Expert Panel Crown Condition and Assessment Damage Causes

Tree Vitality (D1)

FutMon Field Protocol
V 1.0; last update 15th May 2009

At the D1 section of the FutMon meeting in Hamburg January 2009, a mutual agreement was achieved, to define some parameters to be mandatory on D1-plots, which have proven to indicate tree vitality by literature. The field protocol and the decision of mandatory assessments of these parameters are mainly related to FutMon D1 plots in the years 2009 and 2010. In addition the parameters are optional for IM1 (ICP forests Level II) and ICP forests Level I-plots.
The additional definition of assessable crown will be used in 2009 and 2010 only at the ICCs.

A new form is prepared for special use at D1 plots (XX2009.D1T; see forms document). Some of the new variables use a new coding which has to be used instead of definitions in the existing Sub manual Crown (www.icp-forests.org). However, in addition the traditional forms have to be filled out with the existing ICP Forests coding and in addition the FutMon participants are asked to assess the new parameters and submit the data for the D1 plots. Thus, the reporting for the testphase2009 – 2010 will be done using both the existing methods and also the new/alternative methods for the D1 plots. Training and discussion of the new parameters will be part of the ICCs 2009 and 2010. It is suggested that experienced participants could give a short introduction of the use of these variables during the ICCs. This will be discussed and agreed with host countries before ICCs.
The tree species of Fagus sylvatica is brought into focus and used as an example for a new concept of tree vitality evaluations. Some indicators have also shown to be relevant for other tree species. Therefore other tree species are included as well.

Content

1. Assessable crown (only at ICCs 2009, 2010)

1.1Definitions

Motivation
It has to be checked if one of the main causes for differing results in defoliation estimations in various European countries is the different understanding of what constitutes assessable crown.

Note
The following definition is to be field-tested at the ICCs 2009 in Finland, the Czech Republic and Italy and used concurrently with the nationally differing definitions. A second test will be done at the photo ICC in 2010.

Method
Three definitions aiming at elimination of lower branches that have defoliation/ branch dieback due to light competition, e.g. by vicinal trees, are used in the European Crown assessment.

a) Assessment of the tree crown ranges from the tip of the tree to the *widest span* of the crown or to where the distance between stem axis and living branches is greatest. Fig.1 shows good examples of this definition in the part "stand". For freely grown trees, a line indicates the lower limit of the assessable crown.
b) Assessment of a defined lower limit; the *upper third* of a trees living crown will be assessed. The evaluations could be compared with the results "entire crown/upper third of the crown" from former ICCs which were made by participants from Estonia. From a practical view, sometimes it is very difficult to define the lowest living branches to be the lower limit of the total crown. This fact may bias the definition of upper third or half of a tree crown. In many cases countries use their own national definition of living crown before they define the assessable crown.
c) Individual countries "*traditional*" procedure of the definition of assessable crown referring ICP Crown Manual (2006).

1.2) Field position of assessment

Motivation
As described in the ICP Forests manual on Crown Condition Assessment, Annex on ICCs, it is necessary to evaluate the variation of defoliation scores which is due to different positions of the participants during the assessment.

Method
The participants are asked to do the first assessments from a fixed position which has to be prepared and marked in the field by the host countries according to the same fixed positions which were used during former courses on the same plots and trees. A second group of assessments will be done following the position or assessment procedure which is used during the field assessments in the participating countries.

Thus, at ICCs on crown condition assessment, each tree will receive two X three = six defoliation scores. As most time during an ICC is needed to get to the different plots and to

find the correct position to the assessed tree the additional assessments on different parts of the crown should not lead to exhaustive time consumption.

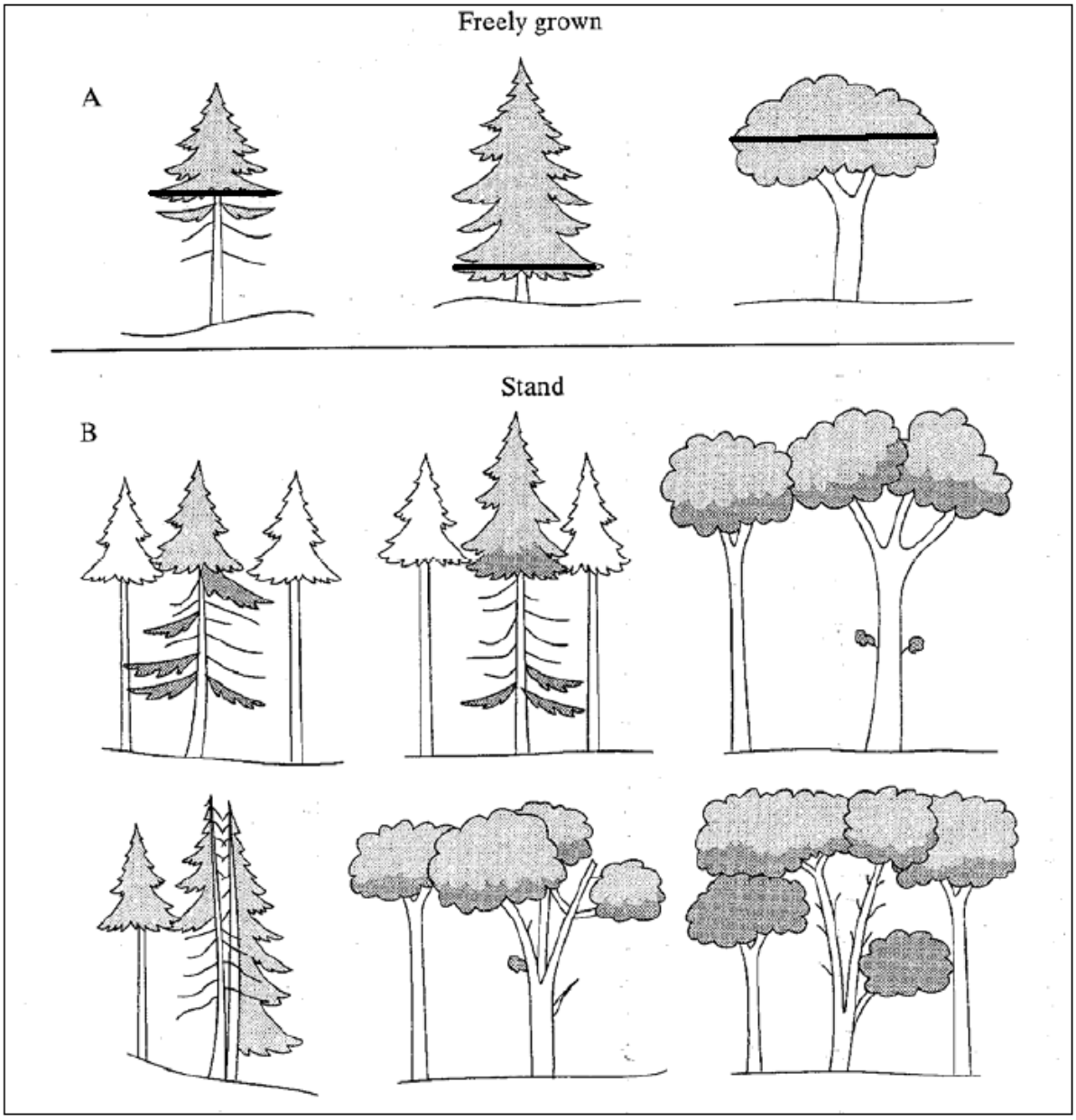

Fig. 1: Illustration of definition a): Assessment of the tree crown ranges from the tip of the tree to the widest horizontal span of the crown (stand: the lighter colour indicates assessable crown; freely grown trees: black line)

2. Tree age (sample tree specific age for all trees used in e.g. crown condition assessment on D1 plots; mandatory)

Motivation

Former evaluation of crown condition data have indicated that one of the main causes for differing results in defoliation estimations in various European countries is the different age of sample trees. Studies show, that even biased age estimations help to explain a substantial amount of defoliation variability.

At the D1 section of the FutMon meeting in Hamburg 2009, a subgroup recommended to include tree age in the list of parameters of D1 plots. In the plenum, a mutual agreement was achieved. It will be evaluated if the submission of tree specific age data will allow for a better interpretation of vitality data. Even if assessment accuracy is expected to be low in most cases the submission of tree specific age should help for a better understanding of stand structure during data evaluations.

Method

For D1 plots, tree age of sample trees must be specified for all of the trees on a plot. The best exact method should be used and described, indicating also the uncertainties of this method. The method defines two new fields in a tree specific table (new "D1-tables"):

1. tree_age
   to be specified in age classes given A1.9 in the ICP Forests manual ("8" is deleted, since this parameter indicates tree age and not stand age; instead of the group >120, the new classes 121-140, 141-160 and >160 years will be added).
2. method_of_age_determination (coding see below)
   1 = assured dates of stand establishment
   2 = tree stumps
   3 = age determination of the lowermost twigs (add estimated time it has taken to grow to that height)
   4 = increment borer, stem discs (from similar sized trees/median sized trees) outside the plot
   5 = assessment (impossible in most cases)
   6 = estimation without any exact information
3. free text option (comments on age assessment)

3. Fruiting

3.1 Fruiting of Fagus ssp., Picea abies and Pine ssp. (terrestrial inventory; **mandatory D1**; in addition to **Manual Crown A1.21 page 26)**

Motivation

Annual seed production of trees with heavy seeds such as beech and oak can cause considerable changes in internal cycles. Annual seed production may cause a significant change in allocation of carbon, nutrients and energy from leaves and stem growth to generative structures. This is an important criterion for tree vitality.

Fruiting always bears upon the assessment e.g. of defoliation as some countries reduce the expected 100% crown if fruiting occurs (e.g. on Scots pine), other countries decided that fruiting and the concurrent missing of needles must lead to a respective increase in defoliation scores.

Note

Only the fruit of the respective assessment year is to be considered.

Pine: only green cones.

Level 1 = low, will, in comparison to the sub-manual Crown, be distinguished into Level 1.1 (absent) and Level 1.2 (scarce), so that a sum of scarce (code 1.2) – medium (2) – high (3) of all trees fructifying in one year can be formed. The question if the scores 1.1 and 1.2 can be distinguished by the field observer for each tree will be discussed evaluating the comment on fruiting assessment which have to be submitted in free word text in case of any problems with the parameter assessment.

Method

Hint: The sum of the new levels 1.1 and 1.2 indicate the group "without" and "low" fruiting (code 1) described in A1.21 of the ICP Forests Manual.

1.1 = absent
: Fructification is absent or inconsiderable. Even reasonably lengthy observation of the crown with binoculars yielded no signs of fruiting.

1.2 = scarce
: Sporadic occurrence of fruiting, not noticeable at first sight. It must be looked for on purpose with binoculars.

2 = medium
: Fructification is such that it can be observed with the naked eye. The appearance of the tree is influenced but not dominated by fructification.

3 = high
: Fructification is obvious and immediately meets the eye, determines the tree's appearance.

Annual assessments have to be done both 2009 and 2010.

3.2 Fruiting of Beech and Oak (mandatory D1 litter fall assessments)

Motivation
In order to validify traditional terrestrial assessments and in order to quantify for element budget considerations the weight of fruits and capsules in the litter should be determined. Assessment of oak fructification is generally not possible in Central Europe during the period in which terrestrial assessment takes place.
Method
Separate biomasses of "fruits" and "fruit capsules" of beech and oak are quantified in addition to the regular litter fall measurements.
The aim is to elaborate an annual sum of fruits and fruit capsules per hectare D1 plot. Chemical analyses should also represent an annual value per plot hectare.
During the FutMon programme this survey of litter fall biomass will be conducted on Beech and Oak D1 plots (main tree species) according to the ICP Forests Manual on Sampling and Analysis of Litter fall for the sampling of litter fall and the calculation of biomass (dry mass) and the Field Protocol on Litter fall. For the submission of data the litter fall forms will be used (XX2007.LFM; see forms document). The sample codes are according to the updated reference list. Here an excerpt with the components which are of special interest for Tree Vitality:

Deciduous trees (Beech, Oak)						
Leaves		**Fruiting components**			larger litter components	**Rest**
main tree species	other species	Fruiting	Fruit capsules	rest	Twigs and branches	other plant biomass
11.1	**11.2**	**14.1**	**14.2**	**14.3**	16	19

Fig. 2: Beech fruits

4. Crown diameter related distance to neighbours (CDRD_N; mandatory D1 all trees with defoliation assessments; in addition to **Manual Crown A1.15 page 21 "Crown shading")**

Hint: This is a new variable with a new coding which is used in addition to A1.15 on D1 plots.

Motivation
The distance between trees explains to a high degree the scattering of characteristic defoliation data.

Note
Crown diameter is a relative measure used to indicate from a given tree crown stand structure in four perpendicular directions. Score values are to be averaged.

Method

Scores for each perpendicular direction
1 = cramped. Canopies overlap.
2 = closed. Crowns touch one another.
3 = loose spread. Gap between crowns ***up to*** one third of average crown diameter
4 = spread. Gap between crowns ***up to*** two thirds of average crown diameter
5 = distant. Gap between crowns from two thirds ***up to*** one whole of average crown diameter
6 = very distant. Gap between crowns > than 1/1 of average crown diameter

Calculation:
[$Score_1$ + $Score_2$ + $Score_3$ + $Score_4$] / 4 = CDRD_N

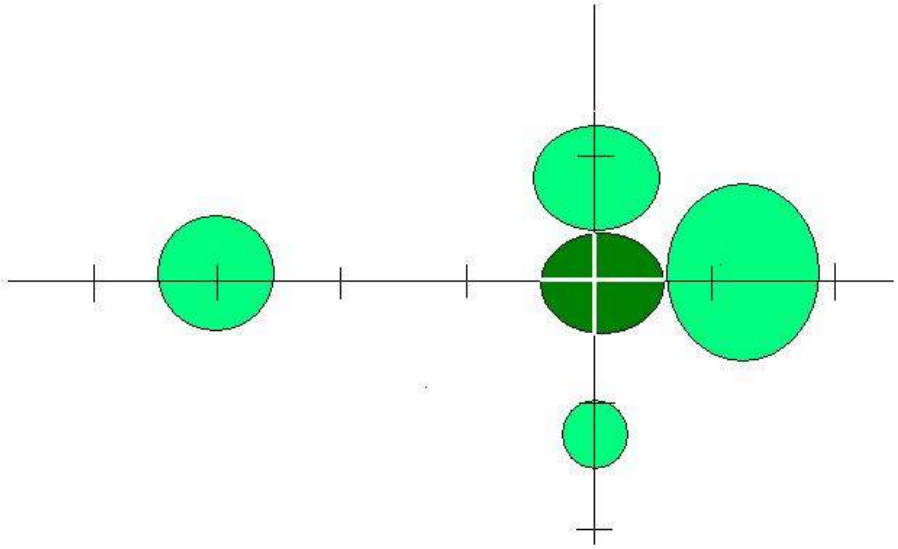

Fig. 3: Example: Crown diameter related distance to neighbours

Example:
[2+2+6+5]/4= 3,75

5. Apical shoot architecture (mandatory D1; Fagus sylvatica)
*in addition to [**A1.23** **Crown form/morphology** (optional Level II)]*

Motivation
The beech architecture model enables one to recognise vitality disorders in time series (Roloff (2001). Having a close look at beech branches, annual shoot length is clearly visible by signs of former buds up to 10 years. From a distance this apical shoot architecture indicates very typical growth patterns, which can be assessed using binoculars.

Note
Only the topmost twigs of a beech's crown are suitable for assessment of the apical shoot architecture. If there is a good visibility on top of the sample trees, it can be done during summer assessment. If there is only a limited view on the top of trees for example in crowded stands, it is recommended to assess apical shoot architecture and to carry out the assessment in the non vegetation period.
Annual assessments have to be done both 2009 and 2010.

Method[1]
1 = Exploratory phase
Apical shoots and upper side buds form long shoots. Flat, longitudinal, expansive shoot development.

[1] Photos: Roloff, Eichhorn; Drawings: Roloff

Fig. 4: Exploratory phase

2 = Intermediary form 1/3

3 = Degeneration phase

Only apical bud forms long shoot. Shoots of side buds are stunted. Spear-shaped development of main shoots with reduced side shoot formation "spear-shaped".

Fig. 4: Spear-shaped degeneration phase (right: from ROLOFF)

4 = Intermediary form 3/5

Fig. 5: Intermediary form 3/5

5 = Stagnation phase

Stunted long shoots, claw-like appearance because of pluriannual short shoot chains.

Fig. 6: Stagnation phase

6 = Intermediary form 5/7

7 = Resignation phase

Die-back of twigs of the topmost part of the crown or even the whole crown itself.

Fig. 7: Resignation phase

6. Species (mandatory D1)

In some genus it is difficult to assess tree species (e.g. Oak ssp.: Quercus x rosacea for the hybrid Q. robur x Q. petraea or alternatively Q. robur x petraea). In this case the respective NFC should submit one possible species and add the information on deviating phenotype in the "other observations" field and the accompanying report.

The list of broadleaved species has to be amended before new species are submitted to the data centre. The Expert Panel will do this – as it is described in the ICP Forests Manual – in co-operation with the FutMon data centre and PCC of ICP Forests and inform the respective NFC and the entire project partner community via the FutMon and ICP Forests web pages.

7. New concept tree removals and mortality (mandatory D1 plots; instead of: Manual Crown A1.13, page 20)

Motivation:
Data on removals and mortality provide essential information in the frame of forest condition monitoring. The present code list in the crown condition manual of ICP Forests (A1.13) is a combination of tree data regarding presence/absence, living/dead, symptoms and causes. Although many different situations are covered, the method has room for improvement. Regarding mortality for instance, reporting of the cause of death is only possible in broad categories, like 'biotic/abiotic reason', even when more detailed information is available (e.g. bark beetle attack, drought, …). Therefore a different approach is proposed, based on the guidelines on the assessment of damage causes. 2009-2010 being a test phase for future forest monitoring, countries report information on 'removals and mortality' both using the existing code system and according to the alternative method for D1 plots. For other plots the additional submission of the new D1 parameter is recommended. For data submission the D1 form XX2009.D1T has to be used for submission of <removal/mortality>, <affected part>, <symptom>, and <cause>. Evaluation of the test phase will result in one method to be continued.

Method:
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. 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).

Reporting of removals/mortality is based on one single code, specifying if:
- the tree is present or removed;
- the tree is dead or alive;
- it is a new tree or an already existing tree in the inventory
- no assessment has been carried out for this particular tree (e.g. due to broken crown)

More information on the condition of the tree and the cause of removal/mortality is provided by using the guidelines of the submanual on the assessment of damage causes (Crown condition manual updated 06/2006 Annex 2) for the symptom description and the reporting of causes. For the symptom description and reporting of the cause the existing codes will be used. The reporting of removals/mortality is mandatory and should include: a/ code for removal/mortality, b/ symptom description, c/ cause of removal/mortality or reason why no assessment was carried out. No quantification of symptoms should be carried out for reporting removals/mortality (i.e. no information on extent).

Removals and mortality will be reported using the following codes:

01: tree alive in current and previous inventory
02: new alive tree (ingrowth)
03: alive tree (present but not assessed in previous inventory)
04: dead tree
05: tree is removed

06: tree is present and alive but no assessment could be carried out (e.g. due to crown breakage)
07: information on this tree is missing for this years inventory (e.g. tree was forgotten during field work)

Examples:
1/ Tree is dead due to bark beetle attack

Reporting:
a/ Removal/Mortality: tree is dead (code: 04)
b/ Symptom description:
- specification of affected part: e.g. stem (code: 32)
- symptom: signs of insects (code: 10)
- symptom specification: boring holes (code: 65)

c/ cause: stem, branch & twig borers (code: 220).

If determination of the causing organism is possible up to species level this can be reported using the existing codes of the Damage manual.

2/ Tree is dead but no symptoms can be seen providing information on the cause of death, which is unknown:

Reporting:
a/ Removal/Mortality: tree is dead (code: 04)
b/ Symptom description:
- specification of affected part: no symptoms on any part of tree (code: 00)
- symptom: blank
- symptom specification: blank

c/ cause: investigated but unidentified (code: 999).

3/ Tree is present and alive but considerable part of the crown is broken due to storm and as a result no crown condition assessment could be carried out:

Reporting:
a/ Removal/Mortality: tree is present and alive but no assessment could be carried out (code: 06)
b/ Symptom description:
- specification of affected part: branches ≥ 10 cm diameter (code: 24)
- symptom: broken (code: 13)

c/ cause: e.g. wind (code: 431)

If the tree is no longer assessed e.g. because it is no longer in Kraft classes 1 – 3, the reported cause will be: competition (code: 850).

4/ Tree is removed due to planned utilisation (e.g. thinning):

Reporting:
a/ Removal/Mortality: tree is removed (code: 05)

b/ Symptom description:
- specification of affected part: no symptoms on any part of tree (code: 00)
- symptom: blank

c/ cause: sylvicultural operations or forest harvesting (code: 540)

8. References

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