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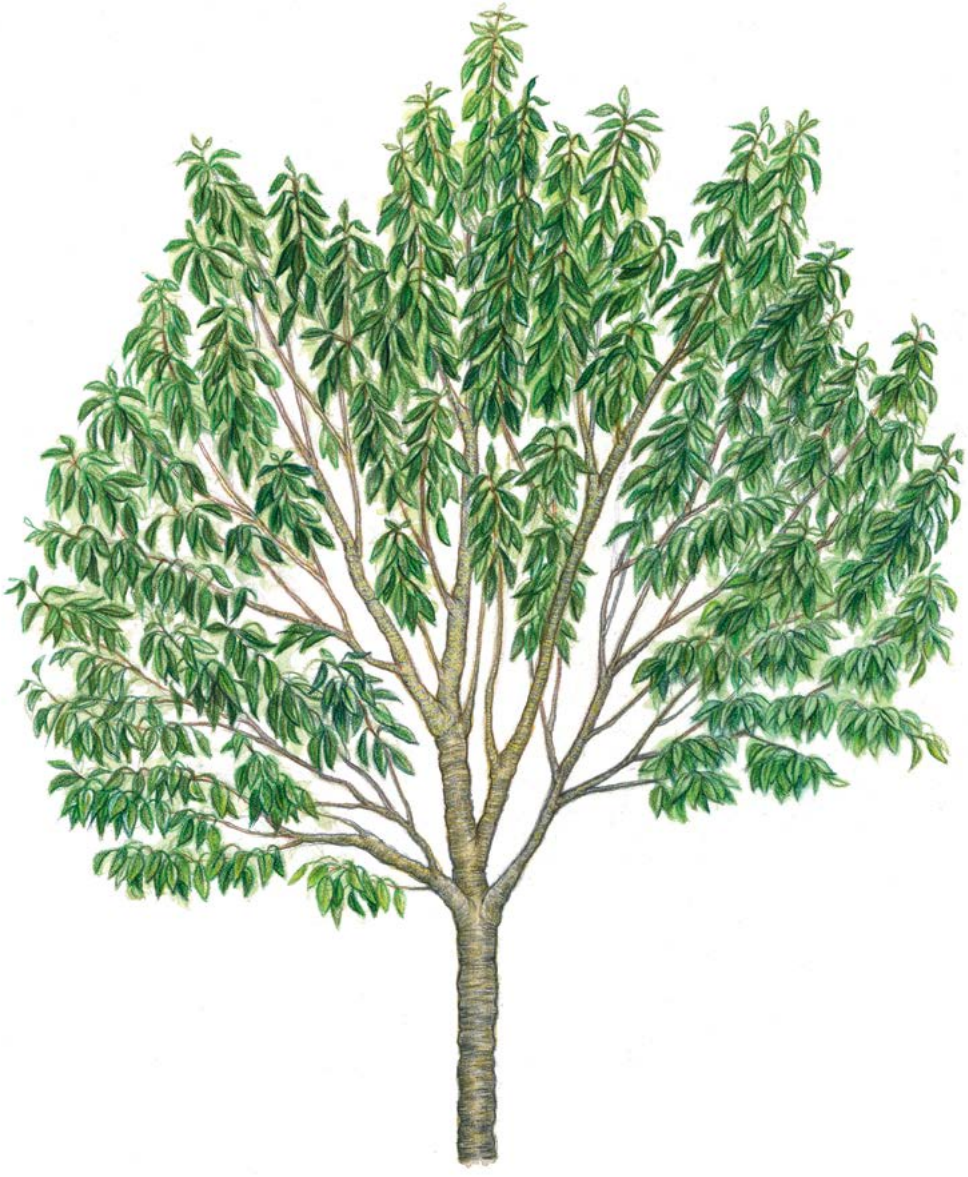
Guidelines for genetic monitoring of

Wild cherry (*Prunus avium* (L.) L.)



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Guidelines for genetic monitoring of

9.2.6 Wild cherry (*Prunus avium* (L.) L.)

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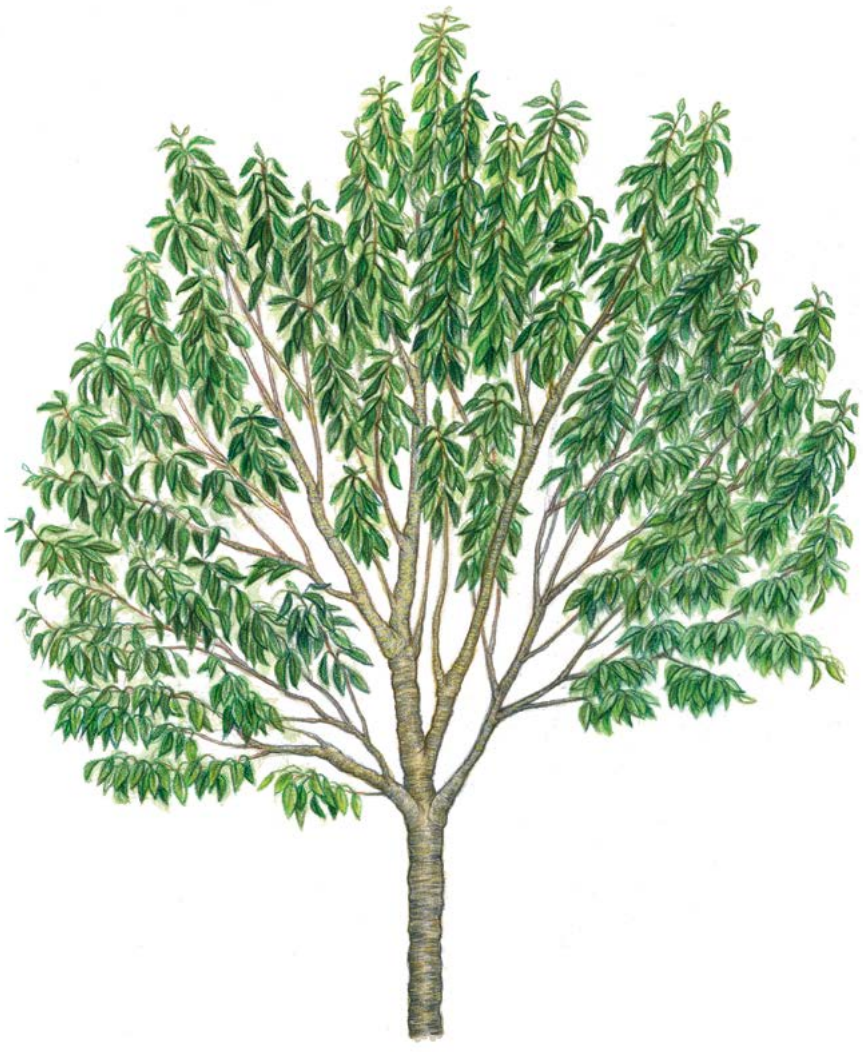

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1 Executive summary

Wild cherry (*Prunus avium* (L.) L.), is a medium sized, fast growing and rather short-lived deciduous tree, with wide natural distribution range, which includes western Eurasia and the northern part of Africa [1]. The species is a pioneer one that grows in a wide range of habitats; however, the species is extremely scattered throughout its distribution as it is highly light demanding and a weak competitor. The species natural populations are characterised by their small size and occur in small groups or are composed of single trees growing at the edges and in the gaps of forest stands. Wild cherry is an important forest tree species from an ecological (it is vital as a food source for many bird and insect species) and economic point of view (wood of wild cherry is as valuable as it is of high-quality and easy to work, therefore is often used for veneer and furniture production, cabinetry, etc.).

These guidelines briefly describe the wild cherry, its reproduction, niche requirements and threats. They provide guidance on establishing a genetic monitoring plot and on recording all field level verifiers.

2 Species description

Wild cherry (Figure 1) is a medium sized, fast growing and rather short-lived deciduous tree reaching the height of 15-30 m. (up to 35 m.) and with a stem diameter (DBH) of up to 90-120 cm [3, 4, 5, 16, 19 and references therein]. Wild cherry has strong apical growth and most of its lateral branches are arranged in annual whorls. The crown is broadly conical and the trunk usually straight. The bark is shiny with large lenticels and peels horizontally [16, 19]. Leaves are light green in spring, dark green in summer and yellow, orange or reddish brown in autumn. They are alternate, pendulous, simple and elliptic-ovate to obovate acute in shape, and their margins are characterised by slightly rounded teeth. There are conspicuous pairs of dark-red glands at the 2-3.5 cm long petiole below the lamina [19].

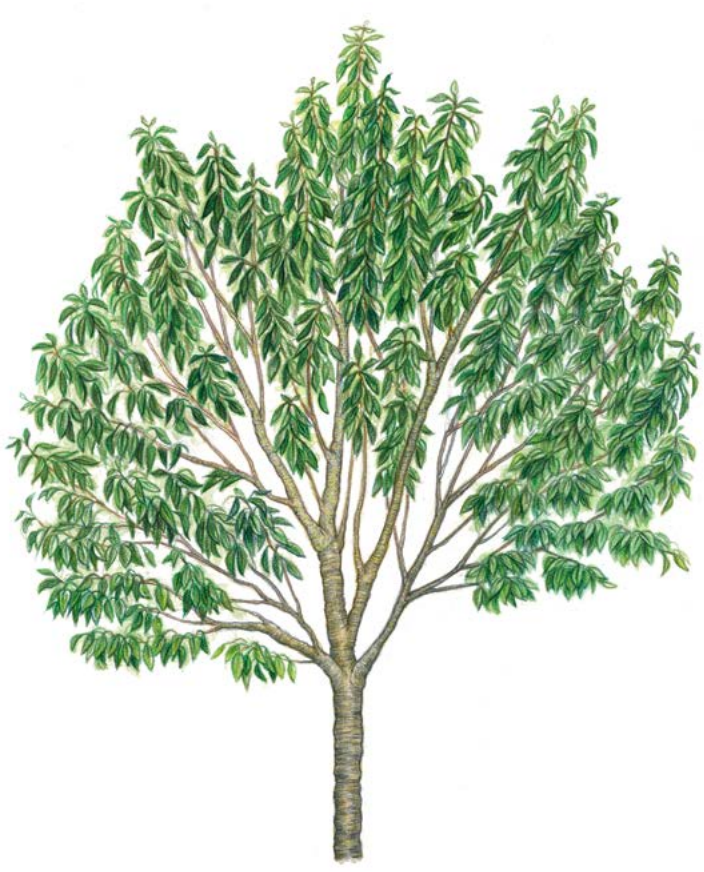

Figure 1. Wild cherry tree (*Prunus avium*) habitus.

3 Reproduction

Wild cherry is a species with a mixed reproduction system involving asexual reproduction via root suckers and sexual reproduction. The species is a monoecious, hermaphrodite tree, with flowers typically pentameric, with white petals, pedunculate and assembled on brachyblasts in groups of three to ten or more [3, 9]. Flowers are insect pollinated, mainly by honeybees, wild bees and bumblebees [2, 3, 5, 16, 19]. Flowering and seed production of wild cherries start at the 4-6 years of age under optimal conditions. It is one of the first trees to flower in the spring and produces masses of white blossoms. The small red or black fruits are edible (Figure 2) [2, 6]. The seeds are spread by birds, and small mammals [5, 16, 19]. Seed dormancy lasts one to two winters. A combination of warm and cold stratification is applied for germination of stored seed [16].

Figure 2. Development of wild cherry (*Prunus avium*) fruits.

The species sexual reproduction is characterised by a gametophytic self-incompatibility system (which is regulated by *''S''* allele) which favours outcrossing and prevents self-fertilisation [7, 11, 12, 15, 16, 17, 9 and references therein]. It can hybridise with other cherry species, particularly when their natural distribution ranges overlap, e.g. with sweet cherry, sour cherry (*Prunus cerasus* L.), European dwarf cherry (*Prunus fruticosa* Pall.) [7, 14, 16, 18], or when the species grows close to areas of cherry cultivation.

Regarding local establishment strategies of the species related to its mixed reproductive system, it is considered that the establishment of a new niche is achieved via seedling recruitment, if it is followed by asexual reproduction via root suckers [13].

4 Environment

The species is a pioneer and grows in a wide range of habitats; however, it falls in the category of species with scattered distribution range, due to its low competitive ability and high demand for light. Wild cherry natural populations are mainly of limited size forming small groups or consisting of single trees growing at the edges and in the gaps of forest stands, due to forest disturbances [16]. The species can quickly colonise open areas (gaps) by seeds or root suckers during the early forest successional stages, but it is often replaced by other hardwood species (climax tree species) during ongoing forest succession [16, 19]. Typically wild cherry prefers deep, light, silty soils (pH 5.5-8.5) that are fertile with a good water supply (precipitation 580-1800 mm per year). It is a cold winter resistant tree species, but flowers can be damaged by late spring frosts. In the core of its distribution the species can be found in deciduous mixed forest type communities of the class *Querco-Fagetea*, such as ravine forests (*Tilio-Acerion*), oak-Hornbeam forests (*Carpinion betuli*), lowland beech forests (*Fagion*), and riverine floodplain forests (*Alno-Ulmion*) [19 and references therein].

5 Threats

As the high forest management system and longer rotation periods have been prevailing in forestry over the last few decades, the conditions for wild cherry have not been the best. Currently, the role of wild cherry in improving the biodiversity of forest ecosystems is recognised, and forest owners promote wild cherry in their forests [9]. The species is relatively sensitive to environmental stresses (e.g. droughts) and can be easily affected by diseases and pests in unfavourable conditions. In addition, its root system is characterised by far-reaching lateral roots in topsoil horizons, and it is vulnerable to strong winds [9, 19 and references therein]. Roots may be attacked by mice and voles, while the natural regeneration of wild cherry trees is especially susceptible to browsing. Leaves can be damaged by caterpillars such as those of the winter moth (*Operophtera brumata* L.), gypsy moth (*Lymantria dispar* L.); fruits can be attacked by European cherry fruit fly (*Rhagoletis cerasi* L.) and the bird-cherry weevil (*Anthonomus rectirostris* L.). Wild cherry can be damaged by bacterial cankers, such as *Pseudomonas syringae* Van Hall or fireblight (*Erwinia amylovora* Burrill), cherry leaf roll virus (CLRV) and fungal pathogens (*Apiognomonia erythrostoma* Höhnel, *Blumeriella jaapi* (Rehm) Arx) [19 and references therein].

6 Plot establishment and maintenance

A forest genetic monitoring plot consists of 50 reproducing trees and the minimum distance of 30 m between any two trees. If a tree is flowering, it is regarded as a reproducing tree. Diameter at breast height (DBH) and social class can be used as a proxy to identify a reproducing tree if the plot is being established outside of the flowering season, relying on the expertise of the local forester. During plot installation, trees should be labelled and the coordinates of all trees taken. At the same time DBH can be measured and samples for DNA extraction taken.

Because of the *Prunus avium* hybridisation with cultivated cherry varieties, it is recommended that FGM plots are selected and established at a secure distance (8-10 km) from the cultivation of domesticated cherry.

Due to wild cherry's scattered distribution and low density in natural forest stands, a preliminary field study is needed; the size and shape of the genetic monitoring plot will need to be adapted to include 50 reproducing trees. In addition, natural regeneration (as cohorts or single saplings) has to be present in the plot. However, it is recommended that the size of the plot is limited to 10 ha; otherwise FGM procedures (sampling, phenology observations, etc.) become too complicated. During wild cherry tree selection it is important to avoid possible clones, therefore if groups of wild cherry are formed by only one genotype per group then only one tree out of them should be selected for FGM.

Equipment needed:

- a device for distance measurement (a pair of range-finding binoculars is recommended)
- a compass,
- a paint with a brush or spray for marking trees
- a tree calliper for DBH measurements and
- a GPS device that is precise enough and allows saving trees' coordinates.

6.1 Plot establishment

6.1.1 Plot selection

To establish a monitoring plot for *Prunus avium*, ideally the initial work should be carried out in spring, when the trees are flowering. Wild cherry can be clearly visible and distinguished from other species in the area in springtime by white coloured blossoms. Visual inspection of the area photos may be used instead of, or additional to, an initial field survey to assess the approximate number, density and distribution of reproducing wild cherry trees in

the selected area. In cases when other trees with white coloured blossom may co-exist in the area at the same time, then priority should be given to a field survey.

At this time, all wild cherry trees in the stand should be mapped using a GPS device. Fifty (50) trees, with the minimum distance of 30 m from each other, should then be randomly selected (Figure 3a). During plot installation these pre-selected trees must be identified in the field and marked.

6.1.2 Plot installation in the field

Using the GPS, all trees selected in the office are located in the forest stand and marked. The minimum distance of 30 m between trees needs to be checked again.

6.1.3 Labelling of trees

Each selected tree must be marked with a corresponding number (1 to 50) and preferably a band painted around the trunk to aid the visibility of the trees from all directions (Figure 3b).

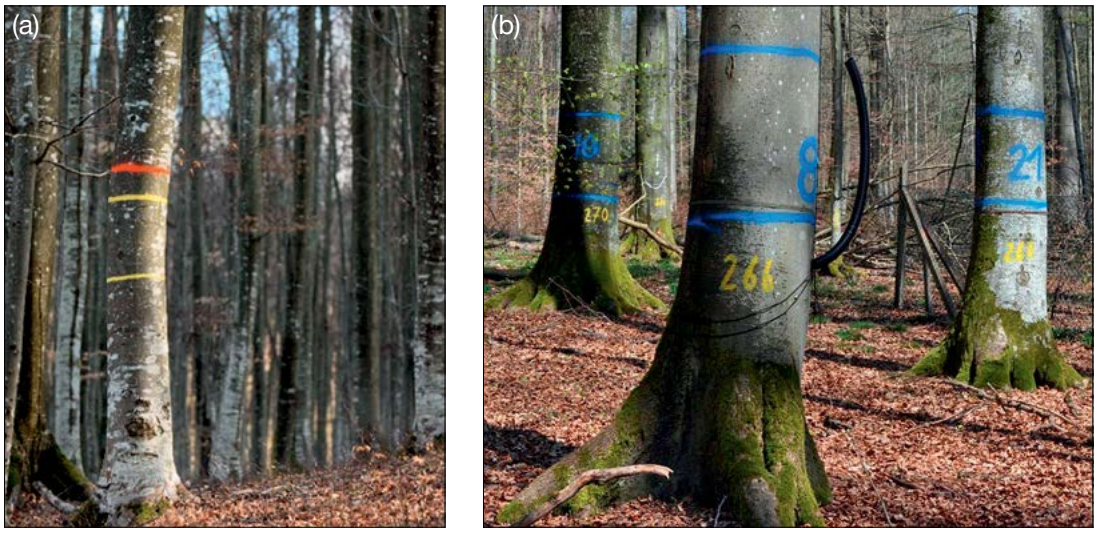

Figure 3: a) All reproducing wild cherry trees in the selected stand are first mapped using a GPS device. Fifty trees, with the minimum distance of 30 m from each other, are then randomly selected for FGM ; b) trees selected for FGM are labelled with corresponding numbers and bands around their trunks to aid the visibility of the trees from all directions (photos are as an example for marking from a European beech FGM plot).

6.2 Establishment of natural regeneration subplots

Natural regeneration centres from the last mast year should be surveyed in the field and their locations logged (GPS coordinates, number of the tree which is next to a NR centre). Because of seed dormancy in wild cherry, natural regeneration of a mast year (year of massive fruit/seed production) can occur one or two years later and seedlings from several years may have originated from the same mast year. From all logged regeneration centres, 20 should be chosen randomly for plot installation. If 20 or fewer natural regeneration centres are present, all should be used.

Inside each selected natural regeneration centre a $1m^2$ plot is to be installed and marked with metal rods. Metal rods should be driven into the ground at each corner of the subplot as deep as possible to prevent them from being removed by animals. The tips of the metal rods should be painted to aid their visibility.

6.3 Plot maintenance

6.3.1 General maintenance

Tree markings and subplot markings must be checked periodically (every two years) and renewed if needed.

6.3.2 Replacement of trees

If a monitored tree dies or is cut due to management, it must be replaced. The nearest suitable tree to the dead one should be chosen considering that the distance requirement of 30 m to the nearest monitored tree is fulfilled. The replacement tree is marked with the next available number higher than 50, i.e. 51, 52, 53, etc. to positively differentiate it from the original 50 selected trees.

If the crown is damaged due to, for example, windbreak, ice or snow-break, but continues to fructify, the tree is kept for monitoring. If the damage is too severe and fructification is not expected anymore, the monitored tree must be replaced. The cause of damage needs to be recorded, as the damage can affect the values recorded for field verifiers and background information.

7 Recording of verifiers and background information

On the monitoring plot, verifiers and background information are periodically recorded. Verifiers are used to monitor the population's genetic properties and its adaptation to environmental changes and/or management, while background information needs to be recorded to assist interpretation of the verifiers. Verifiers can be observed at three different intensity levels: basic, standard and advanced.

Higher levels of observation (standard, advanced) must also include recording for all the preceding levels (basic, standard). This is not necessary for recording of background information.

Table 1. List of verifiers and background information with short description and observation frequency to be recorded during field work at the wild cherry genetic monitoring plots.

	Name	Basic level	Standard level	Advanced level
Verifiers	Mortality / survival	Adult trees: Counting of the remaining marked trees every year or after every extreme weather event/disturbance	Same as basic level	Same as basic level
		Natural regeneration: /	Counting of remaining seedlings on the natural regeneration subplots, twice per decade	Same as standard level
	Flowering	Stand-level estimate, every year	Individual tree level observation, during two major flowering events per decade, ideally equally spaced*	Individual tree level observation, during two major flowering events per decade, ideally equally spaced*
	Fructification	Stand-level estimate, every year	Individual tree level observation, the same year as the assessment of the flowering at the standard level (regardless of the fructification intensity)*	Counting of fruit, during the same years as the assessment of flowering at the advanced level, regardless of the fructification intensity * Seeds are collected for laboratory analyses for every assessed fructification event at the advanced level
	Natural regeneration abundance	Stand-level estimate, every year	Counting of seedlings according to the protocol in the 2nd and 7th years after the mast year**	Counting of seedlings according to the protocol in the 2nd, 7th, 12th, and 17th years after the mast year**
Background information	DBH class distribution	/	Measurement every 10 years	Same as standard level
	Height class distribution	/	Measurement every 10 years	Same as standard level
	Budburst	/	Individual tree level observation according to the protocol, every 5 years	Individual tree level observation according to the protocol, every year
	Senescence	/	Individual tree level observation according to the protocol, every 5 years	Individual tree level observation according to the protocol, every year
	Flowering synchronisation	/	/	Individual tree level observation, during each assessed major flowering event
	Senescence	/	Individual tree level observation, every 5 years	Individual tree level observation, every year
	Flowering synchronisation	/	/	Individual tree level observation, during each assessed major flowering event

* Ideally at least one major fructification event should be assessed per decade. However, a major flowering event does not necessarily lead to a major fructification event. If no major fructification event follows the assessed flowering event, assessment of both flowering and fructification needs to be repeated during the next major flowering event, regardless of the time passed between successive major flowering events. Basic level observations are used to identify major flowering and fructification events.

** Because of wild cherry seed dormancy, natural regeneration of a mast year (year of massive fruit/seed production) can occur one or two years later and seedlings from several years may have originated from the same mast year.

7.1 Protocols for recording of verifiers

7.1.1 Mortality / survival

Mortality describes mortality of adult trees. Its counterpart survival stands for trees that are still alive since the previous assessment. Survival is calculated as 1 – Mortality.

7.1.1.1 Adult trees: Basic, standard and advanced level

The verifier for mortality of adult trees. It is estimated by counting the remaining alive marked trees every 10 years and after every extreme weather event/disturbance. Mortality is the difference between the initial number of marked trees and the trees remaining alive of the original 50.

7.1.1.2 Natural regeneration: Standard and advanced level

Mortality of natural regeneration is calculated from the verifier Natural regeneration abundance. Mortality is the difference between the initial number of NR plants and the plants remaining alive at the time of the next counting. For each round of assessment, the NR is counted first in the year of germination and then again after 5 years at the standard level, while at the advanced level the counting is also performed after 10 and 15 years. Assessment of NR abundance is carried out twice per decade, ideally approximately every five years.

7.1.2 Flowering

This verifier describes the flowering intensity and the proportion of trees thus affected. Usually wild cherry flowers can be recorded from March until May in central Europe. Flowering is earlier when preceded by a warm winter. Usually wild cherry flowers every second year.

7.1.2.1 Basic level

This verifier is recorded every year at the stand level; however, because of the scattered distribution of wild cherry all 50 monitored trees must be visited to get a good estimate of the average condition in the stand. Recording is carried out when flowering is in full progress. The estimate of average condition is provided after a walk throughout the monitoring plot. Two scores are given, one for flowering intensity and one for proportion of flowering trees in the stand.

Code	Flowering intensity at the stand level	Average proportion of the crown flowering (%)
1	No flowering: No or only occasional flowers appearing on trees	0 – 10
2	Weak flowering: Some flowers appearing on trees.	> 10 – 30
3	Moderate flowering: Moderate number of flowers appearing on trees.	> 30 – 60
4	Strong flowering: Abundant number of flowers on trees.	> 60 – 90
5	Massive: Huge number of flowers on trees.	> 90

Code	Proportion of trees in the stand with the given flowering intensity stage (%)
1	0 – 10
2	> 10 – 30
3	> 30 – 60
4	> 60 – 90
5	> 90

7.1.2.2 Standard level

This verifier is recorded during two major flowering events per decade, ideally equally spaced in time from one another. It is recorded at an individual tree level on all 50 monitored trees. A major flowering event is when at the basic level flowering intensity is strong or massive (code 4 or 5) and the proportion of trees with the given flowering intensity is above 60% (code 4 or 5). Recording is carried out when flowering is in full progress. One score is provided for each tree.

Code	Description	Proportion of the crown flowering (%)
1	No flowering: No or only occasional flowering appearing on a tree.	0 – 10
2	Weak flowering: Some flowers appearing on a tree.	> 10 – 30
3	Moderate flowering: Moderate number of flowers on a tree.	> 30 – 60
4	Strong flowering: Abundant number of flowers on a tree.	> 60 – 90
5	Massive: Huge number of flowers on a tree.	> 90

7.1.2.3 Advanced level

This verifier is recorded during two major flowering events per decade, ideally equally spaced in time from one another. It is recorded at an individual tree level on all 50 monitored trees. A major flowering event is when at the basic level flowering intensity is strong or massive (code 4 or 5) and the proportion of trees with the given flowering intensity is above 60% (code 4 or 5). On average, two visits to the plot are needed; the first one early enough to observe the early stages of flowering and the second one when flowering is in full progress [8]. For a graphical representation of flowering stages, see Figure 4.

Code	Flower phenology stages
1	Buds not active, scales brown and closed
2	Buds increase size, scales start to separate so that first leave edges are visible
3	Flower bud broken, flowers petals still closed, petiole elongating
4	Flowers petals open completely, the stigma is receptive, and the anthers dehisce their pollen

Code	Description	% crown flowering
1	No flowers: No or only occasional flowers appearing on a tree.	0-10
2	Weak flowering: Some flowers appearing on a tree.	>10-30
3	Moderate flowering: Moderate number of flowers.	>30-60
4	Strong flowering: Abundant number of flowers.	>60-90
5	Massive flowering: Huge number of flowers.	>90

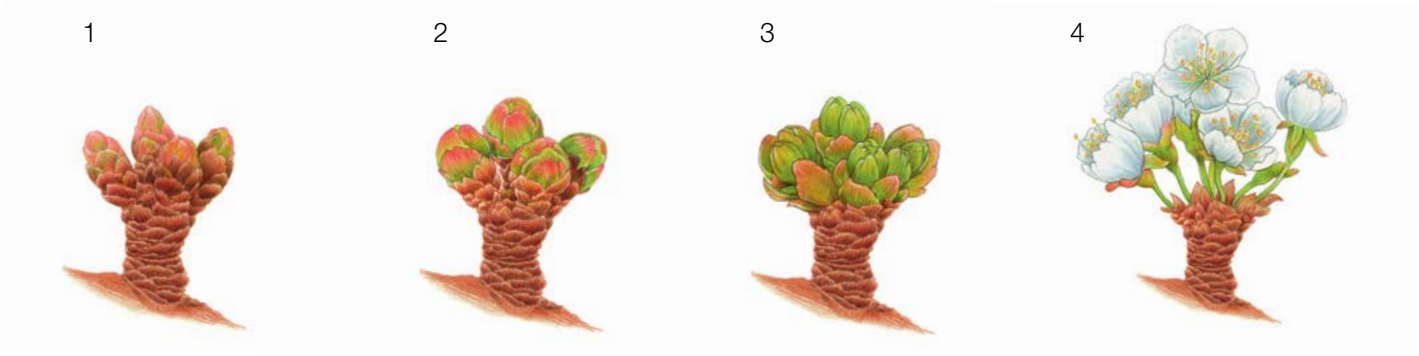

Figure 4: Picture guide for description of flowering for the advanced level verifier Flowering.

7.1.3 Fructification

This verifier describes the presence of fructification and its abundance. Data for this verifier should be collected during fructification, from late spring to mid or late summer in central Europe. Usually wild cherry fructification occurs every second year.

7.1.3.1 Basic level

This verifier is recorded every year at the stand level; however, because of the scattered distribution of wild cherry all 50 monitored trees must be visited to get a good estimate of the average condition in the stand. Two scores are given, one for fructification intensity and one for proportion of fructifying trees in the stand.

Code	Fructification intensity at the stand level	Average proportion of the crown bearing fruit (%)
1	No fructification: No or only occasional fruit appearing on trees	0 – 10
2	Weak fructification: Some fruit appearing on trees	> 10 – 30
3	Moderate fructification: Moderate amount of fruit appearing on trees	> 30 – 60
4	Strong fructification: Abundant amount of fruit appearing on trees	> 60 – 90
5	Massive: Huge amount of fruit appearing on trees	> 90

Code	Proportion of trees in the stand with the given stage of fructification intensity (%)
1	0 – 10
2	> 10 – 30
3	> 30 – 60
4	> 60 – 90
5	> 90

7.1.3.2 Standard level

This verifier is recorded during the same years as the assessment of the flowering at the standard level (regardless of the fructification intensity). It is recorded at an individual tree level on all 50 monitored trees. Recording is carried out before fruits start falling or are eaten by birds. One score is provided for each tree.

Ideally, one major fructification event should be captured following observations of major flowering events per decade. However, a major flowering event does not necessarily lead to a major fructification event. If no major fructification event follows the assessed flowering event, assessment of both flowering and fructification needs to be repeated during the next major flowering event, regardless of the time passed between successive major flowering events. Basic level observations are used to identify major fructification events. A major fructification event is when at the basic level fructification intensity is strong or massive (code 4 or 5) and the proportion of trees with the given fructification intensity is above 60% (code 4 or 5).

Code	Fructification intensity	Proportion of the crown fructifying (%)
1	No fructification: No or only occasional fruits appearing on a tree.	0 – 10
2	Weak fructification: Some fruit appearing on a tree.	> 10 – 30
3	Moderate fructification: Moderate amount of fruit appearing on a tree.	> 30 – 60
4	Strong fructification: Abundant amount of fruit appearing on a tree.	> 60 – 90
5	Massive: Huge amount of fruit appearing on a tree.	> 90

7.1.3.3 Advanced level

This verifier is recorded at an individual wild cherry tree level on all 50 monitored trees during the same years as the assessment of flowering at the advanced level, regardless of the fructification intensity. Recording is carried out before fruits start falling. One score is provided for each tree. Simultaneously, seed is collected for seed and genetic analysis for the advanced level verifiers and background information.

Ideally, one major fructification event should be captured following observations of major flowering events per decade. However, a major flowering event does not necessarily lead to a major fructification event. If no major fructification event follows the assessed flowering event, assessment of both flowering and fructification needs to be repeated during the next major flowering event, regardless of the time passed between successive major flowering events. Basic level observations are used to identify major fructification events. A major fructification event is when at the basic level fructification intensity is strong or massive (code 4 or 5) and the proportion of trees with the given fructification intensity is above 60% (code 4 or 5).

The verifier is recorded by counting fruits using binoculars. The average of three rounds of counting is reported. Each round of counting consists of the number of fruits that the observer is able to count in 30 seconds. For all trees, the same part of the crown should be investigated. Once the observation part of the crown part is selected, the same one should be selected for every subsequent monitoring of this verifier. The upper third of the crown is preferred to the bottom and middle part for counting.

Two values are recorded; the number of fruits and the part of the crown monitored.

Number of fruits counted in 30 seconds (average of 3 rounds)
X

Code	Part of the crown monitored
1	Bottom
2	Middle
3	Top

7.1.4 Natural regeneration abundance

This verifier describes the presence and abundance of natural regeneration (NR) at the monitoring plot. At the basic level it is recorded every year using expert opinion. Wild cherry seed dormancy can last one or two winters, so first seedlings might occur only 1.5 – 2.5 years after fructification.

7.1.4.1 Basic level

This verifier is recorded at the stand level (check the areas with existing and flowering wild cherry trees and open areas suitable for new NR establishment) every year, in the autumn. Expert opinion is used for estimation. Two values should be selected, one for new natural regeneration (one-year seedlings) and one for established regeneration (seedlings that are older than one year). Since light is a crucial factor for new NR establishment of wild cherry, forest gaps and open areas or forest edges should be the focus. Since the abundance of natural regeneration for wild cherry is usually scarce, only two abundance stages are applied.

Code	Description: new regeneration (current-year seedlings)
1a	There is no or very little new natural regeneration on the monitoring plot
2a	New regeneration is present in sufficient quantity on the monitoring plot

Code	Description: established natural regeneration (saplings)
1b	There is no or very little established natural regeneration on the monitoring plot
2b	Established regeneration is present in sufficient quantity on the monitoring plot

7.1.4.2 Standard level

Wild cherry seed dormancy can last one or two winters, so the first seedlings might occur only 1.5 – 2.5 years after fructification. The establishment of NR subplots and the beginning of NR abundance observations must adapt to the duration of the seed dormancy in the monitored location. This verifier is recorded by counting of plants/seedlings 2nd and 7th years after the assessed major fructification event. Ideally, twenty (20) new NR subplots for wild cherry have to be established after the next assessed major fructification event which should be approximately five years after the previous one.

Number of seedlings counted on a subplot
X

For subplot establishment see 6.2 Establishment of natural regeneration subplots.

7.1.4.3 Advanced level

Wild cherry seed dormancy can last one or two winters, so the first seedlings might occur only 1.5 – 2.5 years after fructification. The establishment of NR subplots and the beginning of NR abundance observations must adapt to the duration of the seed dormancy in the monitored location. This verifier is recorded by counting of plants/seedlings 2nd, 7th, 12th and 17th years after the assessed major fructification event. Twenty (20) new NR subplots for wild cherry have to be established after the next assessed major fructification event. When a major fructification event is every year or every two years then approximately five years should be between the consecutive assessed major fructification events.

Table 2: Timeline of natural regeneration abundance (NR) assessment. In this example, the first assessed fructification event takes place in the 2nd year of the monitoring decade, and considering wild cherry seed dormancy of one or two winters, 20 NR subplots are established in the 4th year of the monitoring decade. The next assessment of fructification is carried out in the 8th year of the monitoring decade. Considering wild cherry seed dormancy, 20 new NR subplots are established in the 10th year of the decade. Twenty new NR subplots are established after each assessed fructification event. Monitoring of NR abundance on each set of 20 NR subplots is carried out every five years. The fructification events corresponding to the assessed NR and timelines of the assessment activities are shaded in the same colour. After the final round of counting of seedlings, monitoring of NR abundance on the respective set of NR subplots is stopped and the respective NR subplots disestablished. S – standard level; A – advanced level.

Year of monitoring	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Fructification event		•			•	•		•		•		•		•			•	•		•		•		•	
NR assessment from the 1st assessed fructification event		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
NR subplots establishment				S	A																				
NR abundance counting				S	A				S					A					A						
NR assessment from the 2nd assessed fructification event								0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
NR subplots establishment										S	A														
NR abundance counting										S	A				S	A				A					A

For subplot establishment see 6.2 Establishment of natural regeneration subplots and for counting

7.2 Protocols for recording of background information

7.2.1 DBH class distribution

7.2.1.1 Standard and advanced levels

DBH is recorded at an individual tree level on all 50 monitored trees every 10 years. DBH is the trunk diameter at 1.30 m of height, i.e. approximately at an adult's breast height. If a tree has more than one trunk, please measure all of them and estimate the average (but try to avoid trees with many small trunks). Add a note in the case of a multi-trunk tree in the notes section. If the tree is leaning, measure DBH perpendicular to the tree trunk. DBH can be measured in two ways:

1) using a calliper, in which cases you would need to measure two perpendicular diameters and estimate the average
2) measure the circumference of the tree and compute the diameter from that value (i.e. divide by π, ~3.14 or use a pi-meter)

The DBH is recorded in cm. The same method must be applied for every subsequent measurement.

7.2.2 Height class distribution

7.2.2.1 Standard and advanced levels

Height is recorded at an individual tree level on all 50 monitored trees every 10 years. Height is measured from the ground to the tallest part of the crown, ideally using a clinometer or hypsometer (vertex). Height is recorded in metres to one decimal place.

7.2.3 Budburst

Budburst describes the process of budbursting (flushing). In wild cherry, budbursting starts together with flowering. Recording is only carried out at the standard and advanced levels. Data for this background information should be recorded in March – May in central Europe. Flushing is earlier when preceded by a warm winter.

7.2.3.1 Standard level

At standard level, budburst is recorded on an individual tree level on all 50 monitored trees every five years. We are looking for the initiation of budbursting (stage 2) and the end of budbursting (stage 4) [8]. The observations cease when all the trees have reached stage 4. Usually, six visits will be needed. For each tree, two estimates are given: stage of budbursting and proportion of the crown budbursting. For a graphical representation of budbursting stages, see Figure 5.

Code	Stage of budbursting
1	Buds are swollen, some leave scales separate so that first leave edges are visible
2	Leaflets reach the same size as the former buds and start to separate
3	Leaves elongate more but still folded
4	Leaves are extremely spread out; leave area clearly increased; peduncles appear so that leaves start to turn round and hang down.

Code	Proportion of the crown with a given stage of budbursting (%) (Modified after [10])
1	> 0 – 33
2	> 33 – 66
3	> 66 – 99
4	100

Figure 5: Picture guide for description of budburst (flushing) for the basic, standard and advanced levels background information Budburst.

7.2.3.2 Advanced level

At the advanced level, budburst is recorded at an individual tree level on all 50 monitored trees every year. For the values (stage of budbursting and the proportion of crown affected) see 7.2.3.1 Standard level.

7.2.4 Senescence

Senescence describes the process of senescence. Recording of this background information is only carried out at the standard and advanced levels.

7.2.4.1 Standard level

At standard level, senescence is recorded on an individual tree level on all 50 monitored trees every five years. We are looking for stage 3, when leaves are yellow and do not photosynthesise anymore. Observations stop when all the trees have reached stage 3. Usually two (2) visits to the plot will be needed. For each tree, two estimates are given: stage of senescence and proportion of the crown senescing. For a graphical representation of stages of senescence, see Figure 6.

Code	Stage of senescence
1	Leaves are green
2	Leaves are green changing to yellow (greenish yellow)
3	Leaves are yellow changing to brown (brownish)
4	Leaves are brown / shed

Code	Proportion of the crown with a given score for stage of senescence (%)
1	> 0 – 33
2	> 33 – 66
3	> 66 – 99
4	100

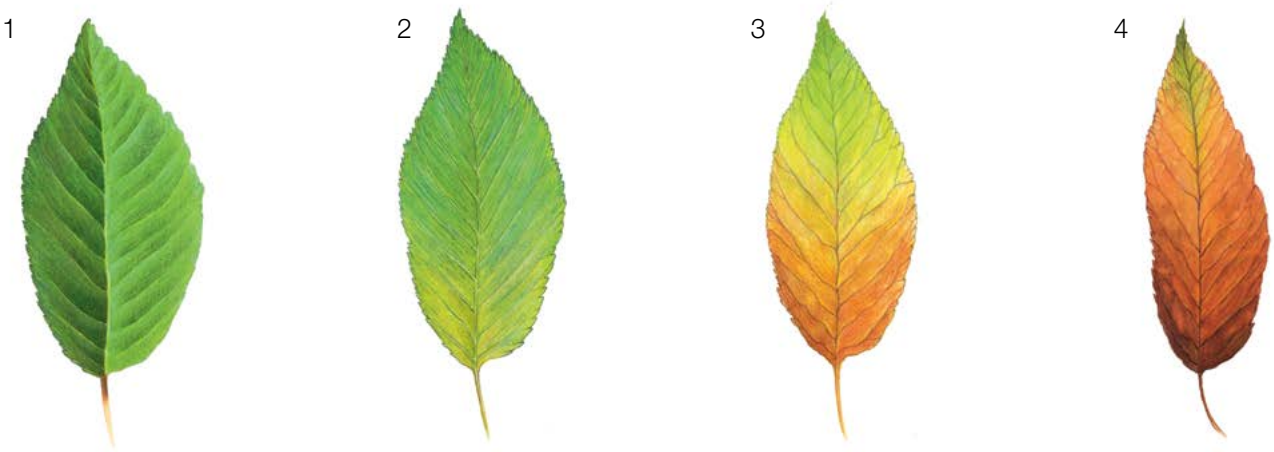

Figure 6: Picture guide for description of leaf colouring for standard and advanced level background information Senescence.

7.2.4.2 Advanced level

At advanced level senescence is recorded on an individual tree level on all 50 monitored trees every year. For the values (stage of senescence and the proportion of crown affected) see 7.2.4.1 Standard level.

7.2.5 Flowering synchronisation

Flowering synchronisation is monitored only at the advanced level, and is based on the data collected for the verifier Flowering. It is used to determine whether flowering time occurs simultaneously within the monitored stand.

7.2.5.1 Advanced level

Flowering synchronisation is recorded on an individual tree level on all 50 monitored trees, during each assessed major flowering event, in the same years as when seed is collected (the same as Flowering at advanced level).

For plot establishment use form 'FGM Plot description'

For verifiers recording use 'Form for recording field level verifiers within FGM'

For background information recording use 'Form for recording field level background information within FGM'

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