

FUTMON FIELD PROTOCOL PHENOLOGY (D1)

V1.1; last update 19th May 2009

Amendment index (compared to V1 from 15th May 2009):

- "form QQQ" at start of Annex 1 replaced by "form .PHE"
 - codes for score of "Intensity of flowering **and damage**" were updated to 6, 7, 7.1, 7.2, and 7.3 in Annex 1
 - "NFC" at end of Annex 2 replaced by "associated beneficiary"
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Phenological observations under FutMon Action D1 can be made in two different ways, manually or using digital cameras.

The phenology observations are made according to the guidelines provided in chapter 9 “Phenological Observations” of the ICP Forests Manual. However, the following points/exceptions should be taken into account:

- Both plot level and single tree level observations are accepted, but wherever possible single tree level phenology should be preferred.
- For plot level observations the guidelines were revised and the data submission form (.PHE) was updated.
- For single tree observations the minimum required frequency is once a week during the critical phases, but daily observations is the optimum. For the selection, trees are preferred that are also selected for D1 girthband measurements.
- For the registration of the trees selected the form (.PLP) has been updated.
- Guidelines for the recording of the events at single tree level are revised. For the submission of the data the updated form .PHI has to be used.
- For the field observations **flushing** and **autumn colouring** are mandatory, the other events are optional. When using cameras all events are mandatory.
- For the use of digital cameras guidelines are given below. For the registration of the observed trees and the analyses of the pictures the same guidelines and forms as for the single tree observations should be used. Data should be submitted at a daily basis.
- The use of cameras is recommended for remote plots where the use of relatively expensive camera systems helps to save a lot of travel costs; in order to fulfil the FutMon contract each associated beneficiary is recommended to test at least one camera system.
- As far as biotic damage is observed during the phenology assessments its appearance is submitted with the phenology data as far as foreseen with the updated forms .PHE and .PHI. The more detailed examination, assessment and data submission on the observed damage has to be done according to the ICP Forests manual on damage assessment. Whenever needed, trained staff should be consulted for damage assessment within the next 4 weeks beginning from the phenology assessment.

Annexes:

Annex 1: revised guidelines for recordings

Annex 2: guidelines for the use of cameras

revised forms are presented on FutMon webpage in a separate excel file on forms and explanatory items

Annex 1: revised guidelines for recordings

1 Recording of phenological events at the plot level

For the recording of the phenological phenomena at the plot level form .PHE is used.

The event codes for the monitored effects and phenological phenomena are:

- 1 = Flushing;
- 2 = Colour changes;
- 3 = Leaf/needle fall;
- 4 = Significant signs of leaf or crown damage (e.g., eaten leaves or bare crown parts);
- 5 = Other damage (breakage, uprooted trees);
- 6 = Lammas shoots / secondary flushing;
- 7 = Flowering.

Scoring system

Occurrence of the events and phenomena (proportion of the forest crown affected):

- 1 < 1% (not to be applied on flowering and damage, codes 7, 4, and 5)
- 2 = 1 – 33% (not to be applied on flowering and damage, codes 7, 4, and 5)
- 3 = >33 – 66% (not to be applied on flowering and damage, codes 7, 4, and 5)
- 4 = >66 - 99% (not to be applied on flowering and damage, codes 7, 4, and 5)
- 5 > 99% (not to be applied on flowering and damage, codes 7, 4, and 5)

Intensity of flowering and damage (optional quantification) (**NEW!**)

- 6 = Flowering / damage absent
- 7 = Flowering / damage present
 - 7.1 = flowering sparse (optional)
 - 7.2 = flowering moderate (optional)
 - 7.3 = flowering abundant or mast (optional)

2 Recording of phenological events at the individual tree level

2.1 Registration of trees selected

For the registration of the trees selected for the recording of phenological events form .PLP is used.

The part of the crown observed (here: the visible part of the crown) should be reported at the time the trees are selected, or whenever it changes, using the following codes (same as described in ICP Forests Manual):

- 1 = top of the crown
- 2 = middle of the crown
- 3 = top and middle of the crown.

The codes for the direction **from** which observations are made are (same as described in ICP Forests Manual):

- 1 = North
- 2 = north-east
- 3 = East
- 4 = south-east
- 5 = South

6 = south-west
 7 = West
 8 = north-west

The codes for the vertical direction **from** which the observations were made are (**NEW!**):

1 = from below
 2 = at crown level
 3 = from above

2.2 Recording of phenological phenomena

For the recording of the phenological phenomena at the single tree level updated form .PHI is used.

The method used for making the observations

1= field observation
 2= Digital camera
 3= Both field observation and digital camera

The event codes for the monitored effects and phenological phenomena are:

1 = Flushing;
 2 = Colour changes;
 3 = Leaf/needle fall;
 4 = Significant signs of leaf or crown damage (e.g., eaten leaves or bare crown parts);
 5 = Other damage (breakage, uprooted trees);
 6 = Lammas shoots / secondary flushing;
 7 = Flowering.

Scoring system

Occurrence of the events (proportion rate of tree compartments affected):

1 < 1% (not to be applied on flowering and damage, codes 7, 4, and 5)
 2 = 1 – 33% (not to be applied on flowering and damage, codes 7, 4, and 5)
 3 = >33 – 66% (not to be applied on flowering and damage, codes 7, 4, and 5)
 4 = >66 - 99% (to be applied on flowering and damage, codes 7, 4, and 5)
 5 > 99% (to be applied on flowering and damage, codes 7, 4, and 5)

Flowering phases:

The number of male flowers that are in the described stage or have already passed this stage is to be recorded using the following classification:

Intensity of flowering and damage (optional quantification) (**NEW!**)

6 = Flowering / damage absent
 7 = Flowering / damage present
 7.1 = flowering sparse (optional)
 7.2 = flowering moderate (optional)
 7.3 = flowering abundant or mast (optional)

Needle appearance, leaf unfolding, autumn colouring and leaf fall:

The proportion of needles or leaves of the visible part of the crown that are in the described stage or have already passed this stage is to be recorded using the following classification:

- 0 = 0%
- 1 = >0 - 33%
- 2 = >33 - 66%
- 3 = >66 - <100%
- 4 = 100%

3 Recording of biotic or abiotic damaging events

Reporting of observed biotic damage will be done using event code 4 or 5 respectively for form .PHE and .PHI, respectively. For damage description the form .TRD and the respective coding described in the ICP Forests manual on Crown condition and biotic damage assessment (Part II) are used.

Annex 2: guidelines for the use of cameras

Advantages of the use of cameras:

- **Enables frequent (continuous) monitoring, also on remote sites**
- **Assessments can be made any time when staff is available**
- **Enables comparison between sites**
- **Improves comparison between years**
- **Enables comparison between countries/regions**
- **Enables better timing of appearance of damages**

Points to be considered

- **High investment costs**
- **Need for power supply**
- **Difficult in dense (conifer) stands**
- **Possible technical failures**
- **Possible vandalism**

The use of digital cameras for monitoring phenology

When using digital cameras the first priority should be that the quality of the pictures (resolution) obtained allow the assessment of phenological phases at individual tree level according the guidelines in the manual on phenological observations with 33% classes. In addition also other aspects of the crown such as damages can be assessed. At each plot at least 10 trees per species should be assessable (tree selection as mentioned above in this protocol).

Technical requirements

The cameras should be weather-resistant, e.g outdoor surveillance cameras are suitable. Important is that the pictures are of high resolution (minimum requirements 6 Mpix with 300 pix/inch / 120 pix/cm), even with full zoom properties. The camera should have its own memory, or be connected to a datalogger. The datalogger and steering unit should be stored in a weather-proof place, and the whole system should be protected against lightning. Power supply can be obtained through batteries, solar panels or connection to the electricity network. The working of the camera should be checked every time the plot is visited.

Location of the camera

If possible the camera should be mounted to a mast that reached over the top of the crowns, e.g. the towers used for the meteorological assessments. In order to be able to observe a number of trees, the camera should be movable and programmable so it can take pictures of the same spot at regular intervals. The position of the camera is selected so that it can cover an optimal number of individual trees within the plot at a area as large as possible. The observations can also be made from below the crowns, but this way the area, and the number of visible trees per camera is more limited. Alternatively more than one camera could be used. The camera should take pictures of the whole upper part of the crown. Trees around the camera are selected and registered using form 12a. For each tree also the part of the crown observed, as well as the direction from which the camera takes the picture are marked. The codes used are the same as for the manual single tree observations.

Data handling

Pictures should be taken a number of times each day (at least 2) because the light conditions change during the day because of the position of the sun. At least every 2 months the data should be collected from the plots in order to secure the data. The camera can also be connected to a network, so the observations can be made at distance. In this case it is still advisable to have the pictures also stored at the plot for backup.

The pictures of the different plots should be analysed by one and the same person, or at least for the different plots of each tree species. This way the effect of the observer is eliminated. The assessments should be made using the same stages and codes as used for the field observations. Only one observation per day should be made.

The pictures should be stored by the associated beneficiaries so they can be used later for inter-calibration as well as for comparison between countries. During the phenological phases to be assessed for each tree at least one picture per day should be saved. For the rest of the growing season at least one picture per week is sufficient. If pictures are also taken during winter also one picture per week can be stored. At form xx metadata about the stored pictures should be submitted annually.

Pictures should be available to other partners of the project. In order to enable for an easy data access the photos and movies may be stored in addition at the FutMon data centre. In order to allow for a consistent and uniform identification and submission of the digital images the form .PHD and a respective Explanatory Item are to be applied.