rag virgin forest, Triglav National Park and Littoral Karst regions*
- ***6th** Management Committee and WG 1&2 joint meeting in Vienna, **Austria**, 15-18 October 1998, with an excursion to forest reserve Lange Leitn, Neckenmarkt and forest reserve Schneeberg*
- ***7th** Management Committee and WG1&2 joint meeting in Thessaloniki, **Greece**, 4-8 May 1999, with excursions to Kassandra peninsula and Olympos National Park*
- ***8th** Management Committee and WG1&2 joint meeting, the final meeting, in Lisbon, **Portugal**, 4-7 November 1999, with excursions to Ave Casta, a natural* Quercus rotundifolia *forest and to a mixed oak forest near Leiria and to the Natural Park of Serra da Arrábida and to the Strict Reserves of* Quercus faginea *remnants*

6 Short Term Scientific Missions

The aim of Short Term Scientific Missions (STSM) was to contribute the realisation of the scientific objectives of this COST Action. The missions strengthened the existing networks by allowing scientists to go to a laboratory or institute in another COST country to get to know different systems on forest reserve classification, to learn a new technique or to make measurements using instruments and/or methods not available in their own country. During years 1997-1999, three calls were opened and 30 scientists travelled from one country to another within the framework of STSM. The home institutions of these people were located in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland and United Kingdom. The missions were carried out to Austria, Denmark, Finland, France, Germany, Greece, Hungary, the Netherlands, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

Each STSM-participant was required to present a written report after his mission. In these reports the STSM –participants stated, that the main objectives of missions included for example discussion on the practical organisation of forest reserves monitoring, identification and copying of relevant data and publications, discussions on methods and results about forest reserves. The main research sub-areas of the missions were natural forest measurement, establishment of forest reserves, management of national parks, composition and structure of ground vegetation, biodiversity of forest reserves, permanent forest plot data analyses, field work techniques and experimental design in natural forests. The participants emphasized the importance of STSM in broadening their skills and understanding outside their own countries. Further co-operation and strengthening of contacts were considered in many cases as very important networking aspect.

Photo Risto Päivinen

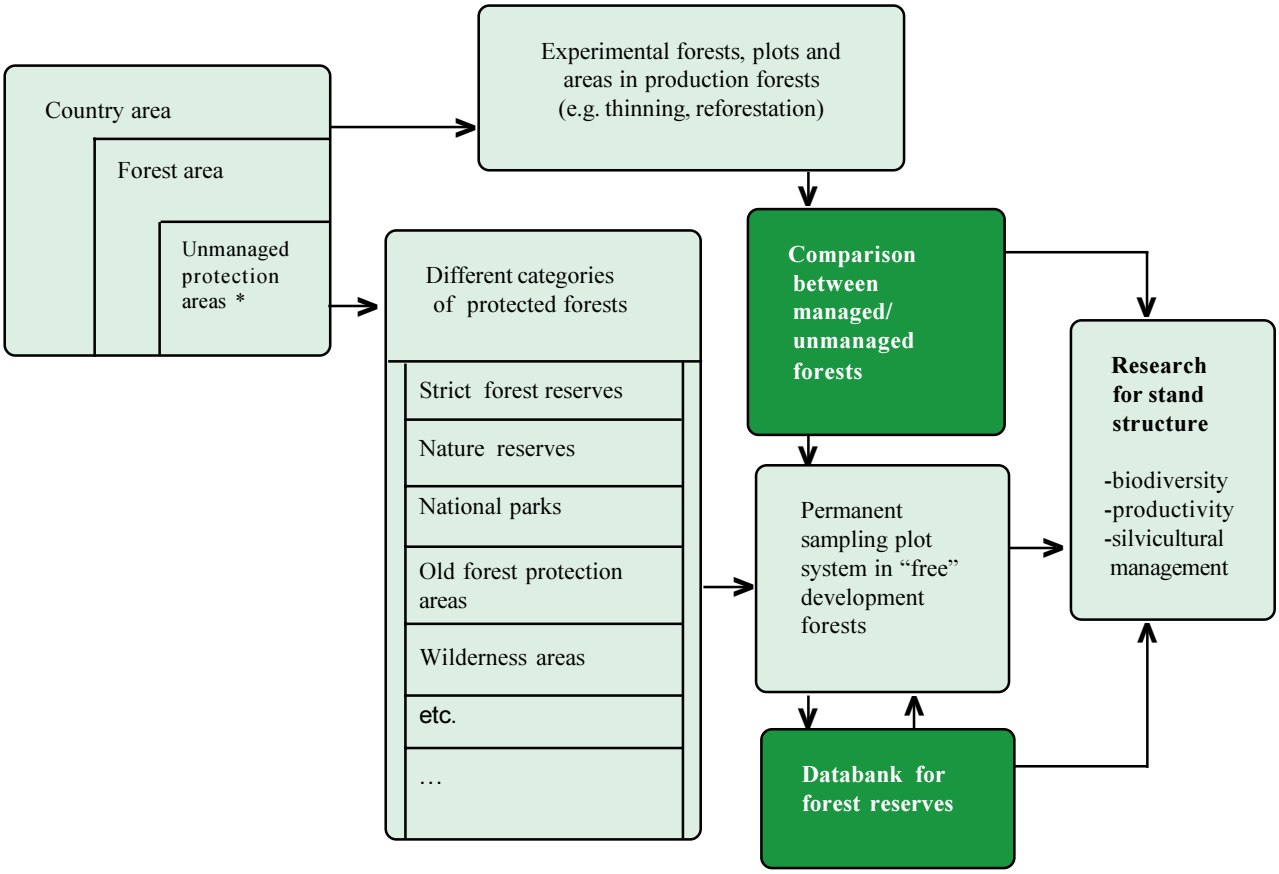
Figure 3. Excursion 1999 to Kassandra peninsula of Chalkidiki, Greece, where a recently burned forest area was examined. From the left Jari Parviainen, Eduard Hochbichler and Georg Frank.

7 Protected forests and research goals of COST Action E4

What kind of natural forests there are in Europe?

Of all the ”natural” forests in Europe, the most interesting category relevant to this Action is the strictly protected forests. They are left to develop freely in a state which is as original as possible. Because forests left for ”free” development can also be found in other categories of protection COST Action E4 surveyed all the categories: strict forest reserves, nature reserves, national parks, old forest protection areas, wilderness areas etc. In order to compare the structure of natural forests to the structure of production forests, a harmonised permanent sampling plot system for natural forests and strict forest reserves was developed. Comparison between natural and production forests is the base for the development of close to nature silviculture. With a permanent sampling plot system the biodiversity components (like dead wood characteristics), productivity and effects of silvicultural management can be studied on a stand level.

According to the information contained in the country reports compiled by COST Action E4, there is nearly 3 mill. ha of ”natural” forests (1,6 % of the total forest area) left in strict forest reserves and other protection categories in Europe (i.e. COST participating countries without Russia). Most of these remnants are located in forest reserves, which are protected by law. There are over 3,500 strict forest reserves in European countries. The outlines of the complexity of forest protection categories in selected European countries participating in COST Action E4 are tabulated (table 1, pages 6 & 7). The list of forest protection categories highlights the complex situation in forest protection: there is nearly 90 different categories of protected forests ranging from national parks to aesthetic forests.



** Unmanaged protection areas: forests allowed to develop freely with minimal or no intervention.*

Figure 4. Protected forests analysed for COST Action E4: focus on unmanaged protection areas, which are researched using permanent sampling plot system. The principal protection category containing forests left to develop freely is the ‘strict forest reserve’ but other ‘freely developing natural forests’ are also included in other protection categories.

Table 1. Forest protection categories from most European countries participating in COST Action E4.

COUNTRY
AUSTRIA
Natural Forest Reserve
Standard Reserve (Reserve of Normal Standard)
Point of Main Effort Reserve (Main Focus Reserve)
Natural Forest Stand
Landscape Conservation Area
Protected Part of the Landscape/Protected Green
Wildlife Park
Nature Park
National Park
Protection ex lege
Gene Conservation Forest
BELGIUM
Nature Reserve
recognised
official
State Nature Reserve with Forest Character (Flanders)
Forest Reserve (Wallonia)
Strict Nature Reserve/Integral Reserve
Directed Reserve
National Park
Nature Park
BOSNIA-HERZEGOVINA*
Virgin Reserves
Forest Reserves
Special Reserves
Park Forests
Natural Park
DENMARK
Legally Protected Area
Private Reserve
Permanent Management Agreement
State Forest Reserve
Untouched (Strict) Forest Research Reserve
Traditional Management System
All Natural State Owned Forest
FRANCE
National Park
Protected Forest
Nature Reserve
Bioreserves
Special Forest Reserve
Strict Forest Reserve
Regional Nature Park
FINLAND
Strict Nature Reserve
National Park
Wilderness Area
Other Protected Areas of the State
Peatland Protection Area
Herb-Rich Forest Preserve
Old Growth Forest Preserve
Wetland Reserves
Protected Shore Line Area
Protected Esker
Privately Protected Area
Nature Conservation of Productive Forests
Ancient Forest Area
Undisturbed Forest
Natural Forest
GERMANY
Large Scale Reserve
Biosphere Reserve
National Park
Nature Park
Landscape Protection Area
Strict Forest Reserve (Strict Nature Forest Area)
Nature Protection Area
Bird Sanctuary
Legally Protected Biotope within Forest Management Areas
Designed Management Forest (Schonwald)
(Spatial) Nature Monument
GREECE
National Park
Aesthetic Forest
Protected Natural Monument
Hunting Reserve
Internationally Important Wetland/Marine Park
World Heritage Site (Natural and Cultural)
HUNGARY
National Park
Landscape Protection Area
Nature Reserve
Forest Reserve
Strict Forest Reserve
ICELAND
Forest Reserve
IRELAND
Protected Irish Woodland
National Park
Nature Reserve
Network Natural Heritage Areas (NHA) and Special Areas of Conservation (SAC)**

* Refer to Diaci (1999).

** These designations are not yet finalised, and figures for forests in these areas are not included for COST E4 data.

ITALY
Strict Reserve (scientific uses only)
National Park
Natural Monument
Biotope
State Natural Reserve
Regional Natural Reserve
Regional Natural Park
Strict Reserve Core
Areas of international importance and other natural protected areas

THE NETHERLANDS
Strict Forest Reserve (National Research Program)
Forest Research Reserve
Forest A-location
Protected Nature Monument
State Nature Monument
National Park
Private Nature Reserve

NORWAY
National Park
Nature Reserve
Forest Reserve
Landscape Protected Area
Natural Monument

PORTUGAL
National Park
Natural Park
Natural Reserve
Natural Monument
Protected Landscape
Biological Interest Site
Strict Nature Reserve
Biogenetic Reserve (European Council)
Ramsar Convention
Biosphere Reserve (UNESCO)

RUSSIA***
State Nature Reserve
National Park
Natural Park
State Nature Refugium
Nature Monument
Dendrological and Biological Garden

SLOVENIA
Forest Reserve
Strict Forest Reserve
National Park/Natural Park
Protection Forest
Forest with Subordinate Productive Functions
Ecocell

SLOVAK REPUBLIC
Protection Forest
  Virgin Forest
  Natural Forest
National Park
Protected Landscape Area
Biosphere Reserve

SPAIN
Parks
Nature Reserve
Natural Monuments
National Park
Natural Park
Protected Landscapes
Strict Reserve
Partial Nature Reserve
Natural Reserve of Wild Fauna
Regional Park
Protected Natural Area
Natural Site
Protection Forest

SWEDEN
Nature Reserve
National Park
OTH (State Forest Reserve and Area bought but not legally protected)
Integrated Monitoring plot
Experimental Forest
Remnant Biotope for Flora and Fauna
Indicators of Biodiversity in the Forest Landscape
Game Research Areas

UNITED KINGDOM
SSSI (Site of Specific Scientific Interest) Designation
National Nature Reserve
SAC (Special Area of Conservation)
Minimum Intervention Wood (Area)
No Silvicultural Intervention Area
AONB (Area of Outstanding Natural Beauty)
National Park
Tree Preservation Order

For detailed definifions see the report WG I (in preparation)
*** Refer to Parviainen et al. (1999).

Table 2. The area of protected forests in some European countries. *Source: Parviainen et al. (1999) (partly updated); Diaci (1999); Ministerial Conference on the Protection of Forests in Europe (1998)*. See explanations in text.

Country	Forest and other wooded land		Strictly protected forest areas				Protected forests	
	Area of forests (1000 ha)	Forest cover as % of total forest area	Area of strict forest reserves (ha)	No. of strict forests reserves	Size range and average size of strict forest reserves (ha)	Strict forest reserves and comparable categories as % of total forest cover actual (target)	Total area of protected forest (ha)	Total area of protected forest area as % of forest cover
Albania	1048	38 %	14500	4	3625	1.38 %	164111	15.7%
Austria	3924	47 %	8062	191	1-553/42	0.2 (0.25) %	49000 (1)	1.2 % (1)
Belgium (Fland.)	135	10 %	1250	35	4-100/35	1 (3.0) %	~5000	3.7 %
Belgium (Wall.)	530	31 %	10	1	10	0.002 %		
Bosnia-Herzeg.	2589	51 %	3125	27		0.12 %	25506	1.0 %
Bulgaria	3357	30 %				1 %	335000	10.0 %
Croatia	2485	44 %	2856	32		0.11 %	181405	7.3 %
Czech	2637	33 %	25000	103	2-2500	0.95 %	175000	6.6 %
Denmark	445	11 %	6085	~300	0.5-370/~20	1.4 %	92000 (2)	20.7 %
Finland	23000	76 %	1530000 (3) (714300)	311	63-71000	6.6% (3.6 %)	2440000 (3) (1309600)	10.6 % (6.5 %)
France	15156	28 %	14000	30	1-500	0.09 (1.0) %	180000	1.2 %
Germany	10700	30 %	24976	679	3-391/36.8	0.24 %	400000	4.0 %
Greece	6513	49 %	142000	39		1 %	951700	14.6 %
Hungary	1748	19 %	3665	63	8.4-260/57	0.2 %	370422	21.2 %
Ireland	570	8 %	5736	34	7-2500	1 %	5736	1.0 %
Italy	8675	29 %	62053	119	1-4000	0.72 %	560409	6.7 %
The Nether.	334	10 %	3028	60	4-411/39	0.9 %	18500	5.5 %
Norway	11950	37 %	148000	160		1.23 %	199500	1.7 %
Poland	8726	28 %	3687	106	44	0.04 %	183246	2.1 %
Portugal	3306	37 %	2827	6	37-1300	0.08 %	560409	6.3 %
Romania	6370	27 %		55	26-2750/408	0.35 %	527000	8.3 %
Russia (Eur.)	132341	39 %	1726000		100-721000/76500	2.1 %	3995600	3.0 %
Slovakia	1920	42 %	15428	76 (19)	203	0.8 %	270000	14.0 %
Slovenia	1110	54 %	10420	186	1-700/57	0.93 (1.4) %	71000	6.4 %
Spain	12511	25 %	32644	87	375	0.26 %	3000000	24.0 %
Sweden	28000	69 %	576163 (4)	849	1-60000	2.5 %	832370 (4)	3.7 %
Switzerland	1186	29 %	1018	39	30	0.08 %	13529	1.1 %
UK	2305	10 %	10000	81	123	0.4 %	128700	5.1 %

1) Austria: The total area of nature protection areas is known, but not the detailed proportion of different categories. Therefore, only the natural parks and strict forest reserves, not other categories of protected forests, are included in this table.

2) Denmark: In the IUCN categories 1-4 (6000 ha in categories 1-2 and 86 000 ha in categories 3-4).

3) Finland: Area and percentage refer to productive forest land (increment > 1m³/ha/year) and forest land with increment 0,1-1,0 m³/ha/year. Numbers in brackets refer to productive forest land.

4) Sweden: Area and percentage refer to productive forest land (increment > 1m³/ha/year).

8 The area of protected forests in COST E4 countries

Table 2 illustrates the total area of forests and other wooded land, the extent of strict forest reserves and strictly protected forest areas and the total area of protected forests in selected European countries in 1998. The data for protected forests include different categories of protected forests outside of normal forest operations, mainly protected forest areas with rare and vulnerable species of high ecological value, excluding areas managed for landscape or protection, i.e. against avalanches or erosion. Definitions are based on national definitions and the statistics of forest area and other wooded land based mainly on the TBFRA 1990.

Photo Tomaž Hartman

Figure 5. Beech virgin forest Krokar, Kocevje, Slovenia 1998

Variation in numbers of protected forests and strict forest reserves

The aims and degree of forest protection vary widely amongst European countries. In the Nordic countries during the last 10-20 years, the primary goal of forest protection has been the preservation of old forest remnants. The aim of forest protection is to maintain flora and fauna, which are not subject to commercial forest operations. In Central Europe, however, forests are protected rather as a part of the landscape, as a cultural feature or as specimens of original forests.

The "reservation" concept used for example in North America, Canada and Russian Siberia, where large continuous areas are left untouched, cannot be applied to the densely populated European continent, where forests have been subjected to human influence for thousands of years. In Southern, Atlantic and Central Europe forests gave way to human settlement, resulting in fragmented and highly altered forest islands by the Middle Ages at the latest.

Due to the continuous use of forests historically, there are few original untouched virgin (natural) forests remaining in Europe. The largest virgin forests can be found on the boreal forest zone on European side of the Russian Federation, in the states of Komi and Archangelsk and in some parts of north-west Carelia near the Finnish border.

Human impact on forests in Northern Europe has also been intensive, although not as intensive as in Southern and Central Europe, lasting for periods of between 300-400 years. Between the 17th and the 19th centuries in Finland, Central-Sweden and Central-Norway, forests were utilised for the production of tar, metallurgy, slash and burn agriculture, hunting and reindeer husbandry.

The common concepts of forest classification and inventory are the basis for international forest resource comparison and measurement and also in the evaluation of forest protection. The present international UN/ECE/FAO **forest definition** for TBFRA 2000 requires that the crown cover is greater than 10 % and tree height is greater than 5 meters. In the past, TBFRA criteria for 1990 were even stricter: crown cover had to be 20 % or more and tree height at least 7 meters. This change in forest protection terminology causes some difficulty when interpreting forest protection statistics, especially when the old classification system is applied. In Scandinavia, the concept of forest is based on productivity as a result of conventional forest management objectives. The annual growth of timber must be greater than 1m^3/ha if an area is to be described as productive forest. For forest land where the mean annual increment of growing stock is typically 0,1-1m^3/ha, the term scrubland is used. Forest land where the increment is less than 0.1m^3/ha is called wasteland. In layman's language, the term forest implies productive forest land only.

Other difficulties in the interpretation of forest protection statistics include an array of different forest protection definitions and the composition and location of protected areas. In addition to the definition of forest, definitions of protected forests and forest protection vary widely. The **protective functions** of forests such as protection against erosion, avalanches, groundwater or shelterwood forests should be distinguished from the **'protected forests'** which are in contrast to timber production areas. These protected forests are mainly set aside for the maintenance of biodiversity. Objectives and goals of protection, forest protection categories in use and permissible management regimes in forest reserves vary enormously in different European countries. This can be seen in the report of WG I of this Action. Protected areas sometimes include areas other than forest, for example, freshwater or mountain regions where forested areas form only part of the total protection area. This may result in the overestimation of the protected forest area if only the total

protection area is quoted. The absolute or relative figure of forest protection in a particular country might not be representative for the whole country, where reserves are unevenly concentrated, for example, if most reserves are located in one region. Comparisons on the basis of percentage/area require careful analysis. In Europe, naturalness, fragmentation, human impact and other characteristics of forest cover also vary considerably from country to country. Regional or national networks have to take this into account by adequate representativity design.

Russia was not a participant of COST Action E4. Due to the importance of this vast area some forest statistics for European Russia are included in table 3 for comparison of forest resources between Europe and European Russia. Stocked forest, which is mainly owned by Federal Forest Service, is included in the figures of European Russia. Stocked forestlands comprise natural and man-made (i.e. closed plantations) forests. Non-stocked forest land covers temporarily non-forested areas, i.e. firedamaged forests, clearfells, dead stands, and continuously treeless areas and woodlands gaps: glades, open lands, sparse woodland and ridelines. Table 3 excludes non-stocked forestland in Russia. *Sources: for Europe 'Forestry Statistics 1992-1996' and 'Finnish Statistical Yearbook of Forestry'. For European Russia 'Chertov et al. (1999)', 'Cost E4' and 'Pisarenko et al. (1999)'.*

Table 3. Forest and other wooded land in Europe

	Mill. ha	Strict forest reserves, mill. ha	% Strict forest reserves of the total forest area	Protected forests mill. ha	% protected forests of the total forest area
European forest area (excluding Russia)	190	*	*	*	*
Forests managed for wood supply (excluding Russia)	138	*	*	*	*
Forest area in COST E4 participating countries	161	2.6	1.6	11.7	7.3
Forest area in European Russia	132-141	1.7	1.2-1.3	4.0	3.1-3.3

* No information provided

9 Main findings

9.1 Terms and definitions for protected forests, especially strict forest reserves (WG I)

Strict forest reserves, i.e. areas in which **no silvicultural operations**, or any other human impacts are allowed, where feasible, occur in Europe under very different forms of protection status. Their area and size also tend to vary widely; most occur in the form of small isolated areas and/or core areas within larger protection categories such as national parks, nature parks, or biosphere reserves. The considerable variation existent in Europe in relation to size and selection criteria are clearly linked to local forest history, land use and natural forest dynamics. The total area of strictly protected forest for the 27 countries involved in COST E4 is calculated to be nearly 3 million hectares or approximately 1.6 % of the total forest area.

In addition, in virtually all countries the term 'strict' varies in its interpretation according to regional and local traditions. Strict does not always imply complete non-intervention management; it may include activities related to hunting, rare species protection, scientific research, ecotourism, control of unwanted exotic tree/shrub/ground layer species, amelioration of anthropogenic disturbances, restrictions to allow natural disturbances develop freely as a result of reserve size limitations and adjacent landowners rights, etc. The ideal non-intervention concept, i.e. the development of appreciable areas of real virgin forest, is not a realistic scenario in Europe now or in future.

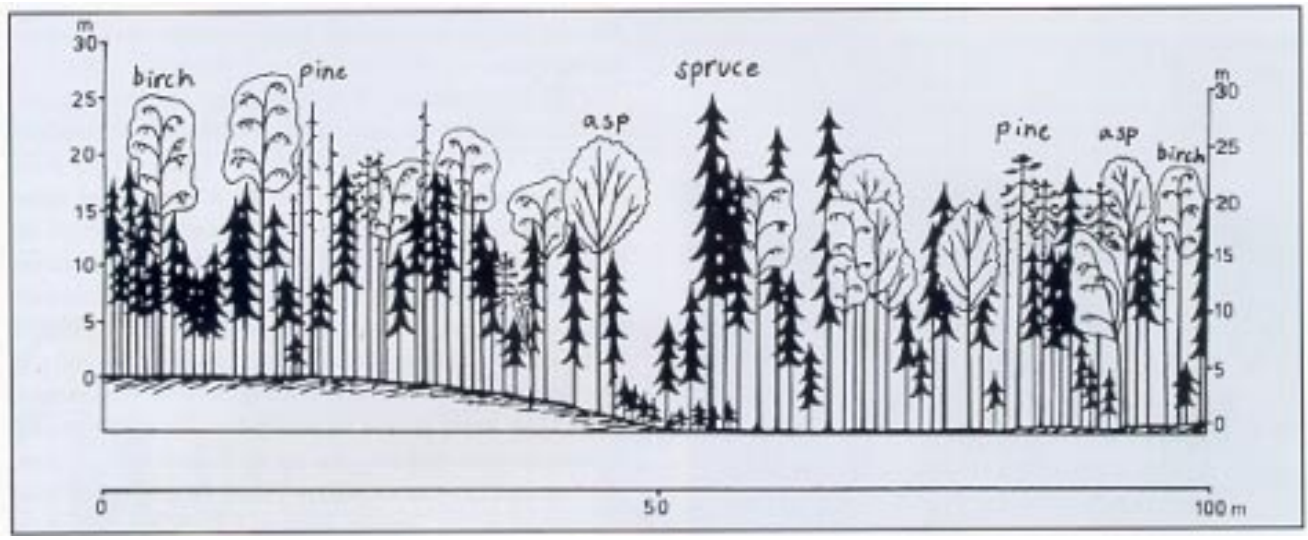
There are a number of fundamental conflicts between the 'wilderness' concept and its development, scientific objectives and social demands. The impacts of scientific research and of common rights of way are not fully compatible with the protection of wilderness as wilderness implies no human impact whatsoever.

On the other hand, management, scientific and social demands are likewise justified and sometimes imperative. Protected areas are important in their own right and should be allowed to develop without interference, where possible, as they support endemic floral and faunal species. However, they are also valuable learning areas for silvicultural

training, for experiencing nature and for fundamental basic scientific research as well as satisfying basic social and recreational demands. Management intervention may, in some cases, be required to ensure the continued existence of the woodland ecosystem, i.e. the removal of *Rhododendron ponticum* in British and Irish forest reserves.

Notwithstanding the appreciable diversity of protection categories (as a result of differences in national legislation amongst the 19 European countries participating in this COST action), forest reserve size, their geographic distribution and alternative management regimes, there are common objectives for all strict forest reserves. These include the protection of natural processes in forests and the species associated with them, and the study of ecological principles, processes and natural dynamics. Scientific research is primarily undertaken to elucidate and expand fundamental scientific knowledge and to use these reference areas for the development of nature-based silviculture in production forest areas outside the reserves.

Boreal, virgin forest, Pyhähäkki, Finland 1979.



Temperate, virgin forest, Slatiora, Romania, 1980.

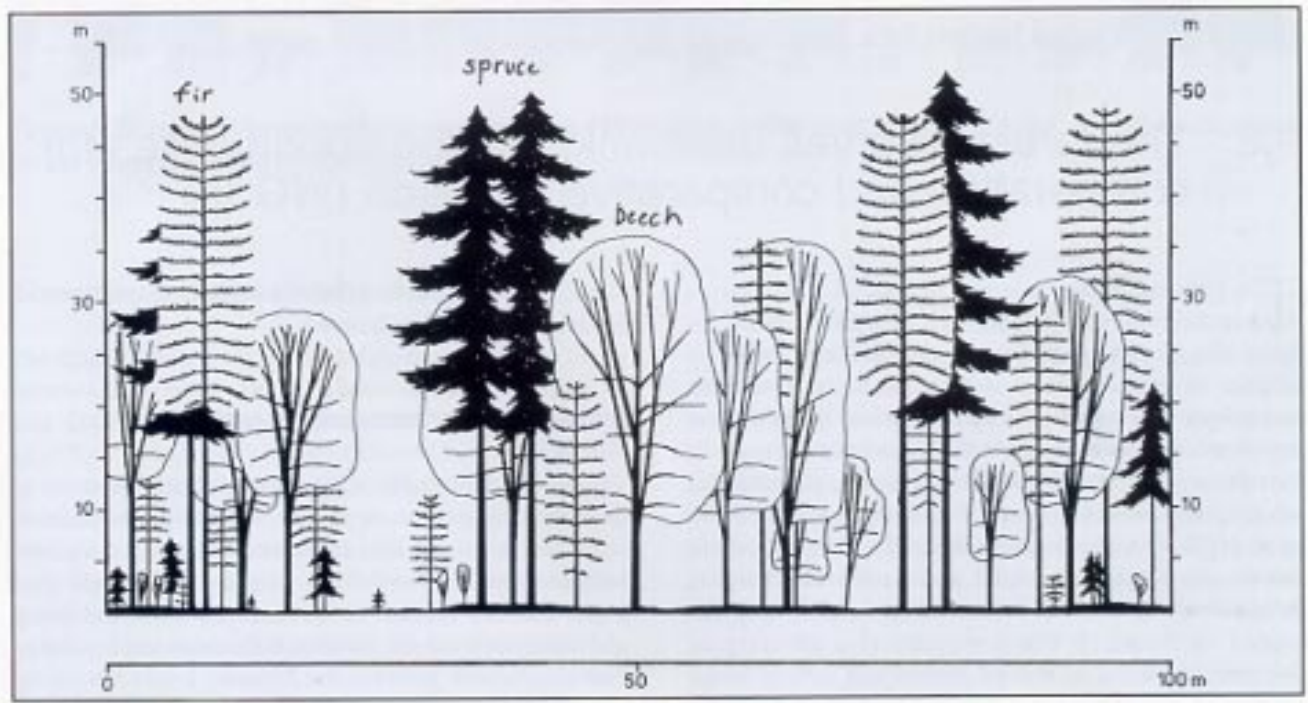


Figure 6. Profiles of old virgin natural forests in boreal and temperate zones according to the measurements of Schmidt-Vogt (see originals in Schmidt-Vogt, H. 1991. Die Fichte II/3. Parey Verlag. Hamburg-Berlin. 804 p.)

9.2 Recommendations for data collection in forest reserves with the focus on regeneration and stand structure (WG II)

The focus of national research programmes, as well as the procedures used for measuring stand structure, differ widely between different countries due to the broad variation in research objectives, size of forest reserves and the availability of financial support. Nonetheless, it increases the effectiveness of research programmes if the data and results can be shared and compared within and between biogeographic regions. This requires that the research methodologies used in different countries are standardised as much as possible. Because of the range of variation in national research programmes, the most practical approach to standardising methods is to focus on a basic inventory, and to recommend the parameters to be measured as a minimum data set in selected reserves.

Photo Erkki Oksanen

Figure 7. Winter in Koli National Park, Finland.

COST Action E4 drew together researchers with considerable collective experience of research in natural forests, to agree a standard methodology and to recommend a minimum data set. The primary goal of the recommended research methodology, and associated parameters, is to describe the stand structure (including canopy layer, shrub layer, regeneration layer and dead wood) and ground vegetation, in a manner which is repeatable, and which enables us to observe and analyse stand development through time.

The recommended methodology is based on two distinct examination units, each with different inventory concepts. On the one hand, there is a requirement to make a representative description over the whole natural forest reserve, and on the other hand, to describe a part of the forest in more detail (Core Area). The representative description of the whole forest reserve is achieved through the establishment of a series of permanent plots (Sample Plots) on a systematic grid-network. Grid spacing and plot size depend on the size and heterogeneity of the research area. Core Areas should be established for more detailed measurements and can be up to 2 hectares in size. Recommendations are made by COST Action E4 on what to measure in the Sample Plots and Core Areas, and on how to measure each component of the forest.

It is hoped that by adopting the minimum data set, researchers can establish functional links with research in other countries.

9.3 The forest reserves databank: serving opportunities for co-operation and comparative research (WG III)

The European databank and the web site on strict reserves can become one of the most important tools for facilitating the co-operation in exchange and comparison of data. Both the database and the web site have been constructed by the European Forest Institute (Finland) and are physically located there **(URL: http://www.efi.fi/Database_Gateway/FRRN)**. The server database is working in a network (Internet) environment and can be accessed through an Internet browser. The web site contains besides the database on strict forest reserves extensive information on the COST E4 Action. Special attention should be drawn to the comprehensive glossary of international terms of natural forests and natural forest research and the terms and definitions concerning the status of protection of forest reserves and natural forests in European countries. These have been compiled by Working Group 1 and added to the Forest Reserves Research Network (FRRN) web site and databank.

Data entry, access and contents

The data is arranged in a relational database structure to meet the requirements of a well designed database. Data-input and update is done by country correspondents who have controlled access for that purpose through individual passwords. EFI monitors the database to ensure the currency and quality of the data. The FRRN databank can be utilised through a search function that is freely accessible for the general public. However, country correspondents may block the accessibility of the data to the general public before the data quality and ownership has been clarified.

The forest reserve is the basic unit of the databank. For every reserve the supplied data covers following issues:

General data

Name, ownership, geographical location, size, status of protection, year of establishment, management history, adjacent land use, altitude

Descriptive data

Tree species composition, age structure, developmental phases, disturbances, forest vegetation types, soil types and climatic conditions

Monitoring and research activities

1) Methods of monitoring stand structure and methods in conducting research in core areas

2) Information on other specific research activities as e.g. pollen analysis, soil analysis, herbal layer, moss/ lichen, fungi, light measurements, genetic resources, faunistic inventories

Meta-data information

1) Organisation that manages and co-ordinates research, contact person information

2) Short descriptions of research projects performed in the reserve

Meta-data information

Organisation that manages and co-ordinates research and short descriptions of research projects performed in the reserve

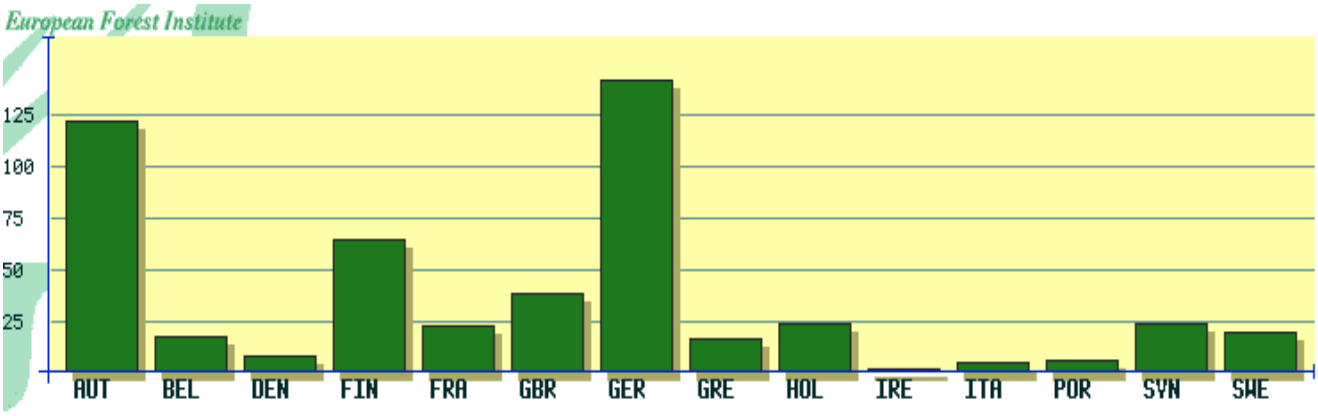


Figure 8. Number of forest reserves entered to the FRRN databank by country in the autumn of 1999 as displayed on the bar chart at the FRRN homepage.

The use of FRRN databank

The database is constantly receiving new entries of forest reserves, as country correspondents continue the input of data. Data on more than 500 forest reserves from currently 15 different countries have been entered into the databank by November 1999. This represents nearly 20 % of a roughly estimated total of 3000 possible sites in the 19 signatory countries of COST E 4 Action.

The fact that there is a definite need for this kind of forum is clearly illustrated by the number of visits to the web site. The database still provides only a very fragmentary image of the total potential, so up to now limited publicity has been made. Nevertheless, about 3000 hits have been counted to the FRRN home page between June 1998 (opening of the database) and November 1999.

The databank covers a large amount of data, of which most is redundant for researchers interested in specific topics. Therefore, it contains a detailed search engine that allows researchers to pinpoint to information associated with individual forest reserves. The search interface permits, very detailed selections as for example: all forest reserves in the databank which are located below an altitude of 600 m, in which *Fagus sylvatica* is the dominant tree species and where scientific studies are performed on wood-boring insects.

The Forest Reserves Research Network databank: a reference point for research into natural forest dynamics, nature-based silviculture and other related topics

In conclusion the FRRN databank has formed an important supplementary output to the COST E 4 Action, alongside the well-received country reports (Parviainen et al. 1999). It has generated considerable interest amongst members of the COST E 4 Action, researchers and scientists. The databank has brought together a group of leading national experts in the field of forest research, which have devoted time to contributing information on forest reserves used for research purposes to the FRRN databank. The databank as such is unique in its kind. It presently contains a large volume of detailed site-based information on Forest Research Reserves at a European scale. It has the potential to serve as a reference point for research into natural forest dynamics, nature-based forestry and other related topics, and as a focal point to further compile and disseminate information on forest reserves. Feedback has shown that the databank has developed into a useful tool for a range of target groups and it appears to have the potential for widespread use.

The main shortcoming is the completeness of the data. Within individual countries and individual sites there is considerable variation in data completeness. In particular, information on stand development, details of the core reserve area, monitoring activities and ongoing research projects are incomplete or may be absent. This may be because no such detailed monitoring has been undertaken, but could reflect the complexity and time consuming effort to compile the requested data. In addition, there are other European countries beyond the COST E4 Action participants who it would desirable to include in the databank.

These aspects of the FRRN databank are a major challenge to be addressed in its further development.

Photo Tomaž Hartman

Figure 9. Alpine protected forest, Natural Forest Reserve Schneeberg, Austria 1998.

9.4 Research in forests left to develop freely

Annotated Bibliography

The countries were asked to select the most relevant and important research reports according to the goals of the Action under the following subtitles:

- *historical perspectives and milestones in the research on natural forests*
- *stand structure research in natural forests*
- *modelling the stand structure*
- *gap dynamics research*
- *successional development, disturbances*
- *biodiversity aspects (dead wood component etc.) related to stand structure*
- *comparisons between natural forest / managed forest applications for silviculture*
- *methods, systems (sampling plot development) for gathering information on natural forests (forest reserves)*

To have a representative choice of the publications 20 to 30 papers per country was proposed. Quotations were made with English title, original title if there is, short abstract and key words. The bibliography includes at the moment the contributions of the countries **Belgium, Finland, France, Germany, Greece, Hungary, Ireland, Italy, The Netherlands, Norway, Portugal, Slovak Republic, Slovenia, Sweden, Spain, United Kingdom**. The actual number of entries is about 430. This bibliography is available on the Internet: www.efi.fi/Database_Gateway/FRRN/ and will be included in the summarizing book of COST E4 during 2000.

A review on the main research areas in natural forests:

In several countries scientific research is one of the most important goals of forest reserves. Strict forest reserves offer a rare chance to study undisturbed forest ecosystems in future. Most countries participating in COST E4 have determined, not only to establish a representative network of strict forest reserves, but also a detailed research programme, if not already implemented. Such programmes generally include traditional basic monitoring of vegetation and structural development, and in some cases also focus on biodiversity and/or other ecological aspects.

In spite of the large differences in the meaning of strict reserves across the participating countries, research projects already completed are strikingly similar amongst the countries involved; monitoring of change in species composition and in the herbal layer, stand structure (gap size, standing volume, dead wood component, age and diameter classes of the stand), soil sampling, monitoring of birds and wood-living insects are the most common areas

of study. Also the constraints limiting the scope of scientific research are similar; acquiring the data is labour intensive, especially where long-term research and monitoring activities are involved. In addition, funds for this type of research are limited, while demands on researchers to provide more practically applicable data are increasing, e.g. on average gap size, standing volume, species composition, dead wood amounts to be left in specific forest types. It is strongly recommended to install EU research programmes in order to profit from synergetic research effects in a transnational and interdisciplinary way.

Photo Tomaž Hartman

Figure 10. Natural *Quercus rotundifolia* forest, Ave Casta, Portugal 1999

10 Conclusions and recommendations

Achievements and outputs

In Europe, COST Action E4 was the first systematic attempt to create a network on forest reserves and to collect information on strictly protected forests. Before this Action was approved a workshop on European forest reserves was organised in 1992 in Wageningen, the Netherlands by the IBN-DLO Institute. A review on structure, succession and biodiversity of undisturbed forests and semi-natural forests and woodlands in Europe was subsequently compiled with support from the European Forest Institute in 1994 (Schuck et. al. 1994: EFI Working Paper 3). During the 4-year term of COST Action E4 an analysis of forest reserves in a total of 27 European countries, including the European zone of Russia was carried out, thereby providing a broad overview of their current status.

In virtually all participating countries a programme or a network of strict forest reserves (or corresponding forest protection categories) have been established. However, European countries differ widely in relation to forest protection policy and its implementation. Hence, as the Action progressed, it transpired that harmonising and analysing the protected forest categories was much more difficult than originally anticipated at the onset. It is clear that forest protection concepts in Europe have been devised to be more versatile than that used in countries with vast untouched forest areas like Canada, Russia, Brazil or USA. Such widely varying concepts and definitions reflect the inherent variation found throughout Europe reflecting millennia of human impact and settlement.

Within the timeframe of the Action a data bank was created, encompassing more than 20 % of the potential strict forest reserves in Europe relevant for future research. The data bank will be an important tool for future research programmes and scientific co-operation. In addition, the Action produced country reports from 26 European countries and the European zone of Russia, incorporating discussions on protected forest issues, descriptions of state-of-the-art forest research and methodology, ongoing research projects, a review of the methods and characteristics used for describing the structure of natural forests, protected forests category lists and an outline of forest reserve management systems. All these outputs are relevant and valuable contributions for future research collaboration, forest policy discussion, forest protection network planning and the development of new silvicultural methods.

A new EU forest research project called NAT-MAN (Nature-based Management of Beech in Europe) has been approved 1999 in the 5th Framework Programme. NAT-MAN is co-ordinated by the Royal Veterinary and Agricultural University, Denmark. This project proposal was initiated on the basis of co-operation between the partners in COST Action E4 and shows an example that COST co-operation is able to create continuation in the form of new projects.

The activities of COST Action E4 has been financed from two sources: the meetings, excursions in connection of the meetings, short term scientific missions, and technical support from COST Secretariat are financed by COST Commission but the national research work as well as the country contribution at European level requires finance from country sources. The co-ordination of the Action was supported by the host institutes of the MC chairmen and WG leaders.

For networking and creating contacts with wide coverage of countries, this structure is an ideal tool. Most of the summarising work and analysis is dependent on the possibilities of the participants and their institutes to carry out the European level work. In order to carry out detailed analysis, overlooks, or special tasks, financial support from European sources could help to set up long-term and more problem-oriented goals. COST Commission has supported financially the establishment and maintaining of forest reserves data bank, and throughout this way the created research and collaboration continues also after the end of this Action.

Photo Erkki Oksanen

Natural boreal conifer forest, Padasjoki, Finland

Photo Jari Parviainen

Naturally regenerated production forest in boreal zone, Pyhäselkä, Finland

Figure 11. Development cycle and biodiversity characteristics of natural forest can serve as a basis for the nature based management of production forests.

How to apply findings from "strict forest reserves"?

Amongst all protected forest categories, the "strict forest reserve" category was singled out for special attention and analysis in COST Action E4. The minimum common criteria for a strict forest reserve is that **no silvicultural management** is carried out within the area in question. Other forms of intervention may occur and these vary between countries. The variation in definitions and terms, in the permissible management regimes adopted and of other categories of forest protection, was considerable. It was particularly evident that meaningful comparisons between protected forests within European countries requires further clarification and analyses. When comparisons are made with respect to interpretation and classification of protected forests with IUCN categories it is especially apparent that there is much confusion and vagueness; further clarification, improvements and adaptations of IUCN classification systems, especially for forest areas is required.

It is generally accepted that natural forests are the basic model for the realisation of nature-oriented silviculture. In strict forest reserves the development cycle of natural forests can be observed, elucidated and understood, and these findings subsequently mimicked in production forests. Management of forests generally should be based on a combination of knowledge derived from research in natural forests and silvicultural experiments carried out in production/conventional forest areas. Substantial resources are required for long term research.

Experimental plots should be established to test different silvicultural systems and techniques. Information from these plots and from strict forest reserves would contribute towards the development of guidelines for "close-to-nature" silviculture.

Locating silvicultural experimental plots close to protected forest areas is seen as a logical, efficient and mutually beneficial strategy. Defining research and management criteria for protected forests (reference areas) in relation to silvicultural experimental plots (managed areas) for the purposes of forest certification and the development of sustainable forest management strategies should also be considered as an objective. It is envisaged that each country will develop different criteria.

Analyses of the country reports indicate that there are many gaps in the protected forest network, especially in the representativity of forest types. The area of forests in strict nature reserves should be increased and the network of strict forest reserves should be officially established and expanded to include all representative European forest types. Some forest types may be under-represented or absent from the reserve networks at present. The result should be a representative strict forest reserve network within each country compatible with a defined European network strategy. In effect, national networks should not be seen in isolation but as part of an overall European forest management and protection strategy.

In developing forest reserve network on an European scale the following areas need to be addressed:

- *define all forest areas with regard to their degree of naturalness*
- *forests should be allotted to predetermined categories agreed on the basis of all the potential forest types that should exist (this addresses conservation of protected forest areas irrespective of silviculture)*
- *how to address nature-oriented silviculture using protected forest reference areas for research.*

Recommendations for future

Although general material was collected and an overview on strict forest reserves and on other categories of protected forests was provided during this Action, comparisons and evaluations of protected forest areas, in addition to the practical application of research in permanent plots to silvicultural systems was not possible to achieve. This baseline material, the data bank and the network of participants can provide the basis for generating numerous new European scale collaboration projects in future. The continued maintenance, improvement and updating of the 'Strict Forest Reserves' database created during this Action - which contains relevant information on research on forest ecosystem dynamics which is/has been carried out - is essential. This could be achieved at the European Forest Institute through the provision of an annual financial contribution through the COST Commission for at least two years. The network should contain a target number of 1,000 reserves by the year 2000, and 2,000 reserves by the year 2002.

Photo Michael Müller

Figure 12. Natural forests are important and valuable habitats for endangered species.

The Action strongly underlines the following recommendations:

Research

1. Strict forest reserves serve as an important basis for close-to-nature silvicultural research and for planning national protected forest networks as well as providing a basis for 'naturalness' inventories. Research in strict forest reserves needs clear conditions (minimum size, legal protection, time frame of protection) in order to fulfil long time study requirements.

2. Multidisciplinary research should be promoted to understand natural forest ecosystems and their functions. Results should be integrated into practical forest management through national and international training programmes and workshops. More interaction between interested and relevant stakeholders is required and dissemination of research/monitoring results at all levels is needed. Promote the exchange of information between scientists and the public; a forum within each country for the exchange of results should be devised.

3. Monitoring programmes should be established in as many forest reserves as is required to determine changes in ecosystem condition from whatever source. Long-term monitoring and research should be co-ordinated at a national level, with EU and international linkage. Regular reporting on the status of European strict forest reserves is desirable in the future.

4. There are many common linkages with other parallel and related European research projects and further tasks could be developed in collaboration. BEAR and EFERN are both relevant parallel projects to COST E4. BEAR (Indicators for Forest Biodiversity in Europe) is a European Concerted Action, which aims to develop a system of forest biodiversity indicators and is co-ordinated by the Swedish Environmental Protection Agency. It is a two-year project involving experts from 26 research organisations representing 18 European countries and the European Forest Institute. The principal achievements of EFERN (European Forest Ecosystem Research Network), which ended in March 1999, were the establishment of a European forest ecology network and a comprehensive report containing current European forest ecosystem research requirements. A new COST Action proposal, namely 'Ecosystem and Landscape Forestry - Management for Sustainability', which is a continuation of EFERN was submitted to the EU COST Commission in 1999.

Photo Tomaz Hartman

Fiqure 13. National landscape of Finland, Koli National Park, Finland 1997

Forest policy discussion and linkages

During COST E4, the political interest in protected forests has increased appreciably. The IFF (Ingovernmental Forest Forum) organised a special expert meeting, hosted by USA and Brazil, in March 1999 in Puerto Rico to discuss protected forest issues. In addition, the Liaison Unit (in Vienna) of the Ministerial Conference on the Protection of Forests in Europe, has also organised several meetings in 1999 (Bad Helenenthal, Vienna, Semmering) to develop closer links between the Work-Programme on the Conservation and Enhancement of Biological and Landscape Diversity in Forests (WP-CEBLDF) and the Ministerial Conference on the Protection of Forests in Europe. Objective 2 of WP-CEBLDF provides for the adequate conservation of all forest types in Europe and this objective will be addressed by the Ministerial Conference Process through in the workings of an *ad hoc* working group called "Biodiversity, Protected Areas and Related Issues". The Liaison Unit has invited experts from COST Action E4 to present the results, outputs and recommendations for further discussion by the Ministerial Conference Process.

Photo Tomaz Hartman

Figure 14. Cultural heritage, St. Dionisious monastery, Olympos National Park, Greece 1999

In Europe, COST Action E4 has provided the catalyst towards the first attempt to classify and analyse protected forest areas. On that basis the following future co-operation in forest policy discussion is recommended:

1. Harmonising the definitions and terms should be continued to have a more objective and refined basis, especially for comparing forest protection status between European countries and to introduce the finalised European approach to the International forum for wider debate on protected forests. It may be worthwhile to start a new COST Action on the development of a special European protected forest classification system.

2. Co-operation between COST E4 experts, TBFRA 2000 national correspondents and IUCN national representatives should be strengthened in order to integrate protected forest data with national forest resource inventory data. This conclusion has been strongly recommended by the ad hoc *"Biodiversity, Protected Areas and Related Issues" group organised meeting in Semmering, Austria, in June 1999 by the Liaison Unit (Vienna) of the Ministerial Conference on the Protection of Forests in Europe. In addition, work is underway to create a new forest conservation atlas for temperate and boreal forest zones of the world. The work is being carried out by the IUCN office in Canada. The data and definitions collected by COST E4 are asked to be integrated to this forest conservation atlas.*

3. The 'Strict Forest Reserve Network' created by the COST Action E4 should be linked to other European monitoring networks such as NATURA 2000 and it should contribute to nature conservation policy at a Pan-European level.

4. Linkages with other relevant programmes, projects and organisations should be created and the results and outputs of COST E4 should be disseminated to these organisations.

Such bodies include:
Environmental Programmes
- *Natura 2000*
- *WWF Programmes for Protected Forest Areas*
- *IUCN and WCMC*
- *ICP Programme*
- *Global Terrestrial Observation System (GTOS)*

Conventions, Protocols and Processes
- *Convention on Biological Diversity (CBD, 1992)*
- *Convention on the Protection of the World Cultural and Natural Heritage (1972)*
- *EU Convention on the Conservation of European Wildlife and Natural Habitats (1979)*
- *EU Forest Strategy*
- *Pan-EU Biological and Landscape Strategy*
- *Intergovernmental Forest Forum (IFF)*
- *Ministerial Conference on the Protection of Forests in Europe*

Institutes
- *European Forest Institute (EFI)*
- *European Environment Agency (EEA), i.e. the Topic Centres, e.g. Nature Topic Centre*
- *European Centre for Nature Conservation (ECNC)*
- *World Conservation Monitoring Centre (WCMC)*
- *World Wildlife Fund (WWF)*
- *EU Commission*
- *International Union of Forest Research Organisations (IUFRO)*
- *Food and Agriculture Organisation (FAO)*
- *Centre for International Forestry Research (CIFOR)*
- *UN ECE Timber Committee*

Dissemination of the results

The Data Bank, which was created during this Action at EFI/Joensuu/Finland (http://www.efi.fi/Database_Gateway/FRRN/) will be the contact point in future for co-operation development, provision of updated site information and dissemination of results. Further financial support has been provided by the COST Commission for the maintenance of the Data Bank. The documents compiled during the Action are available at the Finnish Forest Research Institute, Joensuu Research Station and at the EFI. The main publication can also be asked from the Working Group leaders and COST E4 participants.

In order to promote the sustainability and importance of natural forest remnants in Europe, a film entitled "Forces of Wood" has been produced by a Finnish film team 'Filmiryhmä Oy'. This film depicts a detailed account on the development of forests in Europe from a historical point of view. It was produced in close collaboration with COST E4. This film will be available for those who are interested in it by writing to: Filmiryhmä Oy, Vyökatu 8, FIN-00160 Helsinki, Finland, fax. +358 9 0 662 602, tel. +358 9 171 055.

11 Publications

Principal COST E4 publications

DIACI, J. (editor) 1999. Virgin Forests and Forest Reserves in Central and East European Countries. Proceedings of the invited lecturers' reports presented at the COST E4 Management Committee and Working Group meeting in Ljubljana, Slovenia 25- 28, April 1998. University of Ljubljana. 171 p. (includes country reports on Bosnia and Herzegovina, Croatia, Czech Republic, Poland, Romania, Slovenia and Switzerland)

MEHMET, M. 1999. Protected Areas in Albania. Directorate General of Forestry, Tirana, Albania. Manuscript. Distributed on ad hoc meeting "Biodiversity, Protected Areas and Related Issues", Semmering, Austria. Liaison Unit of the Ministerial Conference on the Protection of Forests in Europe. 3 p.

PARVIAINEN, J., LITTLE, D., DOYLE, M., O'SULLIVAN, A., KETTUNEN, M. & KORHONEN, M. (eds.) 1999. Research in Forest Reserves and Natural Forests in European Countries - Country Reports for the COST Action E4: Forest Reserves Research Network. EFI Proceedings No. 16. European Forest Institute. 304 p. (includes a summary of the reports and separate country reports on Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Russia and United Kingdom).

COST E4: Forest Reserves Research Network documents will be published in 2000 by EU printing house as a combined book, which includes the following reports:

PARVIAINEN, J., KASSIOUMIS, K., BÜCKING, W., HOCHBICHLER, W., PÄIVINEN, R. & LITTLE, D. COST Action E4: Forest Reserves Research Network. Mission, Goals, Linkages, Recommendations and Partners. Final Report. Joensuu, Finland 28 p.

BÜCKING, W., AL, E., FALCONE, P., LATHAM, J. & SOHLBERG, S. Working Group I. Strict forest reserves in Europe and forests left to free development in other categories of protection: Definitions and terminology, characteristics of existing reserves.

HOCHBICHLER, E., O'SULLIVAN, A., van HEES, A. & VANDEKERKHOVE, K. Working Group II Report. Recommendations for Data Collection in Forest Reserves, with an Emphasis on Regeneration and Stand Structure.

PÄIVINEN, R. , SCHUCK, A., MOUNTFORD, E., EMBORG, J., VANDEKERKHOVE, K. & LIN, C. Working Group III. Forest Reserves Research Databank.

BÜCKING, W. (editor). Working Group I. Annotated Bibliographies. Annotations to selected papers on research in strict forest reserves.

Publications based on material gathered during COST E4

PARVIAINEN, J., SCHUCK, A. & BÜCKING, W. 1995. A Pan-European system for measuring biodiversity succession and structure of undisturbed forests and for improving biodiversity-oriented silviculture. In Bamsey, C.R. (ed.) Proceedings: Innovative Silviculture Systems in Boreal Forests, A symposium held in Edmonton, Alberta, Canada, October 2-8, 1994. Edmonton. p. 77-82.

BÜCKING, W., 1997. Natural Forests, Strict Forest Reserves, Wilderness Areas in Germany and in Europe. (Naturwald, Naturwaldreservate, Wildnis in Deutschland und Europa) in "Forst und Holz", 1997, Germany. p. 515-522.

BÜCKING, W. 1999. Naturwaldreservate in Deutschland – Urwald von morgen. Rückblick-Ausblick. NUA (Natur-und Umweltschutzakademie Nordhein-Westfalen, Recklinghausen), Seminararbericht 4, 21-31.

PARVIAINEN, J. and BÜCKING, W. 1997. Strict forest reserves in Europe. Effort to enhance biodiversity and strengthen the research in natural forests in Europe. Programme and abstracts of the Conference "Naturalness and European Forests". Strassbourg, France. 26-29.10.1997.

PARVIAINEN, J. 1998. Efforts to enhance biodiversity and research in natural forests in Europe (EU/COST Action E4). AISF-EFI International Conference on Forest Management in Designated Conservation and Recreation Areas. 7-11 October, 1998. Florence, Italy. University of Padua Press. 11-19.

PARVIAINEN, J. 1998. Waldbauliche Neuorientierung – Erfahrungen aus den skandinavischen Ländern. Nauchaltigkeit in Europa nicht durch Unterentwicklung waldbaulicher Strategien bedroht. Holz-Zenralblatt 112:1596.

PARVIAINEN, J. 1998. How close to nature should silviculture in Europe develop. Nordic symposium on "New stand types in boreal forestry – ecological features and silvicultural consequences". Vaasa, February 10-11, 1998. Metsäntutkimuslaitoksen tiedonantoja, Finnish Forest Research Institute, Research Papers 714: 7-20.

PARVIAINEN, J., BÜCKING, W., VANDEKERKHOVE, K., SCHUCK, A. & PÄIVINEN, R. 2000. Strict Forest Reserves in Europe : efforts to enhance biodiversity and research on forests left for free development in Europe (EU-COST-action E4). Forestry 73 (1).

Azione COST E 4: Ricerca Nelle Riserva Forestali Protette. (Jari Parviainen) Sherwood n. 46/giugno 1999: 39- 41. Arezzo, Italy.

Other publications related to this Action

BROEKMEYER, M.E.A. and VOS, W., 1993. Forest reserves in Europe: A review.In Broekmeyer, M.E.A., Vos, W. and Koop, H. (eds.), 1993: European forest reserves. Proceedings of the European forest reserves workshop. PUDOC-DLO, Wageningen, 306 p.

Forestry Statistics 1992-1996. Eurostat. European Communities, Luxembourg, 1998. 148 p.

Finnish Statistical Yearbook of Forestry. Finnish Forest Research Institute. Gummerus Kirjapaino Oy, Jyväskylä 1998. 344 p.

International Forest Conservation: Protected Areas and beyond 1999. A discussion paper for the Intergovernmental Forum of Forests. Commonwealth of Australia. International Forest Section Environment Australia, Canberra. 52 p.

Protected Areas for a New Millennium. The Implications of IUCN's Protected Area Categories for Forest Conservation. A joint IUCN and WWF Discussion Paper.Published by WWF and IUCN, Gland, Switzerland. January 1998. 15 p.

SCHUCK, A., PARVIAINEN, J. & BÜCKING, W. 1994. A review of approaches to forestry research on structure, succession and biodiversity of undisturbed and semi-natural forests and woodlands in Europe. Working paper 3. European Forest Institute.62 p.

PARVIAINEN, J., SCHUCK, A. & BÜCKING, W. 1994. Forestry research on structure, succession and biodiversity of undisturbed and semi-natural forests and woodlands in Europe. In Paulenka, J. & Paule, L.(editors). Conservation of Forests in Central Europe. Proceedings of the WWF Workshop held in Zvolen, July 7-9, 1994. Autora Publishers: 23-30.

PISARENKO, A.I., STRAKHOV, V.V., PÄIVINEN, R., KUUSELA, K., DYAKUN, F.A. & SDOBNOVA, V.V., 1999. Development of Forest Resources in the part of Russian Federation. Russian Federation. European Forest Institute Research Report 11. Brill Academic Publishers. In print.

Sustainable Forest Management in Europe. Special Report on the Follow-up on the Implementation of Resolutions H1 and H2 of the Helsinki Ministerial Conference 1998. Follow-up reports on the Ministerial Conferences on the Protection of Forests in Europe. Volume II. Third Ministerial Conference on the Protection of Forests in Europe. Liaison Unit in Lisbon. 274 p.

Photo Risto Päivinen

Figure 15. COST E4 participants coming together for a group photo at Joensuu 1997. From the left Erwin Al, Henk Koop, Patrick Falcone, Diarmuid Mc Aree, Eduard Hochbichler, Minna Kettunen, Richard Bradshaw, Åsa Aradottir, Dimitrios Trakolis, Kostas Kassioumis, Gregor Chatziphilippidis, Michael Morecroft, Winfried Bücking, Retana Javier.

Electronic Data bank (Forest reserves network data bank):
http:/www.efi.fi/Database_Gateway/FRRN.

12 Invited lectures in the meetings

Invited presentations in the meetings of COST E4 activities during 1996-1999

2nd Management Committee Meeting in Fontainebleau, France, 12-14th of September, 1996

Why research in natural reserves? *Nigel Dudley*, WWF, Equilibrium, 23 Bath Buildings, Bristol BS6 5PT, United Kingdom, fax. 44 117 942 8674, e-mail: equilibrium@compuserve.com

Presentation of the preliminary country reports (18 countries)

WG 1 meeting in Freiburg, Germany, 23-24th of January, 1997

Contributions to Forest Reserves Research from Long-Term Permanent Plots, *Heinrich Spiecker*, University of Freiburg, Institute of Forest Yield, Bertoldstrasse 17, D-79085 Freiburg i. Br. Germany, e-mail (organisation): instww@sun2.ruf.uni-freiburg.de

WG 2 meeting in Göttingen, Germany 21-23rd of April, 1997

Sampling and analysing longterm stand structure data in Slovakian forest reserves, *Stefan Korpel/Milan Saniga,* Technical University of Zvolen, Faculty of Forestry, Masarykova 24, 96053 Zvolen, Slovak Republic, e-mail: saniga@vsld.tuzvo.sk

Forest reserves of Lower Saxony (introduction to the field trips), *Fritz Griese,* Göttingen, Germany

Silvi Star model, *Henk Koop*, DLO Institute for Forestry & Nature Research (IBN-DLO), Bosrandweg 20 / PO Box 23, NL-6700 AA Wageningen, The Netherlands, fax: 31 317 424 988, e-mail: h.g.j.m.koop@ibn.dlo.nl

Model analysis by FOREST, *Alessandro Cescatti*, Viote del Monte Bondone, Italy, e-mail: cescatti@cealp.it

Modelling of tree growth and stand light climate, *Jürgen Nagel, Sven Wagner,* Göttingen, Germany

3rd Management Committee Meeting and Working Group 1 and 2 joint meeting in Finland, 30th of July-3rd of August, 1997 including a scientific excursion to forest reserves in Finnish Lapland and Russian Karelia

Successional development of natural forests

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4th Management Committee and WG 1 and 2 joint meeting in Brussels, 24-25th of November, 1997

"Naturalness and European Forests", a short review of the Conference held in Strassbourg, France 26-29 October 1997. *Annik Schnitzler,* University of Metz, Faculté de Sciences, ile de Saulcy, 57045 Metx Cedex 01, Strassbourg, France, e-mail: schnitz@sciences.univ.metz.fr

5th Management Committee and WG 1 and 2 joint meeting in Ljubljana, Slovenia, 26-28th of May, 1998, including a scientific excursion

Presentation of the country reports from Eastern European Countries (6 countries):

Development of forest reserve concept and the close to nature silviculture in Slovenia, *Dusan Mlinsek,* University of Ljubljana, Slovenia

Overview and state of the Action, *Jari Parviainen,* Finnish Forest Research Institute, P.O. Box 68, FIN-80101 Joensuu, Finland, e-mail: jari.parviainen@metla.fi

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-Reporting of the mid-term evaluation, *Piotr Paschalis,* Head of evaluation team, Warsaw Agricultural University, Faculty of Forestry, Poland, e-mail: paschalis@delta.sggw.waw.pl

6th Management Committee and WG 1 and 2 joint meeting in Vienna, Austria, 15-18th of October, 1998, including a scientific excursion

Natural Forest Reserves in Austria - a historical overview of a novel approach, *Kurt Zukrigl*, Ghelenstrasse 34/4 stg./12, A-1130 Wien, Austria, tel. and fax. 431 803 5981

Protected Area Management Categories - The IUCN Concept and its Application in Practice, *Robert Brunner,* Nationalpark, Thauatal, Kirchengasse 39/13, A-1070 Wien, Austria , fax 43 1522 8696

Hemeroby - A New Method to Assess the Naturalness of Forest-Ecosystems, *Gerfried Koch*, Federal Forest Research Institute, Haupstrasse 7, 1140 Vienna, Austria, fax. 431 878 38 2250, e-mail: gerfried.koch@fbva.bmlf.gv.at

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7th Management Committee and WG 1 and 2 joint meeting in Thessaloniki, Greece, 4-8th of May, 1999, including a scientific excursion

COST TC Forests and Forestry Products activities, *Yves Birot*, **chairman COST TC Forestry,** INRA, Paris, France, e-mail: remy@paris.infa.fr

The NATURA 2000 network in Greece and Cyprus, *Panagiotis Dimopoulos, Kyriacos Georghiou*, Biology Dept, Univ. Athens, Greece

Forest management and Forest protection in Greece, *Nikolaos Efstathiadis,* Ministry of Agriculture, Athens, Greece

Nutrients cycles in Greek forest Ecosystems, *Dimitrios Alifrangis,* Department of Forestry, Aristotele Univ. Thessaloniki, Greece

Dendrological and floristic aspects of the forest reserves in Bulgaria, *Peter Zselev,* University of Forestry, Sofia, Bulgaria

8th Management Committee and WG 1 and 2 joint meeting (the final meeting) in Lisbon, Portugal, 4-7th November, 1999, including a scientific excursion

"Strict forest reserves and National Protected Areas", *Maria de Lurdes Carvalho,* Instituto de Conservacao da Natureza, Direccao de Servicos de Conservacaoa da Natureza, R. Ferreira Lapa, 38-40 D, 1169 Lisboa, Portugal

"Forest evolution in the South and Center of Portugal in the last 15000 years", *José Mateus,* Instituto Portugues de Arqueologia, Av. da India, 126, 1300-300 Lisboa, Portugal

Photo Tomaz Hartman

Figure 16. Springtime in the beech virgin forest Krokar, Kocevje, Slovenia 1998

13. Short Term Scientific Mission -participants

1997, 11 missions

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Photo Tomaž Hartman

Figure 17. COST E4 group - Kuhmo, Finland 1997

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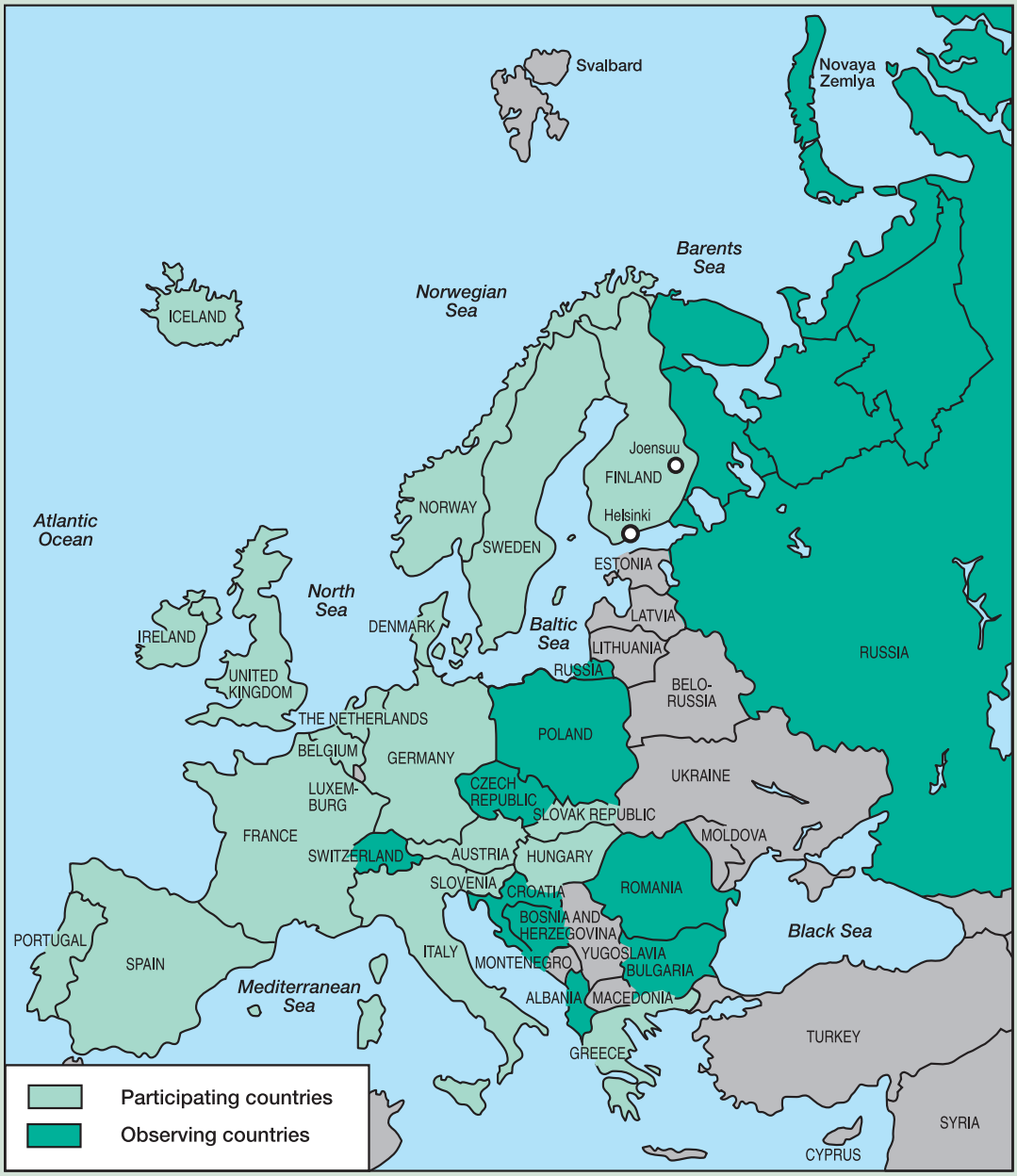

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