CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests

United Nations
Economic Commission
for Europe

European Commission

Forest Condition in Europe

Results of the 1994 Survey

1995 Executive Report

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CONTENTS

PREFACE

The present report is the fourth in the series of annual Forest Condition Reports of the United Nations Economic Commission for Europe (UN/ECE) and the European Union (EU). This series of reports documents the results of both the national and the transnational crown condition surveys, which are conducted annually within the International Cooperative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) of UN/ECE and under EU-Council Regulation (EEC) No. 3528/86 on the Protection of the Community's Forests against Atmospheric Pollution. It is the objective of these two pogrammes to continuously monitor and document the extent and development of recent forest damage in Europe, as well as to contribute to cause-effect studies.

ICP Forests was brought into being under the Convention on Long-range Transboundary Air Pollution in 1985, which in the meantime has been ratified by 39 Parties. Of these Parties, 34 states and the European Union are participating in ICP Forests. Also participating are Estonia and the Republic of Moldova, which are expected to sign the Convention in the near future. The participating countries in Europe submit reports on the results of their annual national forest condition surveys to the Programme Coordinating Centre West (PCC West) of ICP Forests. Canada and the United States of America report every year on their research and forest health monitoring programmes in North America.

Besides conducting national surveys, an increasing number of countries have been participating in a special transnational survey, in which every year crown condition and a number of site parameters are assessed on the plots of a uniform (16x16 km) large-scale grid. Having been started by the EU in 1987, the transnational survey is today carried out by 29 countries, comprising all 15 EU-Member States and 14 non-EU countries. These countries submit their transnational data either to the European Commission (EC) or directly to PCC West of ICP Forests. At PCC West the data of all 29 countries are evaluated for the preparation of the annual report.

The preparation of the present report was made possible thanks to

- the submission of forest condition data by the participating countries,
- financial support granted by the European Commission,
- voluntary financial contributions granted by UN/ECE countries,
- the calculation of geographical coordinates of the inventory grid intersection points by the European Commission.

SUMMARY

The present report is a description of the forest condition in Europe, based on the results of transnational and national surveys of the United Nations Economic Commission for Europe (UN/ECE) and the European Union (EU). National survey results from 32 European countries, referring to 29 739 sample plots with 648 425 sample trees are presented. The plots cover about 152.6 million hectares of forests. 29 of these countries have also submitted results of the 16x16 km grid (transnational survey). The results of the 1994 survey indicate that forest damage continues to be a serious problem in Europe, as a substantial proportion of the forests was defoliated and/or discoloured. Improvements and worsenings were found throughout the various climatic regions, however, forest condition in Europe has generally deteriorated.

The transnational survey results for 1994 revealed that 26.4% of the total sample of around 102 300 trees were defoliated by more than 25% and were thus classified as damaged. This means an increase by 3.8 percent points compared to the respective value of 22.6% in 1993. The total tree samples of 1993 and 1994 can be compared, but detailed analysis should be corrected for changes in the total sample.

In 1994, 12.1% of the total tree sample showed a discolouration of more than 10%. This is 2.1% higher than in 1993.

As regards the two main species groups, 24.3% of the total broadleaves and 28.0% of the total conifers were found damaged in 1994. This indicates that the broadleaves are still in a slightly better condition. Among the most common species, the most severely affected broadleaved species group was *Quercus* spp. (deciduous), of which 32.4% trees were damaged, followed by Other broadleaves with 27.5% trees damaged. *Abies* spp. and *Picea* spp. were the most affected of the common coniferous species with 32.9% and 30.2%, respectively.

In order to be able to trace the development of forest condition over several years without distortion due to differences in the samples, special tree and plot samples which were common to certain survey years were analyzed. Such common samples were determined for the periods 1993-1994 and 1988-1994.

The share of damaged Common Sample Trees (CSTs) of 1993-1994 increased within that period from 23.1% to 26.2%. Of the individual regions, the largest increase (from 16.2% to 21.9%) occurred in in the Mediterranean (higher) region, particularly in *Quercus suber*, *Quercus ilex* and *Eucalyptus* spp., and was mainly attributed to heat and drought. However, the latter species showed the lowest damage in the mediterranean regions. A similarly high increase in damaged trees (from 27.2% to 32.6%) was found for the Continental region, where *Abies alba* and *Quercus* spp. in Romania were particularly affected and damage was mainly attributed to drought and local air pollution. In the Subatlantic region, the respective increase (from 39.3% to 43.8%) was partly due to summer drought, subsequent insect attack and local air pollution in *Pinus sylvestris*, *Picea abies*, *Fagus sylvatica* and *Quercus* spp. in the main damage areas of Germany, the Czech Republic, Poland and the Slovak Republic.

In the subsample of the common trees of the surveys from 1988 to 1994, the development of the defoliation of 12 species was analyzed. With the exception of *Abies alba*, the proportion of damaged trees increased in all species during this period. Among the conifers,

although *Picea sitchensis* still indicates the greatest increase from 2.3% in 1988 to 20.3% in 1994 there has been some improvement from 1993 to 1994. This increase is thought to be mainly caused by attacks of *Elatobium abietum* (green spruce aphid). A similarly alarming deterioration appeared in Pinus halepensis, the damaged share of which increased from 5.2% in 1988 to 22.1% in 1994. In contrast, the respective proportion of *Abies alba* diminished slightly from 25.8% to 23.9%. *Abies alba* had its largest share of trees defoliated, namely 30.1%, in 1993. Concerning *Quercus robur*, a little improvement occurred in 1994, however, its damaged share increased remarkably from 13.0% in 1988 to 24.9% in 1994.

In 1994, adverse weather conditions, particularly drought and heat, as well as insects, fungi, game, action of man, air pollution and forest fires were the most important probable causes for the observed defoliation and discolouration, as reported both in the national and the transnational surveys. There were only a few reports on known pollution sources to have direct impact on forest condition. However, there might be more widespread effects of air pollution, which could not be found in the assessment.

According to the results of the national surveys, particularly in the main damage areas of some countries, but also in several other regions, air pollution is considered as of major concern, because the atmospheric concentrations and the depositions of several air pollutants exceed the critical levels and loads for forest ecosystems. These countries, in which a high level of air pollution has been detected, regard air pollution as the most important factor causing forest damage. The majority of the remaining countries consider air pollution as a predisposing, accompanying and locally triggering factor for the weakening of forest ecosystems.

The survey results reveal a large spatial and temporal variation. It is therefore necessary to continue the monitoring on Level I and to foster synoptical evaluations of its results together with other large-scale ecological parameters in order to verifiy effects caused by long-range transboundary air pollution. It is planned to evaluate the complete Level I dataset in the future.

In addition to the Level I monitoring, for the recognition of factors and processes with special regard to the impact of air pollutants on the more common forest ecosystems an intensive monitoring (Level II) has been designed and is under implementation. This was accomplished by means of a number of selected permanent monitoring plots, on which besides crown condition assessment also a soil inventory, foliar analyses, increment studies, deposition measurements and meteorological studies are being conducted.

The report also outlines possible future development in programme monitoring activities and in assessment and reporting of the results.

1. INTRODUCTION

Forest condition in Europe has been monitored now at a large scale for 9 years. This common large-scale monitoring programme of UN/ECE and EU has the objective to gain knowledge of the spatial and temporal variation of forest condition. This objective is reached by means of an extensive monitoring approach (Level I), which is based on a grid of systematically selected plots covering the forest area of a country (national grids of different densities) and of Europe (16x16 km grid). On these plots crown condition is assessed along with a range of other parameters, namely altitude, age, aspect, soil unit, water availability, humus type, and easy identifiable damage types. Moreover, on a large proportions of these plots soil and foliar analyses are also conducted.

In order to contribute to a better understanding of cause-effect relationships, a more intensive monitoring approach (Level II) has been also implemented. This approach is based on a smaller number of monitoring plots situated in selected forest ecosystems and having a higher monitoring intensity per plot. Besides crown condition assessment and soil and foliar analyses, increment studies, deposition measurements and meteorological measurements are also carried out on Level II.

The present report documents the results of the 1994 crown condition assessment of ICP Forests and EU on Level I. Based on the results of previous surveys, the development of crown condition since the beginning of the monitoring is also described. Evaluations including the soil and foliar analyses on Level I as well as the more intensive monitoring on Level II will be a subject of future reports.

The content of the present report has been structured as follows:

In Chapter 2 the principles of the survey methods are outlined. The knowledge of the survey methods is essential for the interpretation of the results.

The results of the 1994 transnational and national surveys are presented in Chapter 3. The transnational results (Chapter 3.1) reflect forest condition in Europe without regard to national borders and refer to correlations between defoliation and discolouration with site parameters. The national reports (Chapter 3.2) reflect forest condition in individual countries with emphasis on its interpretation in connection with the multitude of damaging agents, particularly air pollution.

In Chapter 4, the transnational and the national survey results are interpreted together, paying special attention to the effects of air pollution. These interpretations represent the view of the members of the two Programmes of UN/ECE and EU.

In Chapter 5 conclusions are drawn from the survey results and their interpretation.

The Annexes provide tables relevant to the national results and a list providing the botanical names of several tree types as well as their names in 12 languages.

2. METHODS OF THE 1994 SURVEYS

2.1 Transnational survey

The transnational survey has the objective to document the spatial distribution and the development of forest condition on the European level. This objective is reached by means of large-scale monitoring of crown condition of forest trees in connection with a number of site parameters on a 16x16 km transnational grid of sample plots. In several countries the plots of this transnational grid are a subsample of a denser national grid.

The coordinates of the transnational grid were calculated and provided to the participating countries by the EC. If a country had already established plots, the existing ones were accepted, provided that the mean plot density resembled that of a 16x16 km grid, and that the assessment methods corresponded to those of the ICP Forests Manual and the relevant Commission Regulations. The fact that the grid is less dense in parts of the boreal forests can be shown to be of negligible influence due to the homogeneity and the current condition of these forests.

2.2 National surveys

The objective of the national surveys is to document the forest condition and its development in the respective country. The national surveys therefore are conducted on national grids. The densities of these national grids vary between 1x1 km and 32x32 km due to differences in the size of forest area, in the structure of forests and in forest policies. Any comparisons between the national surveys of different countries should be made with great care because of differences in species composition, site conditions and reference trees.

2.3 Selection of sample trees

On each sampling point of the national and transnational grids, provided that it falls into forest land, in an ideal situation at least 20 sample trees are systematically selected according to a statistically sound procedure. Predominant, dominant, and co-dominant trees (according to the KRAFT system) of all species qualify as sample trees, provided that they have a minimum height of 60 cm and that they do not show significant mechanical damage. Trees removed by management operations, blown over by wind or having died must be replaced by newly selected trees. In a special evaluation of the data from 1988 to 1993 (Forest Condition Report 1994) it was shown that this replacement of trees does not distort the survey results.

2.4 Assessment parameters and data presentation

Defoliation of the sample trees of each plot is assessed by comparison with a reference tree of full foliage as well as discolouration. Photo guides suitable for the region under investigation may also be used when no reference tree can be found in the vicinity of the sample trees.

In principle, the transnational survey results for defoliation are reported in 5% steps and the national survey results for defoliation according to the traditional classification

(Table 2.4.1-1). Most countries also report their national results for defoliation in 10% steps. The assessment down to the nearest 5 or 10% permits studies of the annual variation of foliage with far greater accuracy than the traditional system of only 5 classes of uneven width. Discolouration is reported both in the transnational and in the national surveys using the traditional classification.

Changes in defoliation and discolouration attributable to air pollution cannot be differentiated from those caused by other factors. Consequently, defoliation due to other factors is included in the assessment results, although known causes should be recorded. However, major mechanical damage (e.g. windbreak, snowbreak) is ruled out as a cause as such trees are excluded from the sample anyhow.

Table 2.4.1-1: Defoliation and discolouration classes according to UN/ECE and EU classification.

Defoliation class	needle/leaf loss	degree of defoliation
0	up to 10 %	none
1	> 10 - 25 %	slight (warning stage)
2	> 25 - 60 %	moderate
3	> 60 %- < 100 %	severe
4	100 %	dead
Discolouration class	foliage discoloured	degree of discolouration
0	up to 10 %	none
1	> 10 - 25 %	slight
2	> 25 - 60 %	moderate
3	> 60 %	severe
4		dead

In the presenting of the results a change is called "significant" if a statistical significance test was performed at a 95% probability level.

Besides defoliation and discolouration, additional parameters have to be assessed on the plots of the transnational survey, as laid down in Commission Regulation (EEC) No. 1996/87. Within the transnational crown condition survey, for each plot the following plot and tree parameters have to be reported:

country, plot number, plot coordinates, altitude, aspect, water availability, humus type, soil type (optional), mean age of dominant storey, tree numbers, tree species, observations of easily indentifiable damage, date of observation.

The transnational survey results are submitted by tree and plot in digital format via EC or directly to PCC West of ICP Forests for screening, storage and evaluation. The national survey results are submitted on paper to PCC West as country related mean values, but classified according to species and age groups. The data sets are accompanied by national reports providing explanations and interpretations.

The results of the evaluation are presented mainly in terms of the percentages of the tree sample falling into the traditional 5 defoliation or discolouration classes. This classification reflects to a certain extent the experience gathered in forest damage assessments in Central Europe between 1980 and 1983. At that time, any loss of foliage exceeding 10% was considered as abnormal, indicating an incipient stage of impaired forest health. Assumptions based on physiological investigations of the vitality of differently defoliated trees led to the establishment of uneven class widths. Because of these reasons and in order to ensure comparability with previous presentations of survey results the traditional classification of both defoliation and discolouration has been retained for comparative purposes, although it is considered arbitrary by some countries.

A certain natural range is taken into account by choosing a border of a defoliation up to 25% as "undamaged". A defoliation of >10-25% indicates a "warning-stage". Therefore, in the present report often a distinction has been only made between defoliation classes 0 and 1 (0-25% defoliation) on the one hand, and classes 2, 3 and 4 (defoliation > 25%) on the other hand.

Classes 2, 3 and 4 represent trees suffering considerable defoliation and are thus referred to as "damaged". Similar to the sample trees, the sample plots are referred to as "damaged" if the mean defoliation of its trees (expressed as percentages) falls into class 2 or higher. Otherwise the sample plot is considered as "undamaged".

The most important results have been tabulated separately for all countries having participated (called "total Europe") and for those 12 countries being EU-Member States in the survey year 1994.

3. RESULTS OF THE 1994 SURVEYS

3.1 Transnational survey

3.1.1 General results

The 1994 transnational survey was carried out in 29 countries, comprising all 12 EU-Member States and 17 non-EU countries. With two non-EU countries more than in 1993 (Bulgaria and Latvia), the number of countries participating in the survey was the largest ever.

In addition, with 102 288 trees assessed on 4 756 plots, the database is now larger than ever before. Compared to 26 084 trees assessed in the first survey in 1987, the database is now approximately four times as large as at the beginning. This extension is partly due to the completion of the grid within EU-Member States, but mainly because of the participation of a growing number of non-EU countries since 1990.

Defoliation was assessed on all sample trees in total Europe and on 48 392 trees in the EU-Member States. In total Europe, the share of sample trees considered as damaged, i.e. having a defoliation larger than 25%, amounted to 26.4%. In the EU-Member States the respective share was 17.7%. The conifers had a higher proportion of damaged trees (28.0%) than the broadleaves (24.3%) in total Europe. As in previous years, this difference was slightly less pronounced in the EU-Member States (18.6% and 16.9%, respectively). Table 3.1.1-1 shows the results in greater detail.

As several non-EU-Member States did not assess discolouration on all of their sample trees, **discolouration** was reported for only 97 078 trees in 1994. 12.1% of this tree sample had a discolouration of more than 10% (Table 3.1.1-2).

Table 3.1.1-1: Percentages of defoliation for broadleaves, conifers and all species.

	Species type	Defoliation							No. trees
		0-10%	>10-25%	0-25%	>25-60%	>60%	dead	>25%	
EU	Broadleaves	49.6	33.5	83.1	14.0	1.9	1.0	16.9	25280
	Conifers	47.2	34.3	81.5	15.7	1.4	1.5	18.6	23112
	All species	48.5	33.8	82.3	14.8	1.7	1.2	17.7	48392
Total Europe	Broadleaves	41.5	34.1	75.6	20.7	2.6	1.0	24.3	44449
	Conifers	37.6	34.4	72.0	24.8	2.1	1.1	28.0	57839
	All species	39.3	34.3	73.6	23.0	2.3	1.1	26.4	102288

Figure 3.1.1-1 shows the spatial distribution of the percentages of damaged trees per plot over the entire survey area. The pie diagram in Figure 3.1.1-1 reveals that on 48.1% of the plots the share of damaged trees is 10% or lower. These plots are mainly located in southwestern Europe, Scandinavia and in the eastern part of the Alps. On the other hand, the share of damaged trees ranges from 51%-75% on 10.1% of the plots, and from 76%-100% on 10.3% of the plots. This means that on 20.4% of all plots more than half of the trees are damaged. As in previous years, the areas with the highest proportion of damaged trees are mainly located in central Europe.

Table 3.1.1-2: Percentages of discolouration for broadleaves, conifers and all species

	Species type	Discolouration						No. trees
		0-10%	>10-25%	>25-60%	>60%	dead	>10%	
EU	Broadleaves	87.9	8.3	2.0	0.8	1.0	12.1	25280
	Conifers	86.8	9.6	1.6	0.4	1.5	13.1	23108
	All species	87.5	8.9	1.8	0.6	1.2	12.5	48388
Total Europe	Broadleaves	87.1	8.7	2.4	0.7	1.1	12.9	43537
	Conifers	88.5	8.2	1.8	0.3	1.2	11.5	53541
	All species	87.9	8.4	2.1	0.5	1.1	12.1	97078

Maps of the distribution of the mean plot defoliation and plot discolouration over the entire area are shown in Figures 3.1.1-2 and 3.1.1-3. The mean plot defoliation (Figure 3.1.1-2) is classified according to the five defoliation classes. On 30.8% of the plots the mean defoliation is larger than 25% (classes 2-4 with 29.8%, 0.8% and 0.2%, respectively). These plots are particularly frequent in central Europe.

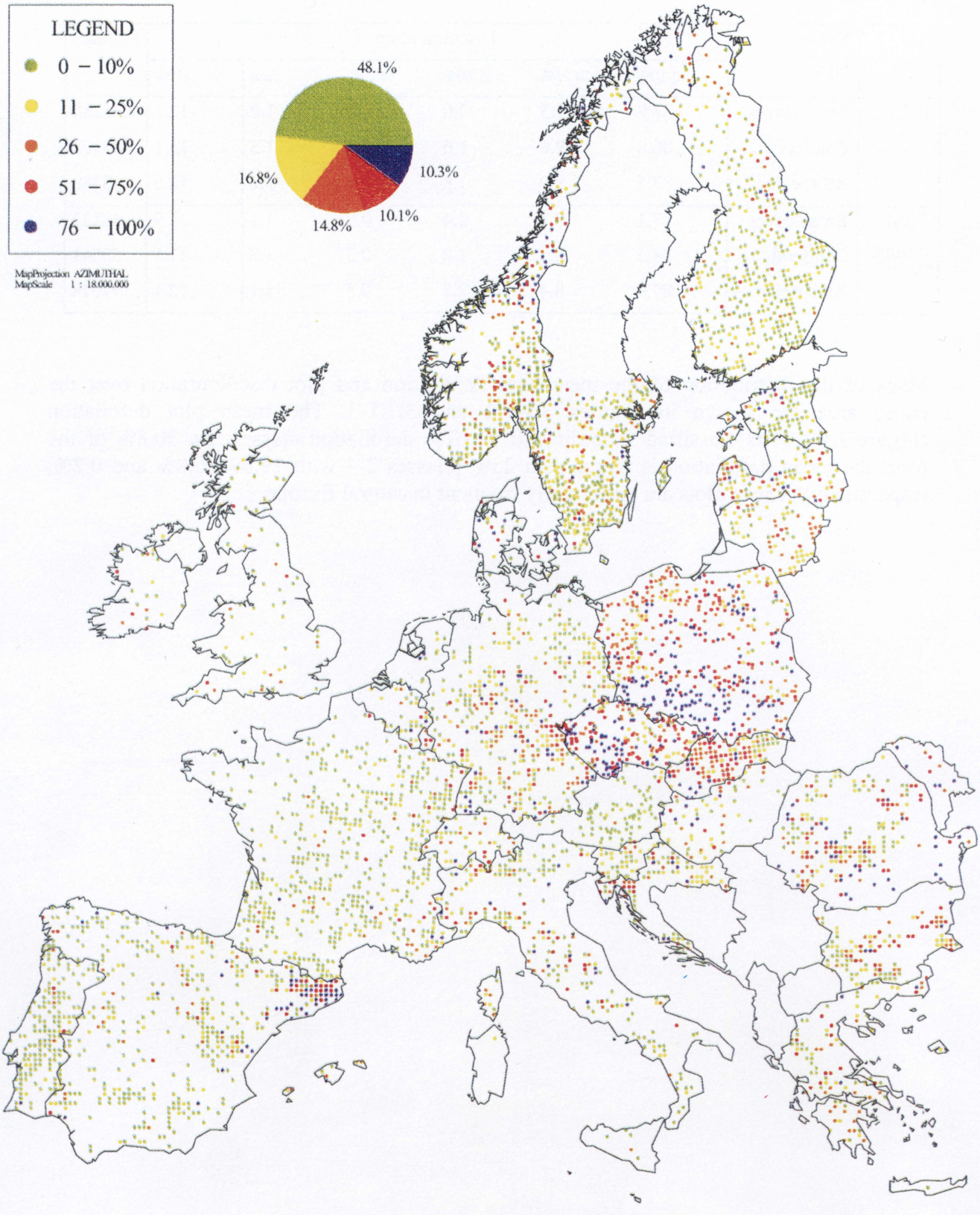

Figure 3.1.1-1: Percentage of trees damaged in 1994. The percentages are the basis for the transnational evaluation and not suitable for comparison between individual countries.

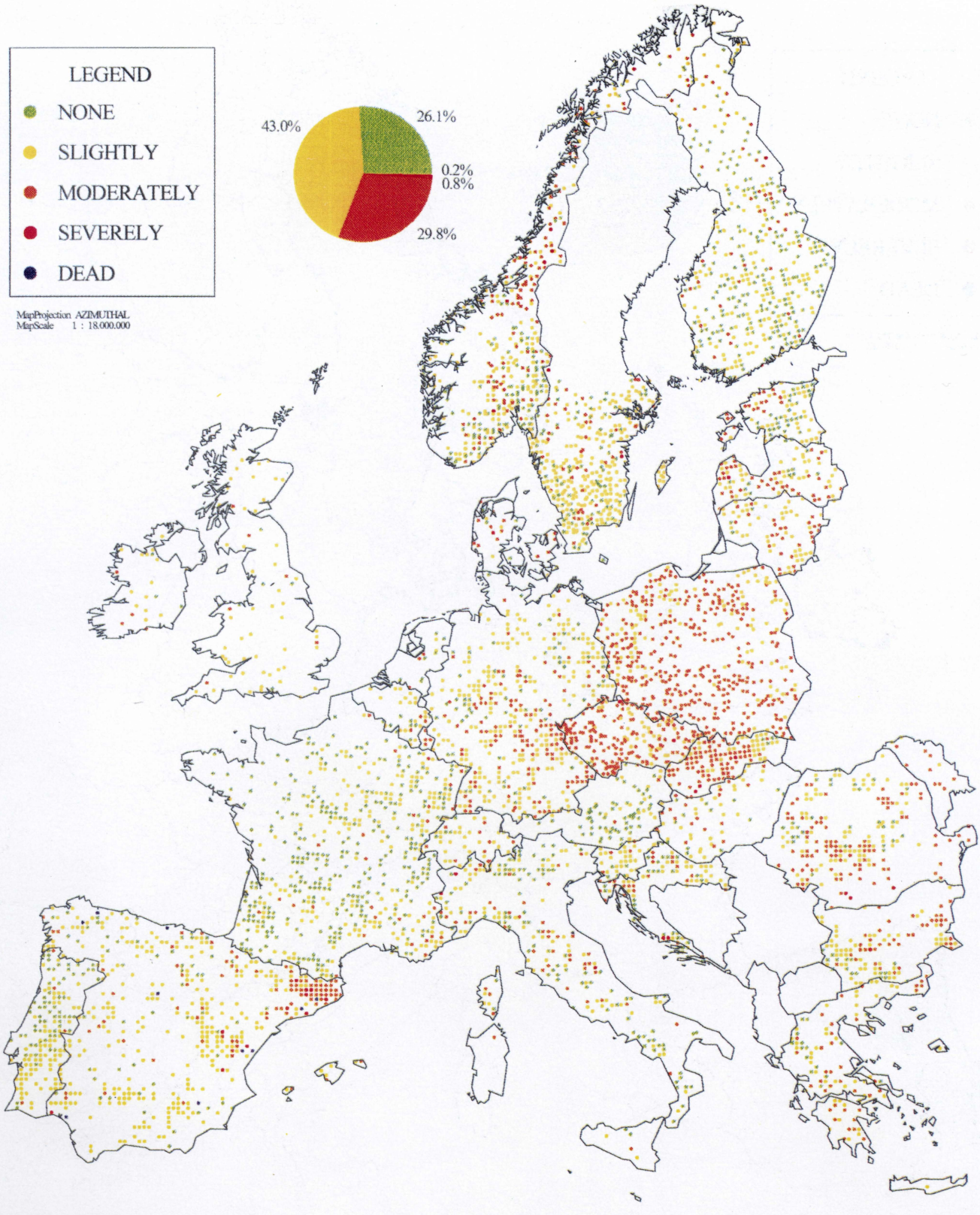

Figure 3.1.1-2: Plot defoliation (1994). The figures for defoliation are the basis for the transnational evaluation and not suitable for comparison between individual countries.

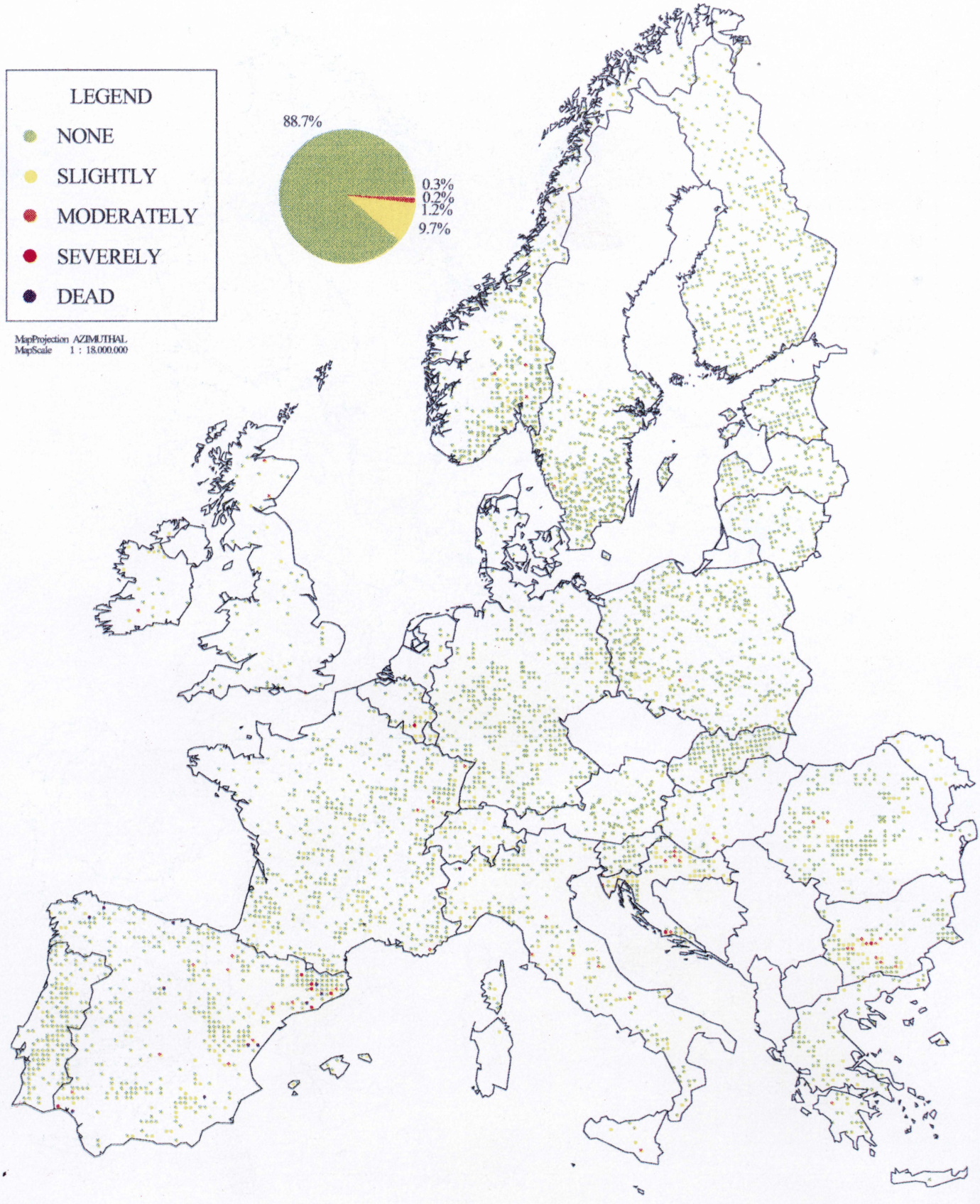

Figure 3.1.1-3: Plot discolouration (1994). The figures for discolouration are the basis for the transnational evaluation and not suitable for comparison between individual countries.

3.1.2 Forest condition by species groups

Among the **broadleaves** of the total tree sample, **defoliation** was highest for *Quercus* spp. (32.4% damaged). The lowest percentage of damaged trees was found for *Quercus suber* with 14.2% and *Eucalyptus* spp. with 10.6%. Of the **conifers**, *Abies* spp. had the highest percentage of damaged trees (32.9%). The lowest share of damaged trees was recorded for *Larix* spp. (19.1%).

Discolouration among the **broadleaves** of the total tree sample was most obvious for *Castanea sativa* (20.0% of the trees discoloured, i.e. showing discolouration greater than 10%). *Betula* spp. showed the lowest percentage of discoloured trees (4.1%). Among the **conifers** the interspecific variation was smaller. In total Europe *Abies* spp. was the species group with the highest percentage of discoloured trees (21.7%). The least discolouration was found in *Larix* spp. with 7.8% of the trees being discoloured.

3.1.3 Defoliation and discolouration by mean age

For both the EU-Member States and for total Europe, Tables 3.1.3-1 and 3.1.3-2 show the percentages of trees in each **defoliation** and **discolouration** class, respectively, for 7 classes of different mean stand age and for a class of irregular age composition.

As in the previous years, the 1994 survey gives evidence of the strong positive correlation between age and defoliation. The share of damaged trees shows a gradual increase with increasing mean age between ages 0-80. With higher ages, however, the share of damaged trees remains at approximately the same level.

The proportion of trees in different discolouration classes do not vary greatly with age. The younger trees (0-40 years) and the older trees (81->120 years) seem to have a slightly larger discolouration than the trees between 41 and 80 years.

Table 3.1.3-1: Percentages of defoliation of all species by mean age

	Mean age	Defoliation							No. of
	[years]	0-10%	>10-25%	0-25%	>25-60%	>60%	dead	>25%	trees
EU	0 - 20	63.6	24.7	88.3	8.0	1.5	2.2	11.7	7654
	21 - 40	54.2	30.0	84.2	12.7	2.0	1.1	15.8	12361
	41 - 60	46.6	35.5	82.1	14.9	1.6	1.4	17.9	8276
	61 - 80	39.6	41.8	81.4	16.3	1.7	0.6	18.6	5444
	81 -100	41.3	39.3	80.6	17.9	0.8	0.7	19.4	4816
	101-120	32.7	40.8	73.5	23.6	2.5	0.4	26.5	2428
	>120	31.4	37.4	68.8	29.1	1.8	0.3	31.2	2701
	Irregular	47.2	35.5	82.7	13.9	1.6	1.8	17.3	4712
	Total	48.5	33.8	82.3	14.8	1.7	1.2	17.7	48392
Total	0 - 20	61.8	24.4	86.2	9.7	2.1	2.0	13.8	9154
Europe	21 - 40	52.6	29.4	82.0	14.8	2.1	1.1	18.0	20242
	41 - 60	37.3	36.0	73.3	23.1	2.4	1.2	26.7	20175
	61 - 80	30.7	39.4	70.1	27.0	2.2	0.7	29.9	17269
	81 -100	33.5	37.0	70.5	27.0	1.9	0.6	29.5	12693
	101-120	30.6	38.4	69.0	27.8	2.9	0.3	31.0	5690
	>120	32.0	36.0	68.0	28.4	3.1	0.5	32.0	5770
	Irregular	46.5	35.2	81.7	15.1	1.8	1.4	18.3	6023
	Total	41.0	34.4	75.4	21.4	2.2	1.0	24.6	97016

Table 3.1.3-2: Percentages of discolouration of all species by mean age

	Mean age [years]	Discolouration						No. of trees
		0-10%	>10-25%	>25-60%	>60%	dead	>10%	
EU	0 - 20	84.6	10.1	2.4	0.7	2.2	15.4	7651
	21 - 40	85.7	10.6	1.8	0.8	1.1	14.3	12360
	41 - 60	90.3	6.8	1.2	0.3	1.4	9.7	8276
	61 - 80	89.5	6.9	1.9	1.1	0.6	10.5	5444
	81 -100	90.1	7.9	1.1	0.1	0.8	9.9	4816
	101-120	89.4	7.5	1.7	1.0	0.4	10.6	2428
	>120	90.6	6.9	2.1	0.1	0.3	9.4	2701
	Irregular	82.7	12.0	2.7	0.8	1.8	17.3	4712
	Total	87.5	8.9	1.8	0.6	1.2	12.5	48388
Total Europe	0 - 20	84.4	10.3	2.7	0.6	2.0	15.6	9150
	21 - 40	85.3	10.3	2.6	0.7	1.1	14.7	20239
	41 - 60	89.3	7.0	2.2	0.3	1.2	10.7	20165
	61 - 80	91.0	6.4	1.4	0.5	0.7	9.0	17266
	81 -100	89.2	8.3	1.7	0.2	0.6	10.8	12680
	101-120	89.6	7.6	1.8	0.7	0.3	10.4	5689
	>120	89.8	7.9	1.6	0.2	0.5	10.2	5766
	Irregular	83.7	11.7	2.5	0.7	1.4	16.3	6023
	Total	88.0	8.4	2.1	0.5	1.0	12.0	96978

3.1.4 Easily identifiable damage

The eight easily identifiable damage types are:

- **game and grazing (damage to trunk, bark etc.)**
- **presence or traces of an excessive number of insects**
- **fungi**
- **abiotic agents (wind, drought, snow etc.)**
- **direct action of man (poor silvicultural practices, logging etc.)**
- **fire**
- **known local or regional pollution (classical smoke damage)**
- **other types of damage**

For these categories, only the **presence** of such damages is indicated. Table 3.1.4-1 presents the data in terms of the percentage of the total tree or plot sample. No indication is given of the **intensity** of the damage. It is possible that more than one type of identifiable damage occurs on a single tree. Such trees will therefore be represented in the table more than once. Of the 102 288 trees of the total tree sample, identifiable damage of one or more causes were reported on 23 083 trees (22.6%). These trees were observed on 2 722 plots (57.2%) of the total plot sample. On the other trees (77.4%) identifiable damage was either not present or not assessed.

In total Europe, as in the previous years, the most commonly observed type of damage was caused by **insects** (9.3% of the trees and 23.4% of the plots). The second and third most commonly observed types were **abiotic agents and fungi** representing 4.9% and 4.6% of the total tree sample respectively.

The presence of the damage types **action of man** and **other damage** was observed less frequently, representing 3.4% and 3.2%, respectively, of the total tree sample.

Game/grazing, fire and damage by **known pollution** (i.e. classical smoke damage caused by air pollution of nearby emittents) were recorded to a far smaller extent, namely on 1.2%, 0.5% and 0.3% of the trees, respectively. Of the total sample, 4.1% of the trees suffered damage from more than one damage type.

Among the trees showing any identifiable damage, the proportions of trees in defoliation classes 2-4 ranged between 0.1% (103 trees) (**known pollution**) and 3.1% (3131 trees) (**insects**) in total Europe.

Table 3.1.4-1: Percentages of trees with defoliation >25% and discolouration >10% by identified damage types.

Damage type	Defoliation % in classes 2, 3, 4 (>25%) of the total tree sample		Discolouration % in classes 1, 2, 3, 4 (>10%) of the total tree sample		Observations % of the total tree sample		% of the total plot sample	
	Total Europe 102288 trees	EU 48392 trees	Total Europe 97078 trees	EU 48388 trees	Total Europe 102288 trees	EU 48392 trees	Total Europe 4756 plots	EU 2007 plots
Game/Grazing	0.3	0.3	0.1	0.2	1.2	1.1	4.4	2.6
Insects	3.1	2.3	1.7	1.6	9.3	9.9	23.4	28.3
Fungi	1.5	0.9	1.2	1.2	4.6	3.4	18.5	14.6
Abiotic agents	1.8	0.9	1.4	1.3	4.9	2.9	21.1	12.8
Action of man	0.9	0.8	0.6	0.8	3.4	3.1	13.7	7.2
Fire	0.4	0.7	0.3	0.6	0.5	0.9	0.7	1.3
Known pollution	0.1	0.0	0.2	0.1	0.3	0.1	0.4	0.1
Other	0.8	0.6	0.5	0.5	3.2	2.0	18.2	8.1
Any ident. damage	7.0	5.5	4.6	4.9	22.6	20.2	57.2	49.5
No ident. damage (or not assessed)	19.4	12.2	7.5	7.6	77.4	79.8	42.8	50.5
Total	26.4	17.7	12.1	12.5	100.0	100.0	100.0	100.0

For 7.0% of the total tree sample of 102 288 trees **any identifiable damage** and at the same time a defoliation of >25% was reported. For 19.4% of the total tree sample no identifiable damage was reported despite a defoliation of >25%. These two percentages sum up to 26.4%, which is the percentage of all trees in defoliation classes 2-4 of the total tree sample. It must be noted, however, that the share of trees showing no identifiable damage comprises an unknown amount of trees not assessed for easily identifiable damage. The same applies to discolouration.

The most pronounced negative effect in terms of discolouration was also observed from trees affected by **insects** with 1.7% of all trees.

Data on identifiable damage only permit very general conclusions on common and widespread damage and do not permit any conclusions on cause effect relationships. Defoliation and discolouration are only suited to describe the general tree condition. Many stress factors could only be identified after more detailed studies as performed in the Level II forest monitoring.

3.1.5 Changes in defoliation and discolouration from 1993-1994

The **total tree samples** of 1993 and 1994 can be compared, but detailed analyses should be corrected for changes in the total sample (e.g. because of an increasing number of participating countries).

For a comparison of the 1993 and 1994 survey results, a subsample called **Common Sample Trees (CSTs)** is defined containing all trees that are common to both surveys. For 1993 and 1994, this common sample consists of 86 085 trees, representing 83.7% of the total tree sample of 1993 and 84.2% of the total tree sample of 1994. This is 1 116 trees or 1.3% more CSTs than in the 1993 survey. The reason for this slight increase in number is the participation of Croatia, Estonia, Moldavia and Slovenia in the transnational forest condition assessment since 1993.

The common sample of 1993 and 1994 was the largest ever since this method of analysis was adopted. The increasing number of CSTs improves the reliability of the calculation of changes in defoliation and discolouration and indicates a growing consistency of the datasets in the participating countries.

The percentages of trees in the different defoliation and discolouration classes for the total tree samples and for the CSTs of 1993 and 1994 are shown in Table 3.1.5-1.

Table 3.1.5-1: Percentages of the total tree sample and the Common Sample Trees in different defoliation and discolouration classes in 1993 and 1994

	Total tree sample		Common Sample Trees	
	1993	1994	1993	1994
Defoliation				
0-10%	43.5	39.3	42.9	39.6
>10-25%	33.9	34.3	34.0	34.2
0-25%	77.4	73.6	76.9	73.8
>25-60%	19.9	23.0	20.8	22.8
>60%	1.9	2.3	2.0	2.3
dead	0.8	1.1	0.3	1.1
>25%	22.6	26.4	23.1	26.2
No. of trees	102 800	102 288	86 085	86 085
Discolouration				
0-10%	90.0	87.9	89.9	88.7
>10-25%	7.2	8.4	7.7	8.0
>25-60%	1.7	2.1	1.8	1.7
>60%	0.3	0.5	0.3	0.5
dead	0.8	1.1	0.3	1.1
>10%	10.0	12.1	10.1	11.3
No. of trees	86 461	97 078	82 005	82 005

3.1.5.1 Changes by climatic region

As in previous years, the total tree sample and Common Sample Trees (CSTs) were classified into climatic regions in order to account for various climatic site conditions. In addition to the 9 regions specified in the 1993 and 1994 reports, a new region "Mountainous (north)" is separated from the region "Mountainous" in order to account for the climatic differences between northern and southern Europe.

The selected climatic regions largely match the most important forest vegetation types. Figure 3.1.5.1-1 shows the distribution and percentages of all plots over the climatic regions.

The percentages of damaged trees and mean plot defoliation were used to quantify the changes in defoliation of the CSTs from 1993 to 1994 for each climatic region. Figure 3.1.5.1-2 displays the changes in the percentage of trees in defoliation classes. The following descriptions refer to the changes in the percentage of trees damaged and differences in mean defoliation between 1993 and 1994.

In terms of differences in **mean defoliation** significant changes were found for the total CSTs of all regions and for each climatic region as well. Except for the Boreal and Atlantic (north) regions the mean defoliation increased significantly from 1993 to 1994 but in no cases the change reached the 5% mark which is the actual assessment accuracy in the field. The most pronounced deterioration of crown condition in terms of **the percentage of damaged trees** occurred in the Mediterranean (higher) region (5.7 percent points) and in the Continental region (4.5 percent points). The increase in the percentages of damaged trees in the Mountainous (north) and the Mountainous (south) region was less obvious, but the shifts are statistically significant. The improvements in crown condition in the Boreal and Atlantic (north) regions proved to be significant only in terms of differences in mean defoliation between 1993 and 1994.

The changes in the percentages of discoloured trees in each climatic region are shown in Figure 3.1.5.1-3. Except for the Atlantic (south) region and the Mountainous regions the results of changes in discolouration correspond to those of defoliation revealing a slightly poorer health status in 1994 compared to 1993. The percentage of discoloured trees rose markedly in the Mediterranean (lower) region by 6.4 percent points followed by the Continental region with an increase by 5.7 percent points. Discolouration decreased notably and significantly by 5.0 percent points only in the Atlantic (south) region. Also decreasing but no significant percentages of trees discoloured were found in the Mountainous (north) and Mountainous (south) regions (-1.3 and -0.2 percent points, respectively).

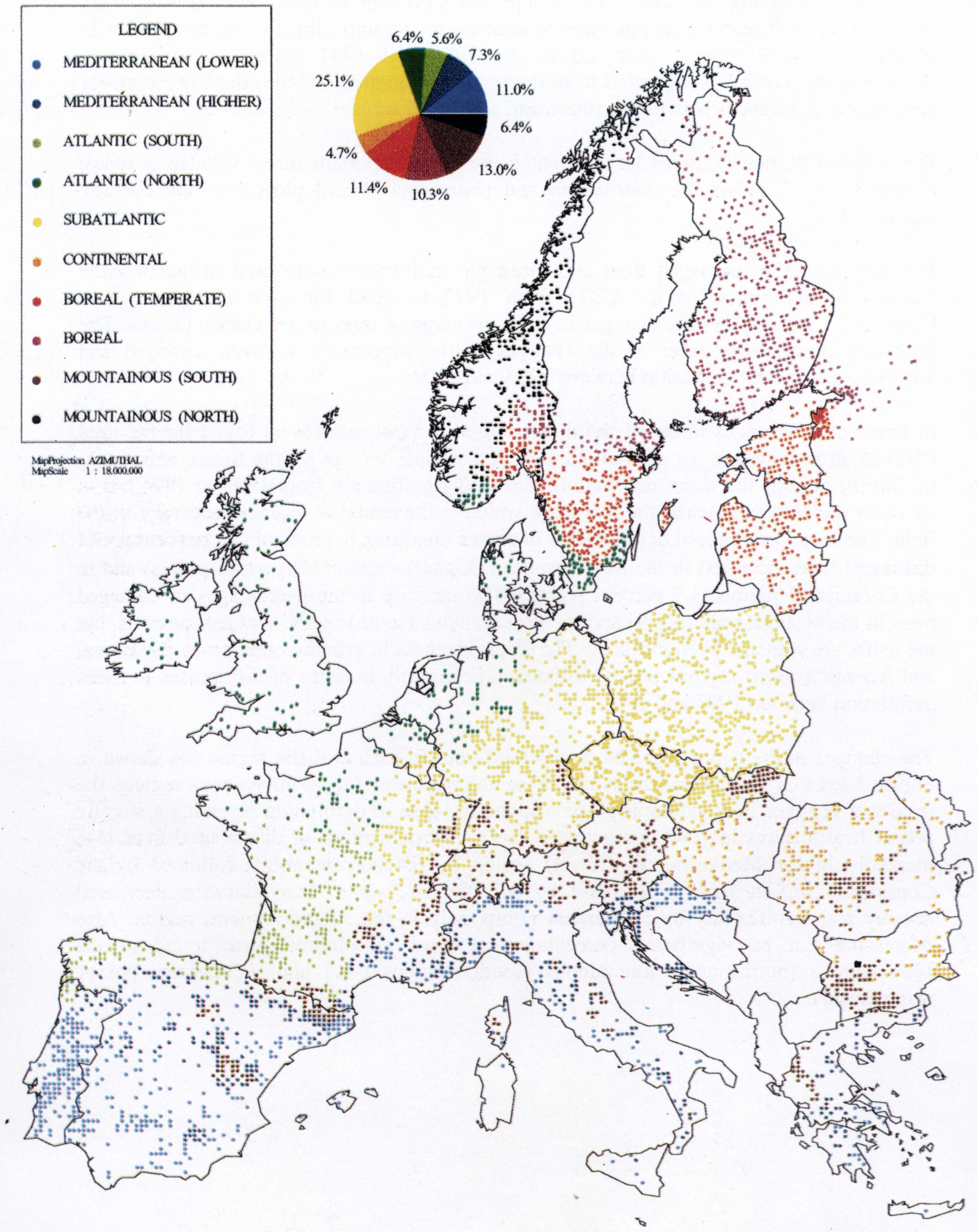

Figure 3.1.5.1-1: Climatic regions

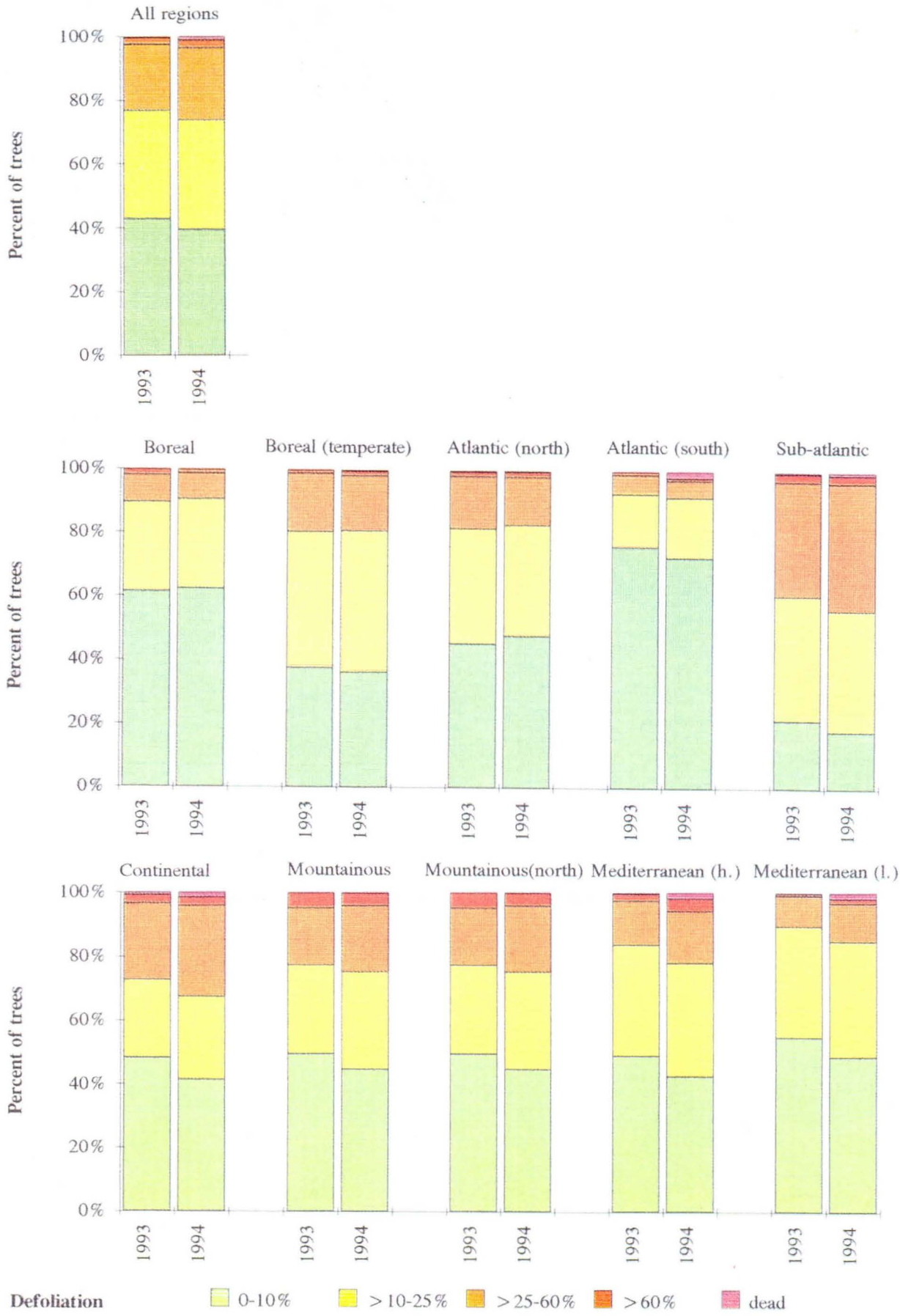

Figure 3.1.5.1-2: Percentages of defoliation of the Common Sample Trees in 1993 and 1994 for each of 10 climatic regions and for the total sample of CSTs.

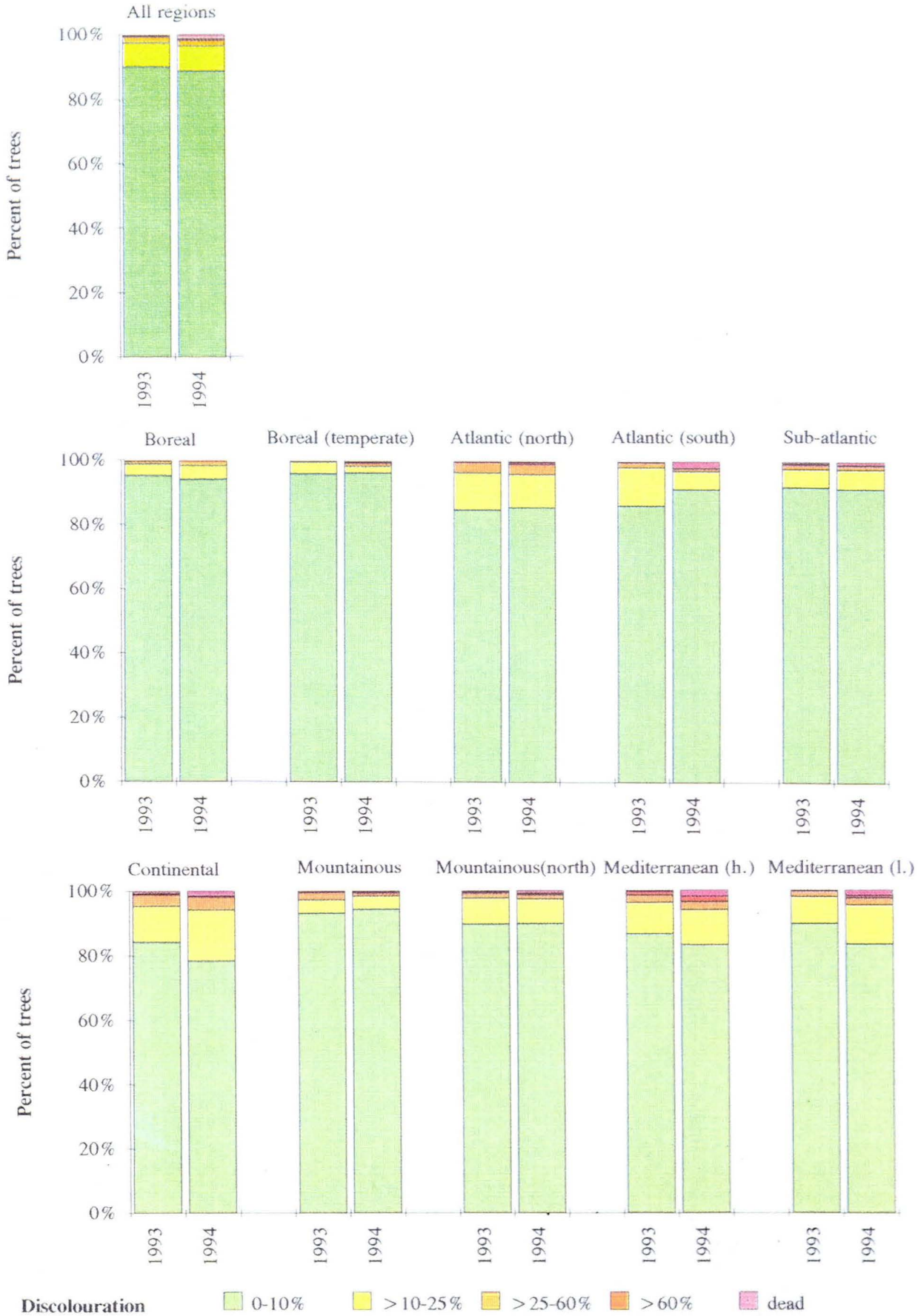

Figure 3.1.5.1-3: Percentages of discolouration of the Common Sample Trees in 1993 and 1994 for each of 10 climatic regions and for the total sample of CSTs.

3.1.5.2 Changes by species group

In 1994, the CSTs as a whole showed a significant worsening in **defoliation**. The share of damaged CSTs increased from 23.1% in 1993 to 26.1% in 1994. In the broadleaved CSTs the proportion of trees defoliated more than 25% rose from 20.0% to 23.6%. In the coniferous CSTs the respective proportion also increased, from 25.4% to 28.2%.

Some of the species among the **broadleaved CSTs** showed a remarkable deterioration, as expressed by the shares of damaged trees. The crown condition of *Eucalyptus* spp., *Quercus ilex* and *Quercus suber* deteriorated notably. The proportion of damaged *Eucalyptus* spp. increased from 4.1% to 11.5%. However, this species has shown the lowest damage figures in the mediterranean area. The share of damaged *Quercus ilex* trees rose from 6.9% to 14.8%. The respective proportion of *Quercus suber* increased from 9.0% to 14.4%. A decrease in defoliation only occurred among *Carpinus* spp., the damaged share of which diminished from 25.9% to 22.1%.

As in the previous report, the rapid changes in vitality among the principal mediterranean species *Eucalyptus* spp., *Quercus ilex* and *Quercus suber* should be interpreted in connection with typical detrimental events in the Mediterranean region, such as drought and fire, especially if only small percentages of trees are affected. Though large, these changes have less influence on the result for the total broadleaves, due to the low numbers of CSTs among these species groups.

The deciduous *Quercus* spp. with 10 798 trees represented the largest number of broadleaved CSTs. Consequently, their increase in the proportion of damaged trees from 26.8% to 30.1% greatly influenced the result for the broadleaved CSTs. Also of influence were Other broadleaves with 6 975 trees and an increase in damaged trees from 20.2% to 26.7%.

Most species groups of the **coniferous CSTs** experienced only slight changes in defoliation from 1993 to 1994, except Other conifers, whose share of damaged trees increased notably from 14.5% to 21.3%, and *Abies* spp., which showed a decrease from 34.0% to 31.9%. Nevertheless, *Abies* spp. had the highest percentage of damaged trees in 1993 and 1994, both among the conifers and the broadleaves. However, with 1 979 trees, *Abies* spp. had only little influence on the total coniferous result, which is dominated mainly by *Pinus* spp. with 27 142 trees and *Picea* spp. with 17 258 trees.

Pinus spp. showed an increase in the proportion of damaged trees from 23.7% to 27.0%. For *Picea* spp., an increase in the share of damaged trees from 28.3% to 30.8% was found. The proportion of damaged coniferous CSTs increased from 25.4% to 28.2% mainly as a result of the deterioration of these most comprehensive species groups.

There was an overall higher **discolouration** in 1994 than in 1993, both in the conifers and in the broadleaves. As in the previous year, some species groups improved over the period (1993-1994), whereas others deteriorated.

Among the **broadleaved CSTs**, the share of discoloured *Eucalyptus* spp. (discolouration classes 1-4) increased considerably from 5.5% to 17.4%. In contrast, the respective proportion of *Carpinus* spp. decreased sharply from 26.3% to 12.9%. Further obvious increases in discolouration occurred in *Quercus ilex* (from 4.5% to 7.8%) and in Other broadleaves (from 12.9% to 14.6%). Other notable decreases in discolouration were found

in *Castanea sativa* (from 23.6% to 20.8%) and in *Betula* spp. (from 5.1% to 3.7%). However, with the exception of Other broadleaves, these tree species comprises only small numbers of CSTs. The total result of the broadleaved CSTs was dominated by the small changes of *Fagus* spp. and the deciduous *Quercus* spp., which with 8 593 and 10 798 trees, respectively, accounted for more than half of the broadleaved CSTs.

Also, both increases and decreases in discolouration were found among the **coniferous CSTs**. The most prominent increases in the share of discoloured trees occurred in *Abies* spp. from 14.2% to 17.0% and in *Pinus* spp. from 7.5% to 11.1%. A notable decrease was found in Other conifers from 12.8% to 8.8%.

3.1.6 Changes in defoliation since 1988

Similar to the Common Sample Trees (CSTs) of 1993 and 1994 (Chapter 3.1.5) a separate sample of trees common to the years 1988-1994 was defined in order to study the trends in forest condition over a longer period. Commencing this time series in 1987 would have resulted into a far lower number of common trees. Of the total tree sample, 28 263 trees common to all surveys from 1988 to 1994 were found.

The evaluation was carried out specieswise both for the total number of common trees and for the individual regions. Only the ten most common species, each of which comprised more than 800 common trees were evaluated, supplemented by *Abies alba* and *Picea sitchensis*. These 2 species had lower tree numbers and were not to be included according to their ranking, but they are of importance in particular regions, especially in the Mountainous and in the Atlantic (north) region. As in the previous surveys, no evaluation was made for those regions in which the number of trees of a certain species was lower than 100. No common trees existed in the Boreal, the Boreal (temperate) and the Continental region.

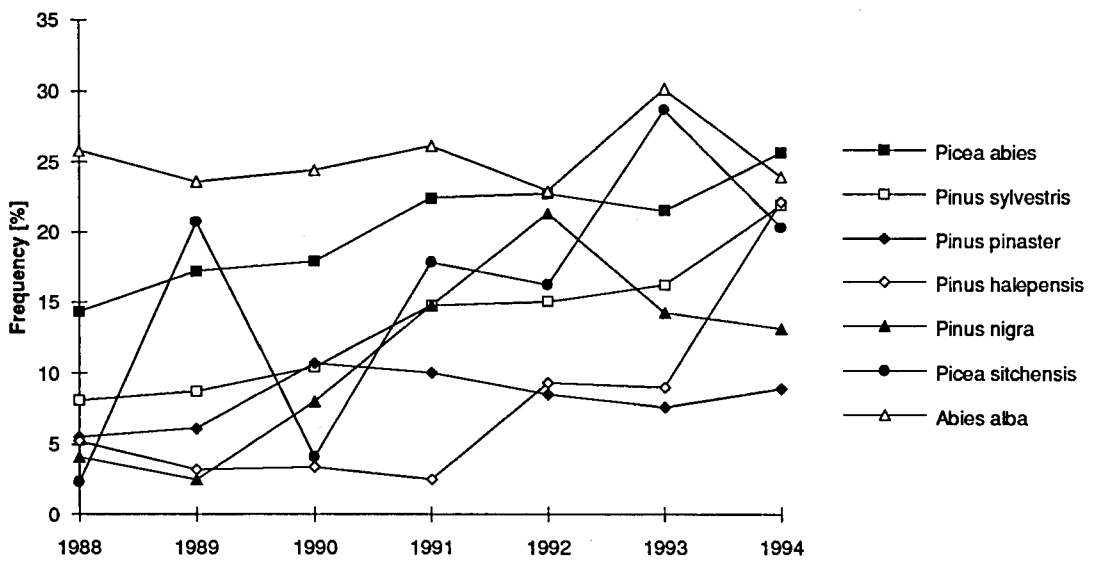

Figure 3.1.6-1: Development of defoliation for coniferous trees (defoliation classes 2-4) common to 1988-1994.

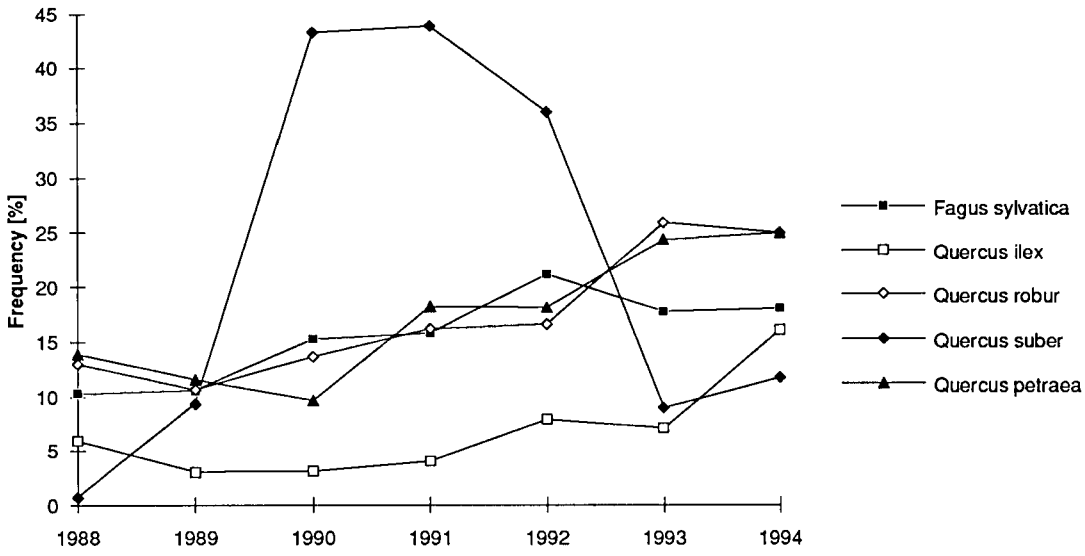

Figure 3.1.6-2: Development of defoliation for broadleaved trees (defoliation classes 2-4) common to 1988-1994.

For the period from 1988 to 1994 in the subsample of common trees the proportions of the trees classified as damaged differed considerably between the individual tree species. The 12 analyzed species showed a more or less obvious increase in the proportion of damaged trees.

Among the conifers, *Picea abies* had the highest percentage of damaged trees in 1994 (25.6%) but the most obvious increase since 1988 was shown by *Picea sitchensis* (2.3% to 20.3%) and *Pinus halepensis* (5.2% to 22.1%). The proportion of damaged *Pinus sylvestris* trees increased steadily from 8.1% to 21.9% within the seven years of observation.

The broadleaved species, as regards, the very obvious increase of the share of damaged trees in *Quercus suber* from 0.7% in 1988 to 43.8% in 1991, diminished rapidly to 9.0% in 1993 (11.8% in 1994). Among the other broadleaved species, *Quercus robur* and *Quercus petraea* showed also a continuous increase from 13.0% to 24.9% and from 13.9% to 24.9%, respectively.

3.2 National survey results

In 1994, 30 European countries submitted national reports in order to present the results of their national surveys. Numerical data were available from 32 countries, which are tabulated in the Annex. Annex I provides basic information on the forest area and survey design of each participating country. The distribution of the trees over the defoliation classes is tabulated for all species in Annex II, for the conifers in Annex III and for the broadleaves in Annex IV. The annual changes in the results are presented for all species, for conifers and for broadleaves in Annexes V, VI and VII. It has to be noted, however, that no direct comparison between the annual results is possible due to differences in the samples.

The results of the submitted national surveys concerning all species assessed can be summarized as follows:

Although no direct comparisons between different countries are possible because of differences in the application of the common methodology and general variations in climatic and site factors as well, the data approve a division of the countries into three groups.

As in the previous year, in Ireland, the Russian Federation and Sweden only conifers were assessed. In four countries, namely Austria, France, Portugal and the Russian Federation, the percentage of sample trees classified as damaged (defoliation classes 2-4) was lower than 10%.

In ten of the countries the percentage of sample trees classified as damaged ranged between greater 10% and 20%. These countries are Belgium (including Flanders and Wallonia), Estonia, Finland, Ireland, Italy, the Netherlands, Slovenia, Spain, Sweden, and the United Kingdom.

In another 18 countries, namely Belarus, Bulgaria, Croatia, the Czech Republic, Denmark, Germany, Greece, Hungary, Latvia, Lithuania, Luxembourg, the Republic of Moldova, Norway, Poland, Romania, the Slovak Republic, Switzerland and Ukraine, the percentage of sample trees classified as damaged was greater than 20%, with a maximum of 59.7%. This is more than a half of the member states from which survey results were reported. In ten of these countries the defoliation was particularly high in coniferous stands. The broadleaved stands were particularly affected in Bulgaria, Germany, Greece, Luxembourg, Norway and Romania.

A deterioration has occurred in 21 countries from which survey results were reported. The following Table 3.2.-1 describes the changes of defoliation observed between 1993 and 1994 in classes 2-4 by referring to all the 32 countries by which survey results were submitted. Changes are rated as unimportant if equal to or less than 5.0 percent points, as slight between 5.1 and 10.0 percent points, as moderate between 10.1 and 20.0 percent points and as substantial if exceeding 20.0 percent points from one year to the next.

As regards all species, a slight increase in defoliation occurred in five countries, whereas a slight decrease was observed only in one country. Changes in defoliation are obvious in the conifers and the broadleaves as well. Concerning the conifers, an increase occurred in six countries, whereas a decrease was observed only in four. In one country the increase in the conifers was moderate, but no substantial increase was found. In comparison to 1993, the defoliation among the broadleaves clearly increased. In seven countries a slight and in

three countries a moderate increase occurred. However, in none of the countries there was a substantial increase in the broadleaves. Besides two countries, in which a slight decrease appeared, there was one country, in which a substantial decrease was found.

Table 3.2-1: Changes in defoliation observed between 1993 and 1994 in classes 2-4

	Number of countries						
	No or unimportant change	Increase of defoliation			Decrease of defoliation		
		Slight	Moderate	Substantial	Slight	Moderate	Substantial
All species	20	5	2	-	1	-	-
Conifers	21	5	1	-	4	-	-
Broadleaves	16	7	3	-	2	-	1

4. INTERPRETATION

In 1994, 32 European countries submitted their national forest inventory data. 29 of these countries also submitted results of the 16x16 km grid (transnational survey). This was the largest number of countries ever having participated in a transnational survey since its establishment in 1987. Of 102 288 trees assessed on 4 756 plots, 26.4% were considered as damaged. Valuable information provided in the national reports was often utilized for the interpretation of the survey results.

As in the previous years, the areas of highest defoliation are located in central Europe, but defoliation is also high in certain areas of northern and southeastern Europe. Defoliation appears to be lowest over most of Scandinavia and in southwestern Europe.

The national reports of two thirds of the countries explain the change forest condition by means of **weather** condition. The weather in 1994 was mentioned mainly as a cause of the deterioration, but sometimes also of the recuperation of forest condition. The national reports of nearly half of the countries emphasize that summer heat and drought in 1994, and in previous years, has acted as a predisposing or triggering factor for the damage observed. Pests are often looked upon as secondary agents, which were fostered by hot and dry weather conditions in 1994. An improvement of forest condition was often attributed to high winter and spring precipitation. These explanations from the national reports are in good agreement with the development of defoliation as derived from the transnational results. The changes in mean plot defoliation from 1993 to 1994 indicate a significant worsening of forest condition in central, eastern, southeastern and southern Europe. From these regions a deterioration of forest condition by drought and heat was also reported by many countries. The regions in central and western Europe, for which a significant improvement of forests can be derived from the transnational results, partly coincide with the countries from which an improvement of forest condition due to higher precipitation was reported. In northern Europe, a harsh winter climate and summer drought are both mentioned as typical stressors.

In accordance with in all previous surveys, the parameter showing the closest correlation with defoliation was **stand age**. The transnational survey revealed an increase in the percentage of damaged trees from 13.8% in age class 0-20 years to 29.9% in age class 61-80 years. With higher ages, the percentage of damaged trees increased slightly to 32.0% in age class >120 years. This is in good agreement with national survey results presented in previous reports, which have shown trees older than 60 years to be clearly more defoliated than younger ones. The close correlation between defoliation and stand age partly reflects the well known natural loss of foliage due to ageing and partly the fact that old trees are overall more susceptible to various environmental stress factors.

Easily identifiable damage was reported for 22.6% of all trees of the transnational survey. As in recent years, the most frequently reported damage type was insect attack with 9.3% of the total tree sample affected. Second on the frequency scale were abiotic agents (4.9%), followed by fungi (4.6%) and action of man (3.4%). This gives evidence of the multitude of stressors responsible for the defoliation assessed. Classical smoke damage was reported for a very small percentage of the total tree sample (0.3%). For 77.4% of the trees no evident damage agent was reported. These trees, however, comprise an unknown proportion of trees on which damage was present, but not reported.

The percentage of damaged trees in 1994 (26.4%) was clearly larger than that in 1993 (22.6%) and of any other previous survey year. However, direct comparisons of the shares of damaged trees in the total sample are biased because the samples differ from year to year. The actual development of forest condition in Europe is better reflected by the Common Sample Trees (CSTs) evaluated for different periods (1993-1994, 1990-1994, 1988-1994).

With 86 085 CSTs of 1993 and 1994, this common sample was larger than ever before, which indicates an increasing consistency of the total data base. The share of damaged trees changed from 23.1% in 1993 to 26.2% in 1994. Although this change was not statistically significant for the total CSTs, statistically significant changes were found in several climatic regions. These changes at the regional scale were often in good agreement with the reports received from the respective countries, shown in the following paragraphs.

The largest increase occurred in the Mediterranean (higher) region, where the proportion of damaged trees increased significantly from 16.2% in 1993 to 21.9% in 1994. The change was also high in the Mediterranean (lower) region, with a significant increase from 10.4% to 15.2%. The deterioration of forest condition is widespread in these two regions especially in the northern and eastern parts of Spain, in Italy and in parts of Greece. The species most affected were *Eucalyptus* spp., *Quercus ilex* and *Quercus suber*. This agrees well with the national reports of these countries. The national reports explain this deterioration mainly by heat and drought.

Another significant increase in the share of damaged CSTs was found in the Continental region, namely from 27.2% to 32.6%. As in last year's survey, this increase mainly reflects the deterioration of forest condition in Romania, where continuing drought and local air pollution caused an increase in defoliation in many species, particularly in *Abies alba* and *Quercus* spp.

The results of the transnational and national surveys give evidence of a large variety of stressors and site conditions influencing the extent of defoliation and discolouration. Adverse weather conditions, insects, fungi, forest fires, game, action of man and air pollution have been reported by the countries as the most important causes. The degree to which individual factors have contributed to the defoliation and discolouration observed, however, cannot be quantified as the two symptoms are non-specific. With the exception of a small (0.3%) proportion of trees, damage by air pollution has not been unequivocally identified from the survey data. However, from the basis of more symptom-specific surveys of air pollution injury and/or a range of experimental research, more than half of the participating countries mention air pollution in their national reports as a possible predisposing, accompanying and locally triggering factor.

The 1994 survey confirms the continuing trend towards the deterioration of forest condition observed in large areas during the recent years. This trend can not be readily explained by site conditions and natural damaging agents alone even though prolonged drought has been implicated as a parameter contributing to forest decline. Long-range transboundary air pollution could also be involved in such a trend. This phenomenon clearly deserves particular attention.

Because of the importance of summer droughts and warm winters for the recent changes in forest condition, special attention should also be paid in the future to the global climate change impacts as well as the effects of air pollution.

5. CONCLUSIONS AND RECOMMENDATIONS

The common large scale monitoring of UN/ECE and EU has the objective to gain knowledge on the spatial and temporal variation of forest condition. This is achieved by means of an annual crown condition assessment in Europe.

In the last 9 years the forest condition survey has been extended and today covers a large proportion of the European region. Notably, over the last years a steady increase in defoliation has been observed in several regions in central and eastern Europe and parts of the mediterranean region. In these regions there is an overall deterioration of the most common species while in other regions the development varies more according to species.

An objective of the Level I approach has been fulfilled while providing a more comprehensive knowledge of the extent, dynamics and spatial distribution of forest damage in Europe. At the same time a comprehensive database has been created and impetus to forest damage research and environmental policies have been given. However, these successive inventories by themselves do not allow cause and effect relationships to be established. The role of air pollution remains difficult to separate from the influence of other environmental factors.

It is recommended to continue the large scale forest condition assessment on an annual basis. The results of this survey gives within a short time and with reasonable efforts a good overview on the annual forest condition. The continuation of the survey is also justified because the deterioration of forest condition is a source of concern as no satisfactory explanation has yet been found. The continuation of the database will enable time series analysis and more complex studies linking forest condition and various factors including air pollution. Lastly it will facilitate the assessment of the effectiveness of air pollution abatement measures in the long term.

The yearly evaluation and the reporting of the results is also needed to keep resource managers and policy makers informed on forest health status and trends. The method of reporting is still under discussion. In future reports, topics of special interest such as the intensive monitoring on Level II will be considered.

A synoptical evaluation of the different datasets on Level I is needed at national and European level in order to gain deeper insight into potential relationships between forest damage and air pollution. The complete Level I data set is suitable for further synoptical analyses in connection with the data sets of other ICPs running under the Working Group on Effects of UN/ECE. Such a study is being planned for the near future and results will be presented in an overview report.

In addition to the Level I network, an intensive monitoring has been designed and implemented on a smaller number of plots (Level II). This Level II programme aims at the recognition of factors and processes with special regard to the impact of atmospheric pollution. This approach allows correlations to be established between the variation of environmental factors and the reaction of ecosystems. Such correlations may be used to support the determination of critical loads and levels. The data obtained will also permit a better interpretation of the findings derived from the large scale systematic network (Level I).

Therefore it is recommended to maintain both levels with increasing emphasis on Level II as this programme develops.

Annexes

Annex I

FORESTS AND SURVEYS IN EUROPEAN COUNTRIES (1994)

Participating countries	Total area (1000 ha)	Forest area (1000 ha)	Coniferous forest (1000 ha)	Broadleav. forest (1000 ha)	Area surveyed (1000 ha)	Grid size (km x km)	No. of sample plots	No. of sample trees
Austria	8385	3857	2922	935	3857	8.7 x 8.7	216	6397
Belarus	20760	7028	4757	2271	6001	16 x 16	407	9788
Belgium	3057	602	302	300	602	8^2 / 16^2	106	2487
Bulgaria	11100	3314	1172	2142	3314	16^2 / 8^2	166	6625
Croatia	5654	2061	321	1740	1175	16 x 16	89	2174
Czech Republic	7886	2630	2051	579	2630	8^2/16^2	213	14342
Denmark	4300	466	308	158	411	7^2/16^2	54	1296
Estonia	4510	1815	1135	680	1135	16 x 16	91	2184
Finland	30464	20059	18484	1575	15304	16^2 / 24x32	381	4261
France	54919	14002	5040	8962	13100	16 x 16	534	10672
Germany	35562	10207	6858	3349	10207	4 x 4	8034	219657
Greece a)	13204	2034	954	1080	2034	16 x 16	80	1888
Hungary	9300	1713	266	1447	1600	4 x 4	1064	22304
Ireland	6889	380	334	46	285	16 x 16	22	441
Italy	30126	8675	1735	6940	7699	16 x 16	211	5854
Latvia	6450	2797	1633	1164	2661	8 x 8	370	9154
Liechtenstein	16	8	6	2	no survey in 1994			
Lithuania	6520	1823	1073	750	1823	16 x 16	73	1761
Luxembourg	259	89	32	54	86	16^2 / 4^2	51	1169
Rep. of Moldova	3376	318	6	312	312	2 x 2	571	21453
Netherlands	4147	311	208	103	281	1 x 1	1259	31475
Norway	30686	13700	7000	6700	13700	9^2/18^2	911	8412
Poland	31270	8654	6895	1759	8654	16 x 16	1398	27780
Portugal	8800	3370	1338	2032	3370	16 x 16	147	4410
Romania	23750	6244	1929	4315	6244	2x2/2x4	7226	184396
Russian Fed. b)	8530	5798	3972	1826	5798	varying	124	2934
Slovak Republic	4901	1885	816	1069	1185	16 x 16	111	4324
Slovenia	2008	1071	500	571	1071	16 x 16	34	816
Spain c)	50471	11792	5637	6155	11792	16 x 16	444	10656
Sweden	40800	23500	19729	3771	20009	varying	4675	15080
Switzerland	4129	1186	818	368	1186	8 x 8	164	1958
Turkey	77945	20199	9426	10773	no survey in 1994			
Ukraine	60370	6151	2931	3220	2021	16 x 16	146	3469
United Kingdom	24100	2200	1550	650	2200	random	367	8808
Yugoslavia d)	25600	6100	900	5200	no survey in 1994			
TOTAL	659918	196862	113032	83827	152576	varying	29739	648425

a) Excluding maquis. b) Only Leningrad Region. c) Excluding Canary Islands.
d) Former Yugoslavia excluding Croatia and Slovenia.

Annex II

DEFOLIATION OF ALL SPECIES BY CLASSES AND CLASS AGGREGATES (1994)

Participating countries	Area surveyed (1000 ha)	No. of sample trees	0 none	1 slight	2 moderate	3+4 severe and dead	2+3+4
Austria	3857	6397	59.9	32.3	7.1	0.7	7.8
Belarus	6001	9788	15.6	47.0	35.2	2.2	37.4
Belgium	602	2487	43.0	40.1	15.6	1.3	16.9
Bulgaria	3314	6625	31.8	39.3	25.1	3.8	28.9
Croatia	1175	2174	46.2	25.0	24.6	4.2	28.8
Czech Republic	2630	14342	8.7	31.6	53.8	5.9	59.7
Denmark	466	1296	38.7	24.8	28.9	7.6	36.5
Estonia	1135	2184	46.4	37.9	14.6	1.1	15.7
Finland	15304	4261	63.2	23.8	11.9	1.1	13.0
France	13100	10672	72.4	19.2	7.3	1.1	8.4
Germany	10207	219657	36.3	39.3	22.9	1.5	24.4
Greece a)	2034	1888	38.0	38.8	18.5	4.7	23.2
Hungary	1600	22304	41.9	36.4	15.8	5.9	21.7
Ireland	285	441	only conifers assessed				
Italy	7699	5854	56.6	23.9	16.0	3.5	19.5
Latvia	2661	9154	24.0	46.0	27.0	3.0	30.0
Liechtenstein			no survey in 1994				
Lithuania	1823	1761	14.8	59.8	23.5	1.9	25.4
Luxembourg	86	1169	33.2	32.0	31.0	3.8	34.8
Rep. of Moldova	1141	21453	only broadleaves assessed				
Netherlands	281	31475	60.7	19.9	16.5	2.9	19.4
Norway	13700	8412	37.9	34.6	22.4	5.1	27.5
Poland	8654	27780	5.2	39.9	51.9	3.0	54.9
Portugal	3370	4410	63.8	30.5	5.4	0.3	5.7
Romania	6244	184396	47.7	31.1	18.1	3.1	21.2
Russian Fed. b)	5798		only conifers assessed				
Slovak Republic	1185	4324	14.7	43.5	36.2	5.6	41.8
Slovenia	1071	816	41.0	43.0	13.0	3.0	16.0
Spain c)	11792	10656	38.4	42.2	13.0	6.4	19.4
Sweden	20009	15080	only conifers assessed				
Switzerland d)	1186	1958	31.8	45.6	20.0	2.6	22.6
Turkey			no survey in 1994				
Ukraine	2021	3469	22.5	45.1	30.0	2.4	32.4
United Kingdom	2200	8808	42.8	43.3	13.0	0.9	13.9
Yugoslavia e)			no survey in 1994				

a) Excluding maquis. b) Only Leningrad Region.
c) Excluding Canary Islands. d) Weighted according to diameter breast height (dbh).
e) Former Yugoslavia excluding Croatia and Slovenia.

Annex III

DEFOLIATION OF CONIFERS BY CLASSES AND CLASS AGGREGATES (1994)

Participating countries	Coniferous forest (1000 ha)	No. of sample trees	0 none	1 slight	2 moderate	3+4 severe and dead	2+3+4
Austria a)	2922	5570	61.3	30.8	7.2	0.7	7.9
Belarus	4122	7207	9.6	46.4	41.8	2.2	44.0
Belgium	302	1218	34.7	44.1	19.0	2.2	21.2
Bulgaria	1172	3912	38.9	36.1	22.3	2.7	25.0
Croatia	321	407	43.3	17.4	34.1	5.2	39.3
Czech Republic	2051	12559	8.1	30.7	55.5	5.7	61.2
Denmark	308	827	40.0	21.3	27.6	11.1	38.7
Estonia	1135	2089	44.0	40.0	15.0	1.0	16.0
Finland	18484	3636	63.2	23.7	12.0	1.1	13.1
France	5040	3710	75.2	16.6	7.3	0.9	8.2
Germany	6858	151245	39.4	39.0	20.3	1.3	21.6
Greece b)	954	1016	47.0	39.8	9.9	3.3	13.2
Hungary	248	3590	47.0	31.8	14.3	6.9	21.2
Ireland	334	441	32.9	47.4	19.0	0.7	19.7
Italy	1735	1321	60.4	24.6	11.4	3.6	15.0
Latvia	1606	6756	19.0	47.0	31.0	3.0	34.0
Liechtenstein	6		no survey in 1994				
Lithuania	1073	1207	13.2	60.5	24.5	1.8	26.3
Luxembourg	32	415	56.4	30.8	11.1	1.7	12.9
Rep. of Moldova			only broadleaves assessed				
Netherlands	182	20600	54.4	17.9	24.1	3.6	27.7
Norway	7000	6680	43.5	34.1	18.1	4.3	22.4
Poland	6895	23400	4.9	39.5	52.7	2.9	55.6
Portugal	1338	1652	70.8	23.8	5.3	0.1	5.4
Romania	1929	40787	54.6	29.9	13.6	1.9	15.5
Russian Fed. c)	3972	2934	51.1	41.3	7.0	0.6	7.6
Slovak Republic	816	1799	8.2	41.5	43.5	6.8	50.3
Slovenia	500	371	32.0	49.0	17.0	2.0	19.0
Spain d)	5637	5394	44.2	36.2	13.3	6.3	19.6
Sweden	19729	15080	57.1	26.7	12.6	3.6	16.2
Switzerland e)	818	1229	29.1	44.9	23.0	3.0	26.0
Turkey	9426		no survey in 1994				
Ukraine	2931	1767	19.9	45.3	32.8	2.0	34.8
United Kingdom	1550	5352	42.1	42.9	13.8	1.2	15.0
Yugoslavia f)	900		no survey in 1994				

a) Only trees 60 years and older assessed. b) Excluding maquis. c) Only Leningrad Region.
d) Excluding Canary Islands. e) Weighted according to diameter breast height (dbh).
f) Former Yugoslavia excluding Croatia and Slovenia.

Annex IV

DEFOLIATION OF BROADLEAVES BY CLASSES AND CLASS AGGREGATES (1994)

Participating countries	Broadleav. forest (1000 ha)	No. of sample trees	0 none	1 slight	2 moderate	3+4 severe and dead	2+3+4
Austria a)	935	827	50.6	41.8	6.5	0.9	7.4
Belarus	1879	2581	32.3	49.1	16.7	1.9	18.6
Belgium	300	1269	51.0	36.2	12.4	0.4	12.8
Bulgaria	2142	2713	21.6	44.0	29.2	5.2	34.4
Croatia	1740	1767	46.8	26.8	22.4	4.0	26.4
Czech Republic	579	1783	13.2	37.9	42.4	6.5	48.9
Denmark	158	469	36.5	31.1	31.1	1.3	32.4
Estonia	680	95	95.0	3.0	1.0	1.0	2.0
Finland	1100	625	63.7	24.3	11.2	0.8	12.0
France	8962	6962	71.0	20.6	7.3	1.1	8.4
Germany	3349	68412	29.8	40.1	28.4	1.7	30.1
Greece b)	1080	872	27.4	37.6	28.5	6.5	35.0
Hungary	1351	18714	40.9	37.3	16.1	5.7	21.8
Ireland	46		only conifers assessed				
Italy	6940	4533	55.5	23.8	17.3	3.4	20.7
Latvia	1055	2398	40.0	45.0	12.0	3.0	15.0
Liechtenstein	2		no survey in 1994				
Lithuania	750	554	18.4	58.3	21.1	2.2	23.3
Luxembourg	54	754	20.5	32.7	43.0	3.8	46.8
Rep. of Moldova	1141	21453	63.5	14.6	18.2	3.7	21.9
Netherlands	99	11875	71.6	23.3	3.4	1.7	5.1
Norway c)	6700	1732	16.4	36.0	39.1	8.5	47.6
Poland	1759	4380	6.9	41.6	48.5	3.0	51.5
Portugal	2032	2758	59.6	34.6	5.4	0.4	5.8
Romania	4315	143609	45.6	31.5	19.4	3.5	22.9
Russian Fed. d)	1826		only conifers assessed				
Slovak Republic	1069	2525	19.3	45.1	31.0	4.6	35.6
Slovenia	571	445	49.0	38.0	10.0	3.0	13.0
Spain e)	6155	5262	32.5	48.2	12.8	6.5	19.3
Sweden c)	3771		only conifers assessed				
Switzerland f)	368	729	37.0	46.8	14.3	1.9	16.2
Turkey	10773		no survey in 1994				
Ukraine	3220	1702	25.2	44.9	26.9	3.0	29.9
United Kingdom	650	3456	43.8	43.8	11.9	0.5	12.4
Yugoslavia g)	5200		no survey in 1994				

a) Only trees 60 years and older assessed. b) Excluding maquis. c) Special study on birch. d) Only Leningrad Region. e) Excluding Canary Islands. f) Weighted according to diameter breast height (dbh). g) Former Yugoslavia excluding Croatia and Slovenia.

Annex V

DEFOLIATION OF ALL SPECIES (1986-1994)

Participating countries	All species									% change
	Defoliation classes 2-4									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1993/1994
Austria				10.8	9.1	7.5	6.9	8.2	7.8	-0.4
Belarus				67.2	54.0		19.2	29.3	37.4	8.1
Belgium				14.6	16.2	17.9	16.9	14.8	16.9	2.1
Bulgaria	8.1	3.6	7.4	24.9	29.1	21.8	23.1	23.2	28.9	5.7
Croatia							15.6	19.2	28.8	9.6
Czech Republic							56.4	53.0	59.7	6.7
Denmark		23.0	18.0	26.0	21.2	29.9	25.9	33.4	36.5	3.1
Estonia	only conifers assessed						28.5	20.3	15.7	-4.6
Finland		12.1	16.1	18.0	17.3	16.0	14.5	15.2	13.0	-2.2
France a)	8.3	9.7	6.9	5.6	7.3	7.1	8.0	8.3	8.4	0.1
Germany b)	18.9	17.3	14.9	15.9	15.9	25.2	26.0	24.2	24.4	0.2
Greece c)			17.0	12.0	17.5	16.9	18.1	21.2	23.2	2.0
Hungary			7.5	12.7	21.7	19.6	21.5	21.0	21.7	0.7
Ireland			only conifers assessed							
Italy				9.1	14.8	16.4	18.2	17.6	19.5	1.9
Latvia					36.0		37.0	35.0	30.0	-5.0
Liechtenstein	19.0	19.0	17.0	11.8			16.0			
Lithuania			3.0	21.5	20.4	23.9	17.5	27.4	25.4	-2.0
Luxembourg	5.1	7.9	10.3	12.3		20.8	20.4	23.8	34.8	11.0
Rep. of Moldova								50.8		
Netherlands	23.3	21.4	18.3	16.1	17.8	17.2	33.4	25.0	19.4	-5.6
Norway	only conifers assessed				18.2	19.7	26.2	24.9	27.5	2.6
Poland			20.4	31.9	38.4	45.0	48.8	50.0	54.9	4.9
Portugal			1.3	9.1	30.7	29.6	22.5	7.3	5.7	-1.6
Romania						9.7	16.7	20.5	21.2	0.7
Russian Fed.			only conifers assessed							
Slovak Republic			38.8	49.2	41.5	28.5	36.0	37.6	41.8	4.2
Slovenia				22.6	18.2	15.9		19.0	16.0	-3.0
Spain d)			7.6	4.5	4.6	7.3	12.3	13.0	19.4	6.4
Sweden			only conifers assessed							
Switzerland	12.0	15.0	12.0	12.0	17.0	19.0	16.0	18.0	22.6	4.6
Turkey										
Ukraine						6.4	16.3	21.5	32.4	10.9
United Kingdom e)		22.0	25.0	28.0	39.0	56.7	58.3	16.9	13.9	-3.0
Yugoslavia f)						9.8				

a) 16x16 km network after 1988. b) For 1986-1990, only data for former Federal Republic of Germany. c) Excluding maquis. d) Excluding Canary Islands. e) The difference between 1992 and subsequent years is mainly due to a change of assessment method in line with that used in other States. f) Former Yugoslavia; Croatia and Slovenia excluded from 1991 results.

Annex VI

DEFOLIATION OF CONIFERS (1986-1994)

Participating countries	Conifers									% change
	Defoliation classes 2-4									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1993/1994
Austria				10.1	8.3	7.0	6.6	8.2	7.9	-0.3
Belarus				76.0	57.0		33.7	33.8	43.0	9.2
Belgium				20.4	23.6	23.4	23.0	18.3	21.2	2.9
Bulgaria	4.7	3.8	7.6	32.9	37.4	26.5	25.5	26.9	25.0	-1.9
Croatia							26.3	33.9	39.3	5.4
Czech Republic							58.4	52.7	61.2	8.5
Denmark		24.0	21.0	24.0	18.8	31.4	28.6	37.0	38.7	1.7
Estonia			9.0	28.5	20.0	28.0	29.5	21.2	16.0	-5.2
Finland		13.5	17.0	18.7	18.0	17.2	15.2	15.6	13.1	-2.5
France a)	12.5	12.0	9.1	7.3	6.6	6.7	7.1	8.2	8.2	0.0
Germany b)	19.5	15.9	14.0	13.2	15.0	24.8	23.8	21.4	21.6	0.2
Greece			7.7	6.7	10.0	7.2	12.3	13.9	13.2	-0.7
Hungary			9.4	13.3	23.3	17.8	20.1	20.1	21.2	1.1
Ireland		0.0	4.8	13.2	5.4	15.0	15.7	29.6	19.7	-9.9
Italy				9.2	12.8	13.8	17.2	15.1	15.0	-0.1
Latvia					43.0		45.0	41.0	34.0	-7.0
Liechtenstein	22.0	27.0	23.0	12.4			18.0			
Lithuania			3.0	24.0	22.9	27.8	17.5	29.2	26.3	-2.9
Luxembourg	4.2	3.8	11.1	9.5			6.3	9.0	12.8	3.8
Rep. of Moldova								45.2		
Netherlands	28.9	18.7	14.5	17.7	21.4	21.4	34.7	30.6	27.7	-2.9
Norway			20.8	14.8	17.1	19.0	23.4	20.9	22.4	1.5
Poland			24.2	34.5	40.7	46.9	50.3	50.8	55.6	4.8
Portugal			1.7	9.8	25.7	19.8	11.3	7.1	5.4	-1.7
Romania						6.9	10.9	16.6	15.5	-1.1
Russian Fed. c)						4.2	5.2	4.5	7.6	3.1
Slovak Republic			52.7	59.1	55.5	38.5	44.0	49.9	50.3	0.4
Slovenia					34.6	31.3		27.0	19.0	-8.0
Spain d)			7.7	4.7	4.4	7.2	13.5	14.7	19.6	4.9
Sweden		5.6	12.3	12.9	16.1	12.3	16.9	10.6	16.2	5.6
Switzerland	14.0	16.0	14.0	18.0	20.0	24.0	19.0	20.0	26.0	6.0
Turkey										
Ukraine				1.4	3.0	6.4	13.8	21.7	34.8	13.1
United Kingdom e)		23.0	27.0	34.0	45.0	51.5	52.7	16.8	15.0	-1.8
Yugoslavia f)	23.0	16.1	17.5	39.1	34.6	15.9				

a) 16x16 km network after 1988. b) For 1986-1990, only data for former Federal Republic of Germany.
c) For 1993-1994, only data for Leningrad Region. d) Excluding Canary Islands.
e) The difference between 1992 and subsequent years is mainly due to a change of assessment method in line with that used in other States.
f) Former Yugoslavia; Croatia and Slovenia excluded from 1991 results.

Annex VII

DEFOLIATION OF BROADLEAVES (1986-1994)

Participating countries	Broadleaves									% change
	Defoliation classes 2-4									
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1993/1994
Austria				15.7	14.9	11.1	9.3	7.7	7.4	-0.3
Belarus				33.4	45.0		14.8	16.6	18.6	2.0
Belgium				8.7	10.0	13.5	11.8	11.7	12.8	1.1
Bulgaria	4.0	3.1	8.8	16.2	17.3	15.3	18.0	16.6	34.4	17.8
Croatia							13.6	15.6	26.4	10.8
Czech Republic							31.9	55.1	48.9	-6.2
Denmark		20.0	14.0	30.0	25.4	27.3	21.2	27.0	32.4	5.4
Estonia				only conifers assessed				1.1	2.0	0.9
Finland		4.7	7.9	12.6	11.6	7.7	10.1	12.8	12.0	-0.8
France a)	4.8	6.5	5.3	4.8	7.7	7.4	8.5	8.4	8.4	0.0
Germany b)	16.8	19.2	16.5	20.4	23.8	26.5	32.0	29.9	30.1	0.2
Greece			28.5	18.4	26.5	28.5	25.0	29.8	35.0	5.2
Hungary			7.0	12.5	21.5	19.9	21.8	21.2	21.8	0.6
Ireland				only conifers assessed						
Italy		3.6	2.9	9.5	15.4	17.1	18.5	18.3	20.7	2.4
Latvia					27.0		19.0	17.8	15.0	-2.8
Liechtenstein	10.0	7.0	5.0	9.0			8.0			
Lithuania			1.0	16.0	15.8	14.9	17.6	23.8	23.3	-0.5
Luxembourg	5.6	10.1	12.3	13.9		33.9	30.5	31.0	46.8	15.8
Rep. of Moldova								50.9	21.9	-29.0
Netherlands	13.2	26.5	25.4	13.1	11.5	9.4	31.1	13.1	5.1	-8.0
Norway					18.2	25.1	38.9	42.1	47.6	5.5
Poland			7.1	17.7	25.6	34.8	40.4	45.6	51.5	5.9
Portugal			0.8	8.6	34.1	36.6	29.1	7.5	5.8	-1.7
Romania						10.4	18.4	21.4	22.9	1.5
Russian Fed.				only conifers assessed						
Slovak Republic			28.5	41.8	31.3	21.1	30.0	29.1	35.6	6.5
Slovenia					4.4	5.8		11.0	13.0	2.0
Spain c)			7.4	4.2	4.8	7.4	11.2	11.4	19.3	7.9
Sweden				only conifers assessed						
Switzerland	8.0	13.0	6.0	5.0	13.0	15.0	11.0	13.0	16.2	3.2
Turkey										
Ukraine				1.4	2.7	6.5	20.2	21.6	29.9	8.3
United Kingdom d)		20.0	20.0	21.0	28.8	65.6	67.8	17.1	12.4	-4.7
Yugoslavia e)		7.3	9.0	8.2	4.4	8.2				

a) 16x16 km network after 1988. b) For 1986-1990, only data for former Federal Republic of Germany. c) Excluding Canary Islands. d) The difference between 1992 and subsequent years is mainly due to a change of assessment method in line with that used in other States.
e) Former Yugoslavia; Croatia and Slovenia excluded from 1991 results.

Annex VIII

MAIN SPECIES REFERRED TO IN THE TEXT

Botanical name	Danish	Dutch	English	Finnish
Fagus sylvatica	Bøg	Beuk	Common beech	Pyökki
Quercus petraea	Vintereg	Wintereik	Sessile oak	Talvitammi
Quercus robur	Stilkeg	Zomereik	European oak	Metsätammi
Quercus ilex	Steneg	Steeneik	Holm oak	Rautatammi
Quercus suber	Korkeg	Kurkeik	Cork oak	Korkkitammi
Pinus sylvestris	Skovfyr	Grove den	Scots pine	Metsämänty
Pinus nigra	Østrisk fyr	Oostenrijkse/ Corsicaanse zwarte den	Corsican/Austrian black pine	Euroopanmusta-mänty
Pinus pinaster	Strandfyr	Zeeden	Maritime pine	Rannikkomänty
Pinus halepensis	Aleppofyr	Aleppoden	Aleppo pine	Aleponmänty
Picea abies	Rødgran	Fijnspar	Norway spruce	Metsäkuusi
Picea sitchensis	Sitkagran	Sitkaspar	Sitka spruce	Sitkankuusi
Abies alba	Ædelgran	Zilverden	Silver fir	Saksanpihta
Larix decidua	Lærk	Europese lariks	European larch	Euroopanlehti-kuusi

Botanical name	French	German	Greek	Italian
Fagus sylvatica	Hêtre	Rotbuche	Οξυά δασική	Faggio
Quercus petraea	Chêne rouvre	Traubeneiche	Δρυς απόδισκος	Rovere
Quercus robur	Chêne pédonculé	Stieleiche	Δρυς ποδισκοφόρος	Farnia
Quercus ilex	Chêne vert	Steineiche	Αριά	Leccio
Quercus suber	Chêne liège	Korkeiche	Φελλοδρύς	Sughera
Pinus sylvestris	Pin sylvestre	Gemeine Kiefer	Δασική πεύκη	Pino silvestre
Pinus nigra	Pin noir	Schwarzkiefer	Μαύρη πεύκη	Pino nero
Pinus pinaster	Pin maritime	Seestrandkiefer	Θαλασσία πεύκη	Pino marittimo
Pinus halepensis	Pin d'Alep	Aleppokiefer	Χαλέπιος πεύκη	Pino d'Aleppo
Picea abies	Epicéa commun	Rotfichte	Ερυθρελάτη υψηλή	Abete rosso
Picea sitchensis	Epicéa de Sitka	Sitkafichte	Ερυθρελάτη	Picea di Sitka
Abies alba	Sapin pectiné	Weißtanne	Λευκή ελάτη	Abete bianco
Larix decidua	Mélèze d'Europe	Europäische Lärche	Λάριξ ευρωπαϊκή	Larice

Botanical name	Portuguese	Russian	Spanish	Swedish
Fagus sylvatica	Faia	бук лесной	Haya	Bok
Quercus petraea	Carvalho branco Americano	дуб скальный	Roble albar	Bergek
Quercus robur	Carvalho roble	дуб черещатый	Roble común	Ek
Quercus ilex	Azinheira	дуб каменный	Encina	Stenek
Quercus suber	Sobreiro	дуб пробковый	Alcornoque	Korkek
Pinus sylvestris	Pinheiro silvestre	сосна обыкновенная	Pino silvestre	Tall
Pinus nigra	Pinheiro Austríaco	сосна чёрная	Pino laricio	Svarttall
Pinus pinaster	Pinheiro bravo	сосна приморская	Pino negral	Terpentintall
Pinus halepensis	Pinheiro de alepo	сосна алеппская	Pino carrasco	Aleppotall
Picea abies	Picea	ель европейская	Abeto rojo	Gran
Picea sitchensis	Picea de Sitka	ель ситхинская	Picea de Sitka	Sitkagran
Abies alba	Abeto branco	пихта белая	Abeto común	Sivergran
Larix decidua	Larício Europeu	лиственница европейская	Alerce	Europeisklärk

For further information please contact:

Federal Research Centre for Forestry and Forest Products
PCC West of ICP Forests
Attention Dr. M. Lorenz, Mr. G. Becher, Mr. M. Förster
Leuschnerstr. 91
D-21031 HAMBURG

European Commision
DG VI F II.2
Rue de la Loi 130
B-1049 BRUSSELS