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PRESENT STATUS AND PROPOSED STRATEGY FOR FURTHER DEVELOPING
THE INTERNATIONAL COOPERATIVE PROGRAMME ON ASSESSMENT AND MONITORING OF
AIR POLLUTION EFFECTS UNTIL YEAR 2001

(Strategy paper adopted by the Task Force on ICP Forests
at its fourteenth meeting)

I. INTRODUCTION

1. In response to the growing concern about the forest damage caused by air pollution, the Executive Body, in 1985, established the International Cooperative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). In 1986 the Member States of the European Union (EU) set up the European Union Scheme on the Protection of Forests against Atmospheric Pollution. Since then, ICP Forests in close cooperation with EU has monitored forest condition in Europe. Today, 35 European countries, the United States of America and Canada participate in the common monitoring programme.

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2. In 1997 at its thirteenth meeting, the Task Force on ICP Forests decided to review its strategy for the implementation and further development of the programme. The present document - its strategy paper - presents the programme's proposed strategy for the period 1998 - 2001:

- Chapter II describes the programme's present status with respect to its original objectives defined in 1985 and reviews its implementation since then;
- Chapter III describes the programme's priorities for the period 1998 - 2001 in view of its slightly revised objectives to meet the present requirements of the Executive Body and the Working Group on Effects;
- Chapter IV describes the programme's strategy and actions to be taken in the period 1998 - 2001 in order to meet the priorities presented in chapter III;
- Chapter V outlines the administrative tools needed to implement the strategy;
- Concluding chapter VI provides a short outlook for the period from 2002 onwards.

II. PRESENT STATUS OF THE PROGRAMME

A. Original objectives of the programme

3. Based on its mandate of 1985 (ECE/EB.AIR/7), ICP Forests has pursued the following objectives:

- (a) To gain knowledge of the spatial and temporal variation in forest condition and of its relationship to stress factors including air pollution on a regional, national and international scale (level I);
- (b) To contribute to a better understanding of the impact of air pollutants and other damaging factors on forest ecosystems and of the cause-effect relationships involved (level II);
- (c) To provide deeper insight into the interactions between the compartments of forest ecosystems under the influence of air pollution stress and other damaging factors (level III).

4. As each of these objectives required a different monitoring intensity, three monitoring levels (I, II and III) were defined (EB.AIR/WG.1/R.122). Levels I and II have already been implemented in close cooperation with the European Union. For this purpose, common methods and criteria for harmonized sampling, assessment, monitoring and analysis were agreed upon (see Manual of ICP Forests, fourth edition, and the relevant EU Regulations). Level III, a harmonized research programme at the European level, has not yet been implemented. However, the first steps have been taken in cooperation with ICP Integrated Monitoring to review and compare relevant parts of their two manuals.

B. Programme implementation

1. Programme status

5. Level I activities (to meet the first objective) - extensive large-scale annual monitoring of tree crown condition - have been carried out on a systematic network representing the forest area of 32 European countries. On parts of this network a soil and a foliar survey has also been carried out.

6. To meet the second objective, an intensive monitoring network of some 860 permanent observation plots has been established in 31 European countries (level II). The European Commission with its consultant, the Forest Intensive Monitoring Coordinating Institute (FIMCI), has set up a database with data on crown condition, soil and soil solution, chemical elements in foliage, increment, deposition and meteorology (EB.AIR/WG.1/1997/3 and EB.AIR/WG.1/1997/5). There are plans to submit information on ground vegetation of the level II plots. Data from 860 plots have been stored together with information on the applied data assessment methods, in order to provide an insight into data quality, comparability and evaluation possibilities. These data and assessment information are already available for use under the data rules laid down by the European Commission. FIMCI has begun to evaluate the data and the first proposals for in-depth studies by external institutes have been reviewed. The level II database provides a solid platform for in-depth studies to explain cause-effects relationships. However, it has to be emphasized that level II consists of selected plots and that comparisons between plots have to be made with great care.

7. For the third objective (level III), monitoring methods are being harmonized in cooperation with ICP Integrated Monitoring. A number of potential common monitoring sites have been identified and evaluations of the relevant scientific literature started. A paper on the effects of heavy metals on forest ecosystems was prepared and published in 1996.

8. Furthermore, ICP Forests in cooperation with the European Commission is now, within the provisions of the Executive Body and EU rules for data exchange, in a position to supply data to other international forums, e.g. the Temperate and Boreal Forest Resources Assessment (TBFRA 2000), the Intergovernmental Forum on Forests (IFF), as well as for the implementation of the relevant resolutions of the First and Second Ministerial Conference on the Protection of Forests in Europe. In this respect, the data that will ultimately be included in the ICP Forests/EU database will also help studies on biodiversity, and temporal and spatial variations in indicators related to sustainable forest management.

2. Main results of the programme

9. With respect to air pollution as one of the stress factors, large-scale monitoring (level I) has:

- (a) Given an insight into trends on crown condition throughout 2 million km² in Europe based on a systematic grid;
- (b) Set up databases on the chemical status of more than 4500 forest soil plots and on the nutritional status of trees on nearly 1400 plots;
- (c) Revealed the complexity of the cause-effect relationships involved in forest ecosystems with air pollution as one of the stress factors for forest condition;
- (d) Indicated for parts of Europe the spatial correspondence between deposition of air pollutants, acidification and heavy metal accumulation in forest soils. Often regions having received high amounts of acidifying substances over a long time coincide with areas of worst crown condition (EB.AIR/WG.1/1997/5);
- (e) Permitted studies of relationships between crown condition and modelled meteorological stress factors, calculated concentrations and deposition levels of ozone, sulphur dioxide, acidity and nitrogen compounds critical to forests (EB.AIR/WG.1/1997/6). For this purpose data and models from EMEP with respect to air pollution were used;
- (f) Increased public awareness of air pollution as a threat to forest health.

10. The implementation of level I has partly met the long-term priority needs defined by the Executive Body, as it has:

- (a) Monitored the spatial distribution and temporal development of forest condition;
- (b) Demonstrated that relationships between crown condition and stress factors (e.g. climatic stressors, air pollution) are not straightforward;
- (c) Disseminated summary results to policy makers and the public.

11. With respect to the intensive monitoring of forest ecosystems (level II), efforts have been successful to:

- (a) Select 860 plots in 31 countries covering the most important forest ecosystems;
- (b) Assess crown condition, soil chemistry, foliar chemical content and forest growth (core surveys) on all plots, and assess deposition, meteorological parameters and soil solution chemistry on a number of these plots;

(c) Set up a level II data centre with submission and validation procedures;

(d) Develop a strategy for evaluating level II data for the coming years.

12. Moreover, both level I and level II data will provide information that is important for the effect-oriented activities (EB.AIR/WG.1/1997/13) and the tracking of acidifying/eutrophying effects.

13. In addition, the common ICP Forests and EU programme has yielded structural benefits in that it has:

(a) Improved the quality of forest ecosystem monitoring by carrying out interlaboratory comparison of soil and foliar samples as well as training courses for field assessments resulting in more harmonized methods;

(b) Improved the cooperation between scientists working on forest condition monitoring all over Europe;

(c) Provided a platform for detailed forest ecosystem research involving the National Focal Centres of ICP Forests, EU and external institutes.

III. PRIORITIES FOR THE YEARS 1998 - 2001

A. Revised objectives of the programme

14. In view of the priorities and requirements of the Executive Body and the Working Group on Effects and based on its own increased knowledge, ICP Forests has reformulated its original objectives as follows:

(a) To gain further knowledge of the spatial and temporal variation in forest condition and of its relationships to stress factors, in particular air pollution, on a subnational, national and international large-scale systematic network (level I);

(b) To contribute to a better understanding of the relationships between air pollutants and other stress factors (causes) and the condition of forest ecosystems (effects) 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 deeper insight into the interactions between the various components of forest ecosystems by means of available information from in-depth studies on the influence of air pollution and other stress factors.

B. Priorities for further implementation of the programme

15. In view of the long-term priorities of the Executive Body and the Working Group on Effects and the programme's revised objectives, ICP Forests has defined the following priorities for the period 1998-2001:

(a) Review the key parameters and their assessment and evaluation methods at level I and level II and their relevance for the future activities and objectives of the programme. The review has the highest priority in order to guarantee the optimal resource use and efficient programme operation;

(b) Further implement the intensive monitoring of forest ecosystems (level II) and evaluate the level II data set at the European level, including assessments of cause-effect relationships. This is a matter of high priority because the evaluation of available data will help in-depth studies of the cause-effect relationships. Critical loads calculations also need these high-quality data obtained by harmonized methods and may be carried out in close cooperation with the Task Force on Mapping;

(c) Annually assess tree crown condition on a large scale (level I). This takes priority because it gives a representative overview of trends in crown condition over Europe and will result, by the year 2001, in a time-series of at least 10 years for most of Europe, which is necessary to ascertain significant trends;

(d) Carry out integrated evaluations of forest health condition using tree crown, soil and foliar data obtained from the large-scale survey of ICP Forests and EU Scheme and large-scale data from other bodies under the Convention. In order to get a holistic picture of forest ecosystem condition, studies of this kind will have to be carried out at both national and European levels;

(e) Extrapolate the relationships identified for level II with available data from level I plots. Relationships recognized at level II can be extrapolated to the large scale only by means of level I data. It will be important to link both levels in a correct way. Extrapolation to level I and interpolation between the level II plots will result in a better knowledge of forest condition at a European scale;

(f) Further improve the understanding of cause-effect relationships by means of in-depth studies. In-depth studies based on results obtained from country reports and other publications, using data from level I and level II and additional information from national or international research projects (e.g. from EXMAN, NITREX, BIATEC, other EU environmental research programmes),

are expected to contribute to a better understanding of cause-effect relationships.

IV. STRATEGY AND ACTION TO BE TAKEN UP TO THE YEAR 2001

A. Monitoring and evaluation

1. Review of the key parameters and their assessment and evaluation methods at level I and level II and their relevance for the future activities and objectives of the programme

Strategy

16. In view of the objectives of the monitoring programme, the list of key parameters and their assessment and evaluation methods will be reviewed. This review will take into account the evaluations carried out on level I and level II and the upscaling the relationships found through the intensive monitoring (level II) to the systematic network (level I).

Actions to be taken

17. (a) The Expert Panels, including ad hoc expert groups, are invited to critically review the monitoring methods and to prepare a list of selected parameters needed for evaluations to be carried out at the European level. This includes reviews on comparability and quality tests (interlaboratory tests);

(b) The Expert Panels should verify the relevance of the existing subprogrammes on level I and level II for explaining the effects of stress factors, including air pollution, on forest ecosystems;

(c) The scientific and practical basis for decisions on future assessments (e.g. frequency, spatial distribution, parameters, methods) from 2001 onwards, will be laid by the Programme Coordinating Group and considered by the Task Force on ICP Forests in 2000.

Output

18. (a) Updated lists of key parameters and their assessment and evaluation methods;

(b) Review report with scientific and practical proposals for monitoring after 2001.

2. Further implementation of the level II monitoring

Strategy

19. The intensive monitoring of tree crown condition, soil, foliage, increment, ground vegetation, soil solution, meteorological parameters and deposition in forests will be continued and possibly extended, if required. A strategy for the evaluation of level II data will be further developed, aiming at a complete level II database and interpretation and evaluation of the data. This strategy will be elaborated by the European Commission, assisted by its consultant FIMCI and the Scientific Advisory Group. Apart from the activities carried out at national level, the strategy should focus on evaluation at the European level. In addition, the level II data will be used to improve existing models.

Actions to be taken

20. (a) Further development and evaluation of the level II data set;
(b) Contribution by the Expert Panels to indicate evaluation possibilities and the comparability of the European data set;
(c) Investigation into the relationships between soil and foliar chemistry and site/stress factors (especially atmospheric pollution) as a short-term aim;
(d) Investigation into the relationship between atmospheric deposition and soil solution chemistry (assessment of input-output budgets) as a medium-term aim. This will allow comparison of critical loads with the present loads on the plots.

Output (all produced by the European Commission)

21. (a) Strategy plan for the scientific evaluation of the level II data;
(b) Annual progress reports on the results of the evaluations of the level II programme.

3. Annual assessment of tree crown condition on level I

Strategy/ Action to be taken

22. Crown condition will be assessed annually at least until 2001 in cooperation with EU to gain data over at least 10 years for most of the level I plots.

Output

23. (a) Annual technical reports on the results of the crown condition assessments on level I;

(b) Continuation of the time series on tree crown condition on a European scale.

4. Integrated evaluations of tree crown data
with soil and foliar data

Strategy/ Actions to be taken

24. The relationships between the spatial and temporal patterns of crown condition and soil condition and the nutritional status of trees have been investigated by the Forest Soil Coordinating Centre (FSCC), in close cooperation with the Programme Coordinating Centre (PCC) and the Flemish Institute for Forestry, in the framework of an integrated study. Studies with similar objectives, including meteorological and air pollution data from external sources, are being carried out, e.g. by the Winand Staring Centre (in the Netherlands). NFCs should encourage these kinds of studies also at national level.

Output

25. (a) Integrated studies of the relationships between crown condition, soil condition, the nutritional status of forest trees and stress factors, including air pollution;

(b) Scientifically sound proposal for a possible repetition of the soil and foliar survey on level I, taking into account the results of the integrated studies.

5. Extrapolation of relationships identified for level II plots
to the scale of the level I plots

Strategy

26. To gain insight into the relationships between air pollution and forest condition at the scale of the level I plots, it is necessary to have site-

specific information, e.g. on the level of atmospheric deposition. Extrapolation of available site-specific atmospheric data from level II is therefore of a high priority.

Actions to be taken

27. (a) Development of upscaling procedures to extrapolate results obtained at level II plots to level I plots. This will include process-based and multivariate geostatistic models;
- (b) Application of the upscaling procedures to atmospheric deposition data.

Output

28. (a) Upscaling procedures and extrapolated results of atmospheric deposition data to level I plots to be used for integrated studies;
- (b) Maps, e.g. with typical factor combinations, representative of their special regions.

6. Further improvement of the understanding of cause-effect relationships

Strategy

29. Preparation of in-depth studies on cause-effect relationships by evaluating available literature (e.g. in the framework of NITREX, EXMAN and other EU environmental research programmes). These activities may help to quantify dose-response relationships. In addition, ICP Forests will try to assess cause-effect relationships on common monitoring plots with ICP Integrated Monitoring.

Actions to be taken

30. (a) Information on the current state of cause-effect research will be summarized, used for the interpretation of the ICP Forests monitoring results and brought to the attention of the Working Group on Effects. This information will also contribute to the preparation of the Working Group's reports on selected topics, e.g. trends, acidification, eutrophication, the role of ozone, etc.;
- (b) Cooperation with ICP Integrated Monitoring will be strengthened by the harmonization of the programme manuals.

Output

31. (a) Evaluations of the relevant scientific literature with emphasis on cause-effect relationships;
- (b) Contributions to the Working Group's substantive report on trends and acidification.

B. Storage and supply of data to other subsidiary bodies under the Convention

32. Following the relevant decisions of the Working Group on Effects (EB.AIR/WG.1/1997/14) and in agreement with the European Commission, PCC is making provision to store copies of data collected in the framework of ICP Forests and the EU Scheme in order to make them available upon request to other subsidiary bodies under the Convention in accordance with the Executive Body's rules for data exchange and the EC guidelines for the management of level II data. However, the data management of the individual surveys remains the responsibility of the respective centres.

33. As a consequence, data from the level I surveys should continue to be submitted to PCC, FSCC and the Forest Foliage Coordinating Centre, whereas level II data should be sent to FIMCI. PCC regularly receives updated copies of the data.

C. Reporting

34. The reporting procedure described in the previous strategy paper of ICP Forests (EB.AIR/WG.1/R.122) has proven successful and will be maintained (see annex I). According to the identified priorities in reporting to the Working Group on Effects, emphasis will be put on reporting level II results in close cooperation with the European Commission. Special topics will be treated whenever possible within separate reports and/or within the programme's contributions to reports prepared by the Working Group on Effects.

35. Three different kinds of reports can be distinguished:

(a) The **executive report** is aimed at a broader readership, including policy makers and the general public. Even though the report will reflect the scientific findings, it will be illustrated and written in a way which is understandable by the public. To give a holistic picture of forest condition, it needs to reflect the latest monitoring results and the main results of ICP Forests and the EU Scheme;

(b) **Technical reports** will be prepared for specific items and will give the complete background of the issue referred to. This includes reports on level I and level II monitoring results and in-depth studies such as integrated studies or literature reviews;

(c) The **executive summary** aims at providing the Working Group on Effects with concise information and will continue to summarize all important results of the year. Reporting of level I results to the Working Group on

Effects will be confined to a minimum of information on crown condition and will be reported only if they reflect new interesting findings, e.g. within the framework of integrative studies.

D. Financing

36. The precondition for the implementation of the ICP Forests strategy described above is adequate long-term financing at national and European levels.

V. ADMINISTRATIVE TOOLS TO IMPLEMENT THE STRATEGY

37. The following tools will be used to carry out the strategy:

(a) The **Programme Coordinating Group** (PCG) will promote and supervise a continuous review of the programme and propose options for action to shape the programme after 2001. This review should provide a clear view of the programme's priorities and, hence, also facilitate the required actions within the programme. PCG recommendations are directed to the Task Force on ICP Forests. In view of the close cooperation with the European Commission, these recommendations are also submitted to the European Commission for consideration. To perform these tasks, PCG needs to meet regularly. At these meetings the European Commission as a member of PCG may be accompanied by the Chairman of the Scientific Advisory Group (SAG) of EC and the EC consultant, FIMCI, whenever appropriate. To facilitate the review process, a limited number of representatives of NFCs will be invited;

(b) The tasks of the **Expert Panels**, including ad hoc expert groups, will be extended. They will be requested to critically review the methods and the list of selected parameters needed for assessments to be carried out at European level, including reviews of the comparability of data and quality assurance tests in 1998/99. The Task Force will put forward the issues to be considered within this internal review process. The Expert Panels will also be invited to give their expert opinions on which evaluations should be carried out. To optimize the contributions from the national experts, the organization of Expert Panel meetings will have to be streamlined. Any meeting announcement will require previous consultation with the Chairman of the Task Force on ICP Forests and the European Commission. The meeting's objectives will have to be clearly defined. To minimize travelling expenses for central and eastern European participants, Expert Panel meetings may be held in those countries. Whenever possible, combined or back-to-back meetings would be preferred, as different groups will increasingly collaborate in dealing with individual issues;

(c) The **Task Force meetings** will be made more effective by delegating editorial work to editorial groups; this would allow the Task Force to discuss important scientific/technical issues in more detail.

VI. DEVELOPMENT OF THE PROGRAMME SCHEME FROM 2002 ONWARDS

38. The implementation of the strategy for the years up to 2001 described above will put ICP Forests in a good position to develop its programme from 2002 onwards. The future shape of ICP Forests will be developed and considered in close cooperation with the European Commission. This is of vital interest to both partners in order to minimize financial requirements and labour efforts and to avoid duplications.

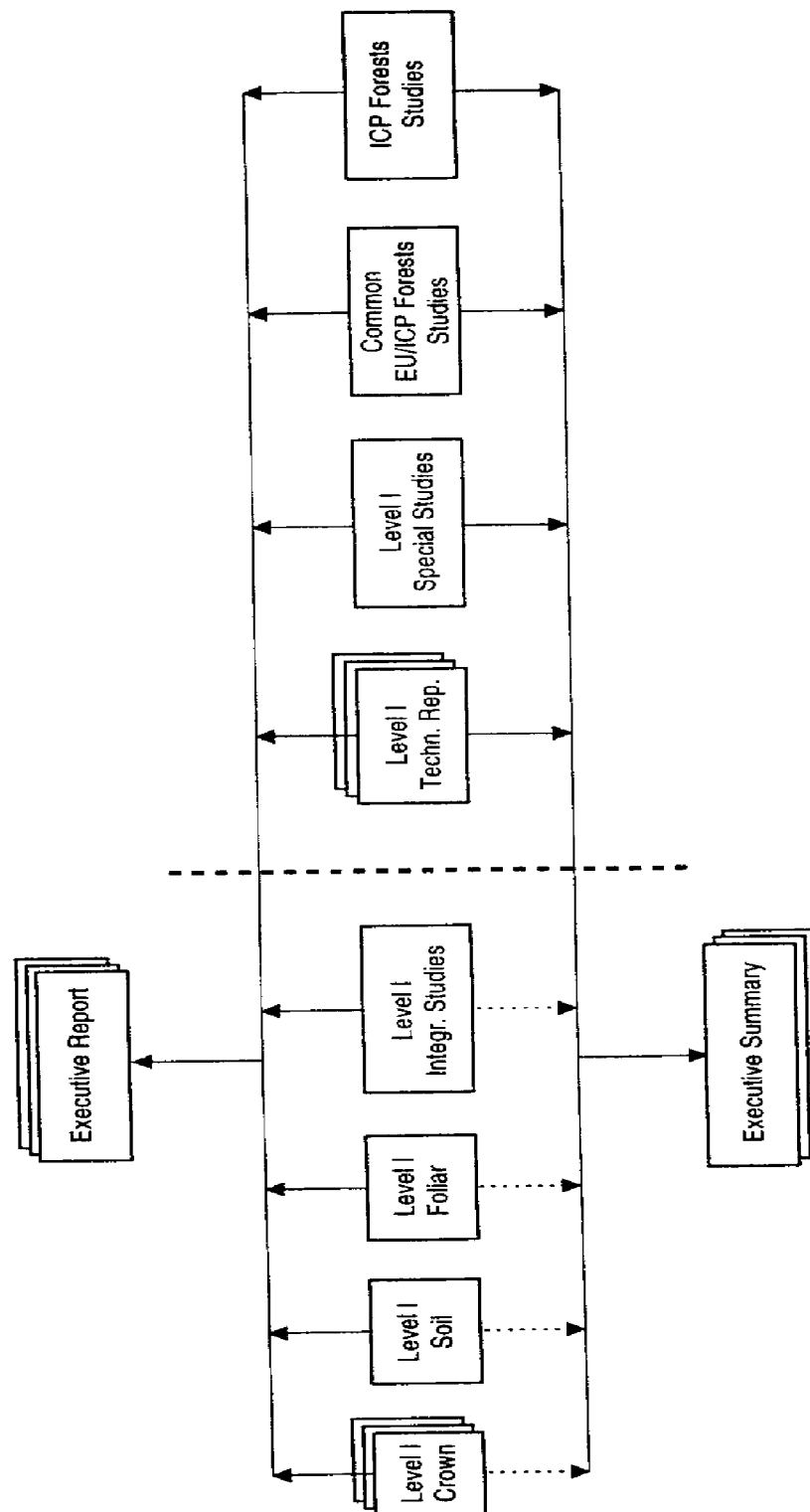
39. As decided by the Executive Body at its fifteenth session, ICP Forests will in 1998/1999, together with all other ICPs and the Task Force on Mapping, be the subject of an independent external review. The outcome of this review of the effect-oriented activities under the Convention will be discussed by PCG and the Task Force in 1999.

40. To create a solid basis for decisions on the programme priorities from 2002 onwards and to enhance the discussion between policy makers, scientists and those responsible for ICP Forests and the EU Scheme, a workshop would be a suitable forum for in-depth consideration of the outcome of internal and external scientific reviews. The European Commission is making preparations for such a workshop in close cooperation with ICP Forests in late 1999. A schematic overview of the different steps of this review process is given in annex II.

41. The review process will result in a decision on the future shape of the ICP Forests programme, preferably at the sixteenth Task Force meeting in 2000. This would coincide with the decision on the continuation of the relevant EU regulation.

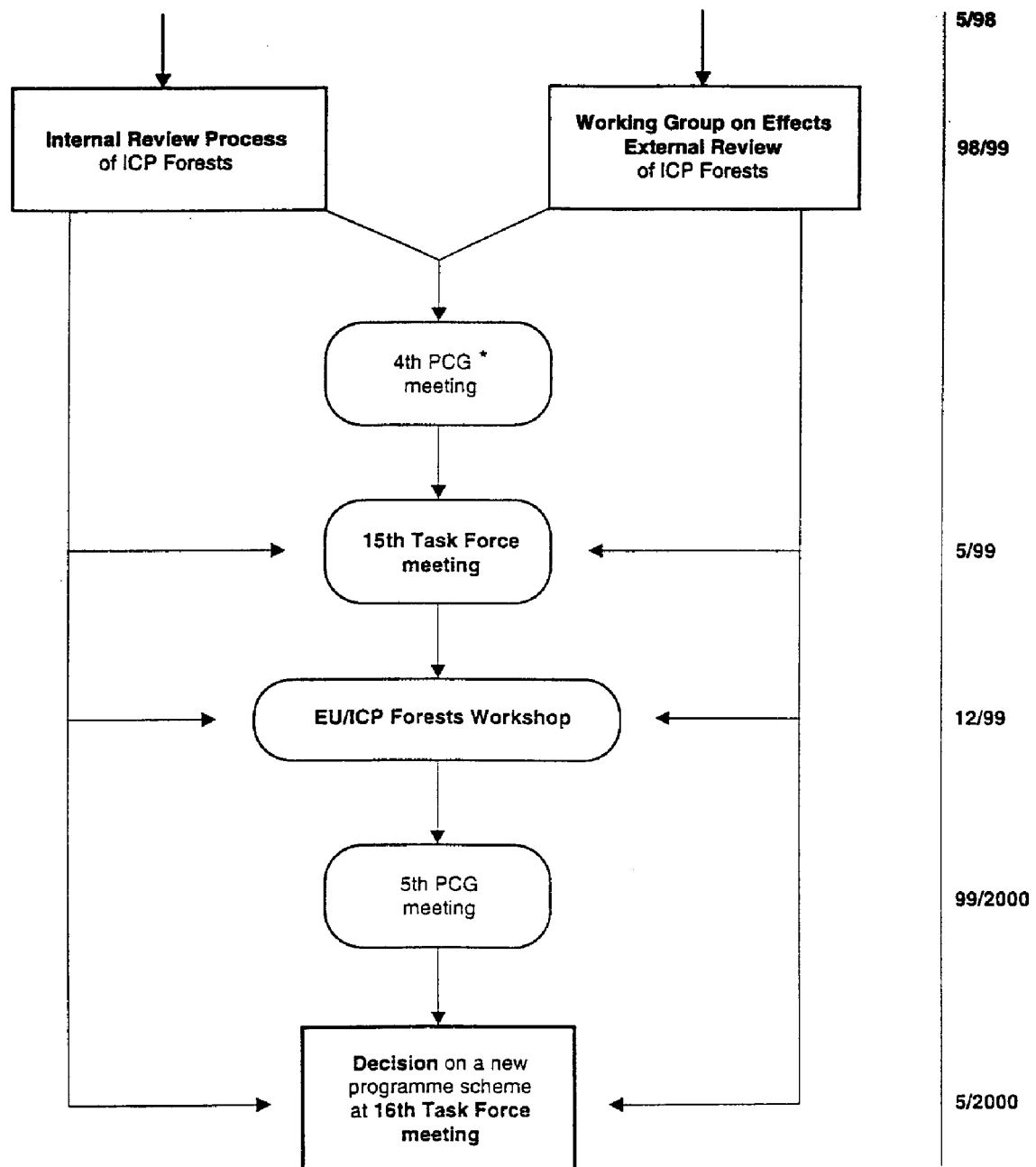
Annex I

Update of Reporting Scheme



Annex II

Review Process of ICP Forests



* Programme Coordinating Group