

**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

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# **Strategy of ICP Forests for the period of 2001 - 2006**



**Prepared by:**

**Federal Research Centre  
for Forestry and Forest Products (BFH)**



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**International Co-operative Programme on Assessment and Monitoring**  
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## **Contents**

<b>I. Introduction</b> .....	1
<b>II. Mandate and objectives of ICP Forests</b> .....	2
<b>III. Monitoring activities</b> .....	3
III.1 General considerations .....	3
III.2 Monitoring activities at Level I .....	3
III.3 Monitoring activities at Level II .....	5
III.4 Integrated evaluations .....	6
<b>IV. Policy implications</b> .....	7
<b>Annexes</b> .....	8
Annex 1: Programme implementations .....	9
Annex 2: Addresses of National Focal Centres .....	13
Annex 3: Members and deputy members of the Scientific Advisory Group (SAG) .....	17
Annex 4: List of selected relevant publications of ICP Forests and EU .....	19

## I. Introduction

In response to widespread concern that air pollution could affect forest condition, the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was established under the UN/ECE Convention on Long-range Transboundary Air Pollution (CLRTAP) in 1985. One year later the European Union (EU) adopted the scheme on the protection of forests against atmospheric pollution and with Regulation (EEC) No. 3528/86 the legal basis for co-financing of relevant assessments was provided. The monitoring activities pursue the objectives of Resolution S1 of the Strasbourg, Resolution H1 of the Helsinki and Resolution L2 of the Lisbon Ministerial Conference on the protection of Forests in Europe. The results of ICP Forests also contribute to the discussion on global forest policy, such as the Intergovernmental Forum on Forests leading to the United Nations Forest Forum and other important discussion forums such as the World Forestry Congress.

Since 1986 the monitoring of forest condition and its development has been carried out under both programmes in close co-operation. At present, 37 European countries as well as the United States of America and Canada are participating in the programmes, which include assessments according to harmonised methods (see ICP Forests

Manual) and which have developed as an important platform for the exchange of expert knowledge. Results of ICP Forests provide the scientific basis for political decisions on air pollution control and thus contribute to the elaboration and review of protocols of the Geneva Convention on Long-Range Transboundary Air Pollution (CLRTAP). Moreover, the wealth of the ICP Forests data for other environment related policies has only recently been investigated. In particular, ICP Forests monitoring activities can be expected to contribute to other aspects of relevance for forest policy, such as effects of climate change on forests, sustainable forest management and biodiversity in forests.

In 1997, at its 13<sup>th</sup> Task Force meeting ICP Forests decided to carry out an internal review of its programme. It was agreed that the results of this review should be presented to the 16<sup>th</sup> Task Force meeting in 2000 for discussion and adoption. As a consequence the ICP Forests programme has been updated as described in this document. The update is based on discussions with DG AGRI of the European Commission. Substantial contributions were received from all Expert Panels, the Programme Coordinating Group and the Programme Task Force of ICP Forests. The contributions and assistance received are gratefully acknowledged.

## II. Mandate and objectives of ICP Forests

Launched by the Executive Body of the CLRTAP as a reaction to widespread forest damage which was supposed to be a possible effect of long range transboundary air pollution, ICP Forests was mandated to monitor air pollution effects on forests and to contribute to a better understanding of cause-effect relationships (ECE/EB.AIR/7).

After a decade of monitoring it became obvious, that forests are affected by a complex of anthropogenic and natural stresses.

Air pollution continues to be regarded as an important stress factor. However the importance of atmospheric pollution varies, its impact depends

on the region and its effects on site and stand conditions. Air pollution and its effects on forest ecosystems are complex and difficult to isolate and quantify. A large number of other stress factors also have an influence on forest condition and must therefore be taken into consideration.

Therefore, the ICP Forests **mandate** is:

- to monitor effects of anthropogenic (in particular air pollution) and natural stress factors on the condition and development of forest ecosystems in Europe and
- to contribute to a better understanding of cause-effect relationships in forest ecosystem functioning in various parts of Europe.

*Based on its mandate, ICP Forests pursues the following objectives:*

- (a) to provide a periodic overview on the spatial and temporal variation in forest condition in relation to anthropogenic (in particular air pollution) as well as natural stress factors on an European and national large-scale systematic network (Level I),
- (b) to contribute to a better understanding of the relationships between the condition of forest ecosystems and anthropogenic (in particular air pollution) as well as natural stress factors through intensive monitoring on a number of selected permanent observation plots spread over Europe (Level II) and to study the development of important forest ecosystems in Europe,
- (c) to provide a deeper insight into the interactions between the various components of forest ecosystems by compiling available information from related studies,
- (d) to contribute in close co-operation with the ICP on Modelling and Mapping to the calculation of critical levels/loads and their exceedances in forests and to improve collaboration with other environmental monitoring programmes inside and outside the CLRTAP,
- (e) to contribute by means of the monitoring activities to other aspects of relevance for forest policy at national, pan-European and global level, such as effects of climate changes on forests, sustainable forest management and biodiversity in forests,
- (f) to provide policy-makers and the general public with relevant information.

The proper implementation of this mandate and these objectives implies a continuation of the monitoring activities by the participating coun-

tries and the careful evaluation and reporting of the data.

## III. Monitoring activities

### III.1 General considerations

In 1985 the participating countries agreed that ICP Forests should fulfil its objectives and mandate by means of assessments on a large-scale 16×16 km grid (Level I) and intensive monitoring on Level II plots.

From 1989 most of the Level I plots have been included in the European survey summing up to 5700 plots nowadays. Since then annual crown condition assessments have been carried out and on most of the plots soil condition and the chemical contents of needle and leaves have been assessed. In 1994, after having agreed on harmonised methods, the selection and installation of the Level II plots commenced. In the meantime most of the Level II plots (870) have been selected and installed and continuous monitoring of site and stress factors as well as on the biological and chemical ecosystem condition is underway. A broad monitoring approach has been chosen by ICP Forests in order to be able to analyse the wide range of factors influencing forest condition.

Based on the results of the monitoring activities ICP Forests was and will be in the position to inform the public on forest condition in Europe and relevant trends. In addition important cause-effect relationships were described, however further efforts are needed in this field.

Whilst the evaluation of the Level II monitoring results is directed towards the identification of cause-effect relationships at the ecosystem level, the survey of crown condition and of soil and foliar chemistry at Level I remains indispensable for obtaining trends and for further integrated evaluations of large-scale data of ICP Forests and other programmes. In addition, by means of large-scale data, processes identified at the ecosystem level may be upscaled to the regional and European level. This requires a careful evaluation of the parameters needed at both monitoring levels in order to ensure a statistically sound upscaling. For holistic views of the complex interrelationships between the manifold causes and effects characterising forest condition at both the small and the large scale, the evaluations must not remain confined to the data of ICP Forests and EU, but should make use of all further data and information sources available from other programmes.

The proper assessment of high quality data and their careful evaluation and interpretation at national and European level will remain of high importance. However, a continuation of these activities will ask for sufficient budget resources at national and European level.



### III.2 Monitoring activities at Level I

For monitoring forest condition and its spatial and temporal changes on a large scale and over a necessary period of time, the so-called Level I network has been established. The Level I system covers the main forests in Europe adequately. The Level I

network consists of approximately 5700 monitoring plots, which are systematically arranged in a nominal 16×16km grid throughout Europe. In addition several countries are executing surveys at a denser national gridnet in order to obtain reliable estimates at national and regional level.

## Crown condition assessment

Crown condition at Level I has proven to be a valuable tool for detecting status and trends of tree condition in Europe. Therefore it is proposed to continue these assessments in the future.

Crown condition is assessed at European level annually at all of the 16×16km Level I points.

The main parameters to be assessed are:

- defoliation/crown transparency
- discolouration
- stand and site characteristics which support the interpretability of the crown condition results and serve as a basis for upscaling Level II results.

Quality assurance has been a matter of particular concern in this part of the programme. In order to detect, discuss and manage differences in methods applied by the countries inter-calibration courses are being offered annually. However to ensure time consistency of national data, differences between countries are accepted. As a result of the internal review and in order to further improve quality assurance, different activities are being developed. Examples are the development

of new concepts and methods for International Intercalibration Courses (ad hoc group chaired by Italy) and the use of digital image processing (ad hoc group chaired by the United Kingdom).

Further details on assessment methods, analysis methods, quality control and data submission are described in part II of the Manual.

### Assessment of the occurrence of identifiable damage causes

Biotic factors can have both a positive or negative effect on forest condition. Occasionally however, crown condition may be seriously affected by damage types caused by e.g. insect pests or fungal diseases.

The presence of these damaging factors is included in the crown condition assessments. A further improvement of the assessment methods will contribute to a better understanding of their influence on tree vitality and is in line with the recommendations from the internal review. Details on definition, intensity of causes, classification of results and data submission will be proposed by an ad hoc group chaired by Belgium-Flanders.

## Forest Soil Condition survey

There are clear correlations between forest soil chemistry and the deposition of acidity and heavy metals. Therefore the soil condition assessment at Level I provides information on soil related stress factors for forest condition with respect to nutrient imbalances and soil condition.

A first forest soil survey was executed by 23 countries in the years 1994/95.

The main objectives of a second soil survey are

- to provide information on changes in soil chemistry,
- to complete soil information at the European

level

- to assess relevant soil parameters, soil layers and plots not considered in the first survey.

Countries willing to carry out a second forest soil survey should sample in the years 2004-2006 on the understanding that the following questions are clarified prior to the start of the assessment:

- Completion of clearly defined and recommended sampling and analytical methods,
- Control of the quality of the analytical methods applied by means of an interlaboratory comparison including practical measures to improve quality assurance,

- In principle all Level I plots will be taken into consideration. However as several countries are recommending to sample only on a selection of plots, the selection criteria for those areas with reduced sampling coverage need to be specified.
- Verification of the relevance of soil data for the Convention on Climate Change.

FSCC and the Expert Panel on Soil are invited to take the necessary steps for clarification.

Details on assessment methods, analysis methods, quality control and data submission will be described in part III of the Manual.

## Forest Foliar Survey

The monitoring of tree nutrition is essential for assessing forest condition, as changes in forest condition may manifest themselves in foliar nutrient concentrations. The main objective of the foliar survey is to monitor the nutritional status of forest trees.

Few countries (16) have analysed the chemical composition of the foliage of Level I sample trees

in the years 1994/95. The data base on tree nutrition at European level is therefore incomplete and needs to be amended.

Countries willing to carry out the foliar survey should sample in the year 2005. Needle and leaf samples should be taken according to the assessment methods, analysis methods, quality control and data submission described in part IV of the Manual.



## III.3 Monitoring activities at Level II

For the intensive monitoring programme (so called Level II-programme) more than 860 permanent observation plots have been established with the aim of in-

vestigating key factors and processes at the ecosystem scale. Plots have been selected in such a way that major forest ecosystems are represented following general recommendations by ICP Forests.

*The following surveys are carried out on Level II plots:*

<b>Survey</b>	<b>Frequency</b>	<b>Intensity</b>
a. Crown condition	at least annually	all plots
b. Soil (solid phase)	every 10 years	all plots
c. Soil solution	continuous	part of the plots
d. Foliage	every 2 years	all plots
e. Deposition	continuous	part of the plots
f. Ambient air quality	continuous	part of the plots
g. Meteorology	continuous	part of the plots
h. Forest growth	every 5 years	all plots
i. Ground Vegetation	every 5 years	all plots
j. Phenology	several times per year	optional
k. Remote Sensing	preferably at plot installation	optional



The Level II approach asks for an integration of the data from various monitoring surveys. The integration of crown condition development patterns including crown morphology with other tree parameters like biotic diseases, growth and phenological parameters will help for example in contributing to the understanding of cause effect relationships.

The monitoring of the complete set of surveys on as many plots as possible is important. In particular it is recommended to concentrate the continuous measurements on soil solution, meteorological parameters and deposition, ambient air quality measurements at the same plot if it is not possible to equip all plots in a country. This may for financial reasons reduce the possibilities to install additional plots.

If all measurements mentioned under points a-i are carried out at the same plot, this plot is then called a key plot. All countries are invited to establish at least 10% of their Level II plots as key plots. While all Level

II plots contribute to a better understanding of the cause-effect relationship (objective b) the key plots will provide the supplementary information necessary to fulfil objective c described in chapter II.

Presently two temporary ad hoc working groups of the Expert Panel on Crown Condition are elaborating proposals for techniques of harmonised litterfall assessment (chaired by France) and on the assessment of the occurrence of identifiable damage causes (chaired by Belgium-Flanders). This work is done in close co-operation with other Expert Panels concerned (e.g. EP on Meteorology and Phenology, EP on Forest Growth, EP on Soil and Soil Solution, EP on Foliage). Both assessments will improve the multiple use of the assessment data and support integrated evaluations.

Details on assessment methods, analysis methods, quality control and data submission are described in part II-VIII of the Manual.



### III.4 Integrated evaluations

The surveys on the Level I and Level II plots provide a valuable source of information for further integrated studies.

Integrated approaches include statistical evaluations applied to data collected within different fields of forest and related ecosystem research. They aim to clarify relations between tree condition features as response parameters and anthropogenic as well as natural stress factors as predictors. They also include modelling approaches related to:

- the fate of elements in the forest ecosystem (e.g. the occurrence of N saturation or Al release), allowing the calculation of critical loads,
- the long-term impact of atmospheric input on nutrient cycling in soil and soil solution chemistry
- the impact of meteorological and soil factors

and deposition on tree growth and species diversity of the ground vegetation.

All these modelling approaches require information from surveys on deposition, meteorology, growth, crown condition, foliage, ground vegetation, soil and soil solution. They are indispensable tools for assessing the impact of policy decisions regarding reductions of depositions.

The integrated evaluation of the existing data as well as of newly generated ones will however require an intensive cooperation between the responsible bodies.

The integrated evaluations will also in the future require the necessary funding for specialised statisticians in the evaluating data centres. The complex results will have to be interpreted with caution and in such a way that they provide understandable information for the public as well as for policy makers.

## IV. Policy implications

Approximately one third of Europe is covered with forest. Forests have high economic, ecological and social values which have to be preserved. In rural areas forest and forest industries create a source of valuable income. Sustainable forest management supplies the demand for the renewable material wood and other forest products. Forests also ensure water reserves, protect against soil erosion and avalanches and provide habitat for flora and fauna. Forests are increasingly accepted as recreational areas by the public. For all these functions forests in Europe have to be stable and healthy.

For the ICPs under the Working Group on Effects as well as for the scientific community the Level I and Level II plots of ICP Forests provide an excellent basis for evaluations of the effects of air pollution on forest ecosystems. ICP Forests and its NFCs are looking forward to a close co-operation at regional, national and European level. In addition, special reports and contributions are targeted for the scientific com-

munity. ICP Forests monitoring activities will contribute to other relevant forest issues such as carbon sequestration, climate change, sustainable forest management and changes in biodiversity.

With its approximately 5700 Level I and 860 Level II plots the pan-European monitoring system of ICP Forests and EU offers a unique source of information on the condition of forest ecosystems. The data gathered in this programme and their evaluation are of great interest for policy making processes not only in the field of environmental protection but also for different kinds of forest policy items, such as sustainable forest management, biodiversity in forest or the effects of climate change on forest ecosystems. Thus the monitoring system of ICP Forests provides a cost-effective multifunctional monitoring approach. ICP Forests offer its various results in print media (e.g. annual Executive Reports) and via Internet (webpage: <http://dainet.de/bfh/inst1/12>) (see Annex 4).

# **Annexes**

# Annexes

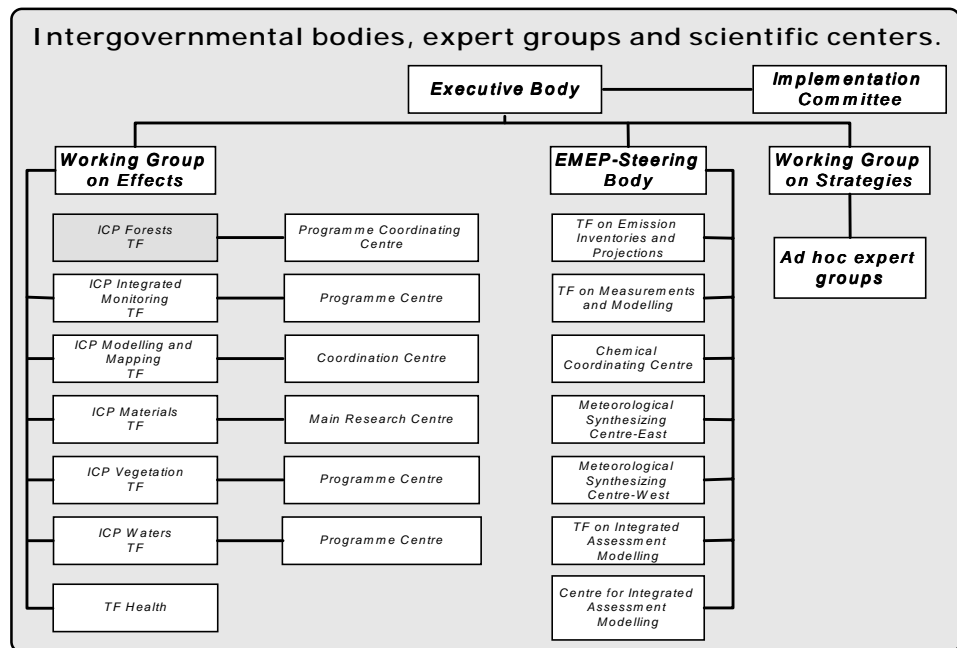
## Annex 1: Programme Implementation

### A1.1 Structure of ICP Forests

ICP Forests was established in 1985 under the UN/ECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and oper-

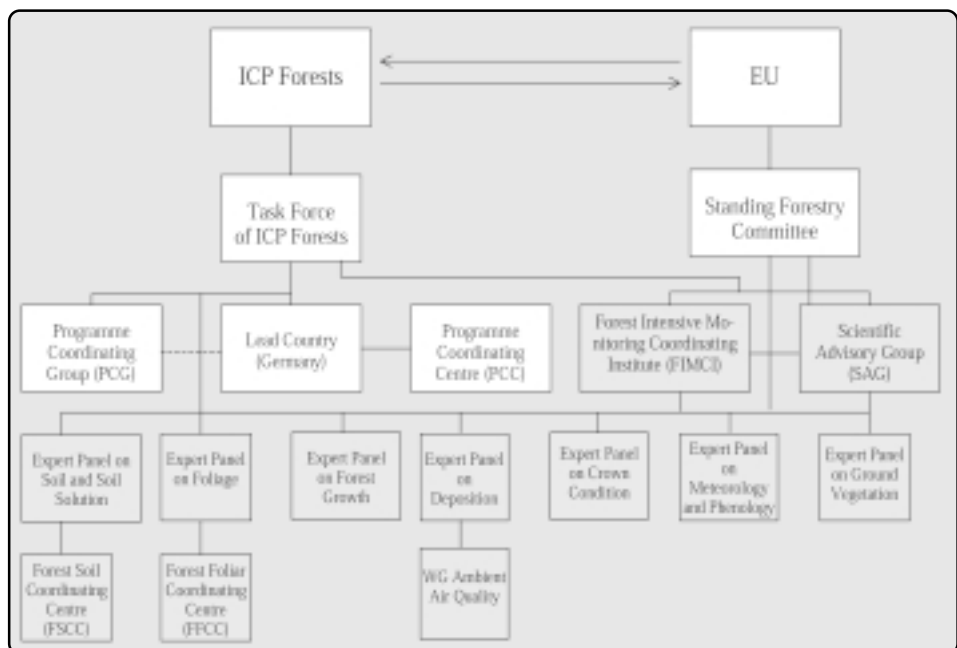
ates under the Working Group on Effects (WGE). The subsidiary bodies of the Convention are shown in Figure 1.

**Figure 1:**  
Bodies under the Convention on Long-range Transboundary Air Pollution.



The structure of ICP Forests is shown in Figure 2. Germany was appointed as Lead Country.

**Figure 2:**  
Bodies of ICP Forests.  
*In grey:* Bodies active at Pan-European level in the framework of ICP Forests and the EU Scheme on the Protection of Forests Against Atmospheric Pollution.



The programme is steered by its Task Force, in which 37 participating countries and the European Commission (EC) are represented. Each participating country maintains a National Focal Centre (NFC) (see Annex 2). Programme co-ordination, storage of relevant parts of the data as well as evaluations and reports with emphasis on crown condition at Level I are entrusted to the Programme Co-ordinating Centre (PCC). The Forest Soil Coordinating Centre (FSCC) is entrusted with the collection and evaluation of the soil data. In the field of the foliar data this work is carried out by the Forest Foliar Co-ordinating Centre (FFCC).

Monitoring at Level I and Level II is carried out in form of a pan-European programme of EU and ICP Forests.

In response to the demand for harmonised monitoring at both levels, Expert Panels were established which were mandated to develop and maintain suitable and up to date methods and to support proper data evaluation at the European level. These are the Expert Panel (EP) on Soil and Soil Solution, the EP on Foliage, the EP on Forest Growth, the EP on Deposition with its working group on ambient air quality, the EP on Crown Condition, the EP on Ground Vegetation and the EP on Meteorology and Phenology. The EU Working Group on Remote Sensing is also contributing to the work of ICP Forests.

The co-ordination, the data management and the reporting at Level II are carried out by the Forest Intensive Monitoring Co-ordinating Institute (FIMCI) being a consultant of the EC. FIMCI manages the Level II data of EU and non-EU countries. The evaluations are advised by a Scientific Advisory Group (SAG), in which experts from non-EU countries are also represented (see Annex 3).

### **A1.2 Task Force of ICP Forests**

The programme is steered by its Task Force, in which 37 participating countries and the Eu-

ropean Commission (EC) are represented. The Task Force is the highest body of ICP Forests. All relevant programme issues have to be presented to the Task Force. The Chairman supported by the Lead Country prepare, convene and chair these annual meetings.

### **A1.3 Task of the Lead Country**

The Lead Country represents ICP Forests in the Working Group on Effects, maintains a close co-operation with the European Commission and is the contact point with other monitoring programmes within and outside the Convention.

The task of the Lead Country is in addition to support the Chairman to prepare, convene and chair the annual meetings of the Task Force. The Lead Country also convenes and chairs meetings of the Programme Co-ordinating Group.

### **A1.4 Task of the Programme Co-ordinating Group (PCG)**

The Programme Co-ordinating Group has the task to promote and supervise a continuous review of the programme and to support the Chairman in all issues of relevance for the future scheme of the programme. Recommendations of the PCG are directed to the Task Force of ICP Forests. To meet these tasks the PCG needs to convene regularly. Members of the PCG are the Chairman of ICP Forests, the Lead Country, PCC, EC and the Expert Panel chairpersons. At these meetings the European Commission may be accompanied by the Chairman of the Scientific Advisory Group and FIMCI whenever appropriate. A participation of representatives of NFCs can also be considered.

### **A1.5 Task of the Programme Co-ordinating Centre (PCC)**

The PCC in Hamburg is entrusted with a broad range of tasks in the fields of programme management, data processing, evaluations and reporting.

The co-ordinating activities consist of assistance to the Lead Country in the administration and further development of the programme, the discussion of methods and evaluation strategies with experts as well as the organisation of intercalibration courses in close co-operation with the Expert Panel on Crown Condition and the EC.

PCC keeps copies of all relevant parts of the data of ICP Forests and the EU scheme in order to make them available under the specific rules of the Executive Body and the EU. In accordance with the programme objectives, PCC in close co-operation with FIMCI and other relevant institutions concentrate on the following points:

- Execution of integrated evaluations of Level I crown, soil and foliar data and relevant external data from other large-scale survey,
- Extrapolation of relationships identified for Level II with available data at Level I plots,
- Further improvement of the understanding of cause-effect relationship by means of in-depth studies including literature reviews,
- Stimulation of common activities with other ICPs under the Working Group on Effects (e.g. common intercalibration course, common ringtests, common workshops),
- Improved co-operation with other international programmes for common evaluation projects.

ICP Forests and the EU have been sharing a common reporting system since 1992.

This system comprises annual Executive Reports which provide a general overview on the monitoring results and its interpretation with respect to relevant results of forest damage research as well as on special topics. The target group for the Executive Report is a broad one, ranging from politicians across NGOs

and environmentalists to forest owners and the general public.

The scientific and technical basis for the Executive Reports are provided by Technical Reports. The Technical Reports on the results of the activities at Level I may vary between a yearly and biannually publication. The target group for these reports are scientists and other experts involved in the work.

PCC is responsible for elaborating the annual Executive Reports and the technical Level I reports.

In comparison to printed media, the Internet will gain increasing importance for the dissemination of results to all target groups. Besides continuously updated basic information on the programme, PCC will regularly provide the latest findings of all surveys on its website.

#### **A1.6 Task of the Forest Intensive Monitoring Co-ordinating Institute (FIMCI) and the Scientific Advisory Group (SAG)**

The co-ordination, the data management and the reporting at Level II are carried out by the Forest Intensive Monitoring Co-ordinating Institute (FIMCI).

Special focus for the coming years will be paid to the following points to be carried out by FIMCI and other institutions:

- Assessment of the responses of forest ecosystems to changes in air pollution by deriving trends in stress factors and ecosystem condition,
- Calculation of critical loads of atmospheric deposition (related to the chemical ecosystem condition) in relation to present loads by evaluating the fate of atmospheric pollutants in the ecosystem in terms of accumulation, release and leaching,
- Study of the impacts of future scenarios of atmospheric deposition on the ecosystem condition,

- Contribution to research on cause-effect relationships such as the investigation of relationships between atmospheric pollution and soil solution chemistry (assessment of input-output budgets) and of the relationships between crown condition and the chemical ecosystem condition,
- Stimulation of common activities with other ICPs under the Working Group on Effects (e.g. common evaluation projects),
- Improved co-operation with other international programmes for common evaluation projects,
- Update of the evaluation strategy, if required,
- Completion of the Level II database.

The scientific and technical basis for the Executive Reports are also provided by Technical Reports on the intensive monitoring elaborated by FIMCI.

### **Scientific Advisory Group (SAG)**

The evaluations of the Level II data are advised by a Scientific Advisory Group (SAG). The SAG consists of a group of persons with specific scientific, technical and geographical experience needed to evaluate the Level II results. Also experts from non-EU countries are represented. These will be appointed by the Task Force (see Annex 3).

The SAG has the tasks to act as a link between the participating countries and FIMCI and to give advice to the NFCs on requests for data release by external institutions. In order to guarantee a good relation with the Expert Panels, the relevant Chairpersons could be invited to meetings of the SAG.

### **A1.7 Task of the Expert Panels (EP)**

The Expert Panels of ICP Forests have the task to further develop the harmonised methods as laid down in the Manual. The Panels cooperate closely with the co-ordinating cen-

tres for data evaluation (PCC and FIMCI) in order to contribute to the data evaluation and quality assurance.

A main task for the Expert Panels is to further support an integrated monitoring and data evaluation approach. For such a specific purpose and for a short period of time only, ad hoc working groups may be established (e.g. ad hoc group on Litterfall) consisting of representatives from different Expert Panels. Also combined Expert Panel meetings may help supporting this aim.

### **A1.8 Task of the National Focal Centres (NFC)**

The NFCs are nominated and financed by the participating countries. They are responsible for the collection, validation, evaluation and storage of their monitoring data and aggregation of national data in accordance with the ICP Forests Manual. The NFCs and their responsible agencies have to ensure that the data is collected according to the methods described in the Manual and that the quality assurance programme has been applied. The NFCs evaluate and interpret their national data. In the last years an enormous potential for evaluation and advancement of knowledge of forest ecosystems have been gained at national level. Increasing attention also at national level is paid to integrated data evaluations.

The NFCs have the task to submit the Level I and Level II data and accompanying information to PCC and FIMCI respectively in accordance with the deadlines agreed and the format laid down in the Manual. The NFCs are invited to participate in the evaluation and interpretation of the data at European level.

## Annex 2: Addresses of National Focal Centres

### Albania

Forest and Pasture Research Institute  
Section of Protection  
Rauga "Halil Bega" nr. 23  
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markus.neumann@fbva.bmlf.gv.at/  
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### Belarus

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### Belgium Wallonia

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Mr. E. Gérard

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### Bulgaria

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e-mail: pafmon@nfp-bgeionet.eu.int  
Ms. Penka Stoichkova / Mr. Dimitar Kantardjiev

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Mr. Kalle Karoles, Director

### **Finland**

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Mr. Hannu Raitio

### **France**

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## **Annex 4: List of selected relevant publications of ICP Forests and EU**

### **Annual Executive Report on Forest Condition in Europe (reports of previous years upon request):**

Fischer, R., De Vries, W., Seidling, W., Kennedy, P., Lorenz, M. 2000. Forest Condition in Europe. 2000 Executive Report. UN/ECE and EC, Geneva, Brussels. 33 p.

### **Annual Technical Report on Forest Condition in Europe (reports of previous years upon request):**

Lorenz, M., Becher, G., Fischer, R., Seidling, W. 2000. Forest Condition in Europe. 2000 Technical Report. UN/ECE and EC, Geneva, Brussels. 86 p.

### **Annual Technical Report on Intensive Monitoring of Forest Ecosystems in Europe (reports of previous years upon request):**

De Vries, W.; G.J. Reinds; M. Kerkvooorde, C.M.A. Hendriks; E.E.J.M. Leeters; C.P. Gros; J.C.H. Voogd; E.M. Vel. 2000. Intensive Monitoring of Forest Ecosystems in Europe, Technical Report 2000. EC and UN/ECE, Brussels, Geneva, 193 p.

### **Others:**

**Anonymus.** 1998. Manual on methodologies and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests. UN/ECE, Hamburg, Geneva.

**Augustin, S. and H. Andreae (Eds.).** 1998. Cause-effect-interrelations in forest condition – State of current knowledge. UN/ECE and EC. Geneva, Brussels, 52 p.

**Müller-Edzards, J.W. Erisman & W. De Vries.** 1997. 10 Years Forest Condition Monitoring in Europe: Studies on Temporal Development, Spatial Distribution and Impacts of Natural and Anthropogenic Stress Factors. Technical Background Report. EC and UN/ECE, Brussels, Geneva. 350 p.

**Seidling, W.** 2000. Multivariate Statistics within Integrated Studies on Tree Crown Condition in Europe – an Overview. UN/ECE and EC, Geneva, Brussels, 101 p.

**Stefan, K., Fürst, A., Hacker, R., Bartels, U.** 1997. Forest Foliar Condition in Europe. Technical Report. Austrian Federal Forest Research Centre, EC, UN/ECE, Vienna, Brussels, Geneva. 184 p.

**Vanmechelen, L., Groenemans, R., Van Ranst, E.** 1997. Forest Soil Condition in Europe. Technical Report. Ministry of the Flemish Community, EC and UN/ECE, Brussels, Geneva. 257 p.

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