FOREST FOCUS DEMONSTRATION PROJECT
BIOSOIL 2004-2005

THE BIOSOIL FOREST BIODIVERSITY FIELD MANUAL

VERSION 1.0/1.1/1.1A

FOR THE FIELD ASSESSMENT 2006-07

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INTRODUCTION

The intention of the Forest Focus Regulation (EC) N° 2152/2003 is to broaden the scope of the monitoring scheme from the protection of forests against atmospheric pollution and forest fires towards other environmental issues such as soils and forest biodiversity. Article 6 of the basic act allows the Commission as well as the Member States to carry out studies and demonstration projects for this purpose. The BioSoil project is such a study, which aims to carry out an inventory of soil chemical characteristics and forest biodiversity at the Level 1 plots. This paper concentrates on the forest biodiversity component of BioSoil. The approach outlined was devised following meetings of biodiversity experts from the Member States combined with field testing of the approach and in co-operation with the Joint Research Centre of the European Commission.

Many initiatives are currently taken to estimate the loss of biodiversity in Europe. Efforts to develop guidelines for assessing forest biodiversity have been under way for many years. Several processes like the MCPFE process (Vienna, 2003) and the Convention on Biological Diversity are presenting lists of indicators relevant to forest biodiversity. However, there is still a need to select and test simple and suitable indicators to measure and describe forest biodiversity at stand as well as at European level and there is still no large scale monitoring system of forest biodiversity in Europe.

The existing Level 1 survey of the monitoring programme represents an option for such a large scale monitoring system. The Level 1 survey is a systematic network based on a 16km x 16km trans-national grid of sample plots and as such represents a statistically unbiased sampling tool for European forests. It should also be stressed that the Level 1 survey does not aim and has not been designed to be a comprehensive forest biodiversity survey, but represents a unique opportunity to examine selected parameters of biological interest in forests at the European level.

The BioSoil initiative represents this opportunity to assess and demonstrate the efficacy of the Level 1 network, as a representative tool of European forests and to address other issues of relevance to European forestry such as forest biodiversity with the addition of a few assessment variables. The approach adopted is known as the stand structure approach, which assumes an increased potential for biological diversity with increasing complexity of the forest stand. This approach is complemented with the addition of biological data such as information on the ground vegetation community.

Objectives of BioSoil Biodiversity

The overall objectives of the biodiversity component of BioSoil are to make an inventory of components of forest biodiversity such as forest structure and species diversity using the Level I systematic network.

The BioSoil project will provide data to support both international and national policy on forest biodiversity, by:

- Conducting a **demonstration study** to collect harmonised information relevant to forest biodiversity at the European level and demonstrate the use of the Level 1 network in this context;

- Presenting a European forest type classification of the Level 1 plots and **provide a first attempt at habitat classification** of the forests of Europe
- Testing selected, internationally recognised, robust and practical indicators of forest biodiversity on a large scale survey thereby to develop a practical methodology as a manual.
- Establishing an improved common baseline framework to integrate other information and ongoing projects (including the soil initiative of BioSoil) on forest biodiversity to achieve maximum added value;
- Designing a multi-scale hierarchical approach to quantify European forest biodiversity and monitor changes over time and space;

BioSoil sampling approach

The sampling approach of the biodiversity component of BioSoil includes the following surveys;

- Plot design:
  - BioSoil sampling plot design
  - Geo-referencing of the plot using a common projection
- Forest type classification
  - Verification of actual forest type
- Structural forest diversity
  - Diameter at breast height and species composition of all woody plants (including standing and lying trees, living and dead))
  - Coarse woody debris, snags, and stumps)
  - Canopy closure and tree layering
- Compositional forest diversity
  - Ground vegetation (vascular plant species list)

Time schedule

The project is foreseen to follow the time schedule outlined below in Table 1.

Table 1: Work plan of the BioSoil biodiversity study

Project period: From:	01.01.2006	To:	31.12.2007	2006				2007			
Main activities over the project period				1	2	3	4	1	2	3	4
Preparation, training				x	x						
A workshop including a pre-field sampling to ensure a harmonised approach for the project					x						
Field assessment of the selected parameters					x	x	x	x	x	x	
Data management and reporting											x

THE BIOSOIL BIODIVERSITY FIELD MANUAL

Introduction

The manual of crown condition assessment gives detailed instructions of crown condition plot establishment and operation. Despite this, although annual surveys of crown condition are conducted at the Level 1 sampling points across Europe, different countries may operate different sampling configurations of the crown condition sample trees. This leaves many countries operating at a point sample level rather than at a plot sample level of known and fixed area.

For the purposes of this demonstration project on BioSoil biodiversity, components of forest biodiversity will be sampled across a known plot of fixed area with the plot location being related to the location of the crown condition survey and to the soil pit of the soil survey of BioSoil.

BioSoil plot installation

The basic BioSoil plot is devised as a circular plot with a radius of 25.24 m (2000 m^2) divided into three circular subplots: an outer subplot (subplot 3) with a radius of 25.24 m (2000 m^2) and including 2 inner circular subplots with fixed radii of 3.09 m (30 m^2, subplot 1) and 11.28 m (400 m^2, subplot 2); see Figure 1.

It is recommended that the BioSoil sampling plot is located in relation to the location of the crown condition assessment and the soil pit of the soil component of the BioSoil project in such way that the soil pit should be within the 2000 m^2, but where possible outside the boundaries of the subplots 1 and 2.

The ground vegetation, forest deadwood surveys, and canopy characteristics, are conducted in the BioSoil subplots 1 and 2 only.

Optionally random sampling units can be established: see Appendix 1.

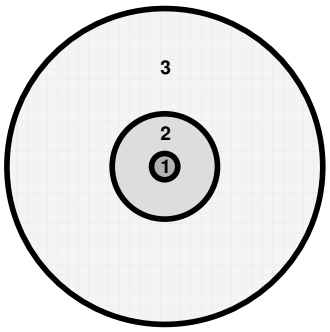


Figure 1: ***The basic BioSoil plot.*** *Coarse woody debris, snags, stumps, ground vegetation and canopy characteristics are measured in the BioSoil subplots 1 and 2 (a total sampling area of 400 m2). Tree species and DBH (diameter at breast height 130 cm) are recorded across the entire BioSoil plot.*

Slope correction

Where the BioSoil plot occurs on steep slopes, slope correction factors must be used.

Clarification:
For plots on flat ground, the radius proposed above can be used. Where the BioSoil plots occur on steep slopes, the plot's radius varies, depending on the steepness of the hill, and the plot becomes oval in shape, not circular. The radius of a plot that occurs on sloping ground must be adjusted using trigonometry (secants) or as done by most foresters by using a slope correction table. The slope of the plot can also be measured using a clinometer.

Method of establishment of the plot

It is important to record the exact centre of the plot. This can be done by registration with GPS coordinates, complemented by simple maps and azimuth along with distance assessments to allow for a precise location of the plot. The plot centre is marked using e.g. a metallic bar (inert material is recommended) driven into the ground, (down to the surface of the forest floor in order not to disturb works or traffic in the forest). The geo-referencing is mandatory to the project, using GPS registration whenever possible.

It is also recommended to draw simple diagrams, and to take photos of the plot to assist possible future plot relocation. The diagrams should include several identifiable elements (road, large tree, rivulet, etc) to help to find the plot again if the GPS registration has not been satisfactory or if the metal pin has disappeared.

Also if there are clear features and characteristics of the plot which may help in the evaluation of the data such as big rocks, rivulets, trails, forest edges, changes in plant communities, it is recommended to make a sketch of these features.

Table 2: *The basic BioSoil circular plot of 25.24 m radius consists of 3 subplots of different radii.*

Unit	Shape	Radius*/(area)
Subplot (1)	Circle	3.09 m (30 m^2)
Subplot (2)	Circle	11.28 m (400 m^2)
Subplot (3)	Circle	25.24 m (2000 m^2)

*distance from the centre of the plot.

Geo-referencing of the plot centre and of the soil pit(s)

The geographic location of the BioSoil plot centre is determined using a GPS receiver. All GPS readings must be differentially corrected to yield an accurate position and elevation. The location of the soil pit must also be geo-referenced.

The BioSoil plot location must be geo-referenced using a common European projection. The ETRS89 Lambert Azimuthal Equal Area Coordinate Reference System (ETRS-LAEA) is recommended being the geodetic datum for pan-European spatial data collection, storage and analysis (Annoni *et al*., 2003). If another system is used, it is mandatory to submit datum and projection in order to make a conversion to ETRS-LAEA possible by the European Commission.

Method

The GPS coordinates are read using the GPS equipment and are noted on the forms **without** decimals. For an exact assessment of the coordinates in the centre of the plot at least 10 (preferably 30) data values from contact with at least 3 satellites (ideally 5-7 satellites) must be read (time 1-3 minutes). If the satellites are too close to each other, the measurement is imprecise. The mean of the coordinate measurement is written in the form and eventually also on the simple drawing.

In the event that the plot centre cannot be located, (*i.e.* poor quality or no signal), the GPS can be registered at another point where signals may be received. The distance and azimuth from this point to the plot centre can be measured and thus the plot centre can be located.

Table 3: ***Mandatory minimum measurement in the BioSoil Plot.*** *Tree species and DBH of standing and lying, living and dead trees (H >130 cm) are recorded across the entire BioSoil plot according to the diameter thresholds shown above. Forest deadwood (incl. coarse woody debris (D>10 cm), snags, stumps), ground vegetation (vascular plant species list only), and canopy characteristics are assessed performed in the BioSoil subplots 1 and 2 corresponding to a total sampling area of 400 m^2.*

BIOSOIL PLOT ASSESSMENTS AND MEASUREMENTS	Subplot 1 30 m^2	Subplot 2 400 m^2	Subplot 3 2000 m^2
General plot description	Yes		
Check of the European forest type classification	Yes		
DBH and species of all woody plants taller than 130 cm (standing and lying, living and dead)	All trees DBH > **0** cm (taller than **130** cm)	All trees DBH ≥ **10** cm	Only trees DBH ≥ **50** cm
Top height and bottom of canopy layer	Selection of minimum 3 trees		
Coarse woody debris, snags, and stumps	D > **10 cm**	D > **10 cm**	No
Canopy closure (visual)	Yes	Yes	No
Tree layering (visual)	Yes	Yes	No
Ground vegetation – vascular species list only	Yes	Yes	No

General Plot Description

A general description of the Level I plot has been performed according to the description of the EU/ICP-Forests Level 1 plots (UN-ECE, 2004). Under the BioSoil demonstration project, this description is validated in the field.

The following complementary parameters are included:

- the previous land use,
- the origin of actual stand
- the forest management such as thinning and selective felling
- the type of forest
- the removal of coarse woody debris
- the pattern of tree mixture
- the age of the dominant tree layer
- the prevalent slope of plot (prevalent slope of the BIOSOIL plot in percent (%)
- the plot orientation (prevalent orientation of the BioSoil plot in 8 main geographic directions).
- the fencing of the plot

The complementary parameters definitions and codes are found in the reference tables on pages 26-32.

The European Forest Type Classification

An ecologically oriented categorisation of the plots is useful for stratification and interpretation of forest plot information throughout Europe. At present a number of different forest type classifications have been proposed to classify the forests of Europe into broad classes based on EUNIS (European Union Nature Information Scheme) and the BEAR project (Larsson et al., 2001). The forest type classification adopted in the BioSoil biodiversity project follows the TBFRA and EUNIS definitions and uses the same methodology as the expanded BEAR forest type classification (Barbati *et al*., 2004).

A parallel study to BioSoil has classified the Level 1 points into broad forest types based on the main tree species and some few other selection criteria using the existing data of the Monitoring Programme (Chirici et al., 2005). A system using the nomenclature developed by the EEA is used, which classifies Europe into 28 general forest types. This process will allow verification of other systems of forest classification and should also be a very useful tool to permit pre-stratification of the plots at national level for sampling purposes.

The European Forest Type Classification performed in the BioSoil will comprise the verification at the plot level of the pre-assessed forest type classification of the Level 1 (EEA system).

A list of the forest type for each Level I plot of the countries will be delivered by the JRC. Countries will confirm this or supply corrected information at the data entry.

Structural Biodiversity

Forest structure is of interest in biodiversity monitoring due to its use by forest organisms, i.e. habitat range. The measurement of forest structure provides an important, robust and repeatable indicator of forest biodiversity. Structural diversity including tree diameter, tree species composition of all trees on the BioSoil sampling plot, deadwood and canopy characteristics, are assessed on the 16 km x 16 km grid as a minimum requirement of the BioSoil project.

Tree diameter distribution, species composition, tree height, and canopy base

The tree diameter distribution is used to describe the structure of the forest stand. The diameter at breast height (DBH at 130 cm) and the species of all woody plants are recorded on standing and lying, living and dead, trees taller than 130 cm. DBH measurements are recorded across the entire BioSoil sampling subplots 1, 2, and 3 using different diameter thresholds in each of the three sub-plots (see below). Trees are considered to be part of the BioSoil plot if the centre of the stem is inside the sampling plot.

Method

The DBH is recorded in cm only and as follows:

- Subplot 1: DBH > 0 cm and taller than 130 cm
- Subplot 2: DBH ≥ 10 cm
- Subplot 3: DBH ≥ 50 cm

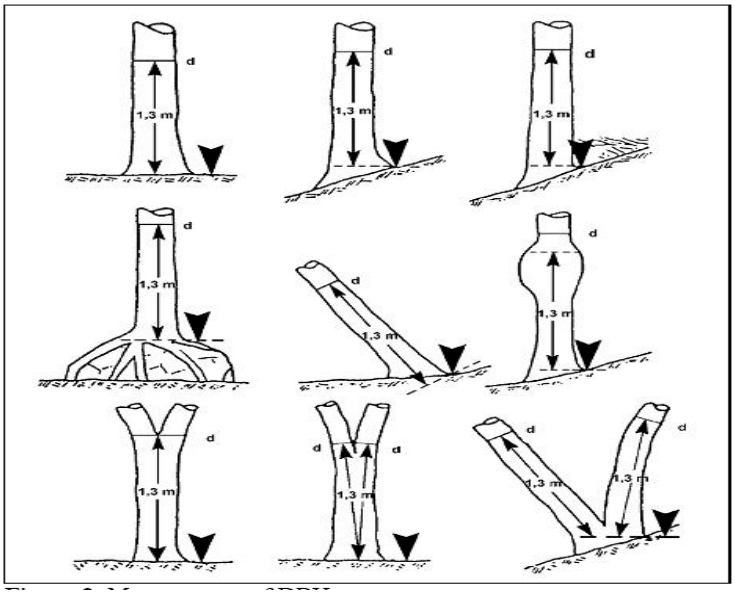


Figure 2: *Guidelines for the measurements of DBH (diameter at 130 cm) in special cases.*

1. Mandatory

- All trees (standing and lying, living and dead) are callipered (or measured by tape) at DBH (130 cm) if the height is greater than 130 cm. Note that snags are only registered in subplots 1 and 2.
- Tree species is recorded for all measured living and dead trees according to the species list.
- Tree status is also recorded: (1: standing living, 2: standing dead, 3: lying dead). For standing and lying dead trees, decay state is also recorded (see p. 14)

- Tree top height and height of base of the canopy layer are measured on a minimum of 3 trees with the largest DBH across the entire BioSoil sampling subplots 1, 2, and 3 and regardless the tree species.

2. Optional

- distance from plot centre to each tree (in meters with 1 decimal)
- azimuth from plot centre to each tree (in degrees 360^{o})

When measuring 130 cm above the ground, it is not necessary to remove litter; however, measure below any large woody debris (e.g., down logs or branches) that may be at the base of the tree, see Figure 2.

To ensure that the breast height is precisely assessed, use a pin of precisely 130 cm when callipering the trees with a height of more than 130 cm. DBH is always measured uphill, from the left side of the tree (with respect to the plot centre), perpendicular to the axis of the tree and always with the ruler of the calliper pointing towards the centre of the plot. If there is abnormal growth on the stem at breast height then the calliper is turned or moved to the closest normal place on the stem. The trees may be marked with chalk after being callipered to avoid repetition of the measurement.

Special considerations for the DBH measurements in the inner BioSoil subplot 1, where all trees higher than 130 cm are measured, may arise. Under situations with high stem numbers, because of e.g. coppices or natural regeneration, where DBH measurements become impractical in the field, a proportion of the total may be measured instead of all trees. The total number of trees in the subplot and the sampling fraction used is to be reported, to allow estimates to be made of the structure of the subplot.

Standing and lying dead trees are callipered, whether there is bark present or not. In cases where the breast height occurs on the broken part of a tree, then calliper the tree at this breast height.

Tree height and canopy base measurements

Minimum 3 dominant trees according to the largest measured DBH are selected for tree height measurements using e.g. a clinometer or a Vertex. The base of the canopy layer is also recorded on the same trees.

Forest deadwood

Forest deadwood is an important component of forest ecosystems in providing habitat, nutrients and shelter to a range of forest organisms. Forest deadwood is a recognised indicator of forest biodiversity as it helps to describe the quality and status of habitats, and the structural diversity within a forest. The forest deadwood assessment involves mandatory measuring of standing and **lying dead trees**[*], coarse woody debris (CWD), **snags**, and **stumps**.

Lying deadwood components, with diameter greater than 10 cm, are considered as coarse woody debris (CWD) and are assessed by a full sampling within the subplots 1 and 2. Coarse woody debris (CWD) includes stems, limbs, branches lying on the ground occurring in the inner subplots 1 and 2.

[*] As standing and lying dead trees are concerned, refer to the chapter "Tree diameter distribution, species composition, tree height"

The mandatory inventory of CWD does NOT include woody pieces less than 10 cm in diameter, dead shrubs, self-supported by their roots, trees showing any sign of life, dead foliage, bark or other non-woody pieces that are not an integral part of a stem or limb, roots or main stem below the root collar. When a piece of CWD has irregular diameter along its length, the section under 10 cm in diameter is not considered.

Fine woody debris is measured as an option only using the same approach as CWD but using a 5 cm threshold in this case.

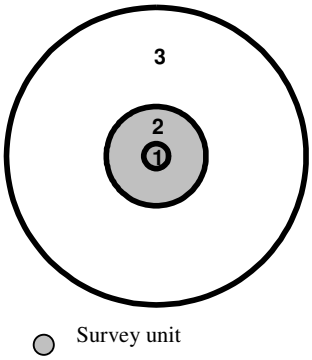


Figure 3: ***Survey units for coarse woody debris, snags, and stumps.***

Method

A **stump** is measured if the centre of the stump is inside the subplots 1 or 2, if stump height (or length if lying) is less than 130 cm from the base and if the diameter at cut is greater than 10 cm. The height (or length if lying) of the stump is measured from stump base until the point where the tree was cut (or where the stem has broken off). The stump diameter is measured at cut height.

A **snag** is defined as a standing deadwood without branches, with a height greater than 130 cm and with a DBH greater than 10 cm (DBH > 10 cm). **If branches are present,** the snag is considered as **standing dead tree** and should be measured with respect to diameter threshold in subplots 1, 2, and 3 (DBH at 130 cm, see Table 3 and refer to the chapter "Tree diameter distribution, species composition, tree height"). **If branches are absent** and if the centre of the snag is inside the subplots 1 or 2 then **snag height and diameter** at half snag height are recorded. Diameter mensuration can be done callipering the snag at 130 cm and visually adjusting the recording to the midpoint of the snag with respect to the 10 cm diameter threshold (Figure 5). **If the snag is less than 130 cm** in height it is considered and measured as a **stump.**

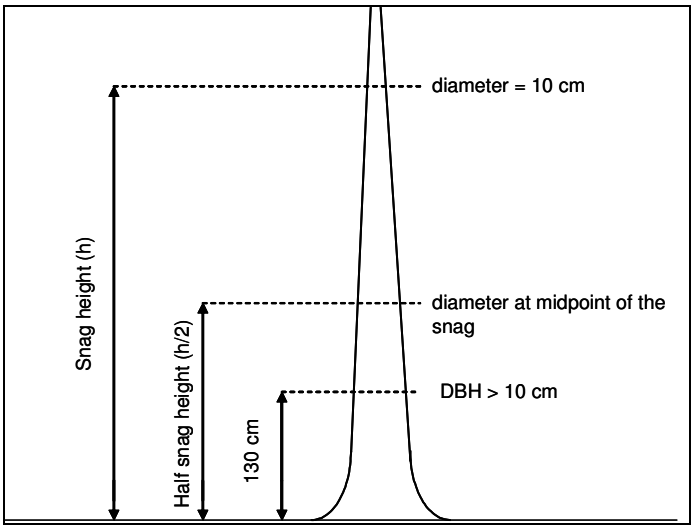


Figure 4: ***Procedure for snag diameter and snag height measurement.***

A piece of **coarse lying woody debris** is surveyed if its diameter at thicker end is greater than 10 cm and if more than 50% of its thicker end lies within the subplots 1 or 2. Diameter measurements are recorded at the mid-point of the CWD piece with diameter greater than 10 cm. The length of the lying woody debris in metres and with 1 decimal is measured from its thicker end until the point after which the size of the diameter is always under 10 cm. The diameter at half length of the piece is also recorded (Figure 5).

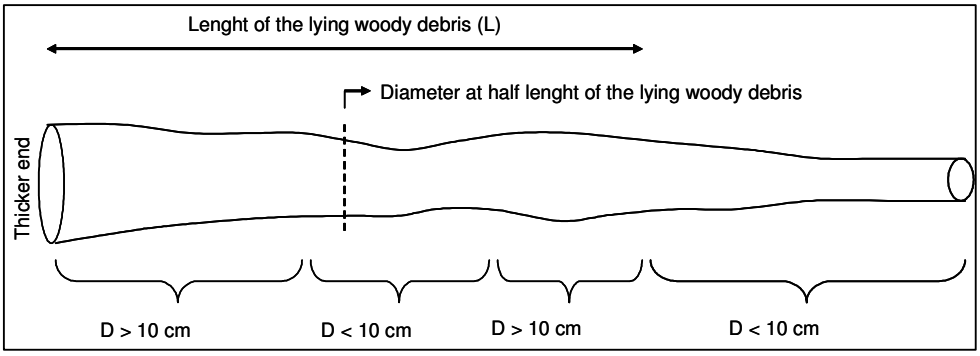


Figure 5: ***Procedure for measure length and diameter at half length of a coarse lying woody debris.***

The forest deadwood measurements include:

1. Mandatory

• Diameter (in cm) and length (in m) of coarse lying woody debris
• Species of the coarse woody debris if possible (see species list)
• Height (in m) and diameter (in cm) of stump less than 130 cm in height with a diameter at normal cut height greater than 10 cm
• Species of stump if possible (see species list)
• Estimated diameter of snag (cm) and snag height (in m)
• Species of snag if possible (see species list)
• Decay state (5 classes) of all deadwood components (see Figure 6 on page 15).

2. Optional
• Diameter (in cm) and length (in m) of fine woody debris
• Species of fine woody debris species if possible (see species list)

The diameter and length of fine woody debris is measured when the diameter of the woody material is equal to or smaller than 10 cm but greater than 5 cm.

Canopy characteristics

The canopy structure has widespread ramifications on the function of the forested ecosystem and its suitability to support other species. It plays an important role for the regeneration of trees as well as for understorey species. They can also serve as early warnings for changes in the abundance of difficult to measure species including endangered species and soil species.

The BioSoil project includes **estimates of canopy closure** and **number of tree layers**.

Canopy closure is estimated as the amount of shade that the canopies of trees create on the ground. Canopy closure is agreed to be estimated visually, but it can be estimated more precisely using a spherical densiometer to measure this amount of shade. The instrument has a round concave mirror with a grid marked on it. The grid divides the mirror into small squares.

Method

The visual estimates of **average canopy closure** are made for each of the BioSoil subplots 1 and 2. Estimates of canopy closure are expressed in 5 % classes; see reference table for codes.

The visual overall estimate of the number of **distinct tree layers** on BioSoil plot is assessed at the same location as for the ground vegetation within the two BioSoil subplots 1 and 2**;** see reference table for codes.

Compositional Biodiversity

Ground vegetation

The species diversity of the understorey vegetation represents an important component of overall forest biodiversity. The diversity and abundance of vegetation has also been linked to the diversity of specific faunal groups by many research projects. In the scope of the BioSoil project, only the vascular plant species have been chosen as a compositional indicator of biodiversity. Other components like bryophytes, lichens, and etc. while recognised as important components of forest biodiversity are not mandatory to record on this occasion. The number of tree layers occurring above the ground vegetation sample areas should also be recorded.

Following the recommendations of the EU/ICP Forest Expert Panel on Ground Vegetation, vascular plant species are assessed across the minimum sampling area of 400m^2.

Vascular plant species are assessed by a full sampling within the inner subplots 1 and 2. Species are described according to the Flora Europaeae and the species codes found in the Manual are used.

As an option, the entire ground vegetation component can be assessed using the approach outlined in the Ground Vegetation Manual (**www.icp-forests.org/pdf/manual8.pdf**).

GLOSSARY AND DEFINITIONS

Canopy base
The canopy base is the height from the ground to the bottom of the live crown of an individual tree (starting at the lowest main branches of the tree).

Coppicing
A tree cutting method based on renewal of newly cut trees by vegetative reproduction like sprouting, growth of several stems from one root system.
'Coppice with standards' includes scattered trees that are left to grow as normal ('standards')
Coppice without standards is considered to be simple coppice

Deadwood

- ***Coarse woody debris (CWD):*** Pieces of lying wood with a minimum small-end diameter D >10 cm. CWD pieces must be detached from a bole and not self supported by a root system with a lean angle of more than 45 degrees from vertical
- ***Decay class (1 – 5)***. The deadwood decomposition is assigned in 5 decay classes according to Hunter 1990 (Figure 6).

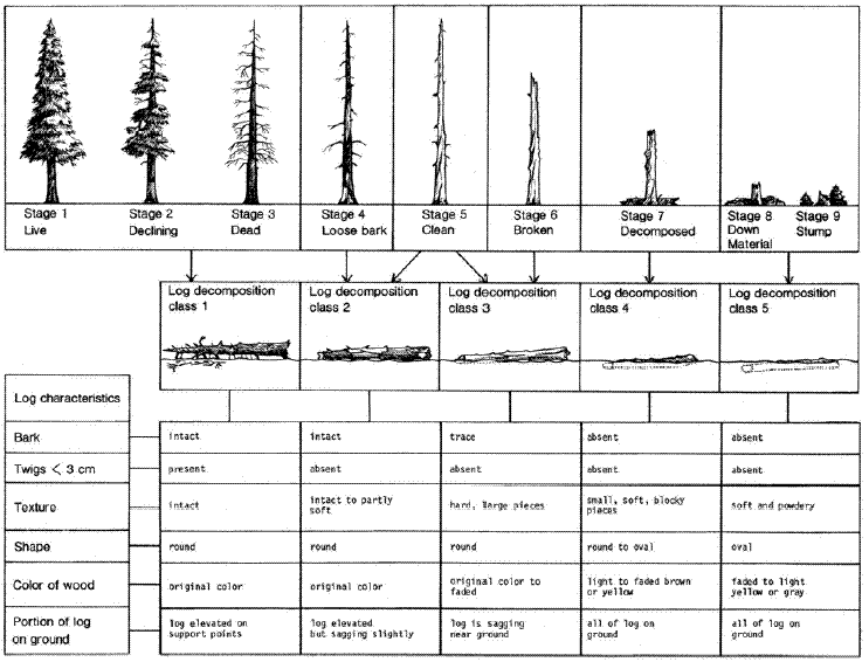


Figure 6: Decay classes

- ***Fine woody debris (FWD):*** Lying woody debris with a diameter between 5 cm < D < 10 cm
- ***Lying dead tree:*** Whole tree lying on the forest floor – the tree must be recognisable and the rooted part must be within the plot to be considered. The diameters of lying dead tree are recorded according to the diameter threshold of:
    - DBH > 0 cm and taller than 130 cm in the BioSoil Subplot 1,
    - DBH ≥ 10 cm in the BioSoil Subplot 2,
    - DBH ≥ 50 cm in the BioSoil Subplot 3.

- ***Snag:*** A snag is defined as standing dead wood **without branches with height greater than 130 cm**, otherwise it may be considered as a standing dead tree if it has branches and is taller than 130 cm or as a stump if the height is less than 130 cm. If branches are present treat as standing dead tree and record the DBH at 130cm height.
- ***Standing dead tree:*** All standing dead trees with a height taller than 130 cm.
- ***Stump:*** Standing dead tree with a height less than 130 cm also including stumps.

Intervention
The term describes the silvicultural activities in the stand, mainly the management operations, clear cutting and regeneration.

Intimacy
The mixture of different tree species in the plot can be described as *intimate* and *non-intimate*:
Intimate relates to a mixture of different tree species throughout the stand
Non-intimate, relates to a mixture of different tree species in small groups or clusters.

High forest
Type of forest where the trees are mainly grown from generative formation/multiplication (by seeds)

- ***Even-aged stand:*** A stand or forest type, in which no or relatively small age differences exist among individual trees within it, usually less than 20% of rotation length (IUFRO, 2000).
- ***Uneven-aged stand:*** **C**onsisting of trees of a range of age classes, with age differences which are significant in relation to the stand structure management and rotation length (IUFRO, 2000).
- ***Femelschlag:*** **P**rogressive cutting. This is a type of regeneration in high forests in which parcels of different sizes or groups of trees are regenerated by combining different cuttings (progressive, shelter, lisiere) échelonnées in time and space and in a given order.
- ***Plenterwald*****:** Forest with a layered structure, without a dominant development stage or a high forest with one to several layers with a structure by groups of trees. Trees of all diameter classes are growing together and where the same type of intervention is always applied,
- ***High forest homogeneous*****:** High forest of homogeneous stands with delimitated area, with a uniform structure (with 1-several tree layers), in which the trees of the main stand have diameter at breast height of same size and are thus assimilated to the same stage of development.
- ***Young to medium forest*****:** Class of forest defined by the mean or dominating size (diameter or height). Depending on the dominating diameter and the inventory different development stages can be distinguished increasing from young growth of dense vegetation with regeneration between 0,5 and 3 metres height, to rigid stems of a diameter less than 20 cm, to young forest defined as a group of trees, not coppices, grown in a way that some of them have reach or will reach the forest stage and having a diameter between 20 and 40 cm, middle forest (diameter of 40 to 50 cm) and old forest with a mean diameter of more than 50 cm.

Regeneration
Re-establishment of a forest stand by natural or artificial means following the removal of the previous stand by felling or as a result of natural causes, e.g. fire or storm (TBFRA 2000).

- ***Natural regeneration:*** Re-establishment of a forest stand by natural means, i.e. by natural seeding or vegetative regeneration. It may be assisted by human intervention, e.g. by

scarification or fencing to protect against wildlife damage or domestic animal grazing (TBFRA 2000).

- ***Regeneration by planting and seeding:*** The act of establishing a forest stand (e.g. plantation) or re-establishing a forest stand by artificial means, either by planting of seedlings or by scattering seed. The material used may be of indigenous or introduced origin. Planting and seeding may take place on forest, other wooded land or other land (TBFRA 2000).

Stand

A community of trees possessing sufficient uniformity in composition, age, arrangement or condition to be distinguishable from the forest or other growth on adjoining areas, thus forming a temporary silvicultural or management entity (IUFRO, 2000).

UTM coordinates

A position on the Earth is referenced in the UTM system by the UTM longitude zone, the projected distance of the position from the central meridian -- called the Easting -- and the projected distance of the point from the equator -- called the Northing.

The point of origin of each UTM zone is the intersection of the equator and the zone's central meridian. In order to avoid dealing with negative numbers, the central meridian of each zone is given a "false Easting" value of 500,000 meters. Thus, anything west of the central meridian will have an Easting less than 500,000 meters. For example, UTM Easting range from 167,000 meters to 833,000 meters at the equator (these ranges narrow towards the poles). In the northern hemisphere, positions are measured northward from the equator, which has an initial "Northing" value of 0 meters and a maximum "Northing" value of approximately 9,328,000 meters at the 84th parallel -- the maximum northern extent of the UTM zones.

DATA FILE STRUCTURE, FORM AND SUBMISSION PROCEDURE

Data preparation

Naming of the BioSoil biodiversity files
The files are named by survey, and follow the same rules as the Forest Focus surveys: CCYYYY.*ext*. The country code can be expressed in letters: e.g France FR or in numbers e.g for France 01, but according to the agreed codes.

File name includes information on country (CC) and year (YYYY) and on the survey (*EXT): CCYYYY.EXT*

File type	Extension
General plot description	GPL
Structural Biodiversity 1: DBH and species table	DBH
Structural Biodiversity 2: tree height and canopy base	THT
Structural Biodiversity 3: coarse woody debris, snags and stumps	DWD
Structural Biodiversity 4: stand and canopy characteristics	CAN
Ground Vegetation Assessment	GVG

File Structure
It was agreed to structure the data to be submitted according to common CSV file format standards. Each line, including the last, will be terminated by a Carriage Return [CR] and the data elements are delimited by commas in both BioSoil projects. A CSV file is an ASCII file consisting of multiple rows/lines of data. It may contain both text and numeric data, but no extra formatting information (e.g. bold text).

File Content
The data are to be submitted in a total of 6 individual files (contents given in detail in the next section). These comprise:

- General BioSoil plot description (.GPL). This contains general information about the name and location of the plot.
- Structural Biodiversity 1 (.DBH). Contains DBH, species and (optionally) locations of all the trees within sampling areas 1, 2 and 3.
- Structural Biodiversity 2 (.THT). Contains the tree heights for the selected largest DBH trees within subplots 1 and 2.
- Structural Biodiversity 3 (.DWD). Contains details of deadwood dimensions and status within subplots 1 and 2.
- Structural Biodiversity 4 (.CAN). Contains details of the state of canopy closure. Also the total number of trees within the sampling area and the percentage assessed for DBH (in those cases where a sample had to be assessed). Also within subplots 1 and 2.
- Ground Vegetation (GVG). Contains assessments of the ground vegetation species and cover within subplots 1 and 2.

The first row of each of the 6 files is the header record. Subsequent rows contain all information for each instance of a measurement. The minimum possible file size is a single row (i.e. a header row, with zero data rows: null return of data).

The header row is used to confirm the parameters represented within the CSV file, and the order in which they are provided. The header row must be constructed as a list of all the field names of the items contained in the file followed by a comma. The correct field names are specified in the reference tables and should be submitted in the order given in the tables. The data rows must follow the order given in the header and a comma must follow each field. A comma must follow null or empty fields.

Data are arranged in a consistent form with one observation per line and with individual values separated by commas. Except where information is actually missing, each line or observation should have all the values filled in.

NOTE: Where data items consisting of text include the comma delimiter character as part of the data, that data item must be included between "double quote" characters (typically ". Note that this is not the same as two single quotes ″).

Example for the general plot file:

Line 1: SEQ, C_COUNTRY, PLOTID, DATE, C_GPSPLOT, DATUM, PROJECT, UTMZONE, C_ACCURACY, EASTSOIL, NORTHSOIL, EASTPLOT, NORTHPLOT, GPSELEV, C_ORIENT, AVSLOPE, C_PREVUSE, C_ORIGIN, C_MANAGE, C_FORTYPE, C_DWREMOV, C_TREEMIX, C_AGE, C_FENCE, C_EFTC, OTHER_OBS **[CR]**

Line 2-n: 1, 8, 1024, 01012007, Y, "ETRS89", "LAEA", 32, 2, 502536, 6163651, 502504, 6163612, 25.3, 4, 7, 3, 1, 3, 5, 4, 3, 2, 2, 7, "nothing to add" **[CR]**

Example for Structural Biodiversity 1 (DBH, and tree species composition):

Line 1: SEQ, C_COUNTRY, PLOTID, SUBPLOT, DATE, TREENO, DBH, C_TSTATUS, DISTANCE, AZIMUTH, C_TSPECIES, C_DECAY, OTHER_OBS **[CR]**

Line 2-n: 1, 8, 1024, 3, 01082007, 54, 23, 1, 2.6, 120, 051, , "nothing to add" **[CR]**

NOTES

- In the second example there is a null value (two consecutive commas) for DECAY (the tree is still alive and no decay code applies).
- Note leading zeros for the DATE values (These can be achieved in Excel by designating the cell as text format).
- It is not necessary to leave spaces between the data items (spaces in the examples above are for reasons of legibility only).
- Some of the assessments are codes rather than measured values (e.g. C_ORIGIN, C_MANAGE). In these cases only certain values are valid entries (e.g. 1-5 for C_ORIGIN). All coded variables in the study begin with the letter C_ and for each one there is an accompanying reference table giving the possible valid values. No other values may be used for these parameters.
- There must not be a Carriage Return **[CR]** character anywhere within a data record, except at the end. **[CR]** always signifies a new record.
- Missing data should be always represented by [NULL]. Do not use any other character (e.g. zero) to represent missing data. Reasons for why the value is missing may be given in the OTHER_OBS field or in the Data Accompanying Report (DAR).

Data accompanying report

Extra information about the plot layout, procedures followed, difficulties encountered and general background information will be supplied in the form of a Data Accompanying report (DAR). This will be in free format (e.g. Word document) and should be named CCYYYYDAR.DOC.

Data validation/submission

The data will be submitted by the NFCs by email to the Joint Research Centre to *tracy.houston@jrc.it* and the deadline for submission will be on June 15th, 2008.

The data will then go through verification procedures similar to those performed on the Forest Focus data:

1. Checks for compliance: whether the data comply with the formats of the data submission forms and whether the values are admissible in the case of categorical data.
2. Checks for conformity: whether the values of the variables are within a range expected for the particular variable (single plot, single parameter)
3. Checks for uniformity: checks whether plot values stand out compared with those around them.

After the checks have been made, a report will be sent to the NFC contact point detailing any irregularities or errors found. The NFC will be invited to confirm the validity of unusual values, and, if necessary, correct erroneous data. Corrected data should be resubmitted in full.

After verification of the validated data by the NFCs, the data will made available according to the same rules as for the Forest Focus data.

DATA CODES AND FIELD FORMS

General BioSoil plot description CCYYYY.GPL

NAME	Description	Code	Format	Reference table
SEQ	Sequence number of plots (1 to 9999)		9999	
C_COUNTRY	Country code (France=01, Belgium=02, etc.)	1-95, 401-416	999	REF_COUNTRY
PLOTID	Observation plot number of the BioSoil plot (max. 99999)	Number	99999	
DATE	Date of the assessment /measurements	Date	DDMMYYYY	
C_GPSPLOT	Georeferencing the BIOSOIL plot centre	N: No, Y: Yes	X	
DATUM	Geodesic system WGS84, ETRS89	Text	Text	
PROJECT	Projection	Text	Text	
UTMZONE	UTM longitude and latitude zone, e.g. 32V, Europe includes 27V to 38S	Text	Text	
EASTSOIL	**Easting** of the BioSoil soil pit	Metres	999999	
NORTHSOIL	**Northing** of the BioSoil soil pit	Metres	9999999	
EASTPLOT	**Easting** of the BioSoil plot centre	Metres	999999	
NORTHPLOT	**Northing** of the BioSoil plot centre	Metres	9999999	
C_ACCURACY	Accuracy of GPS location estimate	1-3		REF_ACCURACY
GPSELEV	Elevation reading from the GPS of the plot centre in metres	Metres	9999.9	
C_ORIENT	Prevalent orientation of the BioSoil plot	1-9	9	REF_ORIENT
AVSLOPE	Prevalent slope of the BIOSOIL plot in percent	%	999	
C_PREVUSE	Previous land-use	1-5	9	REF_PREVUSE
C_ORIGIN	Origin of the actual stand	1-5	9	REF_ORIGIN
C_MANAGE	Forest management such as thinning and selective felling	1-4	9	REF_MANAGE
C_FORTYPE	Forest Type	1-8	9	REF_FORTYPE
C_DWREMOV	Removal of coarse woody debris	1-7	9	REF_DWREMOV
C_TREEMIX	Pattern of tree mixture See also glossary for explanations	1-3	9	REF_TREEMIX
C_AGE	Mean age of the dominant storey (in 20 year classes from 1-8 and unknown (=9))	1-9	9	REF_AGE
C_FENCE	Fencing	1-3	9	REF_FENCE
C_EFTC	European Forest Type Classification	1-14	99	REF_EFTC
OTHER_OBS	Remarks	Text	Text	

DBH, species composition CCYYYY.DBH

NAME	Description	Code	Format	Reference table
SEQ	Sequence number of plots (1 to 9999)		9999	
C_COUNTRY	Country code (France=01, Belgium=02, etc.)	1-95, 401-416	99	REF_COUNTRY
PLOTID	Observation plot number of the BioSoil plot (max. 9999)	Number	99999	
SUBPLOT	BioSoil subplot	1,2,3	9	
DATE	Date of survey	Date	DDMMYYYY	
TREENO	Tree number	Number	9999	
DBH	DBH (at 130cm) in cm	cm	999	
C_TSTATUS	Status of trees: Standing and lying, living and dead trees: if branches are still present then standing dead tree; if without branches then snag (go to table with CWD, snags and stumps).	1-3	9	REF_TSTATUS
DISTANCE	If tree position is measured: Distance between the BioSoil plot centre and the tree (in metres)	metres	9999.9	
AZIMUTH	If tree position is measured: Azimuth (Compass direction) from the centre of the BioSoil plot to the tree (360 deg: North=0)	Degrees (0-359)	999	
C_TSPECIES	Tree species		999	REF_TSPECIES
C_DECAY	Only for standing and lying dead trees	1-5	9	REF_DECAY
OTHER_OBS	Remarks	Text	Text	

Tree height and canopy base CCYYYY.THT

NAME	Description	Code	Format	Reference table
SEQ	Sequence number of plots (1 to 9999)		9999	
C_COUNTRY	Country code (France=01, Belgium=02, etc.)	1-95, 401-416	99	REF_COUNTRY
PLOTID	BioSoil plot number		9999	
SUBPLOT	BioSoil subplot (1, 2, 3)	1-3	9	
DATE	Date of survey	Date	DDMMYYYY	
TREENO	Number of the tree where tree height is measured		999	
C_TSPECIES	Tree species *		999	REF_TSPECIES
DBH	DBH (at 130cm) in cm*	cm	999	
TREHEIGHT	Height of the tree (in metres)	metres	99.9	
BASECAN	Height of the base of the canopy layer (in metres)	metres	99.9	
OTHER_OBS	Remarks	Text	Text	

** [NB. These are a repetition of the measurements reported in the DBH file; included here for validation purposes]*

Coarse woody debris, snags and stumps CCYYYY.DWD

Countries who wish to carry out more detailed assessments should include full callipering of all the deadwood components listed above plus if desired lying fine woody debris and accumulations according to the standard protocol outlined in the ForestBiota manual (www.forestbiota.org).

NAME	Description	Code	Format	Reference table
SEQ	Sequence number of plots (1 to 9999)		9999	
C_COUNTRY	Country code (France=01, Belgium=02, etc.)	1-96	99	REF_COUNTRY
PLOTID	BioSoil plot number		9999	
SUBPLOT	BioSoil subplot (1, 2). In case of use of the random selected units use (3, 4, 5, and 6 for unit a,b,c and d, respectively).	1-2 or 3-6	9	
DATE	Date of survey	Date	DDMMYYYY	
C_DWTYPE	Type of the coarse woody debris, snag or stump.	1-5	9	REF_DWTYPE
C_DWSPE	Species of the deadwood	1-3	9	REF_DWSPE
DWDIA	Median diameter for deadwood in cm (above D ≥ 10 cm)		99.9	
DWLEN	Length or height of the deadwood in m (above D ≥ 10 cm)		99.9	
C_DECAY	Decay class of the deadwood The degree of decay is assessed visually and by banking on the wood	1-5	9	REF_DECAY
OTHER_OBS	Remarks	Text	Text	

Stand and canopy characteristics CCYYYY.CAN

NAME	Description	Code	Format	Reference table
SEQ	Sequence number of plots (1 to 9999)		9999	
C_COUNTRY	Country code (France=01, Belgium=02, etc.)	1-96	99	REF_COUNTRY
PLOTID	BioSoil plot number		9999	
SUBPLOT	BioSoil subplot (1,2). In case of use of the random selected units use (3, 4, 5, and 6 for unit a ,b , c, and d, respectively).	1-2 or 3-6	9	
DATE	Date of survey	Date	DDMMYYYY	
C_CANCLO	Canopy closure score (Open is 0% and full closure is 100%)	1-5	99	REF_CANCLO
C_TREELAY	Number of tree layers	1-5	9	REF_TREELAY
NO_OF_TREES	Total number of trees within the subplot that are measured for DBH (ie all trees >130cm for subplot 1; all trees with a DBH>10 for subplot 2)		9999	
SAMP_PERC	Percentage of trees assessed for DBH (normally 100% unless total number of trees make this impractical)		999	
OTHER_OBS	Remarks	Text	Text	

Ground Vegetation Assessment CCYYYY.GVG

NAME	Description	Code	Format	Reference table
SEQ	Sequence number of plots (1 to 9999)		9999	
C_COUNTRY	Country code (France=01, Belgium=02, etc.)	1-96	99	REF_COUNTRY
PLOTID	BioSoil plot number		9999	
SUBPLOT	BioSoil subplot (1, 2). In case of use of the random selected units use (3, 4, 5, and 6 for unit a ,b , c, and d, respectively).	1-2 or 3-6	9	
DATE	Date of survey	Date	DDMMYYYY	
GVSPEC	Species code from the Flora Europeae		xxx.xxx.xxx	
C_LAYER	Surface layer	1-6	9	REF_LAYER
COVER	Percent cover	0-100%	999.99	
OTHER_OBS	Remarks	Text	Text	

REFERENCE TABLES

REF_ACCURACY

Code	Description
1	Less than 1 metre
2	1-10 metres
3	10-50 metres

REF_AGE

Code	Description
1	0-20 years
2	21-40 years
3	41-60 years
4	61-80 years
5	81-100 years
6	101- 120 years
7	>120 years *(corresponds to the yearly measured mean age of the crown condition survey)*
8	Irregular stands
9	Unknown

REF_CANCLO

Code	Description
1	Open sky
2	1-25%
3	25-50%
4	50-75%
5	>75%

REF_COUNTRY

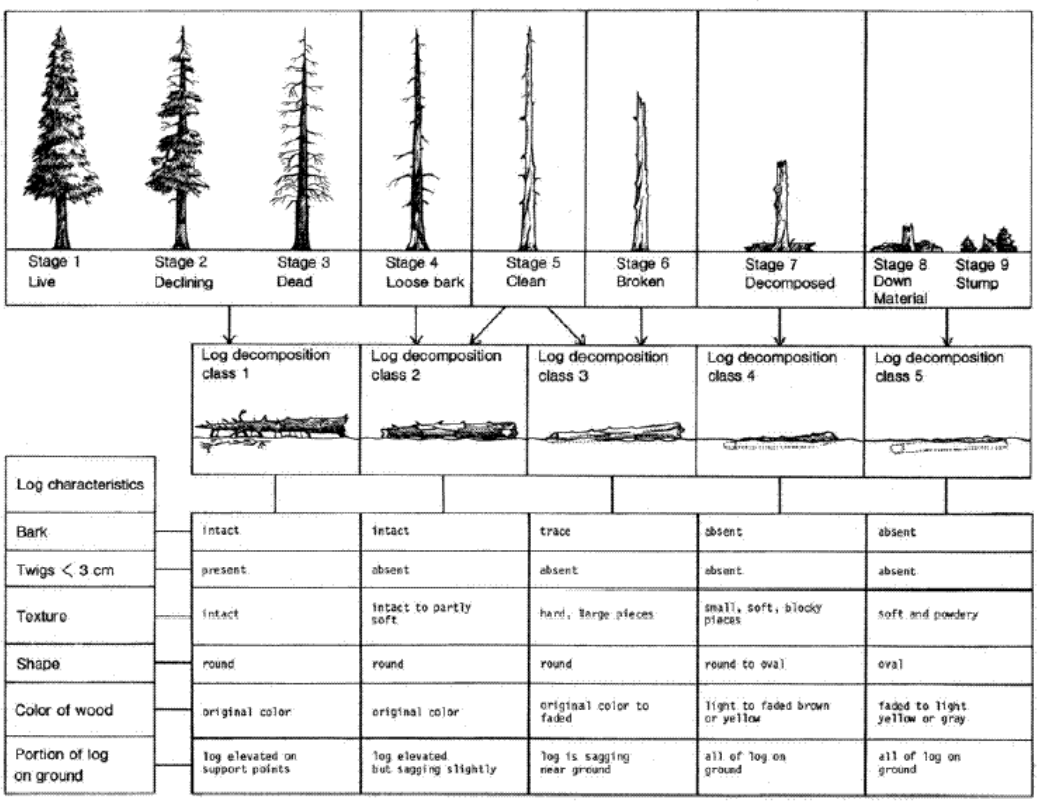
Code	Description
1	France
2	Belgium (all)
201	BE (Flanders)
3	Netherlands
4	Germany (all)
401	Baden-Württemberg
402	Bayern
404	Brandenburg-Berlin
407	Hessen
408	Mecklenburg-Vorpommern
409	Niedersachsen
410	Nordrhein-Westfalen
411	Rheinland Pfalz
412	Saarland
413	Sachsen
414	Sachsen Anhalt

Code	Description
415	Schleswig-Holstein
416	Thüringen
5	Italy
6	United Kingdom
7	Ireland
8	Denmark
9	Greece
10	Portugal (all)
101	PT (mainland)
102	PT (Azores)
11	Spain
12	Luxembourg
13	Sweden
14	Austria
15	Finland
50	Switzerland

Code	Description
51	Hungary
52	Romania
53	Poland
54	Slovak Republic
55	Norway
56	Lithuania
57	Croatia
58	Czech Republic
59	Estonia
60	Slovenia
61	Moldavia
62	Russia
63	Bulgaria
64	Latvia
65	Belarus
66	Cyprus

REF_DECAY

Code	Description
1	No evidence of decay
2	Solid wood. Less than 10 % changed structure due to decomposition; the wood is solid at its surface. The wood is attacked only to a very small degree by wood decomposing organisms
3	Slightly decayed. 10-25% of the wood has a changed structure due to decomposition. This can be assessed by sticking the wood with a sharp object
4	Decomposed wood 26-75% of the wood is soft to very soft
5	Very decomposed wood. 76% - 100 % of the wood is soft



REF_DWREMOV

Code	Description
1	Yes, all stems and main branches have been removed
2	Yes, stems and main branches have been removed
3	No, stems and main branches are lying in the forest
4	partly, some stems and main branches have been removed, others still present
5	Unknown
6	Introduced
7	Presence of accumulation (branches have been stacked in piles or in rows)

REF_DWSPE

Code	Description
1	Deciduous
2	Conifer
3	Unknown

REF_DWTYPE

Code	Description
1	Coarse woody debris (D>10 cm) *Coarse woody debris includes stems, limbs, branches lying on the ground with a diameter of 10 cm*
2	Fine woody debris (5 cm <D<10 cm) *Fine woody debris includes wood pieces with a diameter between 5.0 and 10.0 cm*
3	Snag *Standing deadwood without branches, with a height > 130 cm and with a DBH > 10 cm.*
4	Stump (snag H<130 cm) *Stump is a snag with a height of less than 130 cm*
5	Other

REF_EFTC

Code	Description
1	Boreal forest
2	Hemiboreal and nemoral Scots pine forest
3	Alpine coniferous forest
4	Atlantic and nemoral oakwoods, Atlantic ashwoods and dune forest
5	Oak-hornbeam forest
6	Beech forest
7	Montaneous beech forest
8	Thermophilous deciduos forest
9	Broadleaved evergreen forest
10	Coniferous forests of the Mediterranean, Anatolian and Macaronesian regions
11	Swamp forest
12	Floodplain forest
13	Native plantations
14	Exotic plantations and woodlands

REF_FENCE

Code	Description
1	Fenced
2	Not Fenced
3	Fenced in parts

REF_FORTYPE

Code	Description
1	High forest (even-aged) – Femelschlag
2	High forest (even aged) – Small groups
3	High forest (uneven aged) – Plenterwald
4	High forest (other)
5	Young/Medium forest (under development to high forest)
6	Coppice without standards
7	Coppice with standards
8	Other

REF_GPSPLOT

Code	Description
Y	Yes, georeferencing the BioSoil plot centre
N	No, no georeferencing of the BioSoil plot centre

REF_LAYER

Code	Description
1	Tree layer
2	Shrub layer
3	Herb layer
4	Moss layer
5	Lower Shrubs (FR)
6	Upper Shrubs (FR)

REF_MANAGE

Code	Description
1	Unmanaged (no evidence)
2	~~Abandoned~~ Management (evidence but for more than 10 years ago)
3	Managed (within the last 10 years)
4	Unknown

REF_ORIENT

Code	Description
1	N
2	NE
3	E
4	SE
5	S
6	SW
7	W
8	NW
9	Flat

REF_ORIGIN

Code	Description
1	Planted
2	Seeded
3	Natural regeneration
4	Mixed
5	Unknown

REF_PREVUSE

Code	Description
1	Forested more than 300 years
2	Forested more than 100 years
3	Forested for 25 – 100 years ago
4	Forested in the past 25 years
5	No information

REF_TREELAY

Code	Description
1	1 layer (one dominant tree layer)
2	2 layers (dominant tree layer plus 1 sublayer)
3	3 layers (dominant plus 2 sublayers)
4	More than 3 layers
5	0 layer, no tree layer

REF_TREEMIX

Code	Description
1	Intimate (different tree species are mixed throughout the stand)
2	Non-intimate (different trees occur in clusters)
3	No mixture

REF_TSTATUS

Code	Description
1	Standing living tree
2	Standing dead tree
3	Lying dead tree

REF_TSPECIES

Code	Description
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
099	Other broadleaves
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
141	Cedrus brevifolia
199	Other conifers

Field Data Forms

Form A: General Biosoil Plot Description

BioSoil PLOT Number: _____
Date: __/__/20__ Team:_____

NAME	INFORMATION	COMMENTS
PLOTID		
C_GPSPLOT		
DATUM		
PROJECT		
UTMZONE		
EASTSOIL		
NORTHSOIL		
EASTPLOT		
NORTHPLOT		
C_ACCURACY		
GPSELEV		
C_ORIENT		
AVSLOPE		
C_PREVUSE		
C_ORIGIN		
C_MANAGE		
C_FORTYPE		
C_DWREMOV		
C_TREEMIX		
C_AGE		
C_FENCE		
C_EFTC		

Form B: DBH and Species Composition

BioSoil PLOT Number: _________

Date: __/__/20__ Team:_____________________

PLOT ID	SUB PLOT	TREE NO	DBH	C_TSTATUS	DISTANCE	AZIMUTH	C_TSPECIES	C_DECAY	OTHER OBS

Form C: Tree Height and Height of Canopy Base

PLOT Number: _____
Date: __/__/20__ Team:_____

PLOTID	SUB PLOT	TREENO	C_ TSPECIES	DBH	TREHEIGHT	BASECAN	OTHER OBS

Form D: Woody Debris, Snags and Stumps

BioSoil PLOT Number: _________
Date: __/__/20__ Team:_____________________

PLOTID	SUBPLOT	C_ DWTYPE	C_ DWSPE	DWDIA	DWLEN	C_ DECAY	OTHER OBS

Form E: Stand and Canopy Characteristics

PLOT Number: _____
Date: __/__/20__ Team:_____

PLOTID	SUBPLOT	C_ CANCLO	C_ TREELAY	NO_OF_TREES	SAMP_PERC	OTHER_OBS

Form F: Ground Vegetation

PLOT Number: _____
Date: __/__/20__ Team:_____

GROUND VEGETATION

PLOTID	SUBPLOT	GVSPEC	C_LAYER	COVER	OTHER_OBS

APPENDIX 1

PROCEDURE FOR ESTABLISHMENT OF ALTERNATIVE (OPTIONAL) DESIGN OF 4 RANDOM SAMPLING UNITS

Optional design for coarse woody debris, snags, stumps, ground vegetation, and canopy characteristics only

Optionally for the specific surveys of ground vegetation and coarse woody debris within the BioSoil biodiversity plot, 4 **randomly selected** squares of 10 m x 10 m (so called random sampling units a, b, c and d) may be established within the 2000 m^2 plot while respecting the overall BioSoil subplot layout 1, 2 and 3 for the other surveys e.g. DBH.

The random selection is carried out by first generating a random azimuth and random distance from the centre of the BioSoil plot to establish a corner of the random sampling unit a. From this first sampling unit the other three sampling units b, c and d may be established by using the same azimuth and distance as for plot ,a, but rotated through 90^o on each occasion. This ensures that the sampling units are not overlapping, see Figure 2.

The random sampling units a, b, c and d are used *optionally* instead of the recommended BioSoil subplots 1 and 2, where countries desire to do so. It is not mandatory to establish the random sampling Units a, b, c and d in the BioSoil plot and when established they may be used for ground vegetation, coarse woody debris, snags, stumps and canopy assessments only.

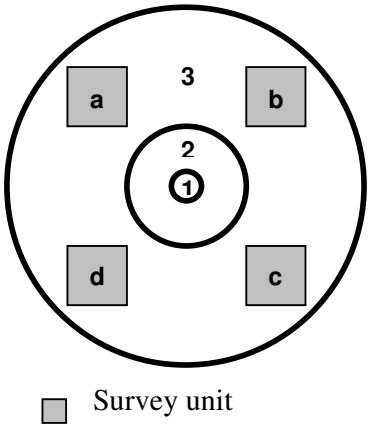


Figure 7: *4 times 10 m x 10 m random sampling units may be installed for the specific surveys of ground vegetation, coarse woody debris (D >10 cm), snags, stumps, and canopy characteristics instead of using the recommended subplots 1 and 2 . Note that the combined sampling area of sampling units a, b, c, and d must be equivalent to subplots 1 and 2 (400m^2).*

Table 4: ***Overview of measurements and assessments to perform if the optional alternative design, the randomly selected sampling units a, b, c, and d. Forest deadwood (incl. coarse woody debris, snags, and stumps), ground vegetation (vascular plant species list only, and canopy characteristics may be assessed in the randomly selected sample units a, b, c and . Each has the size of 10 m x 10 m each; the total sampling area is 400 m2.***

	Randomly selected sampling units a b c d
General plot description	-
Check of the European forest type classification	-
DBH and species of all woody plants taller than 130 cm (standing and lying, living and dead)	-
Top height and bottom of canopy layer	-
Coarse woody debris, stumps and snags	D > **10 cm**
Canopy closure (visual)	Yes
Tree layering (visual)	Yes
Ground vegetation – vascular species list only	Yes

APPENDIX 2

ASSESSMENT OF SOIL FAUNA STATUS

Paulo Sousa, University of Cuimbra, Portugal

This assessment is not a part of the current BioSoil Biodiversity project

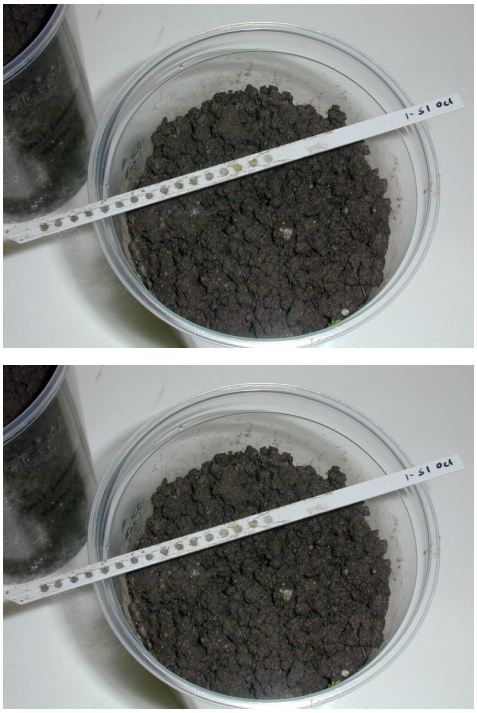
Assessment of soil fauna status

In this section two protocols are presented both aiming to assess the status of soil mesofauna in the BioSoil sampling sites.

Soil microarthropods are known to be sensitive to changes in land management and are known to be good indicators of below ground biodiversity. The two approaches presented here, although they cannot be seen as biodiversity indicators, *sensu stricto*, they are known as assessment tools for a rapid evaluation of the ecological status of the soil using microarthropods. Each one of them can be adopted as an optional parameter in the BioSoil Biodiversity component. The choice amongst the two might depend on the resources available and/or possible collaborations established with research institutions at each country.

Approach 1 – Bait lamina

The first approach – the ***Bait Lamina*** – is based on measuring, *in situ*, the activity of soil mesofauna. Perforated strips, filled with a bait mixture, are inserted into the soil. After a period of 7-14 days, they are removed and the pierced holes (caused by microarthropods eating the bait) are counted (Fig. 1).



Changes in soil quality, caused by, e.g., management, pollution, and inducing changes in soil mesofauna can be depicted by analysing the data.

This method allows a comparison between sites, not only regarding total activity, but also changes along the soil profile. It was developed in Germany, but it is now widely used as a cost-effective and fast screening tool for extensive monitoring of forest soil quality in several countries (e.g., UK).
Advantages – Visual evaluation of the pierced holes. No expertise nor equipment needed
Disadvantages – Necessary two visits to the plot and cost of baits (estimated in 34,40€ per plot, considering 16 baits per plot).

To buy the Bait-lamina strips and to check references for the method, please contact Terra Protecta GmbH, Berlin, Germany (www.terra-protecta.de).

Bait-lamina Protocol

I. Material and Equipment:

1. Bait-lamina: Plastic strips (120 mm x 6 mm x 1 mm) with a sharpened tip at the lower end. In the lower part (85 mm) of each lamina 16 holes of 1.5 mm diameter are drilled, which are 5 mm apart from each other. (Ready-made bait-lamina are provided by TERRA PROTECTA, Berlin).

2. Bait material: Mixture consisting of powder of cellulose and bran (70 : 30 %), together with a small amount of activated carbon. Alternatively, various natural materials (e.g. powdered beach leaves) are also possible. The material is applied as a paste and allowed to dry. NOTE: this is only needed if buying non-filled strips

3. Sharpened knife.

II. Performance:

Filling the plastic strips (NOTE: this is only needed if buying non-filled strips)
The lamina can be filled or re-filled by performing the following steps:

1. It must be checked whether all holes are empty. This could be done either by mechanical washing or by biological cleaning (e.g. by keeping the lamina in a compost heap for a few days).

2. The empty lamina (approx. 50) are spread out on a flat surface. They should be fixed together by two stripes of adhesive tape to form one block.

3. The bait material is moistened with water in order to get a paste.

4. This paste is plastered using a spatula on top of the lamina in a way that only the holes are filled. Afterwards, the lamina are left to dry for approx. 10 minutes.

5. The block of taped lamina is turned around and step 3 and 4 are repeated.

6. After drying, the individual lamina are separated and ready for use.

Mode of use in the field
Bait-lamina strips are inserted into small slits burrowed into the soil with a knife.

A minimum of sixteen bait-lamina should be used in each site (four rows of baits each – see Fig. above). Ideally more than one of these groups should be used, but since our true

replicates are the plots one group might be enough. Samples can be done within the 400m2 plot.

The exposure period depends on the climatic conditions (especially the soil moisture): usually 7 – 14 days (up to 20 days possible).

Measurements and Records
At the end of the exposure period, Bait-lamina are retrieved from their burrow and visually assessed (strips held against light):

- Visual distinction of "fed" (perforated) versus "not-fed" holes.
- Feeding rate is measured as absolute number of "fed" holes.

The results are expressed as percentage of "fed" holes versus the absolute number of holes. Additionally, the vertical distribution of the feeding activity is shown graphically.

Comments
In order to assess the results of the Bait-lamina test small soil samples (approx. 25 g) should be taken as close as possible to the exposure area of the Bait-lamina to measure soil humidity.

Approach 2 – The QBS index

The second approach – the ***QBS index*** – is a simple eco-morphological index, allowing the assessment of the biological quality of the soil based on the types of soil microarthropods collected in soil samples. Proposed by Parisi (2001), does not have the limitation of needing an expert to identify the animals till species level. It is based on the identification of the collected animals into different morpho-types, with each type receiving an eco-morphological index (from 1 to 20). Higher index values are attributed to those types showing truly euedaphic characteristics. Afterwards, index values for each type are summed up, obtaining a total score per site.
This QBS index presented nice correlations with land use intensity, pollution impact and different farming practices, being already used as a monitoring tool in soil monitoring programmes.
Advantages – Only one visit to the site needed. No deep taxonomic expertise needed.
Disadvantages – Some extraction equipment needed.

QBS Protocol

I. Material and Equipment:

1. Soil core extractor (not mandatory)
2. Fauna extraction apparatus (Berlese-Tulgren funnels or MacFadyen extractor)
3. Stereo-microscope
4. Plastic and other normal labware

II. Performance:

Sample collection in the field and extraction of the soil fauna

A soil core of 100cm2 (square of 10X10cm) and 10cm deep is taken from each plot. The litter layer of that area (if present) is collected separately. Samples are placed in plastic bags (preferably cooled) and transported to the laboratory.
Ideally more than one soil core should be collected from each plot, but since our true replicates are the plots one might be enough. Sample cores can be taken within the 400m2 plot.
In order to assess the results of the QBS index small soil samples (approx. 25 g) should be taken as close as possible to the sampled area of the Bait-lamina to measure soil humidity.
In the laboratory, soil and litter samples are placed in Berlese-Tulgreen funnels (or other faunal extraction apparatus) and left for 5-7 days. For more information on extraction procedures you can consult any soil ecology book.

Measurements and Records

Extracted animals are separated into different morpho-types. Each type has a score attributed according to the following tables (adapted from Parisi et al., 2005):

Table 1 - Eco-morphological scores for mesofauna groups (based on Parisi et al., 2005)

Group	Score	Group	Score
Acari	20	Hymenoptera (in general)	1
Araneae (small forms, low pigmentation)	5	Hymenoptera (Formicidae)	5
Araneae (forms > 5mm)	1	Insect larvae	10
Blattaria	5	Insects (adults)	1
Chilopoda (forms > 5mm, well develloped legs)	10	Isopoda	10
Chilopoda (other forms)	20	Microcoryphia	10
Coleoptera	Table 2	Opiliones	10
Collembola	Table 3	Orthoptera (in general)	1
Dermaptera	1	Palpigradi	20
Diplopoda (forms > 5mm)	10	Pauropoda	20
Diplopoda (forms < 5mm)	20	Protura	20
Diplura	20	Pseudoscorpiones	20
Diptera (larvae)	10	Psocoptera	1
Embioptera	10	Symphyla	20
Hemiptera (general epigeous or root-feeding forms)	1	Thysanoptera	1
Hemiptera (Cicada larvae)	10	Zygentomata	10

Table 2 - Eco-morphological scores for Coleoptera (based on Parisi et al., 2005)

Coleoptera	Score
Clearly epigeous forms	1
Main adaptations to edaphic life that can be detected:	
(a) dimmentions < 2mm	4
(b) thin integument, often tan-brown	5
(c) hind wings reduced or absence	5
(d) microphtalmy or anophtalmy	5
For these forms the total score is equal to the sum of scores in detected characters. Example: if only (a) and (b) are present, the total sum is 1+4+5=10	

Table 2 - Eco-morphological scores for Collembola (based on Parisi et al., 2005)

Coleoptera	**Score**
1) Clearly epigeous forms: middle to large size, complex pigmentation present, long, well-developed appendages, well developed visual apparatus (eye spot and eyes)	1
2) Epigeous forms not related with grass, shrubs or trees well-developed appendages, (possible) well-developed setae or protective cover of scales, well-developed visual apparatus	2
3) Small size -though not necessarily- forms, usually limited to litter, with modest pigmentation, average length of appendages, developed visual apparatus	4
4) Hemi-edaphic forms with visual apparatus still developed, not elongated appendages, cuticle with pigmentation	6
5) Hemi-edaphic forms with reduced number of ommatidia, scarcely developed appendages, often short or absent furca, pigmentation present	8
6) Eu-edaphic forms with no pigmentation, reduction or absence of ommatidia, furca present - but reduced	10
7) Clearly eu-edaphic forms: no pigmentation, absent furca, short appendages, presence of typical structures such as pseudo-oculi, developed postantennal organs (character not necessarily present), apomorphic sensorial structures	20

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Diplopoda (forms < 5mm)	20	Protura	20
Diplura	20	Pseudoscorpiones	20
Diptera (larvae)	10	Psocoptera	1
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