UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE
CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

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

MANUAL

on
methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests

Part II

Visual Assessment of Crown Condition

updated: 06/2006
new forms to be applied from 2007 onwards

Contents

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0. Amendment history
(amendments in comparison with version of 2004)
ANNEX 1:

1. Annex 1, A1.1: **Country code** list amended.
2. Annex 1, A1.6: The **humus type** is no longer defined in this section but a link is set to the respective section in part IIIa of the ICP Forests Manual on Sampling and Analyses of Soil.
3. Annex 1, A1.9: The **mean age** of dominant storey: definition of class 7 is defined correctly (> 120 years instead of > 121 years).
4. Annex 1, A1.10: The **soil unit** is no longer defined in this section but a link is set to the respective section in part IIIa of the ICP Forests Manual on Sampling and Analyses of Soil.
5. Annex 1, A1.12: The **species list** is amended by tree species (codes 91, 92, 93).
6. Annex 1, A1.18: **Discolouration** ("old definition") is no longer mandatory but optional on Level I and Level II. The text is re-phrased with a link to ANNEX 2 ("new definition"). The table for coding discolouration is completed by code 4 (dead trees).
7. Annex 1, A1.21: **Fruiting** now is optional also on Level I (not assessed on Level I before). In the text the importance of this information especially for beech is underlined.

ANNEX 2: ASSESSMENT of damage causes

8. **Introduction**: re-phrased in order to improve the description which damage symptom to assess in which way.
9. A2.5 **Parameters** to be assessed: Adaptations according to the revised submission forms.
10. A2.5.1 **Symptom description**: re-phrased in order to improve the description which damage symptom to assess in which way.
11. A2.5.1.2 **Symptoms and their specifications**: in point a. the usage of "National lists" is specified.
12. A2.5.1.2: under **Specifications** "b. Avoiding duplication of crown condition assessment is" is revised
13. A2.5.1.3 **Age of the damage** is a new parameter (optional on Level I and Level II)
14. A2.5.2 **Causal agents / factors**: 3rd paragraph: A procedure is described how to amend the list of causal agents for species which are not already included but were investigated.
15. Table A2-6: Eriophyes ilicis was moved to code 800 (other) with code 87001 in the newly introduced class 870 "mites"
16. Table A2-7: added "Lophodermella sulcigena" under 301 under other Lophodermium (genus affected: Pinus sp.); included Armillaria spec. in code for scientific name of cause (Annex 3 in internet presentation; see below).
17. Table A2-8: included under physical factors "rock fall" with code 434.
18. Table A2-9: added code 581 and 582; old "systematically wrong code number" remain in action
19. Table A2-11: added "Clematis sp" as 81005 and "Mites" as 870.
20. A2.5.2.1: The list of codes for **scientific name of cause** (table A2-12) is skipped from the manual; a link now is set to "http://www.icp-forests.org/WGbiotic.htm >> click on annex 3"

FORMS for submitting data from the NFCs to the data centres

21. The **forms were revised** in a way that there are 3 forms for Level I and 3 forms for Level II, respectively:
    The first form for a reduced plot file (PLO and PLT, respectively),
    the second from for the submission of crown/tree related parameters (in general 1 observation for each tree, TRE and TRC, respectively) and
    the third form for submission of damage assessment data (0 to n observations for each tree, TRF and TRD, respectively).

22. The parameters which have to be submitted with the particular forms may change over time. Therefore, with the update from June 2006 the NFCs are asked to start each data file with a comment line. This line is starting with an exclamation mark followed by the names of the parameters, each separated by a comma. For each data file a proposal is given at the top of the respective form.
23. Forms A1, A2, A3, B1, B2, B3, and C remain unchanged!

1. Introduction

The assessment of crown condition is central to the ICP Forests operated under the UNECE since 1985. The assessment methods developed in the mid-1980s for Level I formed the basis of the assessments in the Level II plots. These were described in the earlier manual on the 'Visual Assessment of Crown Condition' and the 'Submanual on Visual Assessment of Crown Condition on Intensive Monitoring Plots'. Within Europe, the combination of almost 6000 plots on a systematic 16x16 km grid (Level I) and almost 900 intensive monitoring plots (Level II) provides a unique and unrivalled data set. Scientific analyses of these data increasingly point to the need for a harmonised approach to data gathering, reporting and analysis. This re-design of the manual allows a harmonised, yet more flexible approach to crown condition monitoring, while retaining continuity and allowing better, more transparent quality assurance. All of the parameters described here have been tested in one or more countries in Europe or North America during the last 15 years. However, the value of the parameters will continue be monitored by an Expert Panel and any necessary adjustments will be recommended to the Task Force of the ICP Forests in future years.

A number of new measures, additional to the existing Level I set of parameters, are proposed in this manual, mainly aiming at a more precise description of observed damages. An important addition is the requirement for the submission of quality control data. Such information is essential for the determination of confidence limits for the data, an important step is the identification of changes through time and in cause-effect studies. Without such confidence limits, the reliable identification of temporal or spatial variation in crown condition will be extremely difficult.

This manual is a synthesis of earlier Expert Panel meetings, manuals, assessment recommendations, pilot studies and the recommendation of the 17th Task Force where the Expert Panel was asked to 'organise the planned workshop on data evaluation' and 'to present a revised submanual to the Task Force in 2003'.

Objectives

The major aim of Level I is to provide a periodic overview on the spatial and temporal variation in forest condition in relation to anthropogenic and natural stress factors in a European and national large-scale systematic network;

whereas the Level II Intensive Monitoring Programme attempts to contribute to a better understanding of the relationships between the condition of forest ecosystems and stress factors, in particular air pollution, through intensive monitoring in a number of selected permanent observation plots spread across Europe;

2. Frequency of assessment

Crown condition assessments are mandatory for both levels at least once a year. The time of the assessment should be between the end of the first flush of foliage (when the leaves and needles are fully developed) and the beginning of autumnal senescence. For most species, the most suitable time for the assessment is mid- to late summer. The assessments should be done during the same period each year (2 to 3 weeks) and within this time window if possible under similar weather conditions.

In regions with regular damage caused by summer drought, monitoring may be shifted to early summer. However, care should be taken to ensure that any effects are not under-estimated.

3. Selection of sample plots and trees

Level I

Within the transnational survey (Level I) sample plots and trees Kraft classes 1-3 (1 = dominant; 2 = codominant, 3 = subdominant; see Fig. A1-1 in Annex 1) should be selected according to a statistically sound procedure which includes the random principle. An example is the 4-point cross cluster, with 4 subplots oriented along the main compass directions at a distance of 25 m from the grid point. On each subplot the 6 trees nearest to the subplot centre are selected as sample trees, resulting into 24 sample trees per plot (see Fig. 1). Other procedures are possible; however, regarding Level I a minimum of 10 sample trees shall be assessed at each sample plot.

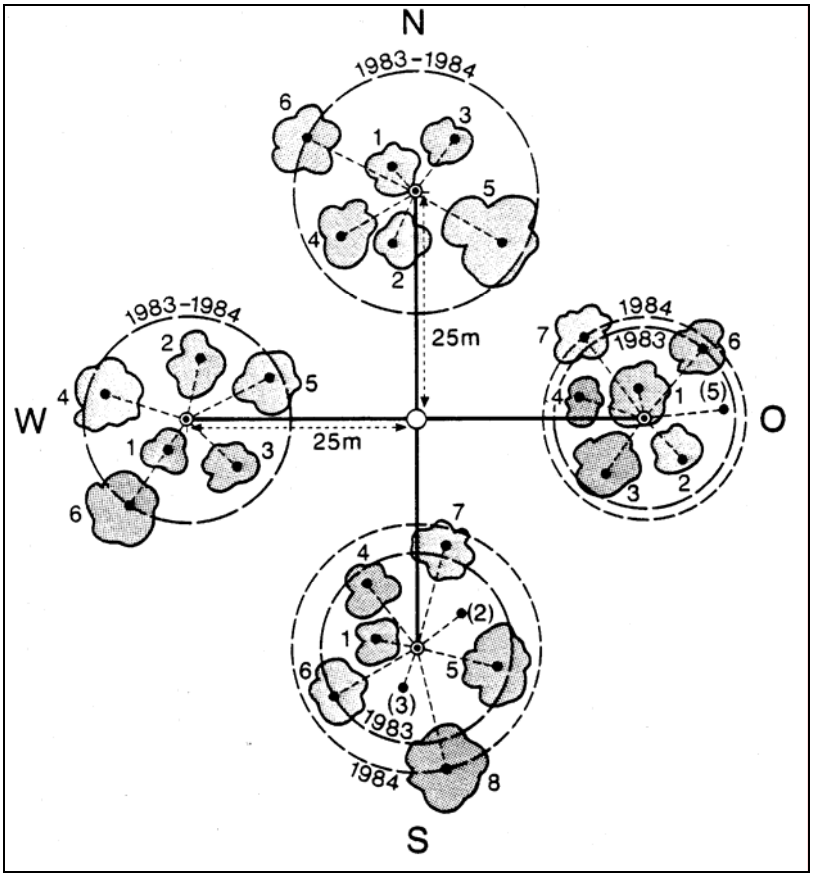

Figure 1: Illustration of 4-point cluster with 6-tree sample and sample tree replacement

Level II

The different aims of Level I and Level II programme may influence plot and tree selection as trees will be observed in more detail over a longer period of time. For intensive monitoring plots – (Level II) – a significantly larger number of sample trees may be selected in order to describe the health status of the stand more completely.

Preferably all trees Kraft classes 1-3 in the plot area should be sampled. The minimum requirement is 10 trees selected according to the method described for Level I. However a higher number of sample trees is highly advisable in order to keep a minimum of 10 identical trees over a long assessment period. If, during plot installation, a subplot was defined, then the assessments described in this chapter refer to all trees in the subplot. When the selection of sample trees follows different procedures (e.g. in very dense stands where crown assessment is impossible

within the plot or subplot boundaries), the procedure should be described and reported to the Programme Coordinating Centre.

Selected trees on both levels should be identifiable (preferably permanently numbered) for re-assessment during the subsequent inventories.

Trees used for other surveys (e.g. foliage analysis, tree-ring analysis) located outside the (sub-) plot should also be assessed in order to correlate their crown condition with corresponding data. In principle, these trees are also permanently and uniquely numbered. These trees should be assessed annually together with the trees at the (sub-) plot.

Trees with >50% mechanical damage in the crown should be excluded when setting up a plot.

The foliage of suppressed trees in high forest stands is mainly influenced by the overstorey. The inclusion of these trees in assessments is therefore optional and will depend on the aims of the national programme and the nature of the forest ecosystem.

In coppice stands, macchia and other forest types where individual stools have many stems, the tree may be considered as a single unit consisting of multiple stems.

It is strongly advisable to map the layout of the plot. If possible, coordinates of the plot centre (Level I) or corners (Level II) should be tied into the national coordinate system for the country or GPS coordinate, facilitating the use of GIS in the analytical stage.

The tree sample on both Levels includes all tree species, provided the trees have a minimum height of 60 cm.

Trees removed within management operations or thrown by wind must be replaced by newly selected trees at Level I and Level II in order to ensure the minimum number of trees to assess. These newly selected trees must be labelled by new numbers which have never before been assigned to any tree at the respective plot. If the stand is clear-cut, the sample point ceases to exist until a new stand has been established.

A periodic revision of the grid for adaptation to changes of forest area should be conducted.

In younger, dense stands, where individual crowns are not assessable, sample trees are selected according to a defined process. This process is repeated until sufficient trees with assessable crowns have been found. Regeneration should be assessed as part of the ground vegetation assessments in the plots. Details are specified in part VIII of this manual.

4. Crown to be assessed

The estimation of crown condition strongly depends on the definition of the assessable crown.

The crown present at the moment of the assessment is to be considered, regardless of the potential or theoretical crown which may have existed in previous years. The influence of any present or absent (removed) trees on the crown of the sample tree must be taken into account when determining its condition. In cases where the sample tree crown is influenced by competition, the assessable crown includes only those parts that are not influenced by other crowns i.e. shading. Parts of the crown directly influenced by interactions between crowns or competition are excluded (see Fig. 2, classification see Annex 1).

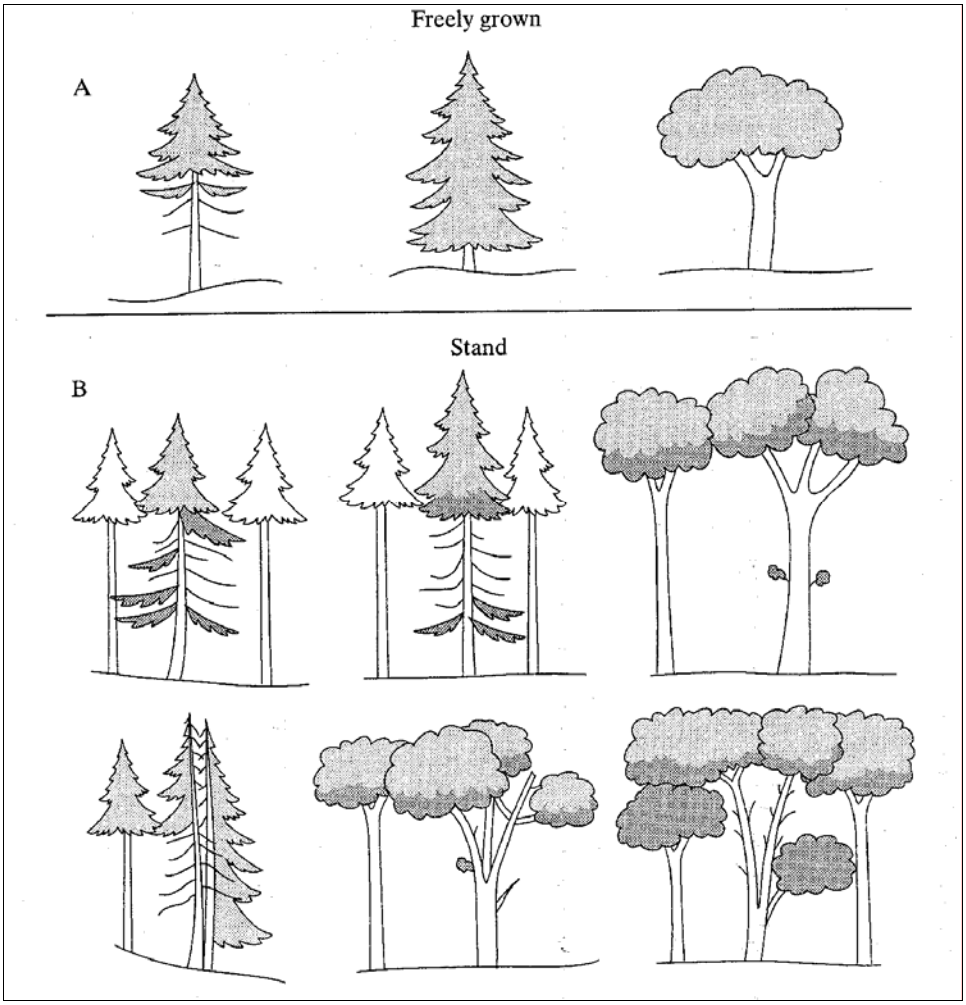

Figure 2: Assessable crown (indicated by light shading) in freely grown trees and trees within stands. Areas of foliage to be excluded are indicated by darker shading. (Based on original diagrams by D´Eon et al. 1994).

The assessable crown of a freely developed tree is defined as the whole living crown from the lowest substantial living branch upwards. The following parts of such a crown must be excluded from the assessment:

- Epicormic shoots below the crown
- Gaps in the crown where it is assumed that no branches ever existed

For the classification of epicormics see Annex 1.

The assessable crown includes recently died branches, but excludes snags that have been dead for many years (i.e. which have already lost their side-shoots), as shown in Fig. 3. Snags represent the historic mortality of parts of the crown and have no influence on the current condition of the tree. They are therefore excluded from the assessment. Dieback of shoots and branches represents an active process in the crown and is therefore included.

The determination of the assessable crown varies between countries, it is therefore essential that it is documented in the photoguides and manuals used.

In coppice (and macchia) stands it may be necessary to consider the assessable crown as a single unit consisting of crown parts from different stems.

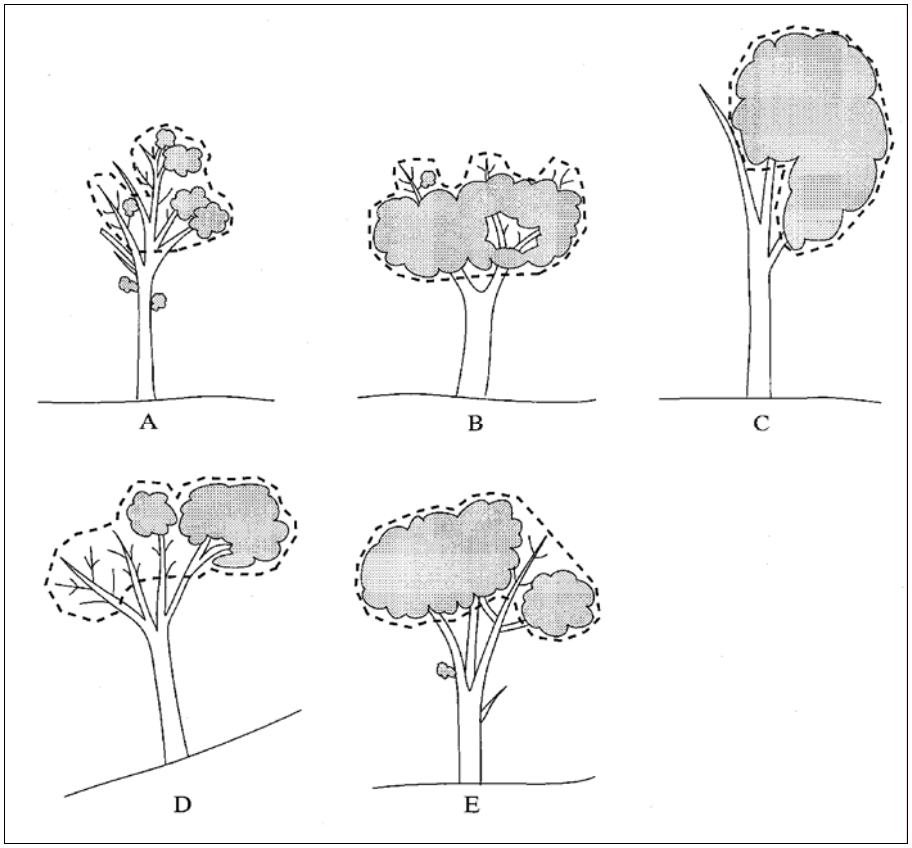

Figure 3: Outlines of the assessable crown (freely grown trees) showing which areas of dieback to include and exclude. Dead branches that exist only as snags (e.g. on the left-hand side of C) are excluded from the assessable crown. Recent dieback, as indicated by the presence of lower order branches, is included (e.g. left-hand side of D). (Based on original diagrams by D'Eon et al. 1994).

5. Direction of assessment

Trees should be assessed from as many directions as possible, at least from two sides, and normally from a distance of about one tree length. In dense stands this may become difficult, but at least parts of the crown can be observed from several directions. The visibility of each crown should be noted on Level II plots using four classes as defined in Annex 1.

- On slopes, monitoring from a position upslope or to the sides is preferable, as defoliation will be underestimated if crowns are monitored from downslope only.
- If trees are observed from fixed points, then the point of observation in relation to the sample tree should be recorded in the national database. With such a system, it is particularly important to document any changes in the observation point.
- The observers should always try to avoid looking into the sun.

6. Reference tree

The concept of the reference tree is one of the most controversial issues in the monitoring programme, yet it is critical to the assessments. Two different types of reference trees are recognised: local reference trees and absolute reference trees. Use of absolute reference trees leads to higher defoliation estimates than the application of local reference trees, but the results are more amenable to temporal and spatial analyses. Most countries have adopted local reference trees as standards.

This local reference takes into account the build-up and the development stage of the tree.

A **local reference tree** or a conceptual (imaginary) tree is defined here as the best tree with full foliage that could grow at a particular site, taking into account factors such as altitude, latitude, tree age, site conditions and social status. It has 0% defoliation. This tree should represent the typical crown morphology and age of trees in the plot. **Absolute reference trees** are the best possible trees of a genotype or species, regardless of site conditions, tree age, etc. A number of photo guides exist which provide guidelines on absolute reference trees in different parts of Europe.

6.1 Documentation and photographs

It is necessary to document details of both absolute reference trees (if not available in a manual) and the local reference tree with photographs backed up with information on the tree (see form PHOT for minimum requirements).

It is advisable to photograph a selection of the trees in different defoliation classes in each area in each year. These should be accompanied by complete assessments of the trees using the relevant forms (PHOT) and should be permanently stored at the appropriate National Focal Centres.

7. Parameters to be assessed

To enable comparison between and within assessments made at Level I and Level II plots, methods for the estimation of defoliation and discoloration remain unchanged. A number of additional assessments were specified in the previous edition of the Manual (1996) for Level II and amended in this edition (2004), so that the actual status of individual trees can be better described. A large number of different parameters are currently being used throughout Europe and North America.

Detailed descriptions of the parameters to be assessed within ICP Forests can be found in Annexes 1 and 2.

The parameters described in this submanual are assessed by ground survey. For the assessment of parameters on tree parts 5 or more meters above ground, the use of binoculars is mandatory. The use of photo guides with typical photos of trees with different defoliation is strongly recommended. Some parameters may require closer observation (e.g. some forms of needle discoloration and foliage deformation). Closer (in-hand) examination is also usually required for full diagnostic assessments. Usually, a closer investigation becomes possible only every two years when the leaves for foliar analysis are picked. While every attempt should be made to provide as detailed and accurate information as possible, observers should always bear in mind that it is better to have no data than to have incorrect data.

8. Guidelines for fieldwork

Defoliation is generally estimated in 5% classes relative to a tree with full foliage (classification see Annex 1). The reference tree can be either a healthy tree in the vicinity (of the same crown type), a photograph locally applicable, representing a tree with full foliage or a conceptual (imaginary) tree. If different classification schemes are used, the class intervals, i.e. the respective defoliation percentages, must be specified.

Observers should have a satisfactory view of the tree from several observation points. On level ground, the optimal view is given at a distance of one tree length. On slopes, trees should be observed at a distance of about one tree length above the tree or at least on the same level.

It is recommended that assessments should be done by two trained observers. When the estimates produced of the two observers differ, both should change their observation position.

Assessments should be done in full daylight, but it has to be recognised that the assessment, particularly of crown discolouration, may be affected by the quality of the light and the time of day.

The spatial and temporal comparison and as a norm for the valuator, the knowledge of optimal / ideal foliated trees of a species, independent of the location/stand is very useful. In this respect, photo guides are a very helpful tool. It is strongly recommended to support all teams of an inventory with such photo guides.

Observers should be provided with locally applicable, standard photographs of trees of each species and of different crown types with which to compare the trees to be assessed. Examples of various defoliation classes can also be provided if this is considered desirable.

9. Quality control and quality assurance

Experience from Level I and Level II has indicated the importance of adequate quality assurance. This is especially so for Level II given the complexity of the data. Four main areas are important

1. selection of field teams
2. training of field teams
3. plausibility of data
4. international quality control

9.1 Selection of survey teams (Level I and Level II)

Ideally field crews should consist of two professionals, at least one a diploma-level/graduate forester as the responsible crew leader.
The number of field crews per country should be optimized in order to facilitate training and harmonization. The number must take into account work loads and inaccurate assessments due to too long survey periods. Frequent changes of staff should be avoided.
Each team or team member has his own ID coordinated by the NFC. All training and field assessment data must contain the surveyors' IDs and date of assessment.

9.2 Training

National Level
Prior to the beginning of the annual field season, survey crews should undergo a period of concentrated theoretical and practical training in measurement and assessment procedures and in filling out the various forms. As far as possible, the field crews should be experienced in phytopathology.

All countries should have a designated person who is considered as a national expert on tree condition assessments and who is responsible either for undertaking the assessments or for training teams to make the assessments. It is recommended that the person is familiar with assessments at an international level and should if possible be a member of the National Reference Team.

Training should be given in the use of the ICP Forests or national manuals. The latter should be updated (at least for those parameters that are used at an international level) in line with recommendations in the ICP Forests manual.

Whenever local reference trees are used it is strongly suggested that photographs of them are also available.

Photographs should be used as a part of the training exercise both to determine variation between surveyors and field scores and variation over time by using the same (or a sub set) every year.

Results of national training courses should be available for audit/analysis. At least one person from a National Reference Team should be available to take part in International Cross-Comparison Courses (see Annex 4).

9.3 Data plausibility

It is strongly recommended that plausibility checks are included in hand-held data gathering devices (if used) and/or in the early stages of data evaluation. Plausibility checks should also be integrated into any national data analysis system and NFC's are responsible for the quality of national data reported.

Field checks
Aims:

1. improve data completeness
2. improve consistency between teams
3. improve data consistency regarding Level II combined indices
4. document variability
5. provide information to improve training

An independent check survey should re-measure a proportion (e.g. 5-10%) of the sample plots assessed by each survey crew and this should be done very close to the actual survey date to avoid differences due to crown development. In case of significant discrepancies, adjustments or clarification of instructions and their application must be arranged immediately to avoid serious systematic errors.

National Focal Centres should compare the control data with the original observations and take action as appropriate. A summary of the data comparisons, together with details of any action taken, should be documented for potential evaluations.

9.4 International Quality Control

ICCs are field exercises aimed to

(i) document the relative position of individual National Reference Teams (NRTs) within the international context,
(ii) monitor the consistency of NRTs' position through time,
(iii) improve the traceability of the data by establishing a direct connection with the data collected at national level. This will also help to explain anomalous year-by-year fluctuations, and
(iv) explore the relationships between the performance of the various NRTs and the major site and stand characteristics

by using field estimates and photo methods.

Detailed methodology see Annex 4.

10. Data reporting and submission

Each National Focal Centre must submit an information describing deviations from UNECE recommended procedures or changes of assessment methods.
Periodical quality control evaluations may be requested by the Programme Coordinating Centre to be part of integrated evaluations.
References to any publications arising from the work on the Level I/ II plots should be notified so that they can be listed on the ICP Forests web site.

Assessment data in electronic format (including mandatory and all optional parameters assessed by the relevant country) must be submitted to the responsible centre by the cut-off date requested. For the format see Annex 3.

Data submission deadlines for the different Levels and data types have to be observed.

Annex 1: Assessment of general plot and tree parameters, foliage, reproductive structures and epicormics

A1.1 Country (mandatory Level I and Level II)

1 France	11 Spain	55 Norway	65 Belarus	75 Iceland
2 Belgium	12 Luxembourg	56 Lithuania	66 Cyprus	76 Holy See (Vatican City State)
3 Netherlands	13 Sweden	57 Croatia	67 Serbia and Montenegro	77 San Marino
4 Germany	14 Austria	58 Czech Republic	68 Andorra	78 Former Yugoslavian Republic of Macedonia
5 Italy	15 Finland	59 Estonia	69 Malta	79 Bosnia and Herzegovina
6 United Kingdom	50 Switzerland	60 Slovenia	70 Monaco	
7 Ireland	51 Hungary	61 Republic of Moldova	71 Albania	95 Canares
8 Denmark	52 Romania	62 Russian Federation	72 Turkey	96 Azores
9 Greece	53 Poland	63 Bulgaria	73 Liechtenstein	
10 Portugal	54 Slovak Republic	64 Latvia	74 Ukraine	

A1.2 Observation plot number (mandatory Level I and Level II)

The observation plot number corresponds to a unique number given to the permanent plot during the selection or installation.

A1.3 Date of observation, date of assessment, date of analysis (mandatory Level I and Level II)

Dates shall be completed in the following order (day, month and year):

Day	Month	Year
08	09	94

A1.4 Latitude/ longitude coordinates (mandatory Level I and Level II)

Fill in the full six figure latitude and longitude coordinates of the centre of the observation plot, e.g:

	+/-	Degress		Minutes		Seconds	
— latitude	+	5	0	2	0	2	7
— longitude	-	0	1	1	5	3	2

the first box is used to indicate a + or - coordinate

A1.5 Availability of water to principal species (estimate) (mandatory Level I)

1: Insufficient
2: Sufficient
3: Excessive

A1.6 Humus type (mandatory Level I)

The classification of the humus type is described in Annex 3, Explanatory item (6) of part IIIa (Sampling and Analyses of Soil) of the ICP Forests manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests

A1.7 Altitude (mandatory Level I and Level II)

1:	≤ 50 m	**14:**	651— 700 m	**27:**	1301— 1350 m	**40:**	1951— 2000 m
2:	51— 100 m	**15:**	701— 750 m	**28:**	1351— 1400 m	**41:**	2001— 2050 m
3:	101— 150 m	**16:**	751— 800 m	**29:**	1401— 1450 m	**42:**	2051— 2100 m
4:	151— 200 m	**17:**	801— 850 m	**30:**	1451— 1500 m	**43:**	2101— 2150 m
5:	201— 250 m	**18:**	851— 900 m	**31:**	1501— 1550 m	**44:**	2151— 2200 m
6:	251— 300 m	**19:**	901— 950 m	**32:**	1551— 1600 m	**45:**	2201— 2250 m
7:	301— 350 m	**20:**	951— 1000 m	**33:**	1601— 1650 m	**46:**	2251— 2300 m
8:	351— 400 m	**21:**	1001— 1050 m	**34:**	1651— 1700 m	**47:**	2301— 2350 m
9:	401— 450 m	**22:**	1051— 1100 m	**35:**	1701— 1750 m	**48:**	2351— 2400 m
10:	451— 500 m	**23:**	1101— 1150 m	**36:**	1751— 1800 m	**49:**	2401— 2450 m
11:	501— 550 m	**24:**	1151— 1200 m	**37:**	1801— 1850 m	**50:**	2451— 2500 m
12:	551— 600 m	**25:**	1201— 1250 m	**38:**	1851— 1900 m	**51:**	> 2500 m
13:	601— 650 m	**26:**	1251— 1300 m	**39:**	1901— 1950 m		

A1.8 Orientation (mandatory Level I)

1: N	4: SE	7: W
2: NE	5: S	8: NW
3: E	6: SW	9: flat

A1.9 Mean age of dominant storey (years) (mandatory Level I)

1: ≤ 20	4: 61-80	7: > 120
2: 21-40	5: 81-100	8: Irregular stands
3: 41-60	6: 101-120	

A1.10 Soil unit (mandatory Level I)

The classification of the soil unit is described in Annex 3, Explanatory item (10) of part IIIa (Sampling and Analyses of Soil) of the ICP Forests manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests

A1.11 Sample tree number (mandatory Level I and Level II)

The tree number is the number which has been assigned to the tree during the installation of the plot.

Note: a copy of the numbers of sample trees that were assessed the year before and which must be included in the assessment in the current year should be provided to the surveyors each year. Further information should not be supplied as repeated assessments of, for example, species, will act as a control on the quality of the observations.

A1.12 Species (Reference Flora Europaea) (mandatory Level I and Level II)

Broadleaves (* = species to be used for the foliage inventory)

001: Acer campestre*
002: Acer monspessulanum*
003: Acer opalus
004: Acer platanoides
005: Acer pseudoplatanus*
006: Alnus cordata*
007: Alnus glutinosa*
008: Alnus incana
009: Alnus viridis
010: Betula pendula*
011: Betula pubescens*
012: Buxus sempervirens
013: Carpinus betulus*
014: Carpinus orientalis
015: Castanea sativa (C. vesca)*
016: Corylus avellana*
017: Eucalyptus sp.*
018: Fagus moesiaca*
019: Fagus orientalis
020: Fagus sylvatica*
021: Fraxinus angustifolia spp. oxycarpa (F. oxyphylla)*
022: Fraxinus excelsior*
023: Fraxinus ornus*
024: Ilex aquifolium
025: Juglans nigra
026: Juglans regia
027: Malus domestica
028: Olea europaea*
029: Ostrya carpinifolia*
030: Platanus orientalis
031: Populus alba
032: Populus canescens
033: Populus hybrides*
034: Populus nigra*
035: Populus tremula*
036: Prunus avium*
037: Prunus dulcis (Amygdalus communis)
038: Prunus padus
039: Prunus serotina
040: Pyrus coomunis
041: Quercus cerris*
042: Quercus coccifera (Q. calliprinos)*
043: Quercus faginea*
044: Quercus frainetto (Q. conferta)*
045: Quercus fruticosa (Q. lusitanica)
046: Quercus ilex*
047: Quercus macrolepis (Q. aegilops)
048: Quercus petraea*
049: Quercus pubescens*
050: Quercus pyrenaica (Q. toza)*
051: Quercus robur (Q. pedunculata)*
052: Quercus rotundifolia*
053: Quercus rubra*
054: Quercus suber*
055: Quercus trojana
056: Robinia pseudoacacia*
057: Salix alba
058: Salix caprea
059: Salix cinerea
060: Salix eleagnos
061: Salix fragilis
062: Salix sp.
063: Sorbus aria
064: Sorbus aucuparia
065: Sorbus domestica
066: Sorbus torminalis
067: Tamarix africana
068: Tilia cordata
069: Tilia platyphyllos
070: Ulmus glabra (U. scabra, U. scaba, U. montana)
071: Ulmus laevis (U. effusa)
072: Ulmus minor (U. campestris, U. carpinifolia)
073: Arbutus unedo)
074: Arbutus andrachne
075: Ceratonia siliqua
076: Cercis siliquastrum
077: Erica arborea
078: Erica scoparia
079: Erica manipuliflora
080: Laurus nobilis
081: Myrtus communis
082: Phillyrea latifolia
083: Phyllyrea angustifolia
084: Pistacia lentiscus
085: Pistacia terebinthus
086: Rhamnus oleoides
087: Rhamnus alaternus
088: Betula tortuosa
090: Crataegus monogyna
091: Ilex canariensis
092: Laurus azorica
093: Myrica faya
099: Other broadleaves

Conifers (* = species to be used for the foliage inventory)

100: Abies alba*
101: Abies borisii-regis*
102: Abies cephalonica*
103: Abies grandis
104: Abies nordmanniana
105: Abies pinsapo
106: Abies procera
107: Cedrus atlantica
108: Cedrus deodara
109: Cupressus lusitanica
110: Cupressus sempervirens
111: Juniperus communis
112: Juniperus oxycedrus*
113: Juniperus phoenicea
114: Juniperus sabina
115: Juniperus thurifera*
116: Larix decidua*
117: Larix kaempferi (L.leptolepis)
118: Picea abies (P. excelsa)*
119: Picea omorika
120: Picea sichensis*
121: Pinus brutia*
122: Pinus canariensis
123: Pinus cembra
124: Pinus contorta*
125: Pinus halepensis*
126: Pinus heldreichii
127: Pinus leucodermis
128: Pinus mugo (P. montana)
129: Pinus nigra*
130: Pinus pinaster*
131: Pinus pinea*
132: Pinus radiata (P.insignis)*
133: Pinus strobus
134: Pinus sylvestris*
135: Pinus uncinata*
136: Pseudotsuga menziesii*
137: Taxus baccata
138: Thuya sp.
139: Tsuga sp.
140: Chamaecyparis lawsonia
199: Other conifers

A1.13 Removals and mortality (mandatory Level II)

Definition

Removals are trees which for some reason are not included in the sample of assessment trees. Mortality refers to assessment trees which have died. A tree is defined as dead if all conductive tissues in the stem(s) have died.

Trees may have to be withdrawn or eliminated from sampling for several reasons. It is important to record this information so that the causes of changes in the numbers of assessment trees in each plot can be assessed. In particular, such information is critical if overestimation of mortality rates is to be avoided.

If a tree has died the cause must be determined (if possible). Standing dead trees (classes 30–32) of Kraft classes 1–3 should remain in the sample and should be assessed as dead trees as long as they are standing (until they are removed or have fallen down).

Note: This practice differs between countries, with some countries removing standing dead trees from the inventory after the initial report of mortality. It is strongly recommended that any standing dead trees in the plots are included in the assessments, regardless of the year of death.

Methods

The following classification must be used:

Code 0: tree alive and measurable (new, note this is different than a missing value)

01 tree alive, in current and previous inventory (formerly blanc)
02 new alive tree (ingrowth)
03 alive tree (present but not assessed in previous inventory)

Tree has been cut and removed, only its stump has been left

11 planned utilization, e.g. thinning
12 utilization for biotic reasons, e.g. insect damage
13 utilization for abiotic reasons, e.g. windthrow
14 cut, reason unknown
18 reason for disappearance unknown

Tree is still standing and alive, but crown condition parameters are no longer assessed

21 lop-sided or hanging tree
22 heavy crown break (over 50% of the crown) or broken stem
23 tree is no longer in Kraft classes 1, 2 or 3 (not applicable to the first inventory in a plot)
29 other reasons (specify)

Standing dead tree

31 biotic reasons, e.g. bark beetle attack
32 abiotic reasons, e.g. drought, lightning
38 unknown cause of death

Trees that have fallen (living or dead)

41 abiotic reasons (e.g. storm)
42 biotic reasons (e.g. beavers)
48 unknown cause

Note: Class 22 is only applicable in those countries that do not record trees with more than 50% crown damage.

Note: Class 23 is only applicable to those countries that restrict sampling to Kraft classes 1, 2 and 3.

Note: Mortality and the number of dead trees present in a plot are two different issues. Annual mortality can be calculated from the number of living trees that are dead the following year. The total number of dead trees in a plot at any one time provides no information on mortality rates, but provides information on the condition of a stand in the year of assessment.

Note: If trees in the plot have not been mapped, there may be some difficulty in identifying the fate of individual trees that have disappeared between surveys.

A1.14 Social class (mandatory Level II)

Definition

Social status is a measure of the height of a tree relative to the surrounding trees. Information on social status is useful as an aid to interpreting crown condition and increment data for the individual trees. For example, dominant trees may be more susceptible to stress than codominant trees.

Methods

Four classes are recognized:

1. dominant (including free-standing): Trees with upper crown standing above the general level of the canopy;
2. codominant: Trees with crowns forming the general level of the canopy;
3. subdominant: Trees extending into the canopy and receiving some light from above, but shorter than 1 or 2;
4. suppressed: Trees with crowns below the general level of the canopy, receiving no direct light from above.

Note: The assessment of the social class of a tree is in some cases difficult. Suppressed trees should not be equated with dying trees as, in a mixed-age stand, they represent future generations of trees. Classification on steep slopes presents a problem as even relatively short trees may receive direct light from above. In such cases, classification should be based on the relative heights of the trees.

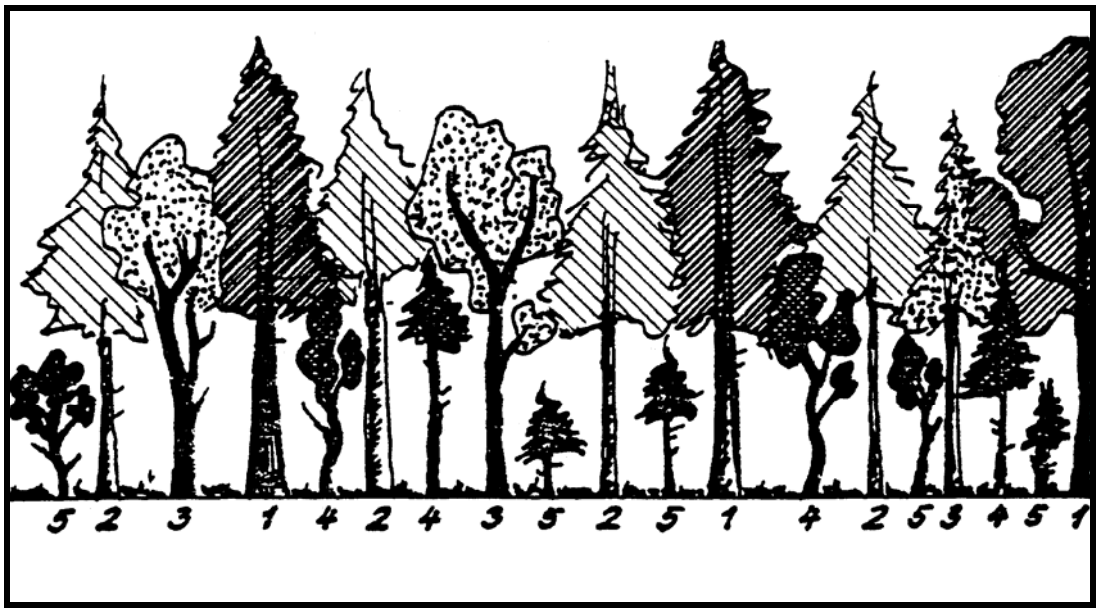

Figure A1-1: Illustration of social status classes (crown canopy classes) after Kraft (1 = dominant, 2 = codominant, 3 = subdominant, 4 = suppressed, 5 = dying)

A1.15 Crown shading (mandatory Level II)

Definition

Crown shading is an estimate of the openness of the tree's situation.

Open-grown trees usually have much larger crowns than ones in closed canopies. In addition, the absence of any competition may change the susceptibility of a tree to particular stresses. A change in the degree of shading may have significant effects on crown condition. Consequently, this assessment should refer to the degree of shading at the time of assessment. This may change

from one year to the next through, for example, thinning operations or storm damage. Consequently, it should be recorded annually.

Methods

Crown shading is assessed on a six-point scale as follows:

1 crown significantly affected (shading or physical interactions) on one side
2 crown significantly affected (shading or physical interactions) on two sides
3 crown significantly affected (shading or physical interactions) on three sides
4 crown significantly affected (shading or physical interactions) on four sides
5 crown open-grown or with no evidence of shading effects
6 suppressed trees

A1.16 Visibility (mandatory Level II)

Definition

The visibility of a crown is the degree to which different parts of the assessable crown can be viewed from the ground.

Crowns with poor visibility are not removed from the sample, but information about the visibility of individual tree crowns is useful to help with the interpretation of the data from those trees. Such trees remain in the sample as the use of an objective sampling design means that their exclusion could lead to bias in the results. Some parameters, e.g. stem and branch damage may be assessable on such trees.

Method

The following codes should be used for the assessable crown:

1 Whole crown is visible
2 Crown only partially visible
3 Crown only visible with backlighting (i.e. in outline)
4 Crown not visible

Note: Class 3 is distinguished from Class 4, as some parameters can still be assessed when only back-lighting is present.

A1.17 Defoliation (mandatory Level I and Level II)

Definition

Defoliation is defined as needle/leaf loss in the assessable crown as compared to a reference tree. Defoliation is assessed regardless of the cause of foliage loss (i.e. for example it includes damage by insects). Defoliation may also include thin crowns caused by a lack of foliage, as this may be indistinguishable from true defoliation.

This is one of the standard assessments made in Level I. Considerable problems exist with its definition, such that complete harmonization of its definition and method of assessment between countries is impossible. For example, the role of flowering is handled differently between countries.

Methods

Defoliation is assessed in 5% steps. These classes are 0, 5 (>0-5%), 10 (>5-10%) and so on. A tree with between >95% and 100% defoliation, which is still alive, is scored as 99. The score 100 is reserved for dead trees (EC Regulation). Trees should be reported in these 5% classes and not in aggregated groupings.

Hint: If the above-ground parts of a tree die (e.g. after a forest fire), the tree is classified as dead. The above-ground parts of the tree are considered dead if the phloem and xylem is dead. Note that dormant buds may continue to flush for one or more seasons on cut logs, indicating that the tissues may remain alive for some time after some people might consider them as dead. Regrowth from the roots is excluded until the shoots attain the requirements for inclusion in the assessments. Although biologically inappropriate, for practical reasons regrowth from the base of the trees should be classified as new stems with new crowns.

A1.18 Discolouration (optional Level I and Level II)

Definition

Originally the assessment of discolouration was defined on national level only.

A European wide adopted assessment of discolouration is now described in the section on damage assessment (ANNEX 2). Countries which are willing to continue the assessment of discolouration according to the classes given below are invited to report the results on an optional basis.

Class	Discolouration	Percentage of needles/leaves discoloured
0	none	0 - 10%
1	slight	>10 - 25%
2	moderate	>25 - 60%
3	severe	>60%
4	dead	dead

A1.19 Foliage transparency (optional Level II)

Definition

Foliage transparency is defined as the amount of skylight visible through the live, normally foliated portion of the crown or branch.

Each tree species has a normal range of foliage transparency. Changes in foliage transparency occur as a result of current damage, frequently referred to as defoliation, or from reduced foliage resulting from stresses during preceding years.

Methods

Estimate foliage transparency in 5% classes based on the live, normally foliated portion of the crown and branches using the transparency diagram in Fig. A1-2. Dead branches, crown dieback and missing branches where foliage is expected to be missing are deleted from the estimate (Fig. A1-3).

Large uniform crowns are scored as if the whole crown should be foliated. When defoliation is severe, branches alone will screen the light, but the surveyors should exclude the branches from the foliage and rate the area as if light was penetrating. For example, an almost completely defoliated dense spruce may have less than 20% light coming through the crown, but it will be scored as highly transparent because of the missing foliage. Old trees, and some broad-leaved species, have crown characteristics with densely foliated branches which are spaced far apart in the crown. These spaces between branches should not be included in the foliage transparency score. When foliage transparency in one part of the crown differs from another part, the average foliage transparency is estimated and recorded.

Foliage transparency should be assessed in the same way as defoliation, i.e. by two observers and from different positions.

Hint: The easiest way to assess foliage transparency is first to mentally draw a two-dimensional crown outline. Then block the foliated area into the crown outline. Lastly, estimate the transparency of this foliated area.

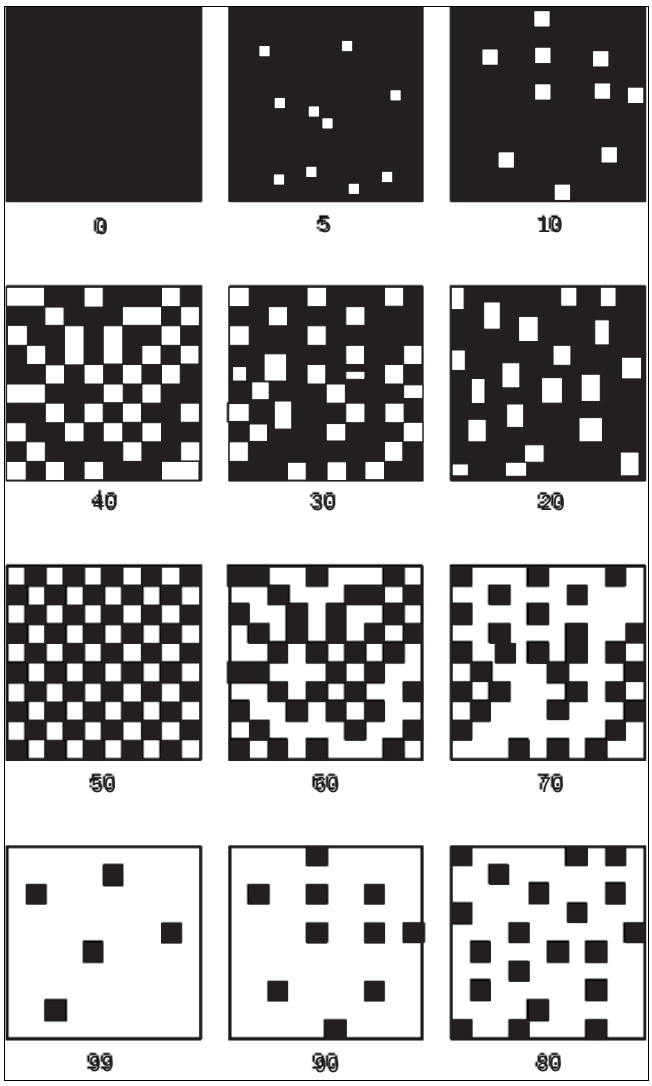

Figure A1-2: Guide to estimating transparency (derived from Tallent-Halsell 1994).

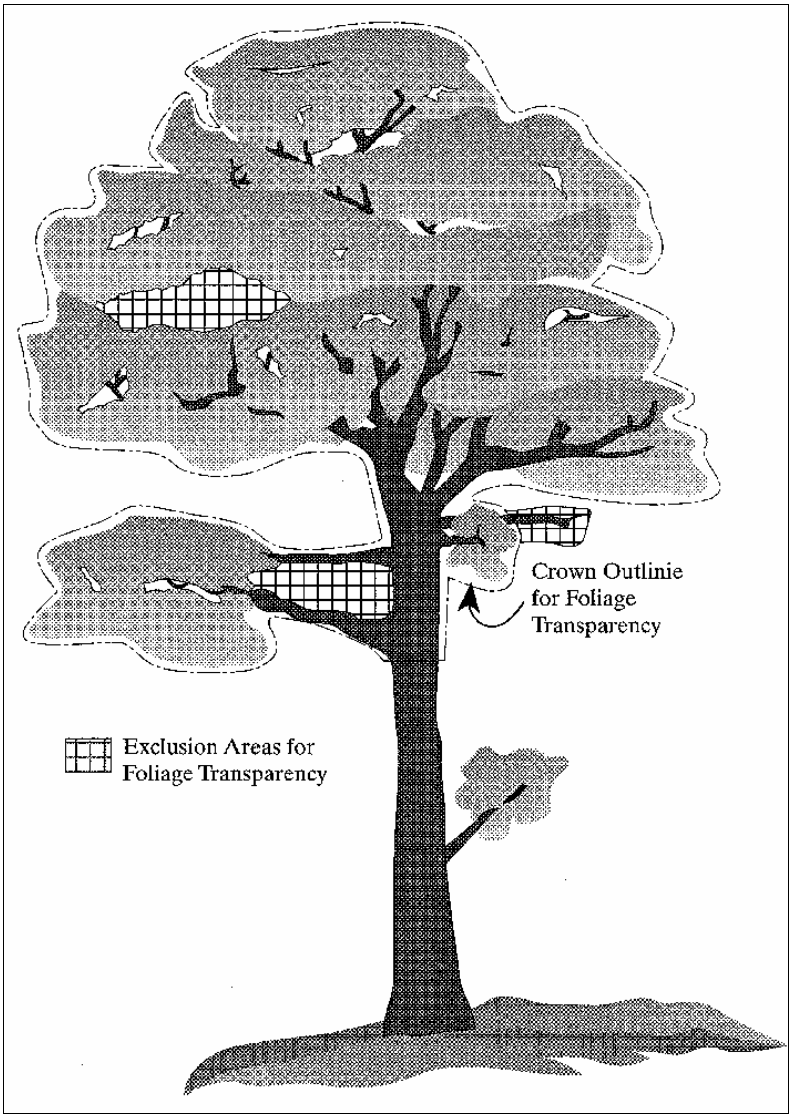

Figure A1-3: Crown outline to be taken into account when estimating foliage transparency. Note the areas to be excluded from the estimates. This is a free standing tree, therefore the assessable crown covers a rather large area (derived from Tallent-Hassel 1994).

A1.20 Flowering (optional Level II)

Definition

This score is defined as the estimation of (current) flowering in the crown.

Flowering is important for two reasons. Firstly, it can affect the defoliation score in the assessable part of the crown, both in the year of flowering and subsequently. Secondly, flowering in the whole crown is of interest because of the effects that it has on the carbon balance of the tree – energy used for flowering cannot be used for increment.

Methods

Two assessments are made: of the assessable part of the crown and of the whole crown. Scoring is:

1 Absent or scarce. The flowers are not seen in a cursory examination.
2 Common. Flowering effect is clearly visible.
3 Abundant. Flowering dominates the appearance of the tree.

Hint: in some species, such as *Pinus* and *Larix*, the flowers will probably have been dropped by the time of assessment. Scoring is based on the gaps along the shoots where the flowers formerly were.

Hint: Some species produce large amounts of green tissues associated with the flowers (e.g. *Carpinus betulus* and *Fraxinus excelsior*). These tissues contain chlorophyll and contribute to the carbon budget of the tree. It is recommended that such tissues are included with the foliage mass when assessing defoliation. As fruiting in such species remains relatively constant from year to year, annual changes in fruiting will not significantly affect the defoliation estimates.

A1.21 Fruiting (optional Level I and Level II)

Definition

This score is defined as the estimation of fruiting in the crown. Only fruits produced in the year of assessment are included.

Information on fruiting is useful to have because of its effect on the carbon economy of the tree. As with flowering, fruiting diverts energy away from other parts of the tree. As with flowering, it may also have an effect on the future branch structure of the tree.

Especially on beech this parameter may provide very valuable information and its submission is very much encouraged.

Methods

As with flowering, two assessments are made: of the assessable part of the crown and of the whole crown. Scoring is:

1 Absent or scarce. The fruits are not seen in a cursory examination.
2 Common. Fruiting is clearly visible.
3 Abundant. Fruiting dominates the appearance of the tree.

Note

Quantitative estimates of both flowering and fruiting can be obtained by the use of litter traps. However, such data cannot be readily related to individual trees.

A1.22 Secondary shoots and epicormics (optional Level II)

Definition

Secondary shoots and epicormics are used synonymously and are defined as shoots that have developed from dormant buds on the stem or on branches.

In some species, the development of secondary shoots is the normal part of crown formation. For example, in *Picea abies*, secondary shoots develop along the main branches to replace older shoots that have lost their needles. In other species, particularly broadleaves, the development of epicormic shoots in the crown and on the stem may reflect increased levels of light penetration through the foliage of the outer crown.

Scoring of the presence of shoots reveals whether the tree is responding to loss of foliage and thus the regenerative capacity of the tree. For example, a heavily defoliated *Picea abies* that has no secondary shoots is indicative of a tree under extreme stress.

Methods
Separate assessments are made of the frequency (3 classes) of epicormics in the assessable crown and on the stem. The assessment must include all epicormics, not only the ones of the current year. Scoring is in three classes:

1 None or rare
2 Medium: light development or only present in parts of the crown or stem
3 Abundant: present throughout the majority of the crown or all over the stem

A1.23 Crown form/morphology (incl. Roloff) (optional Level II)
Definition
Crown form is defined as the appearance of the crown. It may be influenced by crown shape and/or by branch habit.

Crown form provides supplementary information about the condition of a tree. In many cases, crown form changes through time. The premature development of such changes often indicates the action of one or more types of stress. However, the separation of stress- and genetically-induced changes is often difficult.

Crown form classifications have been so far been developed for *Picea* spp., *Fagus sylvatica* and *Pinus sylvestris*. *Note*: the use of the Roloff classification system for species other than *Fagus sylvatica* must be undertaken with special care and is not recommended.
Methods
Picea (Fig. A1-4)
11 comb
12 brush
13 plate
14 mix

Fagus sylvatica (Fig. A1-5)
21 trees with vigorous growth both of apical and side shoots
22 reduced apical shoot growth, side shoots are still formed but at lower frequency (mainly consisting of short shoots)
23 strongly reduced apical shoot growth, no new lateral branches are formed. Shoot appearance is “claw-like”
24 development of 23, with loss of side shoots
29 other
Pinus
31 pine, vigorous apical dominance with tree growing strongly upwards
32 pine, reduced or no apical dominance with crown showing signs of widening
33 pine, as 32, but lower branches being lost through suppression
34 platform developing, with dominant growth direction no longer upwards,
but crown still with some depth
35 platform fully developed, no vertical growth
39 other (specify)

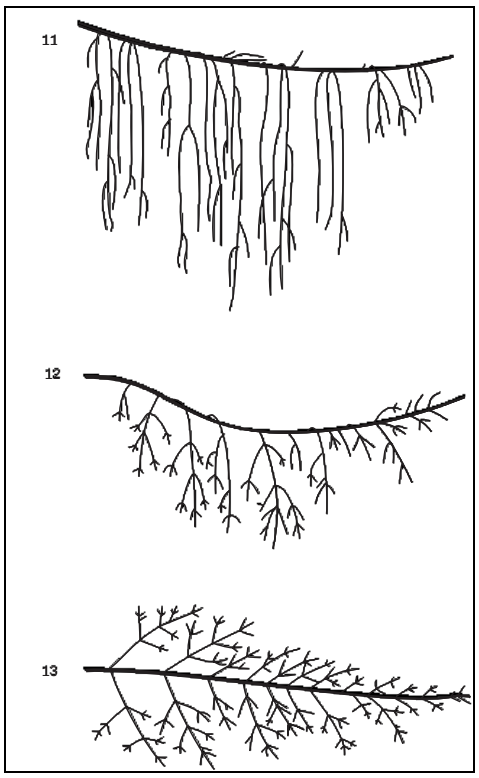

Figure A1-4: Crown form in *Picea* spp. 11: Comb; 12: Brush; 13: Plate.

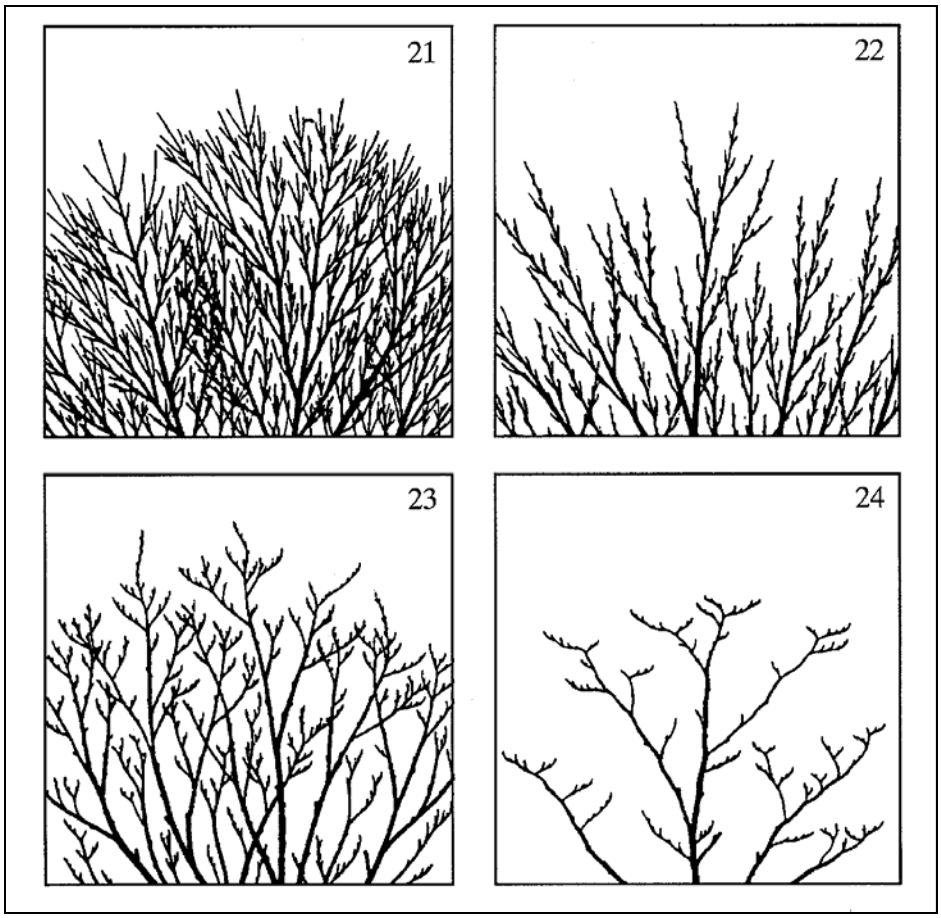

Figure A1-5: Crown form in *Fagus sylvatica*. 21: Vigorous growth of apical and side shoots; 22: Reduced apical growth; 23: Development of „claws“; 24: Disintegration of crown.

Annex 2: Assessment of damage causes

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ad hoc Working Group Biotic Damage
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A2.1 Introduction

The causes of damage to a tree and their influence on crown condition are central to the study of cause-effect mechanisms. Without this information, data on defoliation and other crown parameters are extremely difficult to interpret. Data on leafloss and discoloration caused by the actions of defoliating insects or other factors will also provide valuable information for interpreting e.g. litterfall measurements and phenological observations.
The main objective of assessing damage causes in the framework of this programme is to provide information about their impact on crown condition. Therefore this assessment should focus on the main damage factors influencing crown condition. Any part of a tree may show symptoms caused by the actions of insects, fungi, weather conditions or other factors. They may consist of defoliation, discoloration, deformations, wounds etc. and their impact may vary from completely harmless to lethal to the tree.
Long-term monitoring may also provide baseline data on the distribution, occurrence and harmfulness of biotic agents / damage factors in Europe. These data may also contribute to other aspects relevant for forest policy like sustainable forest management.

A2.2 Definitions

Damage is defined as an alteration or a disturbance to a part of the tree which may have an adverse effect on the ability to fulfill its functions.
Symptom: Any condition of a tree resulting from the action of a damaging agent that indicates its occurrence (e.g. defoliation, discoloration, necrosis)
Sign: Evidence of a damaging factor other than that expressed by the tree (e.g. fungal fruiting bodies, nests of caterpillars)
Discolouration: any deviation from the usual colour of the living foliage for the assessed tree species.
Dieback: branch mortality which begins at the terminal portion of a branch and proceeds towards the trunk and/or the base of the live crown.

A2.3 Selection of sample trees

Level I + Level II: assessment of damage causes is mandatory for all trees of the crown condition sample.

A2.4 Frequency and timing

Level I + Level II: assessment of damage causes should be carried out during normal crown condition assessment in summer.
At Level II plots where the complete programme is carried out, the so-called ‘key-plots’, an additional visit for damage assessment is strongly recommended if important damage is observed outside the period of crown condition assessment. The observations of the staff responsible for deposition sampling or phenological observations may act as an early warning system. This additional visit should be made at the time when the main damage cause is supposed to be at its maximum (e.g. spring for defoliators).

A2.5 Parameters to be assessed

The assessment of damage causes consists of 3 major parts:

- symptom description
- determination of the cause
- quantification of symptoms (extent)

The following table gives an overview of mandatory (M) and optional (O) parameters at Level I and Level II plots.

		Level I	Level II
Symptom description	Specification of affected part	M	M
	Symptom	M	M
	Specification of symptom	O	M
	Location in crown	O	M
Cause		M	M
Extent		M	M

In case that **more than one damaging agents/factors** are found on the same tree they should be reported using additional lines in the submission forms (more than one line per tree).
In the event of **several symptoms** on a tree caused by the **same, identified agent/factor,** only the main symptom shall be reported in the submission forms.
If a damage of a tree is observed and **the cause is unknown**, the symptoms and the extent should be reported nevertheless (regarding defoliation see "specifications", point b, page 34). However in the field "cause" the code 999 should be entered (see Chapt. A2.5.2).

A2.5.1 Symptom description

"Describe what you see" could be a summary of the aims of the symptom description: it indicates which *part of the tree* is affected and the *type of symptom* it shows. It is an essential step for diagnosis of the causal agent and for the study of cause-effect mechanisms. However this does not mean that every symptom observed has to be reported. The symptom description should focus on important factors for which an actual or future impact on may influence crown condition. See also National lists (page 34).
The symptom description does not deal with quantification: it indicates only the presence of symptoms. For quantification see A2.5.3.
In principle the symptom description is restricted to causal agents or factors which may influence crown condition (defoliation, discoloration). However this does not mean that the symptom description is restricted to symptoms observed on the foliage: damage to the branches or the stem (e.g. bark beetle attack) often results in defoliation but its contribution in the defoliation score may be very difficult to assess. Therefore the symptom description should cover all affected parts of the tree.
As regards the crown the **total crown** (which may be different from the assessable crown) should be taken into account. This is important because symptoms that may be recognized outside the assessable crown may indicate the start of a process which may affect the assessable crown at a later stage (e.g. *Peridermium pini* infection in *Pinus*).

A2.5.1.1 Affected part of the tree and location in crown

Three main categories are distinguished for indicating the affected part of the tree: (a) leaves/needles; (b) branches, shoots & buds; (c) stem & collar. For each affected part further specification is required, which is important for diagnostic purposes. For this more detailed description, the categories used in other parts of the crown manual are applied. A separate code allows for reporting also the location in the crown. This may provide further valuable information for the diagnosis.

Affected part	**Specification of affected part** (mandatory Level I and Level II)	Code	**Location in crown** (optional Level I, mandatory Level II)	Code
Leaves/needles	Current needle year	11	Upper crown	1
	Older needles	12	Lower crown	2
	Needles of all ages	13	Patches	3
	Broadleaves (incl. evergreen spec.)	14	Total crown	4

Affected part	**Specification of affected part** (mandatory Level I and Level II)	Code	**Location in crown** (optional Level I, mandatory Level II)	Code
Branches, shoots & buds	Current year shoots Twigs (diameter < 2 cm) Branches diameter 2 – < 10 cm Branches diameter ≥ 10 cm Varying size Top leader shoot Buds	21 22 23 24 25 26 27	Upper crown Lower crown Patches Total crown	1 2 3 4
Stem & collar	Crown stem: main trunk or bole within the crown Bole: trunk between the collar and the crown Roots (exposed) and collar (≤ 25 cm height) Whole trunk	31 32 33 34		
Dead tree	*see below*	*04*		
No symptoms on any part of tree	*see below*	*00*		
No assessment	*see below*	*09*		

Table A2-1: Affected parts of a tree and location in the crown.

Special cases:

The following codes for special cases shall be reported in the column for 'specification of affected part' of the tree:

a. Dead trees:

Dead trees should be reported using code 04. The cause of death should be reported in the column for the causal agent / factor.

b. No symptoms at all are observed on any part of the tree:

In order to avoid that the observers have to report that there are no symptoms on the foliage, nor at the branches and the stem, this case should be reported using code 00.

c. No assessment of damage causes was made

Report code 09 in the column for specification of affected part.

A2.5.1.2 Symptoms and their specification

Symptoms are grouped into broad categories like wounds, deformations, necrosis etc. A separate code (specification of symptom) allows for a more detailed description. Nests of caterpillars, fungal fruit bodies etc. are not considered as symptoms but are defined as 'signs' of insects, fungi, ... Their presence provides valuable information for diagnostic purposes and should be reported. *If signs of insects or fungi are observed it is important to report also the observed damage symptoms.*

An overview of symptoms, specifications and codes is given in Table A2-2. For the field teams this table provides a complete overview of the section on symptom description, including the codes for reporting.

Affected part	Symptom / sign (mandatory Level I and Level II)	Code	Symptom/sign specification (optional Level I, mandatory Level II)	Code
Leaves/needles	Partly or totally devoured/missing	01	holes or partly devoured/missing	31
			notches (leaf/needle margins affected)	32
			totally devoured/missing	33
			skeletonised	34
			mined	35
			Premature falling	36
	Light green to yellow discolouration	02	overall	37
	Red to brown discolouration (incl. necrosis)	03	flecking, spots	38
	Bronzing	04	marginal	39
	Other colour	05	banding	40
			interveinal	41
			tip, apical	42
			partial	43
			along veins	44
	microfilia (small leaves)	06		
	other abnormal size	07		
	Deformations	08	curling	45
			bending	46
			rolling	47
			stalk twisting	48
			folding	49
			Galls	50
			wilting	51
			other deformations	52
	other symptom	09		
	Signs of insects	10	black coverage on leaves	53
			nest	54
			adults, larvae, nymph, pupae, egg masses	55
	Signs of fungi	11	white coverage on leaves	56
			fungal fruiting bodies	57
	Other signs	12		
Branches shoots& buds	devoured / missing	01		
	Broken	13		
	Dead / dying	14		
	Abortion / abscission	15		
	Necrosis (necrotic parts)	16		
	Wounds (debarking, cracks etc.)	17	debarking	58
			cracks	59
			other wounds	60
	Resin flow (conifers)	18		
	Slime flux (broadleaves)	19		
	Decay/rot	20		
	Deformations	08	wilting	51
			bending, drooping, curving	61
			cankers	62
			tumors	63
			whitches broom	64
			other deformations	52
	other symptom	09		
	Signs of insects	10	boring holes, boring dust	65
			nest	54
			white dots or covers	66
			adults, larvae, nymph, pupae, egg masses	55
	Signs of fungi	11	fungal fruiting bodies	57
	Other signs	12		

Table A2-2: Symptoms/signs and specification of symptoms/signs; part I / II

Affected part	Symptom / sign (mandatory Level I and Level II)	Code	Symptom/sign specification (optional Level I, mandatory Level II)	Code
Stem / collar	Wounds (debarking, cracks etc.)	17	debarking	58
			cracks (frost cracks, …)	59
			other wounds	60
	Resin flow (conifers)	18		
	Slime flux (broadleaves)	19		
	Decay/rot	20		
	Deformations	08	cankers	62
			tumors	63
			Longitudinal ridges (frost ribs, …)	68
			other deformations	52
	tilted	21		
	fallen (with roots)	22		
	broken	13		
	Necrosis (necrotic parts)	16		
	other symptom	09		
	Signs of insects	10	boring holes, boring dust	65
			white dots or covers	66
			adults, larvae, nymph, pupae, egg masses	55
	Signs of fungi	11	fungal fruiting bodies	57
			yellow to orange blisters	67
	Other signs	12		

Table A2-2: Symptoms/signs and specification of symptoms/signs; part II / II

Important remarks:

a. National lists

Table A2-2 aims at giving an overview of the more important symptoms that may occur in trees. The symptom description is mandatory for foliage, branches and stem, but countries are free to select for each affected part the more important symptoms at national level. If a selection is made this should be reported to the international data centre.
In order to reduce the time needed for the symptom description countries may wish to compose a national standard list with a complete symptom description for well-known and frequently occurring damage factors for their field teams. This way the surveyor will only have to fill in the name of the causal agent and the quantification of the damage. In the event of damage by a factor which is not on the standard list, the complete symptom description should be made.
Reporting to the international data centre however should always include the complete symptom description.
The categories 'other' (symptom, sign, colour etc.) should be specified in the remarks column.

b. In the event of symptoms of **ozone damage** the guidelines of the 'Submanual on Ozone injury on European Forest Ecosystems' (Part X of this manual) shall be applied.

Specifications

a. If damage symptoms on a tree are observed and **the cause is unknown**, the symptoms and the extent should be reported nevertheless. However in the field "cause" the code 999 should be entered (see Chapt. A2.5.2).

b. Avoiding duplication of crown condition assessment:
Crown condition assessment in the ICP Forests monitoring programme mainly deals with defoliation. This symptom is also very important for the assessment of damage causes. In this respect the following rules apply:

- if defoliation of a tree is observed and **the cause is unknown**, defoliation should only be reported in the crown condition assessment, and should **not be reported** as a symptom in the damage causes section. However, other relevant symptoms observed on the same tree (e.g. dead branches) should be reported.

- If defoliation can partly or totally be attributed to a certain**, identified cause(s)** (e.g. defoliators), defoliation should be reported in the damage causes section in addition (see 2.5.2 and 2.5.3).

c. Necrosis of leaves/needles and its pattern is an important symptom for diagnostic purposes. For the assessment of damage causes **necrotic leaves** or parts of leaves should be reported as 'red to brown discoloration, incl. necrosis' (code 03) and should not be considered as defoliation.

d. In the event of **several symptoms** on a tree caused by the **same, identified agent/factor,** only the main symptom shall be reported.

e. **Dead branches**: Snags (dead branches which are dead for several years and without side shoots) and dead branches due to competition are excluded from the assessment of dead branches.
In some tree species (e.g. spruce), small dead branches may be a 'normal' phenomenon. This should not be reported except when an abnormal percentage of dead branches is observed.

A2.5.1.3 Age of the damage

(optional Level I and Level II)
Recording this parameter helps in detecting new epidemics. Moreover, some injuries, like harvesting scars remain visible for many years.

The age of the damage shall be reported using the following classes:

Code	class damage age	description
1	Fresh	damage that has begun after the last year's inventory
2	old	damage that has begun earlier
3	fresh and old	both, fresh and old damage is visible

A2.5.2 Causal agents / factors

(mandatory Level I and Level II)

Determination of the causal agent that is responsible for the observed damage symptoms is crucial for the study of cause-effect mechanisms. The description of symptoms is an important step in the diagnostic process, but damage symptoms on their own do not always provide the explanation for the observed damage. In many cases further examination will be necessary to determine the causal agent. However there should be no destructive sampling within plot boundaries.
Determination of causal agents should be carried out by trained observers and should be confirmed by an expert phytopathologist whenever possible.
In case that more than one damaging agents are found on the same tree they should be reported using additional lines in the submission forms (more than one line per tree possible).
In case that damage has to be reported caused by a damage factor for which no code is foreseen this should be reported to the PCC of ICP Forests. PCC will take care that a respective code will be defined by the EP and be provided to the NFCs.

Causal agents are grouped into the following categories:

Agent group	Code
Game and grazing	100
Insects	200
Fungi	300
Abiotic agents	400
Direct action of men	500
Fire	600
Atmospheric pollutants	700
Other factors	800
(Investigated but) unidentified	*999*

Table A2-3: Main categories of causal agents / factors

In each category a more detailed determination is possible according to a hierarchical coding system (see Tables A2-3 – A2-11). Report the damage cause as detailed as possible, if possible up to species level. E.g. a code 210 for insects is more helpful than a score 200, as in the first case it is specified that the causal agent is a defoliator.

Agent group	Code	Class	Code	Type	Code
Game and grazing	100	Cervidae	110	Roe deer	111
				Red deer	112
				Reindeer	113
				Elk/Moose (*Alces alces*)	114
				Other Cervidae	119
		Suidae	120	Wild boar	121
				Other Suidae	129
		Rodentia	130	Rabbit	131
				Hare	132
				Squirrel etc.	133
				Vole	134
				Beaver	135
				Other Rodentia	139
		Aves	140	Tetraonidae	141
				Corvidae	142
				Picidae	143
				Fringillidae	144
				Other Aves	149
		Domestic animals	150	Cattle	151
				Goats	152
				Sheeps	153
				Other domestic	159
		Other vertebrates	190	Bear	191
				Other vertebrate	199

Table A2-4: Codes for agent group 100 (game and grazing)

				CONIFERS			
Agent group	Code	Class	Code	Main species	Code	Affected genus	Symptoms
INSECTS	200	Defoliators	210	*Acantholyda sp.*		*Pinus*	Shelter made of silky threads and frass, on the needles,
				Brachonyx pineti		*Pinus*	Fine spots with a central hole in the needles and presence of small holes in the sheaths
				Brachyderes suturalis		*Pinus*	Devoured needles forming a thick saw edge
				Diprion pini		*Pinus*	Summer defoliations. False caterpillars, greenish with brown - orange head. Eggs in the needle margins and pupas in the soil
				Gelechia senticetella		*Juniperus, Cupressus*	Silky threads in dry twigs
				Lymantria dispar		*Larix, Picea, Pinus*	Devoured needles; caterpillars with long hairs, variable yellow to black coloured with characteristic double row of blue and red spots on the back
				Lymantria monacha		*Pinus*	Eggs disposed in cracks of the bark. Recently born caterpillars disposed in lines in the trunk. Summer defoliations.
				Bupalus piniarius		*Pinus*	
				Choristoneura murinana		*Abies*	
				Cephalcia abietis		*Picea*	
				Cephalcia lariciphila		*Larix*	
				Dendrolimus pini		*Pinus*	
		Stem, branch & twig borers (incl. shoot miners)	220	*Dioryctria sylvestrella*		*Pinus*	Boring hole with resin crumb on the trunk along with sawdust and reddish excrement rests
				Hylobius abietis		*Pinus*	Shallow bites in thin twigs and young pines
				Ips acuminatus		*Pinus*	Star - shaped system of galleries under the bark . Trees damaged situated in sparce close groups. Death of trees in summer.
				Ips sexdentatus		*Pinus*	Star - shaped system of galleries under the bark . Trees damaged situated in close groups. Death of trees in summer. Adult is bigger than the adult Ips sexdentatus
				Ips typographus		*Picea*	Bark beetle, borer, killing red spruce, dangerous for whole forest
				Magdalis sp.		*Pinus*	Punctures in buds and young twigs. Dry and hollow young shoots
				Orthotomicus sp.		*Pinus*	Long star - shaped system of galleries under the bark Adults of very small size.
				Phaenops cyanea		*Pinus*	damage of larvae in part of stem with thick bark, galleries of older larvae with 'cloudy' boring dust; beetle dark blue with green glow
				Pissodes castaneus		*Pinus*	Very small holes with resin drop resina in buds and shoots. Galleries under the bark and pupation chambers with thick wood chips.
				Pityogenes chalcographus		*Picea, Larix, Abies, Pseudotsuga*	
				Pityokteines curvidens		*Abies*	
				Retinia resinella		*Pinus*	Thick and big resin crumb, hollow inside, along with excrements, in small branches and/or buds
				Semanotus laurasi		*Juniperus*	Galleries and pupation chambers in branches and twigs. Reddish small areas disperse in the crown.
				Tomicus destruens		*Pinus*	Dry and hollow apical twigs. Resin crumb in trunk with a hole for entering. Under bark galleries with shape of fish thorns. Death of the trees in spring.
		Bud boring insects	230	*Rhyacionia buoliana*		*Pinus*	Hollow buds and young shoots (bayonet shaped shoots),
				Rhyacionia duplana		*Pinus*	Hollow buds and young shoots (bayonet shaped shoots), along without resin crumbs.
		Fruit boring insects	240	*Dioryctria mendacella*		*Pinus*	Irregular shaped boring holes filled with resin in the fruit (pine cones). Presence of galleries with excrements and silky threads.
				Pissodes validirostris		*Pinus*	Round and clean boring holes in the pine cones. Egg - layings are covered with a dark stopper and disposed in the pine cone scales
		Suking insects	250	*Haematoloma dorsatum*		*Pinus, Juniperus*	Eggs - laying in shape of a "spit" over grasses. Reddened needles.
				Leucaspis pini		*Pinus*	Adults with eliptic white bodies (like white scales stucked to the needles).
				Matsucoccus sp.		*Pinus*	Breakage and formation of scales in stems. Adults with eliptic sessile bodies under the bark.
		Mining insects	260	*Epinotia subsequana*		*Abies*	Brown and curved needle in part of its length, with a boring hole.
		Gallmakers	270				
		Other insects	290				

Table A2-5: Codes for agent group 200 (insects): Conifers

				BROADLEAVES			
Agent group	**Code**	**Class**	**Code**	**Main species**	**Code**	**Affected genus**	**Symptoms**
I N S E C T S	200	**Defoliators** (incl. skeletonizers, leaf rollers etc.)	210	*Abraxas pantaria*		*Fraxinus*	It attacks leaves during the summer. Caterpillars let themselves down from the crown by means of silky threads
				Agelastica alni		*Alnus*	Leaves are skeletonized and devoured irregularly. Eggs are yellow and the egg - laying is over the leaf.
				Altica quercetorum		*Quercus*	Leaves look brown due to the skeletonizing.
				Epirrita autumnata		*Betula*	leaves devoured
				Galerucela linneola		*Populus, Salix*	Leaves skeletonized with the veins intact and damages in buds. Eggs - layings in the back side of the leaf.
				Gonipterus scutellatus		*Eucalyptus*	Leaves devoured, with margins looking as narrow and deep saw teeth
				Leucoma salicis		*Populus, Salix, Betula*	White eggs - layings in trunks and branches.
				Lymantria dispar		*Quercus*	Attacks the current year leaves and in extreme cases also the older ones. Eggs - laying look like yellow mass and are
				Archips xylosteana		*Quercus*	Attacks the tip of the current year shoots. Shelter is made with young leaves tied toghether by means of silk threads.
				Lymantria monacha		*Quercus, Fagus, Betula u.a.*	
				Melolontha spec.		*Quercus u.a.*	
				Operophthera brumata		*Quercus*	
				Operophthera fagata		*Fagus*	
				Thaumetopoea processionea		*Quercus*	
				Melasoma populi = Chrysomela populi		*Populus, Salix*	Leaves devoured starting from the margins and /or in holes. Orange eggs - laying over the leaf. Very typical larvae (easy to recognise)
				Tortrix viridana		*Quercus*	Attacks the current year shoot tips. Makes a shelter with young leaves tied toghether by means of silky threads. Greenish caterpillar, they let themseves down by means of silky threads.
				Xanthogaleruca luteola		*Ulmus*	Leaves look brown due to skeletonizing.
		Stem, branch & twig borers (incl. shoot miners)	220	*Agrilus grandiceps*		*Quercus*	Death of thin twigs as it is a twig girdler - galleries . Circular exit holes
				Cerambyx sp.		*Quercus*	Big eliptic holes at the base of the trunk and thick branches through which sawdust flows. Big sized galleries
				Coroebus florentinus		*Quercus*	Death of small and median sized branches. Death of twigs due to twid girdling (galleries) Tha damage looks like red flashes distributed all along the crown
				Agrilus biguttatus		*Quercus*	
				Agrilus viridis		*Fagus*	
				Crematogaster scutellaris		*Quercus*	Great number of small holes in the cork. Ants.
				Cryptorrhynchus lapathi		*Populus, Salix*	Circular holes in the trunk trough which small wood chips flow. Superficial girdling damages.
				Melanophila picta		*Populus*	Debarking and eliptic holes with a compact dark brown coloured detritus at the base of the trunk.
				Paranthrene tabaniformis		*Populus, Salix*	Circular holes in the trunk through which flows round wood chips Rests of the chrysalis in the hole. Affects to young
				Phoracantha semipunctata		*Eucalyptus*	Eliptic holes in the trunk. Wide galleries under the bark.
				Platipus cylindrus		*Quercus*	Circular holes in the trunk through wich flows sawdust , which is acumulated at the base of the trunk.
				Sesia apiformis		*Populus, Salix*	Circular holes at the base of the trunk and chrysalid cocoons made of sawdust. Affects to trees of more than 10 - 15 centimetres of dbh
		Bud boring insects	230				
		Fruit boring insects	240	*Curculio glandium*		*Quercus*	Boring holes in the acorns
		Sucking insects	250	*Ctenaritaina eucalypti*		*Eucalyptus*	Small aphids over young shoots. Bent shoots and sap fluxes
				Kermes sp.		*Quercus*	Spherical bodies covered by a brilliant black reddish wax cover, situated in the stalks insertion areas of leaves, buds
		Mining insects	260	*Rhynchaenus fagi*		*Fagus*	Many small holes in the leaf, it mines the leaf starting from the central vein to the margins
		Gallmakers	270	*Cynips tozae*		*Quercus*	Big spherical greyish - brown galls with a crown of teeth on the top, in small branches or twigs.
				Dryomyia lischtensteini		*Quercus*	Hemispheric or irregular shaped swellings at the back side
				Mikiola fagi		*Fagus*	Small pink galls with a shape like waters drops, on the leaf
		Other insects	290				

Table A2-6: Codes for agent group 200 (insects): Broadleaves

				CONIFERS			
Agent	**Code**	**Class**	**Code**	**Main species**	**Code**	**Affected genus**	**Symptoms**
FUNGI	300	Needle casts and needle- rust fungi	301	*Lophodermium pini = Leptostroma pinostri*		*Pinus*	Long brilliant black carpophores located on the upper needle surface
				Lophodermium sulcigena		*Pinus sp.*	
				Cyclaneusma minus = Naemacyclus minor		*Pinus (Sylvestris, radiata)*	Formation of traverse reddish brown stripes (banding) and presence of elliptic carpophores (ligth brown or the same colour than the needle)
				Phaeocryptopus gaeumannii		*Pseudotsuga*	
				Rhabdocline pseudotsugae		*Pseudotsuga*	
				Mycosphaerella laricina		*Larix*	
				Naemacyclus nivens		*Pinus*	Ligth coloured carpophores. When they come off, they leave holes in the needles.
				Thyriopsis halepensis		*Pinus*	Needles with circular black carpophores with brown centre.
				Mycospherella pini = Dothistroma septospora		*Pinus (radiata, nigra, halepensis)*	It is the so called "red banding" in needles
				Chrysomyxa abietis		*Picea*	yellow to orange-brown spots on needles which fall prematurely
		Stem and shoot rusts	302	*Melampsora pinitorqua*		*Pinus*	Shoots are curved in shape of "C" or "S". To complete its biological cycle needs host trees pertaining to Populus and/or Pinus genus
				Cronartium ribicola		*Pinus strobus*	
				Coleosporium tussilaginis = Coleosporium senecionis		*Pinus*	"Blister rust" of the needles. Blisters are orange when full and white when empty.
				Cronartium flaccidum = Peridermium pini		*Pinus*	"Blister rust" of the bark. Girdling of the branches or trunk with abundant resin flows. Blisters are orange when full and white when empty.
		Dieback and canker fungi	309	*Gremmeniela abietina*		*Pinus*	Death of branches and buds with black carpophores over the bark. When it ripens pink pendants with conidia go out.
				Cenangium ferruginosum		*Pinus*	Death of branches and buds. Black carpophores over the bark
		Blight	303	*Shaeropsis sapinea = Diplodia pinea*		*Pinus*	Side shoots are curved, presenting deformations, resin flows and black carpophores.
				Sirococcus conigenus		*Pinus (halepensis)*	Death of shoots and reddish brown hanging needles.
		Decay & root rot fungi	304	*Fomes pini = Trametes pini*		*Pinus*	Flat woody carpophores with "horse hoofs" shape, greyish brown
				Amillaria mellea		*many tree species*	White leather cover visible when debarking roots and root collar, goes up. Forms honey coloured mushrooms with foot, in small groups
				Heterobasidion annosum		*Abies, Pinus, Picea, Larix, Pseudotsuga*	White leather cover but less dense than the one from Armillaria visible when debarking the root or root collar. Mushrooms are greyish brown with white margins and they are stuck to the root collar surface
		Other fungi	390				

				BROADLEAVES			
Agent	**Code**	**Class**	**Code**	**Main species**	**Code**	**Affected genus**	**Symptoms**
FUNGI	300	Leaf Spot fungi	305	*Drepanopeziza punctiformis = marssonina brunea*		*Populus, Salix*	Small round spots, with brown margins and greyish white centre.
				Rhytisma spp		*Salix, Acer*	Big black irregularly- shaped scabby spots
				Taphrina aurea		*Populus*	Yellowish swellings or bumps
				Mycosphaerella maculiformis		*Castanea*	Chestnut rust. Reddish brown dots distributed all along the leaf
				Septoria populi		*Populus*	Grey spots limited by a necrotic margin
				Harknessia eucalypti		*Eucalyptus*	Reddish brown irregular spots
				Mycosphaerella eucalypti		*Eucalyptus*	Red spots
		Anthracnose	306	*Apiognomonia spp.*		*Quercus, Juglans*	Affects to the veins
		Powdery mildew	307	*Uncinula spp.*		*Populus, Salix,*	Greyish white powder over buds and/or leaves (oidium)
				Microsphaera alphitoides		*Quercus*	White powder over the leaves (oidium)
		Wilt	308	*Ophiostoma novo - ulmi*		*Ulmus*	Shoots and buds wilt, when cutting the buds and thin branches you can see a necrotic ring which corresponds to the vascular collapsing
				Ceratocystis fagacearum		*Quercus*	
				Venturia populina = Pollaccia elegans		*Populus*	leaves are brown coloured and curved by the stalk
		Rust	302	*Mellampsora allii - populina*		*Populus*	Yellow to orange dots in the back side of the leaf
				Melampsoridium betulinum		*Betula*	rapidly multiplying small spots on leaves which fall prematurely
		Blight	303	*Botryosphaeria stevensii = Diplodia mutila*		*Quercus*	Dry and curved shoots (dieback) with necrosed bark and longitudinal cracks where the carpophores appear
				Hypoxilon mediterraneum		*Quercus*	The bark comes off, showing plates, in trunk and branches
				Fusicoccum quercus		*Quercus*	
				Dothichiza populea		*Populus*	Black carpophores in buds and branches bark
		Canker	309	*Cryphonectria parasitica = Endothiella parasitica*		*Castanea*	Yellowish leather cover (triangle shaped) under the cracks of the bark
				Pezicula cinnamomea		*Quercus*	
				Stereum rugosum		*Quercus, Fagus*	
				Cytospora crysosperma= valsa sordida		*Populus*	Orange carpophores over the bark
				Nectria spp.		*Quercus*	Red carpophores under the bark cracks
		Decay & Root rot	304	*Fomes fomentarius*		*Fagus*	Flat woody carpophores with a "horse hoofs" shape. The upper part has a concentric flat area greyish brown coloured
				Ganoderma applanatum		*Fagus*	Flat woody carpophores with a "horse hoofs" shape. The upper part is covered by a reddish brown powder
				Ungulina marginata		*Fagus*	Flat woody carpophores with a "horse hoofs" shape. The upper part is reddish brown with yellowish margins and the bottom part is yellowish.
				Amillaria mellea		*many tree species*	
				Phytophthora spec.		*Alnus, Castanea, Quercus, Betula, Fagus*	Black spot with jagged margins under the bark and blackish flows
		Deformations	310	*Taphrina kruchii*		*Quercus*	Witches broom, with many buds presenting chlorotic and abnoramlly small sized leaves
		Other fungi	390				

Table A2-7: Codes for agent group 300 (fungi)

				CONIFERS/BROADLEAVES				
Agent group	Code	Class	Code	Type	Code	Specific factor	Code	Symptoms
A B I O T I C	400	Chemical factors	410	Nutritional disorders- nutrient deficiencies	411	Cu - deficiency	41101	
						Fe - deficiency	41102	
						Mg - deficiency	41103	
						Mn - deficiency	41104	
						K - deficiency	41105	
						N - deficiency	41106	
						B-deficiency	41107	
						Mn - toxicity	41108	
						Other	41109	
				marine salt + surfactants	412			
		Physical factors	420	Avalanche	421			
				Drought	422			
				Flooding /High water	423			
				Frost	424	Winter frost	42401	
						Late frost	42402	
				Hail	425			
				Heat /Sun scald	426			
				Ligthning	427			
				Mud/ land slide	429			
				Snow /Ice	430			
				Wind/ Tornado	431			
				Winter injury - winter desiccation	432			
				Shallow/ poor soil	433			
				Rock fall	434			
		Other abiotic factor	490					

Table A2-8: Codes for the agent group 400 (abiotic factors).

Agent group	Code	Class	Code	Type	Code	Symptoms
Direct action of men	500	Imbedded objects	510			
		Improper planting technique	520			
		Land use conversion	530			
		Silvicultural operations or forest harvesting	540	Cuts	541	
				Pruning	542	
				Resin tapping	543	
				Cork stripping	544	
				Silvicultural operations in close trees and other silvicultural operations	545	
		Mechanical/ vehicle damage	550			
		Road construction	560			
		Soil compaction	570			
		Improper use of chemicals	580	Pesticides	546, 581	
				Deicing salt	547, 582	
		Other direct action of men	590			

Table A2-9: Codes for the agent group 500 (direct action of man).

Agent group	Code	Class	Code
Atmospheric pollutants	700	SO_2	701
		H_2S	702
		O_3	703
		PAN	704
		F	705
		HF	706
		Other	790

Table A2-10: Codes for the agent group 700 (atmospheric pollutants).

Agent group	Code	Class	Code	Species/Type	Code	Affected genus	Symptoms
Other	800	Parasitic/Epiphytic/Climbing plants	810	*Viscum album*	81001	*Pinus*	
				Arceuthobium oxycedri	81002	*Juniperus*	
				Hedera helix	81003	*All sps*	
				Lonicera sp	81004	*All sps*	
				Clematis sp	81005	*All sps*	
		Bacteria	820	*Bacillus vuilemini*	82001	*Pinus halepensis*	Swellings of different sizes in branches and branchlets
				Brenneria quercinea	82002	*Quercus*	Slime flux in fruits
		Virus	830				
		Nematodes	840	*Bursaphelenchus xylophilus*	84001	*Pinus*	fast reddening of the crown and sudden death of the tree
		Competition	850	Lack of ligth	85001		
				Physical interactions	85002		
				Competition in general (density)	85003		
				Other	85004		
		Somatic mutations	860				
		Mites	870	*Eriophyes ilicis*	87001	Quercus	Areas with abundant reddish brown hair at the back side of the leaf
		Other (known cause but not included in the list)	890				

Table A2-11: Codes for the agent group 800 (other)

A2.5.2.1 Scientific name of cause (mandatory Level I and Level II)

If the organism involved can be identified the scientific name must be reported, using the codes of 7 letters. As a general rule the codes consist of the first 4 letters of the Genus name, followed by the first 3 letters of the species name (e.g. Lophodermium seditiosum = LOPHSED). If the Genus name has only 3 letters, these are followed by the first 4 letters of the species name (e.g. Ips typographus = IPSTYPO). Codes for the most common damaging species are listed in the internet file http://www.icp-forests.org/WGbiotic.htm >> click on annex 3. This table also provides information on synonyms and tree species on which the damaging agents occur most frequently.

The following sources of information provide information for the field observers to facilitate the diagnosis:

- Tables A2-3 – A2-11 contain the coding system for damaging agents. Especially the sheets on insects and fungi provide information about specific symptoms caused by a selection of relevant organisms.
- **http://www.icp-forests.org/WGbiotic.htm >> click on Annex 3, provides codes for the scientific names of causal agents.**
- http://www.icp-forests.org/WGbiotic.htm >> click on Annex 4, provides examples, descriptions and photographs of damage caused by important categories of insects and fungi.
- http://www.icp-forests.org/WGbiotic.htm >> click on Annex 5, provides a key with symptoms linked to frequently occurring damage causes. However keep in mind that these are *possible* damage causes, other factors may cause similar symptoms. Diagnosis should always be confirmed by an expert phytopathologist whenever possible.

Important remark

Tables A2-3 – A2-11 give an overview of some important damaging factors in Europe. At national level however, important factors may be missing, while others may be less important. Therefore countries may wish to compose their own national list of damaging agents/factors and classify these according to the groups and classes of the manual. Reporting to the international data centre should always be done according to the categories and codes of the manual.

A2.5.3 Quantification

For foliage and branches quantification of symptoms is referring to *the assessable crown*.

A2.5.3.1 Extent

The **extent** of the damage indicates the quantity (%) of the affected part of the tree due to the action of the causal agent or factor. Damage to the branches is expressed as a % of affected branches, damage to the stem as a % of the stem circumference.
The extent of **symptoms reflecting defoliation** (e.g. leaf damage by defoliators) indicates the % of **the leaf area** which is lost due to the action of the agent/factor concerned. This means that the extent should take into account not only the % of affected leaves, but also the 'intensity' of the damage on leaf level: physiologically it makes a difference for a tree if 30 % of its leaves show only some small holes or if 30 % of its leaves are totally devoured.
The affected leaf area is expressed as a percentage of the actual foliage at the time of observation.

Examples:

- Crown condition assessment results in a total defoliation score of 40 % (including defoliation by identified causes like defoliators). 20 % of the leaves in the assessable crown are totally devoured by defoliators → extent of defoliator damage = 20 % (class 2 – see A2.5.3.2);
- Crown condition assessment results in a total defoliation score of 40 % (including defoliation by identified causes like defoliators). 20 % of the leaves in the assessable crown are partly devoured by defoliators → extent of defoliator damage is e.g. 10 % (in any case < 20 % since the affected leaves are only partially devoured).

A2.5.3.2 Extent classes (mandatory Level I and Level II)

The damage extent will be reported in the following classes:

Class	Code
0 %	0
1 – 10 %	1
11 – 20 %	2
21- 40 %	3
41 – 60 %	4
61 – 80 %	5
81 – 99 %	6
100 %	7

Table A2-13: Damage extent classes.

Countries using different classes (e.g. 5%) should report their results according to the classes as above.

Specifications:

a.) Damage to the **stem** is expressed as a percentage of the stem circumference according to the classes as above.

b.) Signs of insects and fungi and the **symptoms** 'tilted tree' and 'fallen tree' should not be quantified.

c.) When **two or more similar symptoms caused by different agents/factors occur on the same part of the tree**, it may be extremely difficult to assess the respective contributions of the agents/factors in the damage extent. In this case only the overall extent and the different factors involved should be reported.

d.) Assessments in **coppice** (and macchia) stands:

- QUANTIFICATION OF STEM DAMAGE PRESENT ON DIFFERENT SHOOTS: the damage is expressed as a percentage of the total stem circumference of coppice i.e. the sum of circumference of each shoot;
- • STEM DAMAGE PRESENT ON DIFFERENT PARTS OF DIFFERENT SHOOTS (for example cankers present on crown stem in one shoot and on roots & collar in other shoots): for 'specification of affected part' use code 34 (whole trunk); for quantification see above;
- ASSESSMENT OF A DEAD SHOOT(S) with the contemporary presence of other living shoots: by convention the dead shoot(s) shall be recorded as illustrated in the table below. Quantification of the symptom (dead branches of varying size) follows the general rule, thus is expressed as % of affected branches.

N. tree	Specification of affected part	Symptom	Location in crown
1	25	14	4

Coppice shall only be recorded as a dead tree (code 4) when all the shoots are dead.
Note: The symptom description is related to the total crown and quantification is related to the assessable crown. Therefore it is possible that the presence of damage symptoms is indicated in the symptom description, but that the extent is 0 % if symptoms occurred outside the assessable crown.

A2.6 Quality assurance and quality control

- field crews should undergo a theoretical and practical training in diagnosing and quantifying the more important damage symptoms prior to the start of the annual field season;
- Diagnosis should always be confirmed by an expert phytopathologist whenever possible.
- If a field check by an expert phytopathologist is not possible photographs of the affected tree and/or samples of affected foliage, branches, fungal fruitbodies etc. may be of help for diagnosis. However damaging trees in the plots by destructive sampling is not allowed. Sampling of nearby trees outside the plot showing the same damage symptoms may be considered. However one should remember that similar damage symptoms may result from different causes.
- Surveyors should be provided with forest pathology field guides to facilitate diagnosis (see 9. References)

See also Crown Condition manual main text chapt. 9 for QA/QC guidelines.

A2.7 Reporting

Validated data are sent every year to the European database accompanied by a "Data accompanying report – questionnaire (DAR-Q), including details on the applied method and any deviation from the manual. It is recommended to include a chapter on damage causes in the yearly national report on forest condition.

A2.8 References

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Annex 3: Forms

The parameters which have to be submitted with the particular forms may change over time. Therefore, with the update from June 2006 the NFCs are asked to start each data file (A3.2) with a header line. This line is starting with an exclamation mark followed by the names of the parameters, each separated by a comma. For each data file a proposal is given at the top of the form.

Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of defoliation:

Country (region): | total area of country (1000 ha): | total forest area (1000 ha): | forest area surveyed (1000 ha):

Institution (National Focal Centre): | total coniferous area (1000 ha): | total broadleaved area (1000 ha):

Survey period: day/month - day/month/year
(from - to)

SURVEY 2006
CONIFERS
form **A1**

updated 06/2006

Classification		Percentage of trees defoliated														
		trees up to 59 years old							trees 60 years and older							
		1	2	3	4	5	6	7(1-6)	8	9	10	11	12	13	14(8-13)	15(7+14)
species:							others	total						others	total	grand total
area of species:																
no. of sample trees:																
defoliation class	percentage of needle loss	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0 not defoliated	0 - 10%															
1 slightly defoliated	>10 - 25%															
2 moderately defoliated	>25 - 60%															
3 severely defoliated	>60% - <100%															
4 dead	100%															
total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Return to: PCC of ICP Forests, Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstr. 91, D-21031 Hamburg, Federal Republic of Germany, e-mail: luebker@holz.uni-hamburg.de

Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of discolouration:

Country (region): | total area of country (1000 ha): | total forest area (1000 ha): | forest area surveyed (1000 ha):

Institution (National Focal Centre): | total coniferous area (1000 ha): | total broadleaved area (1000 ha):

Survey period: day/month - day/month/year

(from - to)

SURVEY 2006
CONIFERS
form **A2**

Classification		Percentage of trees discoloured (yellowed)														
		trees up to 59 years old							trees 60 years and older							
		1	2	3	4	5	6	7(1-6)	8	9	10	11	12	13	14(8-13)	15(7+14)
species:							others	total						others	total	grand total
area of species:																
no. of sample trees:																
discolouration class	percentage of needles disc.	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0 not discoloured	0 - 10%															
1 slightly discoloured	>10 - 25%															
2 moderately discoloured	>25 - 60%															
3 severely discoloured	>60%															
4 dead																
total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Return to: PCC of ICP Forests, Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstr. 91, D-21031 Hamburg, Federal Republic of Germany, e-mail: luebker@holz.uni-hamburg.de

Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of defoliation and discolouration (combined assessment):

Country (region): | total area of country (1000 ha): | total forest area (1000 ha): | forest area surveyed (1000 ha):

Institution (National Focal Centre): | total coniferous area (1000 ha): | total broadleaved area (1000 ha):

Survey period: day/month - day/month/year

(from - to)

SURVEY 2006
CONIFERS
form **A3**

Classification	Percentage of trees damaged (defoliation and yellowing combined)														
	trees up to 59 years old							trees 60 years and older							
	1	2	3	4	5	6	7(1-6)	8	9	10	11	12	13	14(8-13)	15(7+14)
species:						others	total						others	total	grand total
area of species:															
no. of sample trees:															
combined damage class	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0 not damaged															
1 slightly damaged															
2 moderately damaged															
3 severely damaged															
4 dead															
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

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Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of defoliation:

Country (region): | total area of country (1000 ha): | total forest area (1000 ha): | forest area surveyed (1000 ha):

Institution (National Focal Centre): | total coniferous area (1000 ha): | total broadleaved area (1000 ha):

Survey period: day/month - day/month/year

(from - to)

SURVEY 2006
BROADLEAVES
form **B1**

Classification		Percentage of trees defoliated														
		trees up to 59 years old							trees 60 years and older							
		1	2	3	4	5	6	7(1-6)	8	9	10	11	12	13	14(8-13)	15(7+14)
species:							others	total						others	total	grand total
area of species:																
no. of sample trees:																
defoliation class	percentage of leaf loss	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0 not defoliated	0 - 10%															
1 slightly defoliated	>10 - 25%															
2 moderately defoliated	>25 - 60%															
3 severely defoliated	>60% - <100%															
4 dead	100%															
total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Return to: PCC of ICP Forests, Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstr. 91, D-21031 Hamburg, Federal Republic of Germany, e-mail: luebker@holz.uni-hamburg.de

Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of discolouration:

Country (region): | total area of country (1000 ha): | total forest area (1000 ha): | forest area surveyed (1000 ha):

Institution (National Focal Centre): | total coniferous area (1000 ha): | total broadleaved area (1000 ha):

Survey period: day/month - day/month/year
(from - to)

SURVEY 2006
BROADLEAVES
form **B2**

Classification		Percentage of trees discoloured (yellowed)														
		trees up to 59 years old							trees 60 years and older							
		1	2	3	4	5	6	7(1-6)	8	9	10	11	12	13	14(8-13)	15(7+14)
species:							others	total						others	total	grand total
area of species:																
no. of sample trees:																
discolouration class	percentage of needles disc.	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0 not discoloured	0 - 10%															
1 slightly discoloured	>10 - 25%															
2 moderately discoloured	>25 - 60%															
3 severely discoloured	>60%															
4 dead																
total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Return to: PCC of ICP Forests, Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstr. 91, D-21031 Hamburg, Federal Republic of Germany, e-mail: luebker@holz.uni-hamburg.de

updated 06/2006

Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of defoliation and discolouration (combined assessment):

Country (region): | total area of country (1000 ha): | total forest area (1000 ha): | forest area surveyed (1000 ha):

Institution (National Focal Centre): | total coniferous area (1000 ha): | total broadleaved area (1000 ha):

Survey period: day/month - day/month/year

(from - to)

SURVEY 2006
BROADLEAVES
form **B3**

Classification	Percentage of trees damaged (defoliation and yellowing combined)														
	trees up to 59 years old							trees 60 years and older							
	1	2	3	4	5	6	7(1-6)	8	9	10	11	12	13	14(8-13)	15(7+14)
species:						others	total						others	total	grand total
area of species:															
no. of sample trees:															
combined damage class	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
0 not damaged															
1 slightly damaged															
2 moderately damaged															
3 severely damaged															
4 dead															
total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Return to: PCC of ICP Forests, Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstr. 91, D-21031 Hamburg, Federal Republic of Germany, e-mail: luebker@holz.uni-hamburg.de

Convention on Long-Range Transboundary Air Pollution
International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests *and*
European Union Scheme on the Protection of Forests against Atmospheric Pollution
Annual report on health status of main tree species on the basis of defoliation:

SURVEY 2006
ALL SPECIES

form **C**

Country:

All species

no. of sample plots	no. of sample trees	% trees defoliated						
		class 0 not defoliated	class 1 slightly defoliated	class 2 moderately defoliated	class 3 severely defoliated	class 4 dead	class 2 to 4 moderately to dead	class 1 to 4 slightly to dead

Return to: PCC of ICP Forests, Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstr. 91, D-21031 Hamburg, Federal Republic of Germany, e-mail: luebker@holz.uni-hamburg.de

updated 06/2006

Annex 4: Design of International Cross-Calibration Courses

Elaborated by
Expert Panel on Crown Condition Assessments
Marco FERRETTI, Volker MUES, in collaboration with:

Dave DURRANT, Johannes EICHHORN, Martin LORENZ, and Andras SZEPESI

updated 06/2006

A4.1 The concept of the ICC system

Details concerning the "New Design of International Cross-Calibration Courses of ICP Forests and the EU Scheme", hereafter referred to as International Cross-comparison Courses (ICCs), are described by Ferretti et al. (2002).

A4.2 Basic design elements

The system of the International Cross-comparison Courses (ICCs) is installed to provide exercises with sufficient space and time replication for the most frequent tree species of the transnational surveys under realistic work condition. It incorporates formally photo QA exercises and its link with the traditional field exercises.

For each of the most frequent tree species ICC sites are spread across Europe. These ICC sites are selected by the hosting countries to ensure the possibility of re-assessments of the same plots in a periodic system to provide data for the documentation of temporal consistency. The willingness of the host countries and of the forest owners to provide the ICC site must therefore be ensured.

A4.2.1 Plot and tree selection

For each ICC site, a number of visual assessment plots (hereafter referred to as visual plots), eventually supplemented by a special photo assessment plot (hereafter referred to as photo-plot), are selected. Each ICC in principle is dealing assessments on two tree species, 3-4 plots per species are used as visual plots, each of them covering a wide range of defoliation values. According to available field conditions the host countries should select the plots varying according to only one or two environmental factors. The plots should be designed consistently with the actual Level I plots in the host country. This will help to provide realistic assessment conditions

All plots should be located as close together as possible in order to prevent cost and time consuming travelling between the ICC plots. Each visual plot should consist of 24-30 trees of the same species. Trees within the visual plots should be selected according to the usual Level I tree selection criteria of the host country. When visual plots are unsuitable for the purposes of photo QA, an ad-hoc photo plot with 24-30 trees should be selected in the surroundings.
The plots should be managed as permanent plots. Plot locations should be recorded and trees permanently numbered and/or geo-referenced to enable the re-assessment of the same trees. Photo-QA exercises can be carried out on the visual plots when the trees fulfil the selection criteria reported in the annex on photo QA. When the visual plots are not suited for the photo QA exercise, then there is the need to select ad-hoc photo-plots. The photos of the photo exercise should be assessed as long as possible after the field assessment of the respective trees. The photos can be mirrored to ensure that objective assessments are made and not the field assessments be remembered by the participants. Furthermore, photos from other ICCs on the respective tree species should be re-assessed in terms of the documentation of temporal consistency.

A4.2.2 Invitation and participation

The host countries decide in co-operation with the Programme Co-ordinating Centre (PCC) of ICP Forests about the dates of the ICCs at the end of the survey period (usually this period lasts from end of June to end of August). For the evergreen tree species in the Mediterranean region, an extension up to the end of September can be allowed. The host countries invite all other NFCs by end of March of the respective year to send their National Reference Teams (NRT) for participation in the ICCs.

The participants of the ICCs should be the NRTs for the concerned species. The National Focal Centres decide about the participation. Ideally National Reference Teams should participate as it is important that the participants at the ICCs also participate in the national courses to get the linkage to the survey results.

A4.3 Implementation of the ICCs

A4.3.1 Field work, use of home references

It is important that the participants work independently and that there is no mutual influence of their assessments. Each team should use its own method and reference standard. Positions for assessments should be marked in the field. After assessing from this position the participants may make a second assessment according to their national methods.

The host country should present site and stand information (age, below/above average site, altitude, etc.). Usually, local reference trees will be not presented, unless a specific request will be made by the crews.

Any discussions or exchange of information, especially concerning individual trees, between the teams should be avoided before and during the cross-calibration field work for the concerned species. However, the experience gained in the past suggests that a brief discussion about the most diverse assessments could help clarification.

There is no evaluation/presentation of assessment results in the field before finishing the last plot of a given tree species. Nevertheless, e.g. presentations of national or regional evaluations could be a topic in the evening to introduce a discussion about special issues.

A4.3.2 Codes

A4.3.2.1 Participant code

Participants of National and International Courses as well as field teams will receive a unique ID number that stays the same through time (**C**ountry, **R**egion, **P**erson // CCRRPPPPP). "Country" referes to the usual country code; "Region" (when applicable) refers to the code of a given region in a country. If it is not necessary to develop a code for "region" the digits for RR should be filled with "99". "Person" is the code given by the NFC to every members of its NRT. NFCs are responsible for the distribution of codes to their staff. Code lists and their annual updates are submitted to PCC by the National Focal Centres by the end of September.

A4.3.2.2 Plot code

The host countries provide the plot IDs for the ICC test ranges according to the following method: the plot ID should be the plot number in case of Level I plots, otherwise "99" and an ICC plot specific ongoing number of 4 digits both divided by an underline. The test range specific ongoing number consists of the country code (first two digits) followed by a plot specific ongoing number. An example of four plot IDs is given below with the second plot being a real Level I plot with plot ID 194:

99_5501, 194_5502, 99_5503, 99_5504

A4.3.3 Data to be recorded

The host countries are asked to provide the plot ID code and a detailed stand description for each ICC test site/plot including latitude, longitude, site type, altitude, exposition, canopy closure, tree species, tree heights, dbh, stand age and recent thinning.

Data	Provided by host	Collected by participant	Entry in the field form by participant	Submitted to PCC by host
General data				
Calendar date			+	+
Participant code			+	+
Plot data				
Plot ID	+		+	+
Latitude	+			+
Longitude	+			+
Altitude	+			+
Aspect	+			+
Canopy closure	+			+
Tree species assemblage	+			+
Tree height (dominant storey, average)	+			+
DBH (dominant storey, average)	+			+
Age (dominant storey, average)	+			+
Tree data				
Species	+	+	+	+
Number	+	+	+	+
determine assessed part of crown e.g. using photographs		+	+	+
Defoliation (0,5,10,15 ... 95,99,100%)		+	+	+
Discolouration (0,1,2,3,4)		+	+	+
Specification of affected part (11, ..., 34), see		+	+	+
Symptom (01,..., 22)		+	+	+
Cause (codes see annex 2, e.g. 81001		+	+	+
Scientific name of cause (codes see annex 6, e.g. LOPHSED)		+	+	+
Extent (0,1,2,3,4,5,6,7)		+	+	+

Table A4-1: Overview of the data and parameters to be provided, collected and reported.

Ideally, all mandatory parameters of the Level I and II crown condition surveys should be covered by the ICCs. However, given the importance of defoliation and discolouration in the reporting of forest condition, these parameters have the highest priority. The mandatory damage parameters are to be assessed too. Additional parameters may be assessed after explicit requests of participating countries or in consequence of changes of the manual on a voluntary basis. Plot ID, date, and ICC participant code should be recorded by the participants once per plot. All these parameters and codes must be entered in the field form. The field forms should be supplied by the host countries.

A4.4 Data submission

If possible data should be digitised during the course. Thus, uncertainties could be clarified directly with the participants.

The data can be handed over to PCC directly at the end of the courses or should be sent to PCC latest by the end of September of the respective year. Furthermore the host country provides a list with the participants and their codes used during the ICC which should be the same as given for the field survey.

Excel Format:

All results of one species (ICC test range) are listed in one file (filename containing species, year, host country, e.g. “ICCFagusSylvatica2003Germany.xls”, or short: “ICCFagSylv03GER.xls”).

The file includes several sheets for the respective plots and parameters, the name of the sheet gives plot ID and parameter (e.g. 99_5501_defoliation, 194_5502_discolouration, …).

Structure of table as follows

Filename (e.g.ICC2003FagusSylvaticaGermany)						
Plot ID and parameter (e.g. 99_5508_defoliation)						
Tree No.	NRT1 (CCRRPPPPP, CCRRPPPP)	NRT2 (CCRRPPPPP , CCRRPPPP)	NRT3 (CCRRPPPPP , CCRRPPPP)	...		
1						
2						
3						
6						
...						
24						

A4.5 References

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