FORSEE: FIELD MANUAL

INTERREG III B

(www.iefc.net)

FORSEE Project *www.iefc.net*

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A Community Initiative
ERDF - INTERREG IIIB Atlantic Area

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TABLE OF MEASUREMENTS

I LOCATING PLOTS ON THE FIELD

I.1. Nodes sampling methodology

FORSEE proposes to do a sampling based on the square grid with nodes 1 Km. such as the ones used by several National Inventories.

The number of sample points to be selected will depend on the surface of the pilot area in each region and of its complexity.

∗Aquitaine:
145 devices, with trapping and resanmpling on a subsample of 80.
∗Galicia:
30-40 complete devices and another 100 devices without the soils study or the IFN plots (the IFN plot will not be established given the fact that Galicia already disposes of the 2nd and 3rd National Forest Inventory and this data is already enough to evaluate the indicators. There will not be many soil samplings due to the fact that there is already enough information to the test indicators from the specific studies done and from the soils analysis on the maps of the agrologic classes).
∗Ireland: 41 non systematic devices placed between the forest owners of the Coop.
∗Navarre: 47
∗Bask Country: 65
∗Palencia: 50 complete devices, and more 130 devices without the soils study
∗Portugal (Centre) ?
∗Portugal (North) 35

I.2. Locating plots

I.2.1. <u>Stage 1: Office work « Locating plots on aerial photos »</u>

The aerial photo interpretation together with the observations done on the field on the sampling plots and the analysis of the wooded and non wooded area form three main sources of data to evaluate the main characteristics of diversity.

The photo interpretation combined with a soil knowledge allows the characterization of the forest areas (specie, structure, stages of development, particular ecosystems), and provides a precious information about the fragmentation and structure of the forest covering. Other parameters can also be estimated, as the forest's height, density, stage of development, and the proportion species all together, allowing the characterization the structural diversity of the forests. Taking into account all these advantages the aerial photo has become the main method chosen by FORSEE to implement on the filed the sampling unities, besides providing a first estimation of the surface.

In general we will work with aerial photos on a scale of 1: 20.000 (except for Ireland that does not have this information)

I.2.1.1 Punctual location

The inventory device is formed by 4 plots' radius (see picture 2):

- NFI plot
- RF satellite (fixed rayon, the same as the NFI plot)
- Satellite 1
- Satellite 2

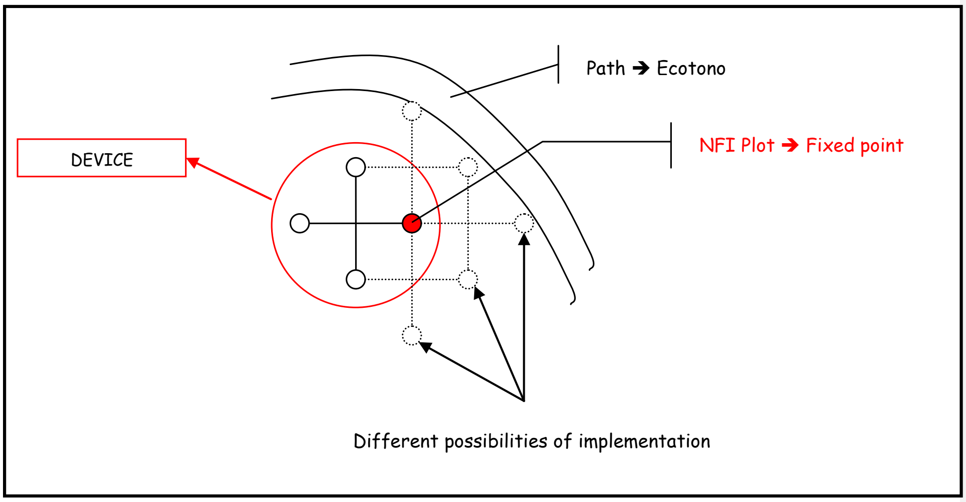
A subsample of node is selected on the grid, taking into account representative and regional working capacities. From this point the other point will be located (centre of the NFI plots) on a first step on a map and then they will be transferred to the aerial photo.

I.2.1.2 Systematic location of the NFI Plots

The NFI plot will be located on the node.

I.2.1.3 Location of the Satellites RF, 1 and 2

The other satellites that form the plot (Satellite RF, Satellite 1 and Satellite 2) will also be located on the photo once the centre of the NFI plots has been located (the nodes of the grid). The position of the device can be changed until we have obtained the most accurate position to fulfil the objectives of our study (search for ecotones, for example, or sticking to forest areas, or in a homogeneous stand), always taking into account the position of the NFI Plots.



Picture 1 Different possibilities of location for the inventory device taking as reference the location of the NFI plot.

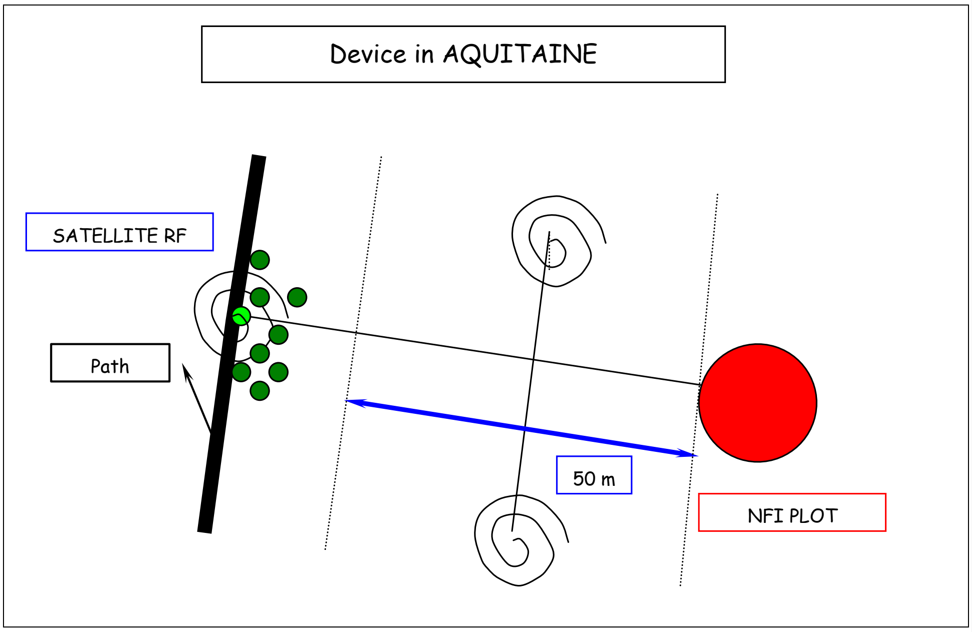
In case there is any problem the entire plot can be moved in a maximum of 400 m. but always on the ortophoto.[1]

*Aquitaine:

Commentaire [C.O.1]: À compléter

The general scheme will be kept, except for some changes regarding the way of implementing, given the fact that a sanitary study is foreseen for the Satellite RF, and for which the presence of a different ecotone will be needed. So, the fixed radius satellite is always on the edge.

[1] La implantacion de parcelas sobre el terreno debe seguir exactamente las decisiones acordadas en el trabajo de gabinete y situarse en la misma superficie de observación que ha quedado definida en la ortofoto. El equipo de campo encargado de llevar a cabo el inventario no tomara decisiones a este respecto.(*IFN France, 2004 Instruction pour les mesures et observations de terrain_pags 29, 30,31_).*



Picture 2 Main characteristics of the device in Aquitaine

I.2.2. <u>Stage 2: Field work "Installing plots"</u>

To locate a sample point or the centre of a plot on the field we will use a **GPS receiver** (in case there isn't any we can use a **map, topographic instruments or a compass).**

The GPS will be useful given the fact that one of its advantages is that it can register a certain position trough the **Waypoint** function and from it different routes can be created (sequenced grouping of waypoints). A route is formed by a starting point and a final one, as also by a series on intermediary locations through it, helping us to easily find the centre of our plots. (See appendix XIV: Basic notions about the location of points with GPS)

I.2.2.1 Materializing the points of inventory

- <u>Transects</u>: materialization of the starting point, the final point and the intersection point with the help of a picket, and materialization of transect itself, with the help of a ribbon (a rope can replace it).

- <u>Centres of the plot</u>: materializing the centre of the plot with picket.

- Marking trees: with ink.

- Sampling points of the soils study: materialized with a picket.

II INVENTORY DEVICE

II.1. Brief Introduction

Each plot is formed by 4 satellites:

II.1.1. The NFI satellite

Where following studies will be carried out:

→ Sanitary and biodiversity (sampling in spiral-20 trees[2])
→ Dendrometric(sampling following concentric plots)
→ Soils Study (systematic sampling: 10 sample points)
→ Snags and stumps inventory (plot with fixed radius[3])
→ Understorey study

II.1.2. The Satellite RF

Where following studies will be carried out:

→ Sanitary and biodiversity (sampling in spiral-20 trees [2])
→ Snags and stumps inventory (plot with fixed radius [3])

II.1.3. Two Satellites: Satellite 1 and Satellite 2

Where following study will be carried out:

→ Sanitary and biodiversity (sampling in spiral-20 trees [2])

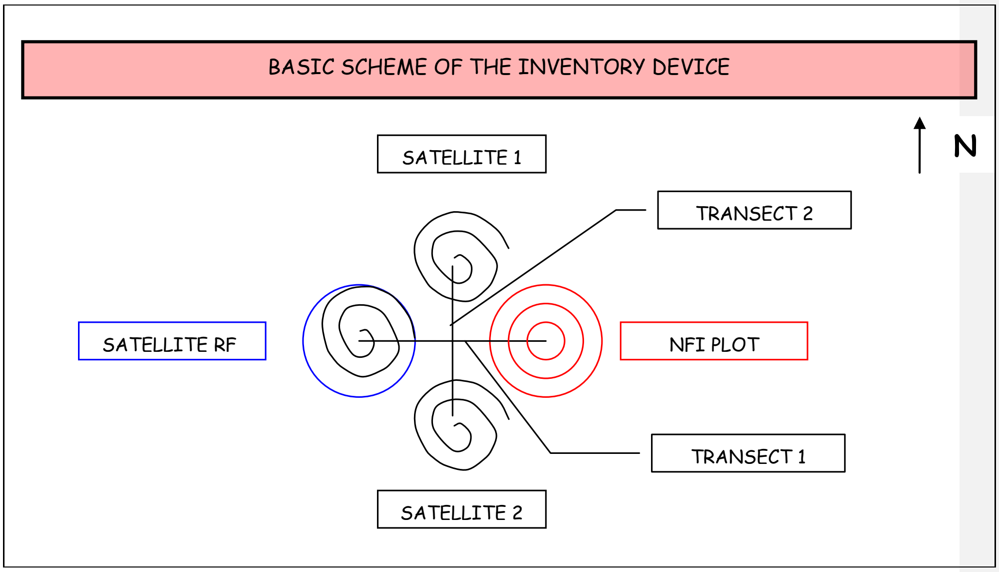
II.1.4. Two transects turned SN or EW: Transects 1 and 2

Where following studies will be carried out:

→ Logs inventory(50 m length by transect)

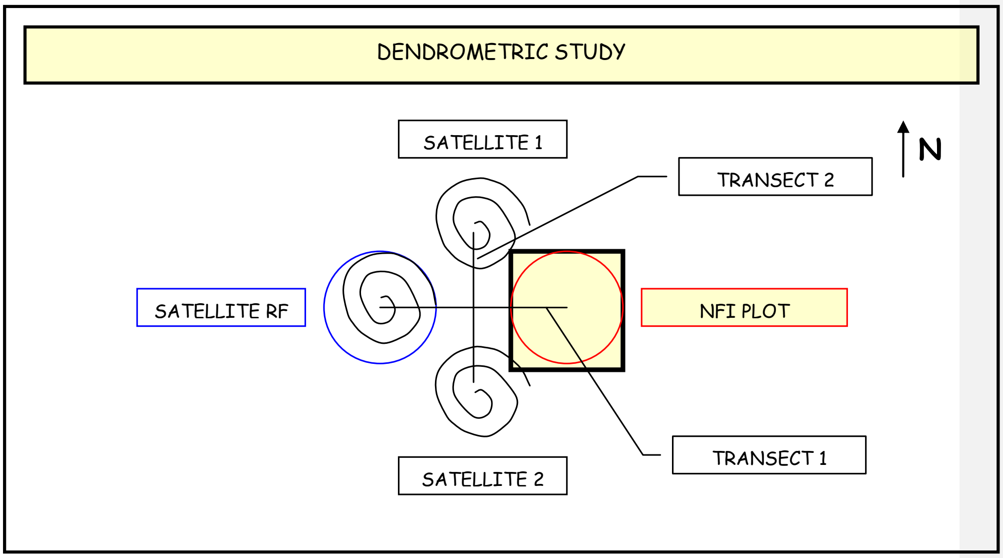
[2] The size of the sample changes according to the level of damages
[3] Same rayon as the NFI Plot

→ Soil study (Soil disturbances -protocol LIS[4]-)

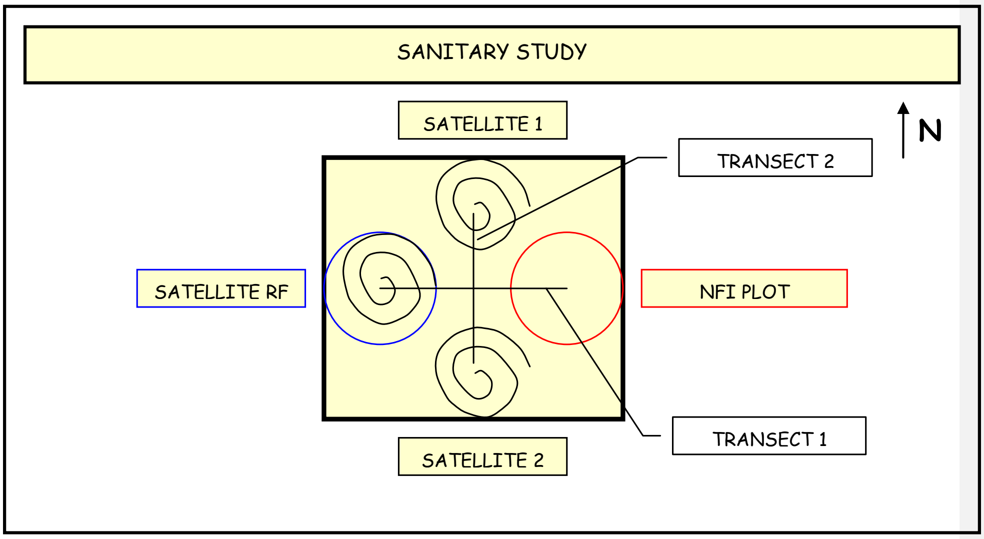


Picture 3 Basic scheme of the inventory device: sampling done trough concentric plots (NFI Plot) and sampling in spiral (Satellites RF, 1 and 2); snags inventory (Satellite RF); logs inventory (Transects 1 and 2)

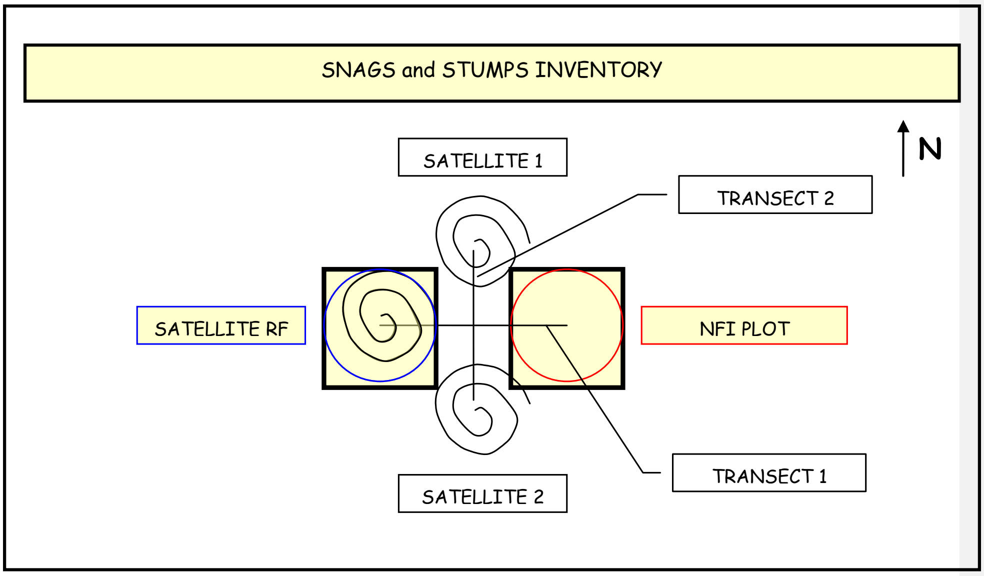
[4] *Metodo del Transecto o Recorrido Linear* (*Line Intersect Sampling)*



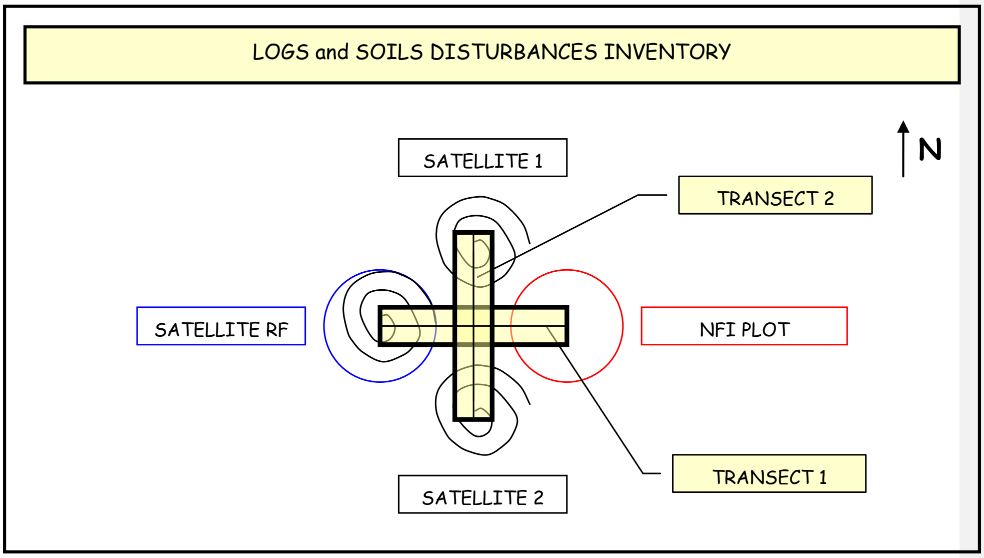
Picture 4 Dendrometric study in the **NFI Plot** following the protocol established by the **NFI of each region.**



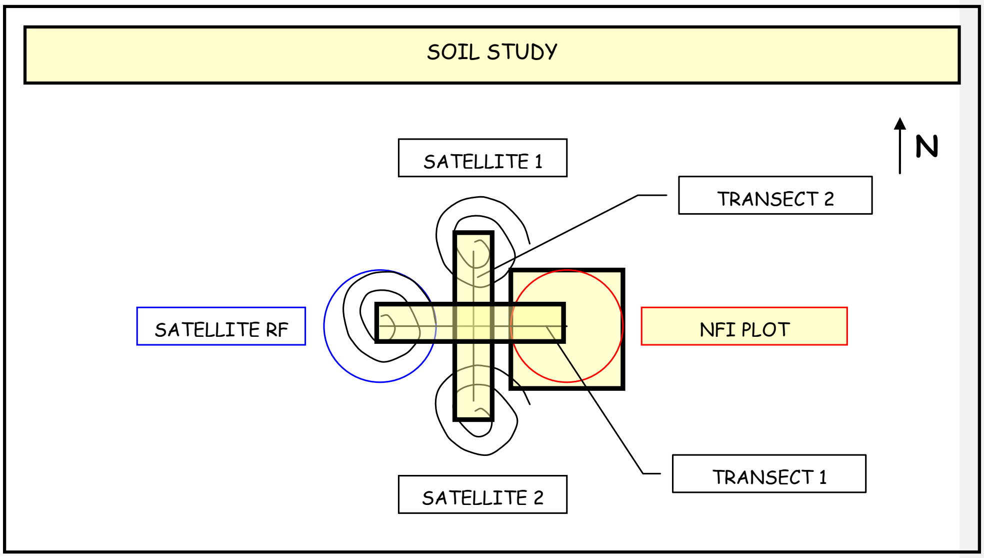
Picture 5 is for the entire **inventory device**, except for the Transects 1 and 2.



Picture 6 Snags inventory: in the **NFI PLOT** (rayon according to the different NFI) and the **Satellite RF** (rayon = rayon NFI Plot)



Picture 7 Logs and soils disturbances inventory on **Transects 1 and 2** (Protocol based on the **Method Line Intersect Sampling**)



Picture 8 Is the Soil study in the **NFI Plot** to take samples of the soil horizons and litter, and in the **Transects 1 and 2** to evaluate the disturbances.

II.2. Description of the plots that form the inventory device

II.2.1. The NFI satellite

The satellite where we will follow the protocol established by the **NFI of each region**, so that we can use the information that it can supply us and extrapolate the data for our study. It will be called **"NFI Plot"**.

II.2.1.1 Characteristics:

This plot will carry out the **SANITARY AND BIODIVERSITY STUDY, DASOMETRIC STUDY, SOILS STUDY AND THE SNAGS AND STUMPS INVENTORY.**

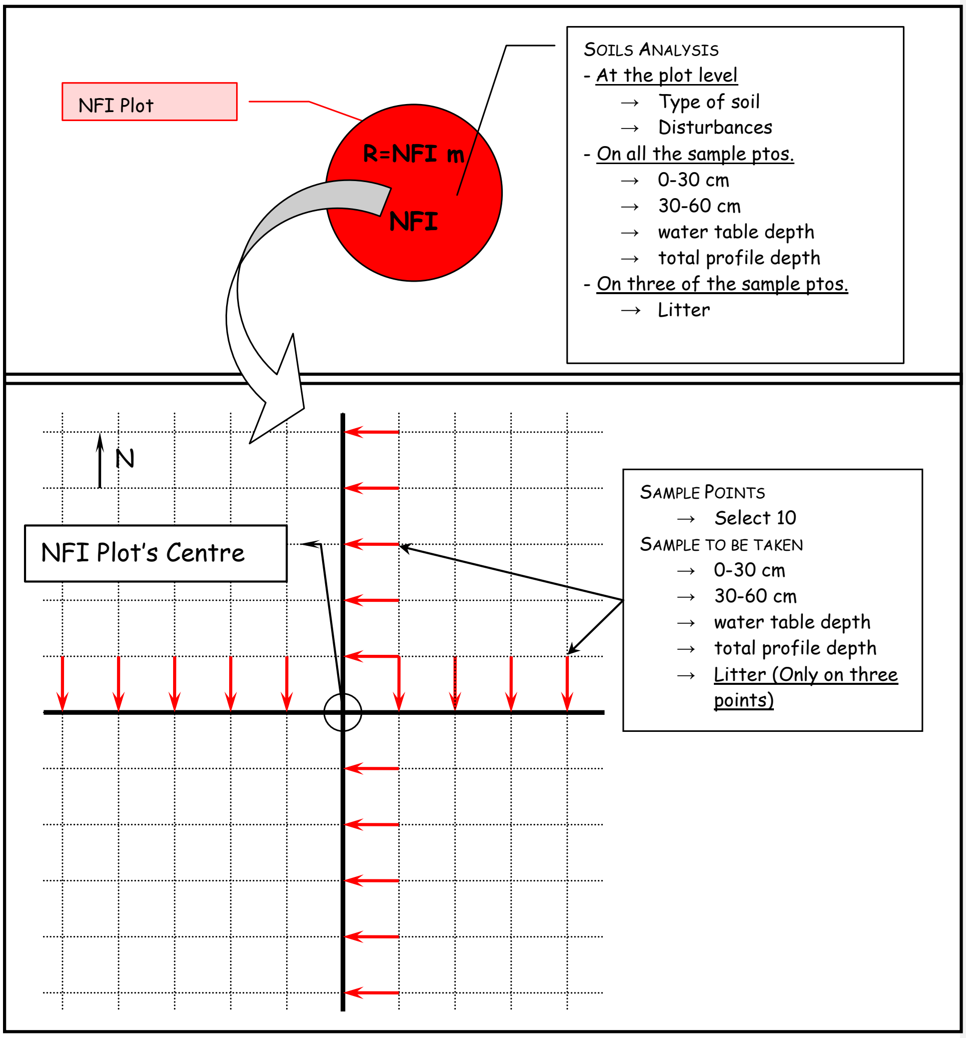
II.2.1.2 Sampling:

To carry out the **DASOMETRIC AND SANITARY STUDY,** we will follow the sampling method based on the implementation of *CIRCULAR CONCENTRIC PLOTS*, as it is indicated by the different NFI of the different areas implicated on the project. So, each region shall adapt its number, rayon and surface according to its NFI. A stems inventory will also be done with different dimensions depending on the subplots that we are working on. So, the inventory characteristics inside the different areas will be:

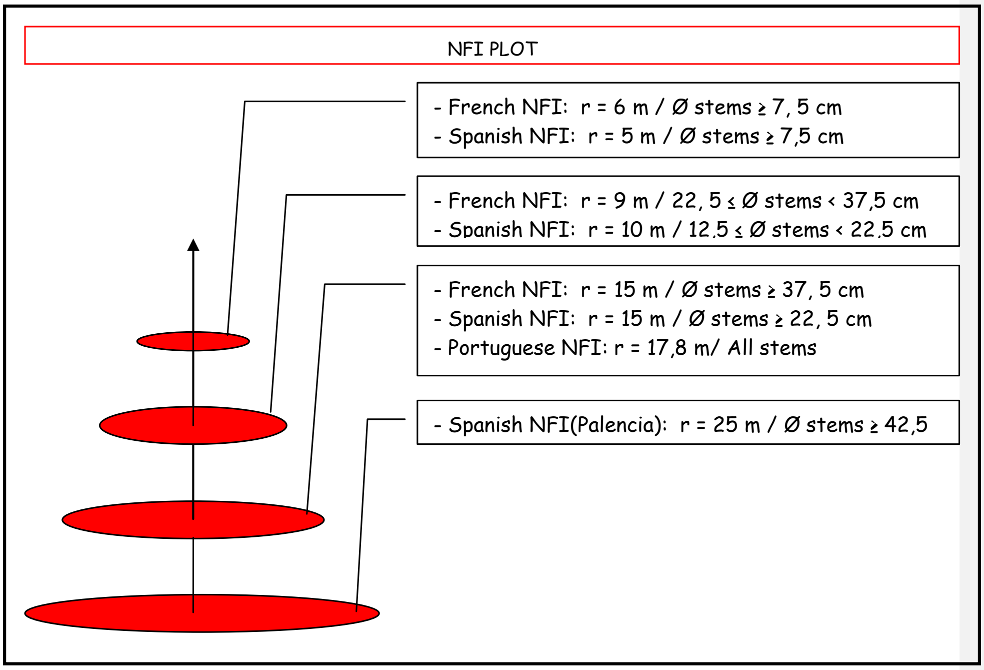
REGIONS	SUBPLOTS		
	RAYON	D.M.I	NUM.
Aquitaine	**6-9-15 m**	**7,5-22,5-37,5 cm.**	**3**
Navarre	**5-10-15 m**	**7,5-12,5-22,5 cm.**	**3**
Galicia	**5-10-15 m**	**7,5-12,5-22,5 cm.**	**3**
Bask Country	**5-10-15 m**	**7,5-12,5-22,5 cm.**	**3**
Palencia	**5-10-15-25 m**	**7,5-12,5-22,5-42,5 cm.**	**4**
Portugal North and Centre	**17,8 m**	**7,5 cm.**	**1**
Ireland			

Table 1 Rayon, number and minimum diameters to be inventoried (d.m.i) of the subplots to be implemented on the different areas that belong to the FORSEE project (National Forest Inventories)

In the **SOILS STUDY,** the sample points will be selected with the help of a square grid with a variable side (1, 2 and 3 m; it is proposed a mesh side of 3m) depending on the characteristics of each region. They will be located on the field following its coordinates (azimuth, distance, taking as a reference the centre of the plot). 10 sample points will be taken. (See III.3 Soils study)



Picture 9 The Soils study will be done on the NFI plot. Proposal for selecting sampling points to be drilled.



Picture 10 Rayon, number and minimum diameters to be inventoried (d.m.i) on the subplots to be implemented on the different areas belonging to the FORSEE project (National Forest Inventories)

II.2.1.3 Variables and stems to be measures/areas for measurement

*II.2.1.3.1. *At the tree level*

Only on living stems that present signs/symptoms:

→ Affected part: (Data 24 AFFECTED PART (C.2.1))
→ Damage description: (Data 24 AFFECTED PART (C.2.1))
→ Affected percentage: (Data 26 AFFECTED PERCENTAGE (C.2.1))
→ Agent: (Data 27 AGENTE (C.2.4))

On all living stems

→ Specie: (Data 7 SPECIE (C.2.4) (C.1))
→ Diameter: (Data 19 DIAMETER (C.2.4) (C.1))
→ Social class: (Data 20 SOCIAL CLASS (C.2.4))
→ Tree number (Data 5 TREE NUMBER (C.2.1))
→ NFI tree number (Data 6 NFI TREE NUMBER (C.1))

Total height (.

→ Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3))
→ Height of the first living branch (Data 23 HEIGHT OF THE FIRST LIVING BRANCH (HCI) (C.2.4))
→ Azimuth (Data 17 AZIMUTH (C.2.4, C.4.1))
→ Distance to the plot's centre (Data 18 DISTANCE (C.2.4, C.4.1)

On all snags

Snag's height: on all snags .

→ Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3))
→ Decomposition status: on all snags (Data 33 DECOMPOSITION STATUS OF LOGS AND SNAGS (C.4))
→ Specie: (Data 7 SPECIE (C.2.4) (C.1))
→ Diameter: (Data 19 DIAMETER (C.2.4) (C.1))
→ Signs of fauna use (Data 34 SIGNS OF FAUNA USE (C.4))

Only on stems "edge"

→ Tree's position: on stems that suffer from the "edge effect" (Data 21 EDGE EFFECT (C.2.4.a)

Only on regular stands and young stems

Age (The gender and specie of each stem will be determined, using as base its phenologic characters and the typical material found on the ground, next to the stump (dead leaves, fruits or part of the fruits).

→ Data 8 AGE (C.1, C.2, C.4)

II.2.1.3.2. *At the NFI's plot level

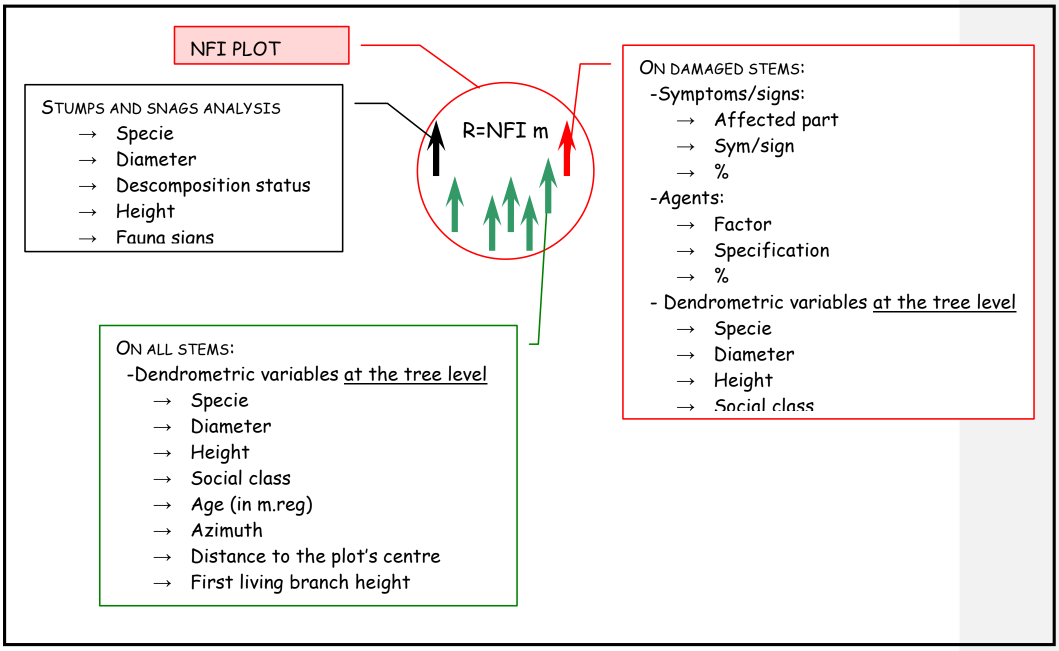
→ Region (Data 1)

→ Closure (Data 2)
→ Time spent with the inventory (Data 3)

Sequence number **(**

→ **Data 4)**

→ GPS position
→ Orientation (Data 9)
→ Slope (Data 10)
→ Topography (Data 11)
→ Regeneration (Data 12 REGENERATION (C.4.2/ C.2.4))
→ Type of association (Data 13 TYPE OF ASSOCIATION (C.5))
→ Recent forest interventions (Data 14 RECENT FOREST INTERVENTIONS (C.2.4.)
→ Piled wood (Data 15 PILED WOOD (C.2.)
→ Basal area (Data 16 BASAL AREA (C.2.4.a, C.1.2, C.1.4))
→ Understorey inventory (Data 39 ESTIMATION OF THE COVER BY LAYER AND DOMINATING SPECIES (C.1))
→ Presence of recent stumps (Data 31 PRESENCE OF RECENT STUMPS (C.2.2) (C.4, C.1))
→ Soil general profile (Data 36 GENERAL PROFIL (C.5)) type of soil (for the plot), sample to be taken and level of the water table (for each sample point)
→ Soil disturbances (Data 38 DISTURBANCES (C.5))
→ Litter (Data 37 LITTER (C.1, C.5)): only o three sample points.



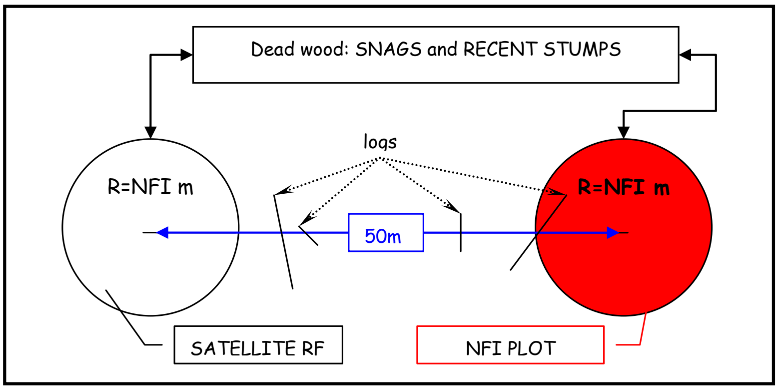
Picture 11 Measurements to be done on the NFI plot **at the tree level**

II.2.2. In the SATELLITE RF (fixed radius)

II.2.2.1 Characteristics

In this plot we will collect data to be done in a known area. The distance between the satellites will be of 50 m. I can be 50 M:

- From centre to centre
- From satellite to satellite



Picture 12 position of the NFI plot, Satellite RF and Transect 1

II.2.2.2 Sampling

Different inventories will be carried out, one to study the Sanitary Status and another one for the DEAD WOOD inventory (**RECENT SNAGS and** STUMPS**)**.

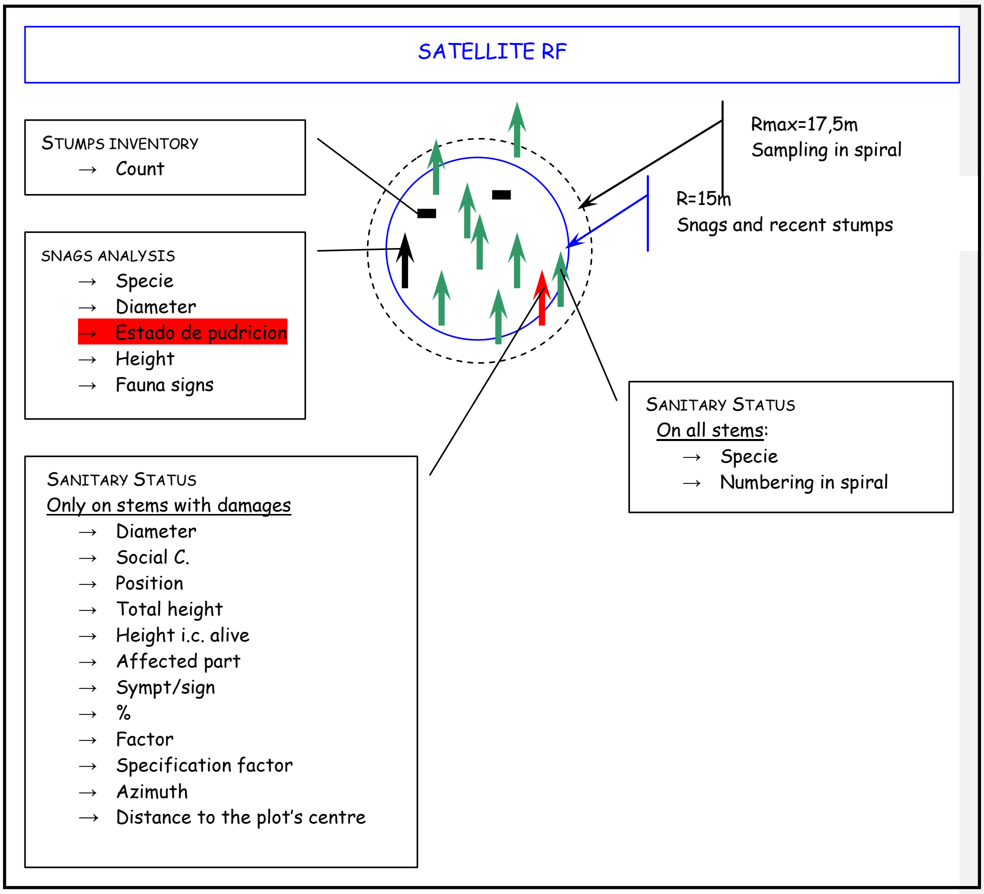
1. – For the **SANITARY STUDY**: ***Sampling in spiral***[5], starting by the trees that are closer to the plot's centre and moving progressively as we step way from it. The size of the sample will be of 20 living trees[6]. Of course that it will not be possible to establish fixed rayon for the satellite following this type of sampling, but we can establish maximum rayon so that we can avoid the overlapping between this satellite and the other plots of the device. Taking into

[5] Sampling in spiral based on the European regulations of the *Mandatory Level I, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe*),

[6] Suitable sample for the damage estimation minor than 15-20%. The region that is not on this situation shall adapt its sample.

account the other characteristics of the device, the maximum rayon established is of 17, 5 m. (despite de fact that there are not enough stems to complete the sample).

2. - For the **Inventory of Snags and recent Stumps**: the surface to do the inventory of snags and recent stumps will be equivalent to a circle with fixed rayon defined in the NFI.



Picture 13 Inventory to be done and the characteristics of the **Satellite RF**

II.2.2.3 Variables and stems to be measured /areas for measurement

*II.2.2.3.1. *At the tree level*

Only on living stems that present signs/symptoms

→ Affected part: (Data 24 AFFECTED PART (C.2.1))
→ Damage description: (Data 24 AFFECTED PART (C.2.1))
→ Affected percentage: (Data 26 AFFECTED PERCENTAGE (C.2.1))
→ Agent: (Data 27 AGENTE (C.2.4))

Total height: (.
→ Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3))
→ Height of the first living branch (Data 23 HEIGHT OF THE FIRST LIVING BRANCH (HCI) (C.2.4))
→ Diameter: (Data 19 DIAMETER (C.2.4) (C.1))
→ Social Class: (Data 20 SOCIAL CLASS (C.2.4))

On all living stems

→ Specie: (Data 7 SPECIE (C.2.4) (C.1))

On all snags

Snags' height: all snags (.
→ Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3))
→ Decomposition status: all snags (Data 33 DECOMPOSITION STATUS OF LOGS AND SNAGS (C.4))
→ Specie: (Data 7 SPECIE (C.2.4) (C.1))
→ Diameter: (Data 19 DIAMETER (C.2.4) (C.1))
→ Signs of fauna use (Data 34 SIGNS OF FAUNA USE (C.4))

Only on stems "ecotone"

→ Tree's position: on stems that suffer from the "edge effect" (Data 21 EDGE EFFECT (C.2.4.a)

*II.2.2.3.2. *At the satellite RF level*

→ Region (Data 1)

→ Basal area (Data 2)
→ Time spent on the inventory (Data 3)

Sequence number (

→ **Data 4)**

→ Presence of recent stumps (Data 31 PRESENCE OF RECENT STUMPS (C.2.2) (C.4, C.1))
→ GPS position

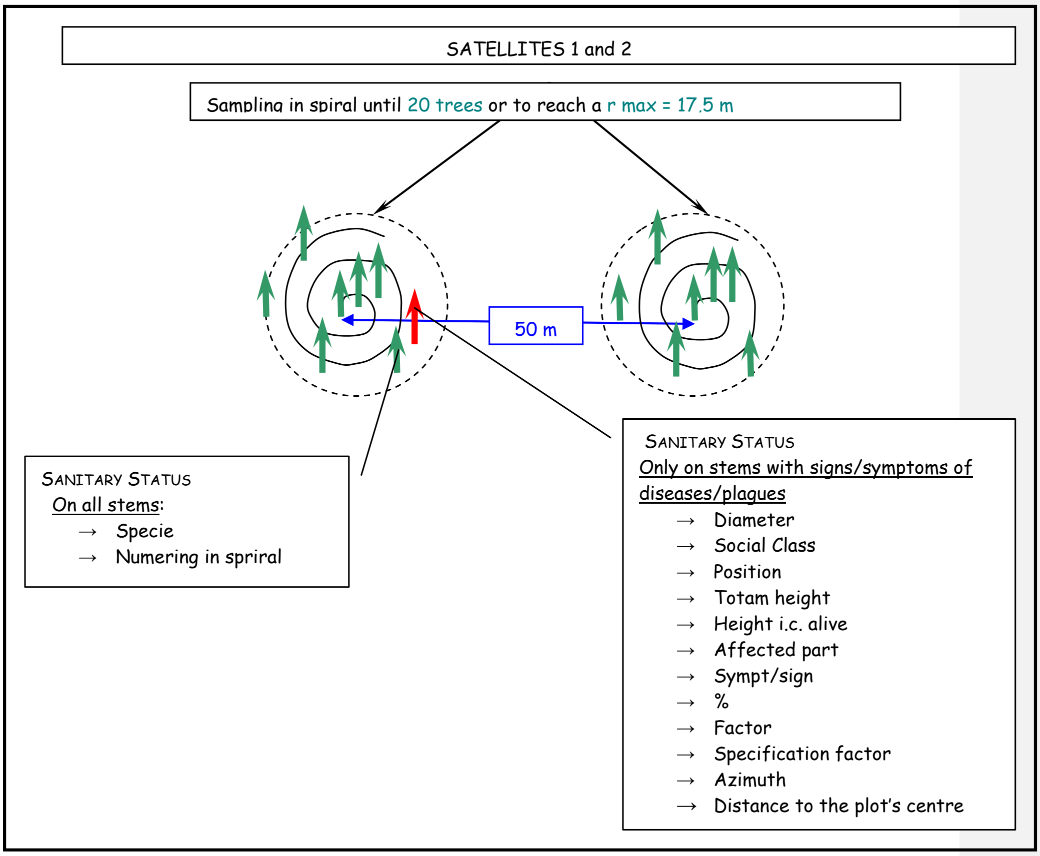
II.2.3. THE SATELLITES 1 and 2

II.2.3.1 Characteristics

Two satellites we will study the **SANITARY STATUS**, without fixed rayon and with maximum rayon of 17, 5 m. The centre of both satellites will have a distance of 50 m. between themselves, and will correspond to the Transect 2 where the "logs" inventory will be done.

II.2.3.2 Sampling:

Sampling in spiral, starting by the trees that are closer to the plot's centre and moving forward as we step away from it. The size of the sample will be of 20 living trees (for estimating damages inferior to 15%), that is why the plot will not have a fixed rayon, only maximum rayon of 17,5 m. despite the number of trees inventoried on this case.



Picture 14 Sampling in Spiral for the **Satellites 1 and 2** and measures to be done

II.2.3.3 Variables and stems to be measured/areas for measurement:

*II.2.3.3.1. *At the tree level*

Only on living stems that present signs/symptoms

→ Affected part: (Data 24 AFFECTED PART (C.2.1))
→ Damage description: (Data 24 AFFECTED PART (C.2.1))
→ Affected percentage: (Data 26 AFFECTED PERCENTAGE (C.2.1))
→ Agent: (Data 27 AGENTE (C.2.4))

Total height: (.

→ Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3))
→ First living branch height (Data 23 HEIGHT OF THE FIRST LIVING BRANCH (HCI) (C.2.4))
→ Diameter: (Data 19 DIAMETER (C.2.4) (C.1))
→ Social Class: (Data 20 SOCIAL CLASS (C.2.4))

On all living stems

→ Specie: (Data 7 SPECIE (C.2.4) (C.1))

Only on stems "ecotone"

→ Tree's position: on trees that suffer from the "edge effect" (Data 21 EDGE EFFECT (C.2.4.a)

*II.2.3.3.2. *At the satellite level*

→ Region (Data 1)
→ Basal area (Data 2)
→ Time spent on the inventory (Data 3)

Sequence number (

→ **Data 4)**

→ GPS position

II.2.4. THE TRANSECTS

Two transects[7] that link two by two the plots that form the inventory device, where the logs inventory will be done (see III.2.2 LOG) ad the study of soil disturbances (see Data 38 DISTURBANCES (C.5))

II.2.4.1 Characteristics:

I) A transect of 50 m length linking the centre of the "NFI plot" and the "satellite RF", called "**transect 1**".

II) A transect of 50 m length linking the centres of the "satellite 1" and "satellite 2", called "**transect 2**".

II.2.4.2 Sampling

"Logs" inventory on all transects length (50 + 50 m). It is quite important that the length of both will be of 50 m in a horizontal projection, which is why the distance on the fields with slope must be corrected. (See implementation of the transects on the field, Page 47)

II.2.4.3 Variables and stems to be measured/areas for measurement

*II.2.4.3.1. *At the transect level*

→ Azimuth (Data 17 AZIMUTH (C.2.4, C.4.1))
→ Slope (Data 10)

*II.2.4.3.2. *At the log's level*

On all logs

→ Specie: on all logs (Data 7 SPECIE (C.2.4) (C.1))
→ Diameter: on all logs (Data 32 D
→ Decomposition status: on all logs (Data 33 DECOMPOSITION STATUS OF LOGS AND SNAGS (C.4))

[7] Sampling based on the *Metodo del Transecto o Recorrido Linear* (LIS: *Line Intersect Sampling)*

III PROTOCOL FOR MEASUREMENTS

III.1. OVERALL DATA

Data 1 REGION

The code corresponding to the region where we are working on will be introduced. The codes to be used will be the following:

REGION	CODE
Aquitaine	1
Bask Country	2
Cantabria	3
Castilla y Leon	4
Galicia	5
Ireland	6
Navarre	7
Portugal Centre	8
Portugal North	9

Data 2 CLOSURE

The closure will be given as a percentage of canopy closure.

Data 3 TIME

In each activity the starting and ending time will be specified

$H_{plot\ transfer}$ (3)		H_{start} (3)		$H_{break\ start}$ (3)	
$H_{arrival}$ (3)		h_{end} (3)		$h_{break\ end}$ (3)	

H_{start} (3) :
$h_{limit\ the\ plot}$ (3)
$h_{inventory}$ (3) :
H_{end} (3)

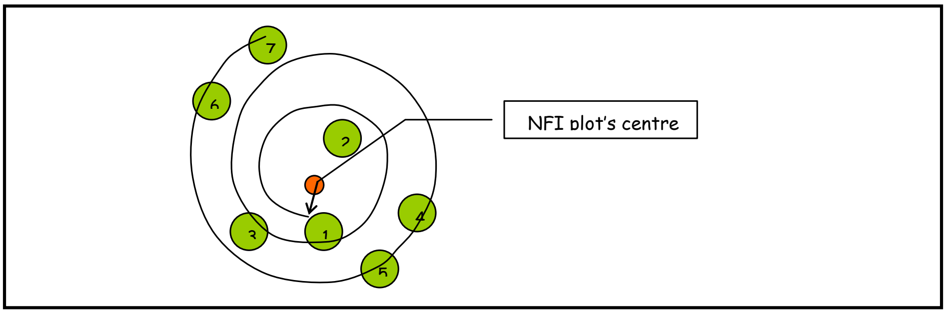
Data 4 PLOT NUMBER

The plot's number will be same that was already designated during its implementation; the same sequence number will be kept.

Sequence nr (4)	33

Data 5 TREE NUMBER (C.2.1)

The tree's numbering will be done in spiral, in an increasing sequence as we move away fro the trees of the satellite's centre.



Picture 15 Numbering trees from the centre of the plot

Data 6 NFI TREE NUMBER (C.1)

If the plot where we are has already been inventoried by its NFI, we will also take note of the number that it was assigned so that we can established a comparison between both inventories in case it will be necessary.

NFI Tree nr. (6)	Tree number (5)
4	1
	2

Data 7 SPECIE (C.2.4) (C.1)

The gender and specie of each stem will be determined, using as base its phenologic characters and the typical material found on the ground, next to the stump (dead leaves, fruits or part of the fruits).

Data 8 AGE (C.1, C.2, C.4)

In case we do an inventory to a <u>regular stand</u>, we will try to estimate the stand's age.

For the young stems and in case of <u>conifers</u> the ones that do not present many flushes per year (the case of Pinus pinaster) we will use the method "verticil counting".

STAND AGE	CODE
≤ 20	1
21 – 40	2
41 – 60	3
61 – 80	4
81 – 100	5
101 – 120	6
> 120	7
Irregular Stand	8

Table 2 Codes to be implemented to define the stand's age *Mandatory Level I and Level II, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe*

Dato 9 ORIENTATION

It will be completed following the table[8]:

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

Table 3 Codes to be implemented to define the orientation *Mandatory Level I and Level II, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe*

Data 10 SLOPE

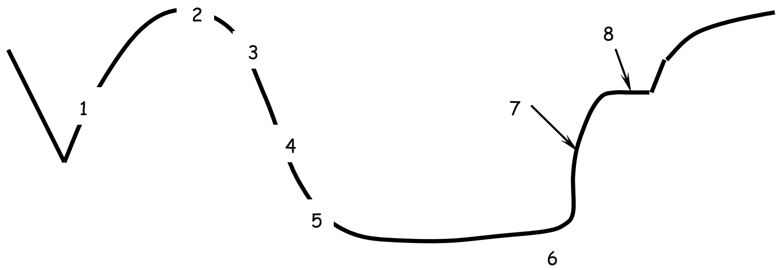
It will be taken following the line of the maximum slope. It will be expressed in %.

Data 11 TOPOGRAPHY

Orientation (9)	1 (North)
Slope(10)	0 (Plan)
Topography (11)	**4 (Medium slope)**

The following scheme will be used:

1: Straight flank
2: Top
3: High slope
4: Medium slope
5: Low concave slope
6: Bottom of the valley
7: Low convex slope
8: Plain on slope



Data 12 REGENERATION (C.4.2/ C.2.4)

The status of the stand's regeneration will be observed, trough a cut or disturbance.

- Natural regeneration: The stand that starts its renovation from seeds, roots or plants that is already there.
- Artificial regeneration: The one that starts by seedling on the stand or by plantation.

Regeneration (12)	P .pinaster	Q.suber	
Artificial			
Natural			

Data 13 TYPE OF ASSOCIATION (C.5)

It is of a great help to complete the soils study.

Defining general and global soil proprieties through mapping (usually on a scale 1/10.000); it allows us to easily recognise the soil type and association.

*Aquitaine, for example, is well adapted to the following classification:

TYPO	TYPICAL VEGETATION	CODE
Dry	Heather (*Culluna vulgaris*) Bell heather (*Erica cinerea)* Rock rose (*Helianthemum allyssoides*)	**S**
Mesophile	Bracken fern (*Pteridium aquilinum*) Commun-furge (*Ulex europaeus*)	**M**
Humid	Purple Moor-grass (*Molinea coerulea*) Gorse (*Ulex nanus*)	**H**

Table 4 Different types of associations *Le maintien de la fertilité des sols forestiers landais dans le cadre de la sylviculture intensive du pin maritime*; INRA

Data 14 RECENT FOREST INTERVENTIONS (C.2.4.a)

Just to observe if the stand has suffered any recent intervention and if so it shall be numbered.

Recent forest interv. (14)	~~YES~~	NO
THINING		
WORK		

Data 15 PILED WOOD (C.2.4.a)

Just to observe if there is any piled wood or nor.

Piled wood (15)	~~YES~~	NO

Data 16 BASAL AREA (C.2.4.a, C.1.2, C.1.4)

To assess it on all satellites allows us to estimate the stand's homogeneity.

(VERTEX / Prisma Relascópico / Cadena Relascópica).

Basal area (16) (m2/ha)	25,6

Data 17 AZIMUTH (C.2.4, C.4.1)

The azimuth of the plot-tree centre and the azimuth of the transects will be measured in centesimal grades ([9]) (centesimal compass)

Data 18 DISTANCE (C.2.4, C.4.1)

The distance between the tree and the plot's centre will be measured. (Ribbon 30 m length / VERTEX)

Data 19 DIAMETER (C.2.4) (C.1)

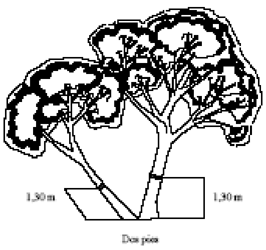
There will be an inventory for the " **DBH - diameter breast height**" or "**diameter 1,30**", which is defined as the one measured on a height of 1,30 m starting from the ground or the tree base, expressed in cm. and usually we will find it written as D.A.P.

The most common tool to be used on this kind of measurements is the **Forcipula**, an instrument usually in metal and with a square shape. Also, the **Cinta Diametral** is quite used, a graduated tape on centimetres that is put around the tree trunk **(**measures the circumference, not the diameter; gives us reliable results)

It is possible to find trees that present special characteristics that must be taken into account when measuring. Bellow there are some examples will and the way we shall precede on each case:

-Forked trees with a high ≤1, 30 m

There will be an inventory in separated for each forked trunk, also on a high of 1, 30 m, and the notes will be taken as if we were dealing with two separate trees.



-Trees with special characteristics on a normal height, as protuberances (hypertrophies), branches appearance...)

The defect must be excluded when cubing, to do so several procedures will be presented using the D.A.P measurement:

a) To carry out the measurement of two circumferences, one above the normal height and another one bellow, establishing the average measure afterwards.

b) To carry out the measurement of only one circumference, placing it a little above or bellow the normal height, always and when the displacement is not more than 10cm.

c) If there is a defect that covers a great part of the trunk (as the case of ice for example), the D.A.P will be measured including the defect, and it will be taken into account in the case there is a cubing afterwards.

d) If there is a great number of defects on the trunk in such a way that it does not allow us to carry out the C.A.P measurement, it will be adopted the solution of doing an estimation as accurate as possible.

The trees with a diameter inferior to 7, 5 cm will not be taken into account (they will be counted on the understorey) (see (38)).

Data 20 SOCIAL CLASS (C.2.4)

The class or social status is a measure of the height of a tree compared to the surrounding trees. Information on social status is useful as an aid to interpreting crown condition and incrementing data for the individual trees.

For this purpose we will use the ***Kraft Classification***, which presents four different social classes:

I. **Dominant**: trees with upper crown standing above the general level of the canopy

II. **Codominant**: trees with crowns forming the general level of he canopy

III. **Subdominant**: trees expending into the canopy and receiving some light from above, but shorter than 1 or 2.

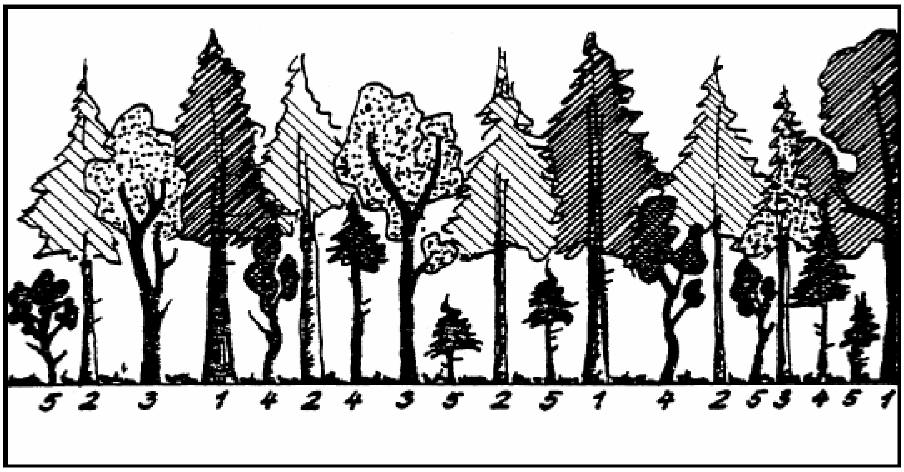
IV. **Suppressed**: trees with crowns below the general level of the canopy, receiving no direct light from above.

An important aspect to be highlighted is that it is important not to mix **suppressed tree** with **dead tree**, which is why we will add a different classification code to be used for the dead trees.

Once the social class has been defined the corresponding code will be assigned and it will be noted on the table.

Social Class	DOMINANT	CODOMINANT	SUBDOMINANT	SUPRESSED	DEAD
Code	1	2	3	4	**5**

Table 5



Picture 16 Illustration of social class status after Kraft (ICP Forests, Visual Assessment of Crown Condition Part II June 2006)

Data 21 EDGE EFFECT (C.2.4.a) (C.4.10.a)

We will define the « **edge** » effect as an imaginary line from which the plot's conditions start to change in relation to the light that the trees are receiving. This happens for example when we find a path or route with a plain surface, etc, any case which might change the tree's light conditions, given the fact that usually the trees that receive a higher amount of light are easily attacked by pests and diseases, so a higher control on them must be done.

We must know if the trees are in the edge or not and to so a YES or NO on your file is enough

.

Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3)

The **tree's total height (Hg)** will be defined as the distance that separates the base of the tree and its top or higher point. This last one is sometimes difficult to establish due to the leaves. On forked trees the height taken into account will be superior to 1, 30 m from the ground.

In case there is a slope, we will always measure on the highest area.

(Hypsometer VERTEX is proposed. It is also possible to use the Blume-Leiss, German origin, and the Suunto, Finnish origin).

Data 23 HEIGHT OF THE FIRST LIVING BRANCH (HCI) (C.2.4)

It is defined as the tree's height between its base and the first branch alive.

It is an important parameter to be obtained so that we can know the longitude of the crown alive and the stability of the tree, together with the normal diameter the slenderness of the tree can be established.

.

DENDROMETRY						
Azimuth (17)	Distance (18)	Diameter (19)	Social C. (20)	Edge Effect(21)	Hg. (22)	Hic (23)
320,6	7,5	25,6	2	---	15,5	7,5

III.2. INVENTORY OF THE SANITARY DAMAGES (C.3) (C.2.4.a)

The study of the sanitary status will be carried out on the on all satellites. It will be done trough an inventory to the stems that present damages (caused by biotic agents -signs[9] or symptoms[10] of plagues and diseases- and non biotic). We will study:

---

[9] Sign: Evidence of a damaging factor other than that expressed by the tree (fungal fruiting bodies, nests caterpillars...)

[10] Symptom: any condition of a tree resulting from the action of a damaging agent that indicates its occurrence (defoliation, discoloration, necrosis...).

→ Affected part
→ Description and % of damage
→ Factor causing the damage and its %

Data 24 AFFECTED PART (C.2.1)

The part of the tree that presents the damage will be specified. (See V.1.2Codes affected parts, signs and symptoms)

Example: P.Pinaster that presents defoliation (1) and cracks (2) on the trunk.

SYMPTOM/SIGN			AGENTE	
Affect P. (24)	Damage description (25)	% (26)	Factor (27)	% (28)
13 (1) (Needles)				
31 (2) (Trunk)				

Data 25 DAMAGE DESCRIPTION (C.2.1)

A brief description of the damage will be done. (See V.1.2Codes affected parts, signs and symptoms)

Example: P.Pinaster that presents defoliation (1) or cracks (2) on the trunk.

SYMPTOM/SIGN			AGENT	
Affect. P. (24)	Damage description (25)	% (26)	Factor (27)	% (28)
13	**01** (1)(defoliation)			
31	**17-59** (2)(Wound/crack)			

Data 26 AFFECTED PERCENTAGE (C.2.1)

To estimate the affected percentage % we will follow different proceedings depending on the type of damage:

- For SIGNS (fungal fruiting bodies, nests caterpillars...) and for the SYMPTOMS IN THE TRUNK (wounds, cankers, tumours...) we will take note of the % of the affected surface in relation to the healthy surface (trunk...). In case there is the need to establish a code for the percentage, we propose the codes defined by the ICP-Forest[11]:

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

SYMPTOM/SIGN			**AGENT**	
Affect. P. (24)	Damage Description (25)	% (26)	Factor (27)	% (28)
13	**01** (1)(defoliation)			
31	**17-59** (2)(wound/crack)	15		

- For the CROWN SYMPTOMS (*) (defoliation, decolouration): The method "<u>local reference tree</u>" will be followed[12]

<u>Method</u>: **LOCAL REFERENCE TREE**

→ **Local reference tree**: The best tree with full foliage that could grow on a particular site. The tree should represent the typical crown morphology and ages of trees in the plot and has 0% defoliation and decolouration as possible.

---

[11] *Mandatory Level I and Level II, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe*

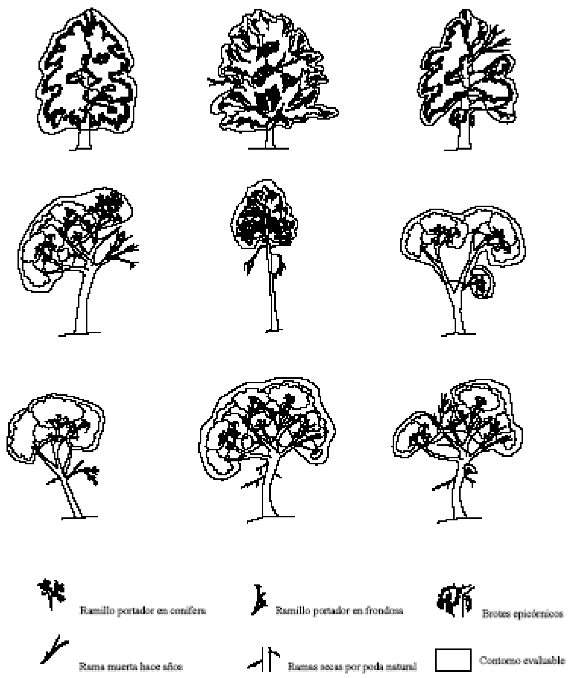
[12] SPCAN – DGCN, Red de Seguimiento de Daños en los Montes (Red CE de Nivel I), Manual de Campo, Ministerio de Medio Ambiente, 2.002

Picture 1 and picture 2 Models of the Local Tree, taken from the Red de Seguimiento de Daños en los Montes (Red CE de Nivel I), Field Manual, Ministerio de Medio Ambiente, 2.002

→ **Assessable crown:** is defined as the whole living crown from the lowest substantial living branch upwards. The following parts of such a crown must be excluded from the assessment: epicorn shoots below the crown, cracks in the crown where it is assumed that no branches ever existed.

→ **Dead crown:** snags that have been dead for many years, which have already lost their side-shoots, and have no influence on the current condition of the tree. They are therefore *excluded from the defoliation assessment*.

Picture 17 Different examples of assessable crowns according to the dead crown.

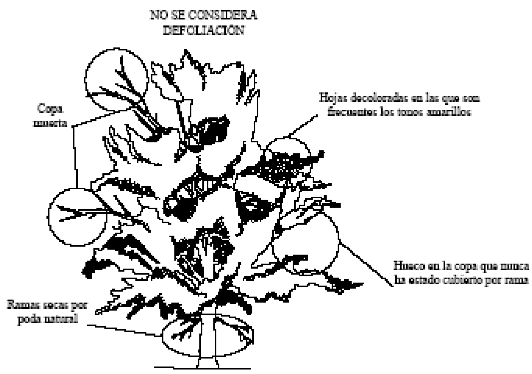


Picture 18 Different examples of assessable crowns

→ **Defoliation:** The assessment is done on the *assessable crown*.

It is NOT considered DEFOLIATION

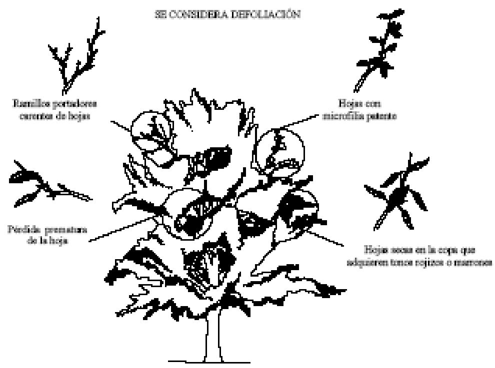
- The dead crown.
- The hollows on the crown that were never covered by branches.
- Dead breaches caused by natural pruning.
- The decolorized leaves where the yellow colour is frequent.



Picture 19 Illustration of what is not considered defoliation

<u>It IS considered DEFOLIATION</u>

- Premature lost of foliage
- Dry leaves on the crown with brown or red colours
- Leaves with obvious microfilia
- Branches with lack of foliage



Picture 20 Illustration of what is considered defoliation

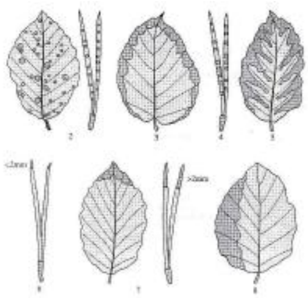
The ***defoliation*** will be estimated in steps of 5%, according to the amount of needles lost by the tree, using as a model the **local reference tree** <u>which percentage of defoliation does not have to be 0%.</u>

% Defoliation	0 %	1-5 %	6-10 %	11-15 %	16-20 %	21-25 %	----
Code	0	5	10	15	20	25	----

The percentages, for statistics purposes can be regrouped as follow:

% Defoliation	0-10	11-25	26-60	>60	100
Class	0	1	2	3	4
Reading	NONE	LIGHT	MODERATED	SERIOUS	DRY TREE

→ **Discoloration:** is defined as the change on the chromatism of the leaves/acicular regarding their natural colour on theory of that specie on that particular location. The leaves or dead acicular will be excluded from the assessment when considered as defoliation.



Picture 21 Frequent types of discoloration on leaves/acicular

The assessment of the **decolouration** of each tree that forms the sample is done at the same time of the defoliation and is also done comparing it to the tree that was used as reference (*reference tree*).

The discoloration is estimated only trough the view and each tree is classified according to the general colour of the crown. When assessing the decolouration we shall take into account the amount of decolorized foliage in comparison to the total foliage of the crown. The intensive decolouration will not be assessed; it will only be done on a small amount of the crown, not very significant. The classes of IPC can be used:

Discoloration	0	1	2	3	4
Code	NONE	LIGHT	MODERATED	SERIOUS	DRY TREE

SANITARY STATUS				
SYMPTOM/SIGN			**AGENT**	
Affect. P. (24)	Damage description (25)	% (26)	Factor (27)	% (28)
13	**01**	**25**		

III.2.1.1 AGENTS

Data 27 AGENTE (C.2.4)

Agent: Responsible for the production of symptoms and signs on the tree.

It consists on specifying which type of agent produced the damage, and to write the corresponding code. (See V.1.3Codes biotic and non biotic agents)

Example: P.Pinaster that presents defoliation (1) and cracks (2) on the trunk

If DAMAGED TREE					
SYMPTOM/SIGN			**AGENT**		
Affect. P. (24)	Damage description (25)	% (26)	Factor (27)	% (28)	**OBSERVATIONS**
13	**01**	**25**	**210** - **Thaumatopoea pityocampa**		
01	**17-59**	**10**	**431** (2) (wind cracks)		

Photo 3 Damage of Paranthrene tabaniformis

Example of Populus with signs of Paranthrene tabaniformis

SYMPTOM/SIGN			AGENT	
Affect. P. (24)	Damage Description (25)	% (26)	Factor (27)	% (28)
31 (2) (Trunk)	**17-60** (debarking: other wounds)		**220** Paranthrene tabaniformis	

Data 28 PORCENTAGE (specification)

It consists on specifying the % of damage according to the agent that caused it.

If DAMADED TREES					
SYMPTOM/SIGN			AGENT		
Affect. P. (24)	Damage Description (25)	% (26)	Factor (27)	% (28)	OBSERVATIONS
13	01	**25**	210 - Thaumatopoea pityocampa	**15**	
			220 – Rhyacionia buoliana	**10**	
01	17-59	**10**	431 (2) (wind cracks)	**10**	

PROTOCOL FOR THE DEAD WOOD STUDY

Data 29 TYPE OF DEAD WOOD TO BE IDENTIFIED

The main groups of dead wood are considered (*Harmon and Sexton, 1996 "Guidelines for measurements of woody detritus in forest ecosystems"):*

- ***Snag***: all the dead trees that are still standing and which the diameter is equal or more than 7, 5 cm.

- ***Log:*** all the dead trees which the diameter is superior to 2, 5 cm, its longitude is superior to 1m and is downed on the ground or suspended by one of its extremes but which the angle that is formed with the ground is higher than 45°, (if the angle is superior to 45° it shall be considered as a *snag)*. Nevertheless, in FORSEE we will consider as a log all stem which diameter is superior or equal to 7,5 cm., and its length superior to 1m.

- Recent ***stumps***

III.2.2. LOGS INVENTORY

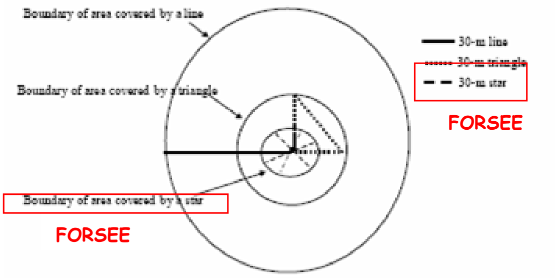
There are several methods for estimating the amount of dead wood (logs), thought the *Line Intersect Sampling* (LIS) is probably the most used one. Besides, LIS allows us to change the sample design according to the objectives of the study to be done; also there is a joint data base for everyone. This is one of the advantages shown by this method, given the fact that the objectives to be fulfilled by the FORSEE are not only about the study of dead wood, but there is a large amount of indicators for which several sample designs have been drawn. By using the LIS method, we will be able to turn the study of indicators belonging to other criterions compatible with our study.

The protocol proposed by FORSEE is based on this model (LIS); nevertheless, some changes were done so that there is a better adaptation to the objectives of the projects. These changes were taken from different methods resumed in *Stahl et al. (2001)*

LIS consists on the implementation of one or several rectilinear transects on the surface to be inventoried, and to carry out different types of measurements (according to the established goals) on the point where the logs are intercepted by thee transect.

<u>Main characteristics of the LIS method</u>:

- *Transept's shape*: for the same length of transects it is likely that we will find more logs when it is only used once. For example, a star comprised of sine 5 m. lines, or a triangle comprised of 10-m sides the possibility of finding a log will be minor if the transect of 30 m is disposed on a single straight line. Nevertheless, the time required to complete an inventory on a single transect is slightly shorter, so it would be useful to use a different design, with a triangle shape for example, that brings the crew back to the starting point.



Picture 22 Area potentially covered by different shapes of line transects.

- *Transept's length*: In general terms, the longer the length of the individual transect is, the smaller the variability is. It follows that the longer the line transect is, the fewer line transects that need to be established to achieve a given sampling error level. However, longer line transects may cause inconvenient (shorter surface of the plot etc.). And as it has already been explained on the previous point, we will save some time by doing a sample on a single transect with a higher length.

Finally, in order to obtain a correct statistic sampling it is more important the transects length than the shape (*Hazard and Pickford 1984 y Pickford and Hazard 1978)*

- *Locating line transects*: the sample points maybe randomly or systematically located (P.L. Marshall, G. Davis, V.M. LeMay, *Using Line Intersect Sampling for Coarse Woody Debris*, TR-003 Ecology March 2000, Page. 5-6).

- Measurements to be done: Will depend on the objectives. The following table offers a summary of the necessary data to estimate certain parameters of dead wood. (Note: It will not be necessary to measure the log's angle taking into account the horizontal considering that they are on the floor.)

Parameters, by CWD class	Piece attributes							
	Transect length (m)	Species	Piece angle from the horizontal (degrees)	Piece diameter (cm)	Rectangle length and width (cm)	Piece length (m)	Piece decay (Class)	Piece density (g/cm³)
Round or semi-round pieces								
Total volume (m³/ha)	x	x	x	x				
Volume, by diameter class (m³/ha)	x	x	x	x				
Total projected area (m²/ha) [a]	x	x	x	x				
Projected area, by diameter class (m²/ha)	x	x	x	x				
Volume, by diameter & length classes (m³/ha)	x	x	x	x		x		
Total pieces (no./ha)	x	x	x	x		x		
Pieces, by diameter class (no./ha)	x	x	x	x		x		
Pieces, by diameter & length classes (no./ha)	x	x	x	x		x		
Projected area, by diameter & length classes (m²/ha) [a]	x	x	x	x		x		
Volume, by diameter & decay classes (m³/ha)	x	x	x	x			x	
Pieces, by diameter & decay classes (no./ha)	x	x	x	x		x	x	
Total biomass (kg/ha)	x	x	x	x			x	x
Biomass, by diameter class (kg/ha)	x	x	x	x			x	x
Biomass, by diameter & length classes (kg/ha)	x	x	x	x		x	x	x
Odd-shaped pieces, & accumulations								
Total volume (m³/ha)	x	x			x			
Total projected area (m²/ha) [a]	x	x			x			
Total biomass (individual pieces only) (kg/ha)	x	x			x		x	x

[a] Total projected area refers to the surface or ground area "covered" by CWD. If the calculations are made based on piece diameters using the formula presented in Section 4.3, then corrections must be made for piece overlap. If intersection widths are measured along the line transects, then the formula presented in Section 5 applies and no corrections for overlap are necessary.

Table 6 The summary of the necessary data for the estimation of certain parameters of dead wood. (P.L. Marshall, G. Davis, V.M. LeMay, Using Line Intersect Sampling for Coarse Woody Debris, TR-003 Ecology March 2000,pg7).

III.2.2.1 Characteristics of the FORSEE logs sampling

- <u>Length and number of transects</u>:

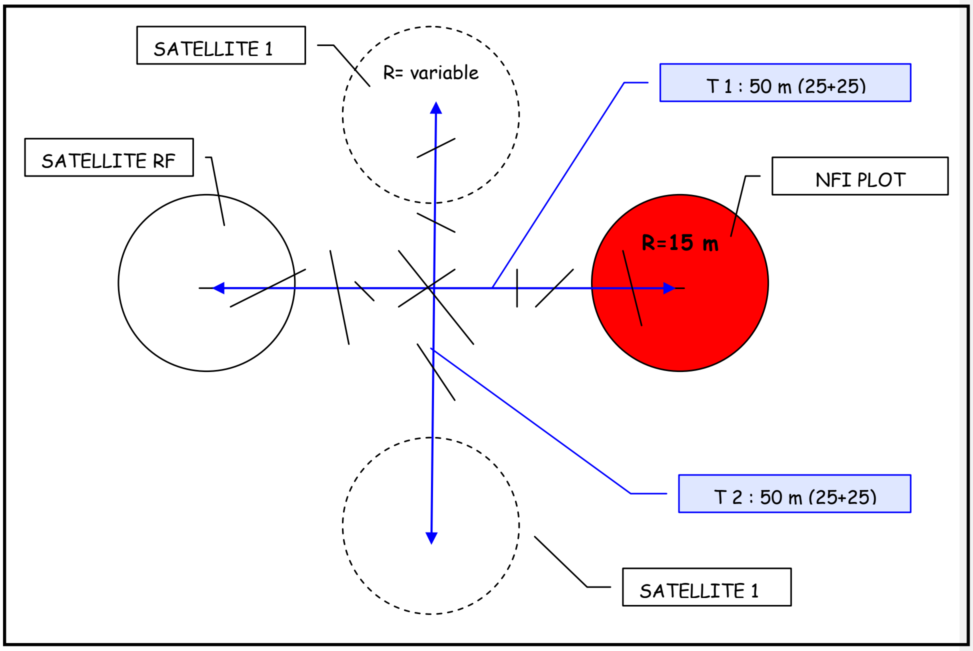
The best option is to implement transects of 25 or 50 m. FORSEE proposal is to fix four rectilinear transects of 25 m.

- Implementation on the field:

With the help of a ribbon we will do the following:

- Transect 1: The centre or the border of the NFI Plot will be fixed as the starting point, and as a direction and also final point we will use the centre or the border of the RF Satellite. Both centres will have a distance of 50 m (25 m + 25 m)

- Transect 2: Staring from the medium point of the transect 1, we will fix the transect 2, positioning its two extremes on an opposite direction and to 25 m. form this point, matching with the centre of the satellites 1 and 2.



Picture 23 Placement of the transects 1 and 2 inside the device for the FORSEE inventory

Picture 4 Transect materialization for the "logs" inventory

Picture 5 with the help of a ribbon (or a rope), we will visualise the transect on the field

- For each fallen trunk (log) or branch that reaches on transect and which Ø > 7, 5 cm we will take note of:

a) Specie (See Data 7 SPECIE (C.2.4) (C.1))
b) Diameter on the interception point (see DATA **32**)
c) Decomposition status (See Data 33 DECOMPOSITION STATUS OF LOGS AND SNAGS (C.4))
d) Fauna characteristics (See Data 34 SIGNS OF FAUNA USE (C.4))

→ Despite the fact that knowing the specie, decomposition status and fauna signs are not necessary parameters for the estimation of volume/ ha, both give us information or understanding and analysing other GFS indicators inside FORSEE (Biodiversity, risks of plagues and diseases, carbon stock...). To assess the rottenness status of logs we propose the criterion done by *Pyle and Brown (1998)*, due to its simplicity in what regards measurements and material requirements.

The length of any of the logs will not be taken, given the fact that it is not important for the established goal. According to the LIS method, it is not necessary to measure the length of the logs to know the volume of dead wood/ha by stem or by diametric class. (See Table 6 The summary of the necessary data for the estimation of certain parameters of dead wood. (P.L. Marshall, G. Davis, V.M. LeMay, Using Line Intersect Sampling for Coarse Woody Debris, TR-003 Ecology March 2000,pg7).

- the volume will be calculated trough the equation (Lofroth, 1992):

$$\boxed{V= (\pi^2 \Sigma d^2)/ 8L}$$

where V: volume (m^3/ha)
d: diameter of each log (cm.)
L: transept's length = 100 m.

- Optionally, we can estimate the trunks length fallen inside the forest with the help of the following equation:

$$\boxed{L = \pi N/ 2t}$$

where L: length o fallen trunks (m/ha)
N: number of interceptions log-transect
t: length of transect= 100 m.

III.2.3. SNAGS INVENTORY

It will be carried out on the circular plots with 15 m rayon, the NFI Plot and the Satellite RF.

For each snag we will determine:

A. Specie (See Data 7 SPECIE (C.2.4) (C.1))

Snag's height (See .

B. Data 22 THE TOTAL HEIGHT OF THE TREE (Hg.) (C.2.4) (C.1) (C.3))
C. DBH (See Data 19 DIAMETER (C.2.4) (C.1))
D. Decomposition status (See Data 33 DECOMPOSITION STATUS OF LOGS AND SNAGS (C.4))

Data 30 LOCATION

Consists on taking note of the plot or transect where the « log » or « snag » will be located for the inventory.

DEAD WOOD													
Location (29)	**S15**	**S15**	**T1**	---									
Typo (28)	Snag	Snag	Log	---									
Specie (7)	131	131	131	---									
Descomp. Status(32)	3	1	4	---									
Diameter (cm.) (19) (31)	18	22,5	13	---									
H snag (cm.) (22)	12,5	16	---	---									
L log (cm.)(optional)	---	---	6	---									
Fauna signs (33)	NO	NO	YES	---									

Data 31 PRESENCE OF RECENT STUMPS (C.2.2) (C.4, C.1)

The stumps inventory will be carried out on the "NFI plot" and in the "satellite RF". It is only about counting the stumps and noting down the number.

Data 32 DIAMETER OF THE LOGS

It will be measured:

- The point of interception log-transect.

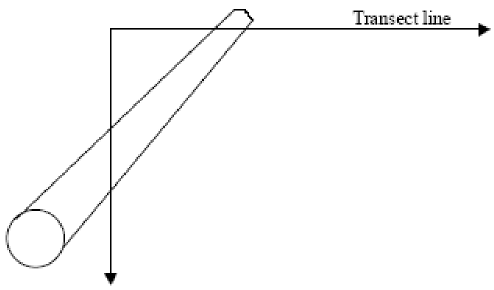

Picture 6 and Picture 7 Interceptions log-transect

- Perpendicular to the log's central axis.

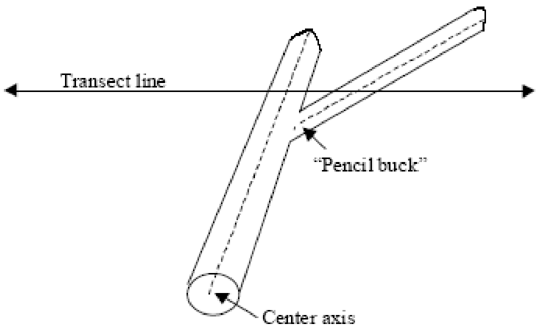
Picture 8 the diameter will be measured perpendicular to the trunk's axis

- Special cases:

♦ The log is intercepted by two different transects: the 2 diameter will be inventoried and only the bigger one will be taken into account.



♦ The log is intercepted twice or more by the same transect, due to branches: If the branches present Ø > 7, 5 cm, they will be inventoried and independent logs.



♦ The log is intercepted twice or more by the same transect, due to its shape: all diameters will be inventoried, and only the bigger one will be taken into account.

♦ Accumulation of dead wood:

a) If the logs are not decomposed, they will be inventoried individually, if not,

b) If it is decomposed wood or very fragmented, we will estimate the area of the rectangle formed by the accumulation of wood and the plan that defines this transect.

Picture 9 Dead wood accumulation

Data 33 DECOMPOSITION STATUS OF LOGS AND SNAGS (C.4)

There are distinct methodologies to be used when inventorying “logs” or “snags”.

To assess the snags decomposition status we can follow the criterion done by *Goodburn and Lorimer (1998)*.

According to these authors the degree of the wood decomposition is measured with the help of a **metal rod having a thickness of 5 mm and a round point (not sharpened)**. We shall analyse the decomposition status and take note of its value on the place that has been designed for it on the file.

Picture 10 assessing the log's decomposition status

The decomposition classes that were considered for the snags and its codes are as follows:

Code	Description
1	The trees is dead, but the crust is still intact; there are no signs of decomposition
2	The bark starts to fall down and some signs of decomposition start to show up; the rod does not enter into the trunk more than 1-2 cm.
3	The detritus start to show up clearly; the rod is easily introduced, without reaching the internal part of the trunk.
4	The detritus are all over the trunk; the rod easily goes through it; the rot wood starts to fall down.
5	The tree does not show much structural integrity; it has lost great part of its volume.

To assess the **log's decomposition status** we will use the methodology describe by *Pyle y Brown* (1998)

The decomposition classes that are considered for the logs and its codes are as follow:

Code	Description
1	The crust is still intact; there are no signs of detritus
2	Little or any crust at all; the surface is hard, but the process of internal degradation might have started.
3	Without crust; the surface is humid and falls down when cut; we can introduce our finger easily, but at the same time it also presents a certain degree of hardness.
4	The log easily crushes or breaks and presents an oval or crushed section; by squeezing with our finger some humidity rises; around it starts to show up some sawdust or small fragments of rot wood.
5	Most of the log has become sawdust.

Picture 11 Status of decomposition level 1

Picture 12 Status of decomposition level 3

Picture 13 Status of decomposition level 5

Picture 14 Status of decomposition level 5

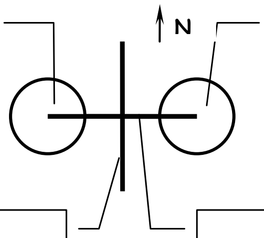
Data 34 SIGNS OF FAUNA USE (C.4)

We shall observe if there is any kind of animal occupation (hollows, bird nests…), and mark "yes" or "no" without specifying it.

DEAD WOOD											
Location (29)	S15	S15	T1	---							
Typo (28)	Snag	Snag	Log	---							
Specie (7)	131	131	131	---							
Descomp. status(32)	3	1	4	---							
Diameter (cm.) (19) (31)	18	22,5	13	---							
H snag (cm.) (22)	12,5	16	---	---							
L log (cm.) (facultative)	---	---	6	---							
Fauna signs (33)	NO	NO	SI	---							

Satellite RF (snags)

PRESENCE : YES / NO
- H $_{start}$ (3): 12h10
- H $_{fend}$(3): 12h35
- N° stumps (30) : 3
- R= 17,8 / 15 m



NFI Plot (snags)

PRESENCE : YES / NO
- H $_{start}$ (3): 11h15
- H $_{end}$ (3): 11h50
- N° stumps (30) : 1
- R= 17,8 / 15 m

T2 (logs)

PRESENCE : YES / NO
- H $_{start}$ (3): 12h40
- H $_{end}$ (3) : 12h50
- L= 50 m
- ORIENTATION : EO

T1 (logs)

PRESENCE : YES / NO
- H $_{start}$ (3) : 11h155
- H $_{end}$(3) : 12h05
- L= 50 m
- ORIENTATION : NS

III.3. SOILS STATUS

III.3.1. PLOT's SELECTION

The measurement of the soil's indicators will be carried out trough the selected plots following a systematic sampling and using a square grid with 1 Km. by side (the same grid will be used for the other indicators belonging to other criterions). The plot where the soils study will be done will be the NFI Plot.

Depending on the type of indicator, the strategy to be used will be the following:

For "long term" indicators: Are those that require a laboratory analysis to be interpreted. The extraction of samples will be done on all the NFI plots of the pilot zone. This group also includes another indicator (*Indicator C.5.3.4 Fast visual assessment of soil disturbance)* which presents a special form of assessment. For that we will use the LIS protocol, using as line of interception transects 1 and 2 introduced for the inventory of dead wood on the soil ("logs"), estimating the percentage of soils disturbances along the transects.

For "short term" Indicators: They will be visually assessed trough observations on the field that shall be carried out in the period between two rotations and if possible in the year after the forest treatments, harvesting, etc. It will be done at the stand level. The study of the soils disturbances shall be done on representative sites defined bellow.

The sites will be selected based on factors that are considered relevant regarding the soil disturbance ("key factors"). On the "key factors" will be taken into account, those that can be well defined and/or are very relevant for the pilot zone.

The critical "key factors" that are more frequent are:

a) physiographic (slope),
b) soil type/ texture / type of mother rock
c) humidity / time of the year when the interventions are done / landscape disposal

Between 3 and 5 representative sites of the area will be studied for each combination of "key factors" (a, b y c) and the "type of management used". 20 sites would the perfect selection at a regional level; 10 plots are the minimum accepted.

The work to be done on these representative sites is described in the index.

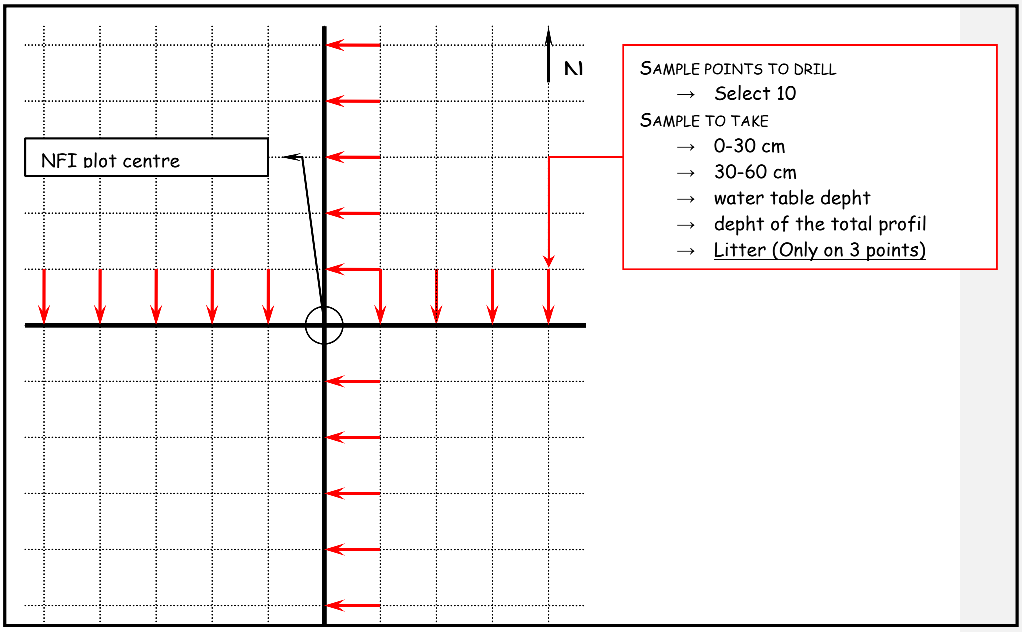
Water quality indicators

As defined in this document. FORSEE indicators specifically designed to assess "Water Quality" are GIS-based, and have no field sampling other that the one required to verify photo interpretation. These procedures should be designed *ad hoc* (check guide lines for mapping).

III.3.2. IMPLEMENTATION OF SAMPLE POINTS IN THE PLOTS STUDY METHODOLOGY

Data 35 LOCALING SAMPLE POINTS (C.5)

The sample points will be selected following the systematic sampling on a square mesh with a variable side (1, 2 and 3 m; we propose that the side of the mesh will be of 3m) depending on the characteristics of each area, centred on the NFI Satellite. They will be located on the field following the coordinates (course and distance, taking as reference the plot's centre). 10 sample points will be used. To help the selection, FORSEE advises to follow the following scheme, where the points are placed on two lines that cross on the centre of the NFI plot:



Picture 24 Location of the sample points

Data 36 GENERAL PROFIL (C.5)

It will be studied:
a) For the entire surface of the **NFI plot**

- Type of soil

b) On **all** the **sample points**

- Study of the organomineral/mineral horizon trough drills placed on a criss-cross pattern, in order to extract two subplots with different depths by sample point.

a) subsample between 0-30 cm.
b) subsample between 30-60 cm.

In order to avoid mistakes on the field it is better to keep each subsample on an individual bag, having 10 distinct samples by subplot and depth. We will take an equal part from each of the samples (office work), and then we will proceed to the mixtures, giving us a sample that is perfectly representative of the plot's horizon, where the chemical analysis will be carried out. Optionally additional samples can be taken at regular intervals up to total soil depth or up to total auger depth (typically no more than 1,20m)

Alternatively sampling could be done based on soil Horizons. So at each plot one litter sample, and several soil samples (1 x horizon) will be taken. In this case the depth of each horizon is to be measured so that the nutrient stocks can also be referred in a *by depth* basis. This procedure will give better information, could allow a better evaluation of changes successive measurements, but, on the other hand, it requires more training of field personnel and introduces some subjectivity).[13]

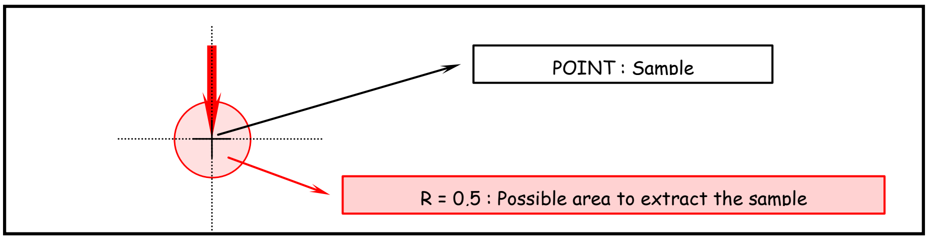
The drill is the recommended soil tool, given that fact that it allow us to easily obtain equal sample sizes. A thick drill was used on exercises done in Lisbon (15/16/17-02-03) but the use of a thin drill is recommended, given the

[13] Given the fact that it is an optional measure, ther should be another protocol to apply it

fact that for the analysis that are going to be done it is not necessary to extract high amounts of soil.

Photos 15 and 16 extraction in profile with a thick grill

In order to obtain a reliable study there will be a minimum of 10 samples by plot (which means 10 samples corresponding to each depth) that will be used for the soils' study, and a minimum of 3 in the case of litter. As it has already been explained the 10 sample points match with the points on the cross. However, when some factors prohibit taking the sample at the exact location, the sampling point may be displaced within 0.5 meters of the exact location. If sampling is still not possible, the point will be replaced and another one in the grid selected within the NFI satellite. It must be properly documented (azimuth, distance).



Picture 25 Possible sample extraction in a surface equivalent to R=0, 5 m.

Other aspects to take into account:

• If in any case there is an obstacle to the sample extraction, the total depth of the profile will be taken note of (presence of the mother rock).

• If there is no problem on the samples extraction, it is advisable to take note of the total profile's depth on one of the samples' points, to be selected randomly.

• It is important to take note of the water table's depth (mainly in Aquitaine) so that we can know the water quality, contamination... and to establish a possible relation between this factor and the sanitary status (dieback...)

• To clean the surface of the soil before introducing the drill.

• The soil sample shall not be taken next to roads, fences or old constructions... We will try to avoid all point that is less than 1, 5 m from a tree so that we can avoid roots.

Photo 17 Preparation of the soil surface before taking the sample

Data 37 LITTER (C.1, C.5)

We will carry out the study of the organic horizon (litter) following the following characteristics:

•The amount of litter to be taken will be equivalent to a surface between 0, 1 and 0, 2 m^2 using as material a square bucket with the dimensions 30 x 30 (cm.), or a circular diameter 0,5 m.

•The number of samples will be 3, to be selected randomly and / or representatively among the 10 sample points. The use of buckets can be arbitrary, from example near a point of soil extraction or between two of them.

•To <u>estimate</u> the surface occupied by the litter we take as reference the total of the surface of the NFI satellite.

• The humus is already included in the sample that is taken for the litter.

• The living matter (herbaceous) will not belong to the sample, given the fact that it will be counted on the understorey estimation.

•<u>Variables to be measured</u>:

- Total depth of the extracted sample if it is <u>higher than 5 cm</u> (it is established that a knife will be used to cut the borders). The sample will be dried and weighted. Some of them can be used to check the C content also.
- If possible, to describe the different layers forming the sample. The dead cover or litter can have until 3 different layers:

Intact litter/dead surface cover	leaves and/or intact acicular on the ground	layer "L"
Litter/fragmented cover	leaves and/or fragmented acicular, where it is still possible to identify the origin of the organic matter that forms it	layer "F"
Humus	horizon that is in a humidification stage, placed right under the fragmented dead leaves, where it is impossible to identify the origin of the organic matter that forms it	layer "H"

Table 7 Litter composition

Data 38 DISTURBANCES (C.5)

- ***Indicator C.5.3.4: Fast visual assessment of soil disturbances (on transects)***

This type of indicator will be studied following the LIS[14] method, used for the "log" inventory about forest soils.

This indicator must be assessed on **all plots** in an **inter-rotation period**[15] and also on those that are **submitted to mechanic interventions.**

The type of disturbance will be described[16] and the % of the lenght that it occupies in relation to the total length of the transect.

The procedure is the following:

• To walk straight trough transects[17].

• To observe during the walk the different type of disturbance found and to note it down. The length of interception ribbon-disturbance will also be noted.

• The surface occupied by the disturbance will be immediately estimated as a percentage of transects total length.

DISTURBANCES (37)	
TYPE	Sup. occupied (%) or (m)
Compactness by machinery	15

[14] *Line Intersect Sampling* (LIS)
[15] the rotation of a forest stand will be defined as the period of time occured from the regeneration until the age for cutting
[16] A disturbance is understood as the erosion/desapearing of the forest surface or its compactation, as a consequence of the impact of the forest machinery, of two many roads and works or other possible factors.

[17] More information in III.2.2 LOG pag45

-"short term" indicators (on specific sites)

These indicators should be measured at the inter-rotation period, and are better measured in the first year after logging and/or site preparation.

The procedure is:

• Identify 10 to 30 sites that are managed under typical management regime and that are representative of the region/pilot zone (as already described).

• Identify the soil disturbance categories that are to be used in the surveys. Typical categories are, for example n:

Non forested linear and non-linear structures (trails, power lines)
Litter removal
Machinery trails and ruts
Compacted areas
Top soil removed, severity/depth classes may be distinguished

• At each stand, EVALUATE the surface occupied by permanent infrastructure and that is forested (non rehabilitated trails, power-lines etc),

• At each stand, EVALUATE the surface occupied by permanent non-linear structures and that is not forested (landing areas…),

• At each stand, EVALUATE SOIL DISTURBANCE in parallel transects [18]. See appendix.

- Indicator C.5.3.1: Risk of erosion (water quality indicators)

See mapping guide.

[18] Following the Metodo de Transectos Paralelos (Evaluation of the surface occupied by permanent linear infrastructuresV.6.2)

SOILS (on the NFI plot)										
H_{start} (3) 12h20										
H_{end} (3) 13,30										
Observations :										
(34)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
R (°)	**0**	**0**	**0**	**100**	**100**	**200**	**200**	**200**	**200**	300
D(m)	3	6	12	3	6	3	6	9	12	6

GENERAL PROFIL (35) and LITTER (36)										
SAMPLE PTO.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
General profile:										
0-30 (cm.)							NO			
30-60 (cm.)			NO			NO	NO			
Total depth(cm.)	70	NO	45	NO	NO	40	25	NO	NO	NO
Water table (cm.)	45	NO	NO	NO	NO	NO	NO	50	NO	NO
Litter :										
Thickness (cm.)				7,5			---			
Layer				L/F			L			
Occupied surf. By litter in relation to the entire plot (%) : 75										
Type of soil in the plot :										
PHOTO	~~1~~	**2**	**3**	~~4~~	**5**	**6**	~~7~~	**8**	**9**	**10**

DISTURBANCES (38) (in the plot)	
TYPE	Occupied surf. (%)
WORK	25

III.4. PROPOSED PROTOCOL FOR ESTIMATING THE UNDERSTOREY

Data 39 ESTIMATION OF THE COVER BY LAYER AND DOMINATING SPECIES (C.1)

It consists on inventorying the FCC and the height of the three dominating species on each layer[19], herbaceous and ligneous.

UNDERSTOREY (in the NFI plot) (40)					
E.ARBUSTIVO	Dominating species				Includes: - trees that were not taken into account on the main inventory - Wood shrubs with h < 2m
	Cover in relation to the total of the plot (%)				
	Medium height (m)				
	Cover by specie				
	Existence of acicular on the understorey				
E.HERBACEO	Dominating species				Includes : - semi-woody shrubs - Grass - DO NOT COUNT what we have used for the dead leaves
	Cover in relation to the total of the plot (%)				
	Medium height (m)				
	Cover by specie				

E.ARBUSTIVO	Dominating species	Ulex europaeus	Erica arborea	
	Cover in relation to the total of the plot (%)	90 %		
	Medium height (m)	1,5	0,4	
	Cover by specie	90	20	
	Existence of acicular on the understorey	SI		

19 Guide de l'utilisateur de la fiche brûlage dirigé, INRA-Avignon

IV FIELD DATA

IV.1. Device

IV.2. NFI plot

IV.3. Satellite RF / Satellite 1 / Satellite 2

COORDINATES					
$H_{plot's\ transfer}$ (3)		$H_{arrival\ plot}$ (3)		Region (1)	
H_{start} (3)		h_{end} (3)		Sequence num (4)	
Pauses: h_{start} (3)		h_{end} (3)			

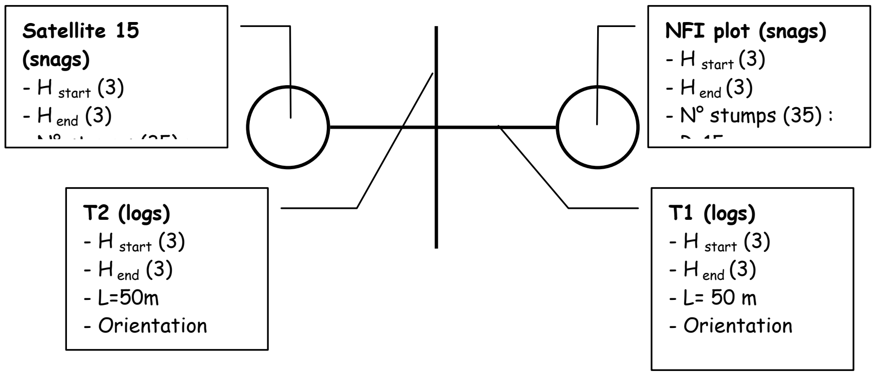
Closure (2)									NFI plot's Photo	Yes	NO

OTHER MEASUREMENTS (in the NFI plot)

Orientation (9)		Piled wood on the road (15)	Yes	NO
Slope (10)		Recent forest interv. (14)	Yes	NO
Topography (11)		Basal area (16) (m2/ha)		
Regeneration (12)	Artificial / Natural	Kind of association (13)		

DEAD WOOD

Localization (29)												
Typo (30)												
Specie (7)												
Descomp. Status (31)												
Diameter (cm) (20)												
H snag (cm) (32)												
L log (cm) (33)												
Fauna signs (34)												



SOILS (in the NFI plot)

H_{start} (3)

H_{end}(3)

Observations:

LOCATING THE FIELD (36)

R (°)														
D(m)														

GENERAL PROFILE (37) and DEAD LEAVES (38)

SAMPLE PTO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
General profile:														
0-30 (cm)														
30-60 (cm)														
Total depth(cm)														
Water table (cm)														
Dead Leaves :														
Thickness (cm)														
Layer														

Occupied surf. By the dead leaves in relation to the total of the plot (%):

Plot's type of soil :

PHOTO	1	2	3	4	5	6	7	8	9	10	11	12	13	14

PERTURBATIONS (39) (in the PLOT)

TYPO	Occupied surf. (%)

UNDERSTOREY (in the NFI plot) (40)

E.ARBUSTIVO	Dominating species			
	Cover in relation to the total of the plot (%)			
	Medium height (m)			
	Cover by specie			
	Existence of acicular on the understorey			
E.HERBACEO	Dominating species			
	Cover in relation to the total of the plot (%)			
	Medium height (m)			
	Cover by specie			

H_{start} :	H_{end} :

Observations

DATA NFI PLOT

Region (1)		Closure (2)									Sequence num.(4)		H $_{start}$(3)	H $_{end}$ (3)

				DENDROMETRIA							If DAMAGED TREE						OBSERVATIONS	Photography
											SYMPTOM/SIGN			AGENTE				
Tree's num. NFI (6) ( )	Tree's num. (5)	Specie (7)	Age of the mass (8)	Course (17)	Distance (18)	Diameter (19)	Social C. (20)	Edge effect (21)	Hg (22)	Hic (23)	Affected part (24)	Damage description (25)	% (26)	Factor (27)	Specific (28)	% (26)		

File SATELLITE 1 / SATELLITE 2 / SATELLITE RF

Region (1)		Closure (2)									Sequence num. (4)		H start (3) :	H end (3) :

			If DAMAGE TREE													**OBSERVATION**	Photography
			ESTADO DENDROMETRICO							**SANITARY STATUS**							
										SYMPTOM/SIGN			**AGENTE**				
Tree's numb. NFI (6)	Tree's number (5)	Specie (7)	Course (17)	Distance (18)	Diameter (19)	Social C. (20)	Edge effect (21)	Hg (22)	Hic (23)	Affected part (24)	Damage description (25)	% (26)	Factor (27)	Specific. (28)	% (26)		

V APPENDIX

CODES

Codes Flora Europaea[20]

Codes affected parts, signs and symptoms [21]

Codes biotic and non biotic agents [22]

MATERIAL LIST

CALCULATING THE EXISTANCE OF C IN THE FOREST ECOSSYSTEM[23]

CALCULATING THE STRUCTURE INDEX[24]

BIODIVERSITY

Inventory of the vascular plants at the device's level[25]

Carabs inventory

Birds' inventory[26]

SOILS STUDY

Estimation of soil disturbances[27]

Estimation of the occupied surface by permanent linear infrastructures[28]

Estimation of the occupied surface by non permanent linear infrastructures [29]

Estimation of the soils losses[30]

Methodological proposal for sample analysis in laboratory

BASIC NOTIONS LOCATION POINTS WITH GPS

FORSEE INDICATORS' LIST

[20] Mandatory Level I and Level II, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe, pags 20-21

[21] Mandatory Level I and Level II, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe, pags 34-36

[22] Mandatory Level I and Level II, Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests, United Nations Economic Commission for Europe, pags 38-45

[23] Mediante Ecuaciones Alometricas y Factores de Expansion de Biomasa

[24] Pommering, A., 2002: Approaches to quantifying foret structures. Forestry, 75, 305-324 y Aguirre, O., Gangying H., Gadow, K., and Jiménez, J., 2003: An analysis of spatial forest structure using neighbourhood-based variables. Forest Ecology and Management, 183, 137-145

[25] Método desarrollado por Braun-Blanquet, como describe Vanden Berghen C., 1973. (Initiation à l'étude de la végétation. Les Naturalistes Belges. Bruxelles.)

[26] Muestro mediante el metodo "point-count" (Blondel et al., 1981; Bibby et al., 1989).

[27] Metodo de Transectos Paralelos

[28] Linear Survey Procedure Method

[29] Non-Linear Survey Procedure Method

[30] Ecuación Universal de Pérdida de Suelo (USLE) (Ver GUIA CARTOGRAFICA FORSEE)

V.1.CODES

V.1.1. Codes Flora Europaea

Frondosas

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: Otras frondosas

Conifers

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: Chmaecyparis lawsonia
199: Otras coniferas

V.1.2. Codes affected parts, signs and symptoms

AFFECTED PART		SIGNS / SYMPTOMS			
ACICULAR / LEAVES					
Needles	13	Defoliated	01		
Leaves	14	→		Holes or partly devoured / missing	31
				Totally devoured / missing	33
				Notches (leaf/needle margins affected)	32
				Skeletonised	34
				Premature falling	36
		Light green to yellow discolouration	02		
		Red to brown discolouration	03		
		Other discolouration	05		
		Microfilia (small leaves)	06		
		Dieback			
		Deformations	08		
		Other symptoms	09		
		Signs of Insects	10		
		Signs of fungi	11		
		Other signs	12		
BRANCHES/BUDS/YEMAS					
Buds	21	Defoliated	01		
Shoots (< 2 cm), Twigs	22	Deformations	08		
Branches (2-10 cm)	23	→		Bending, drooping, curving	61
Branches (> 10 cm)	24			Cankers	62
Buds	27			Tumours	63
Leader shoot	26			Whitches broom	64
				Other deformations	52
		Broken	13		
		Dead/Dying	14		
		Abscission/Cut	15		
		Necrosis (necrotic parts)	16		
		Wounds (debarking/cracking)	17		
		Resin flow (conifers)	18		
		Slime flux (broadleaves)	19		
		Decay / rot	20		
		Other symptoms	09		
		Signs of Insects	10		
		Signs of fungi	11		
		Other signs	12		
TRUNK/STUMP					
Trunk	31	Deformations	08		
Bole	32	→		Cankers	62
Roots (exposed)/Stump	33			Tumours	63
				Whitches broom	64
		Necrosis (necrotic parts)	16		
		Wounds (debarking)	17		
		→		Debarking	58
				Cracks (frost cracks…)	59
				Other wounds	60
		Resin flow (conifers)	18		
		Slime flux (broadleaves)	19		
		Decay / rot	20		
		Broken	13		
		Tilted	21		
		Other symptoms	09		
		Signs of Insects	10		
		Signs of fungi	11		
		Other signs	12		

V.1.3. Codes biotic and non biotic agents

BIOTICS	
GAME AND GRAZING (100)	
Deer	110
Gnawing	120
Birds	140
Other vertebrates	190
INSECTS (200)	
Defoliators	210
Stem, branch and twig borers (incl. shoot miners)	220
Bud boring insects	230
Fruit boring insects	240
Sucking insects	250
Other insects	290
FUNGI (300)	
CONIFERS	
Needle casts and needlerust fungi *(Lophodermium/Leptostroma, Cyclaneusma/Naemacyclus, Thyriposis, Mycospherella/Dothistroma*)	301
Stem and shoot rusts *(Melampsora, Cronantium, Coleosporium, Cronantium)*	302
Dieback and canker fungi *(Canangium, Gremmeniela)*	309
Blight *(shaeropsis/Diplodia, Sirococcus)*	303
Decay and root rot fungi*(Fomes/Trametes, Amillaria, Heterobasidion)*	304
FRONDOSAS	
Leaf Spot fungi*(Drepanopeziza/Marssonina, Rhytisma, Taphrina, Mycosphaerella, Septoria, Harknessia)*	305
Anthracnose *(Opiognomonia)*	306
Powdery mildew (*Mycosphaera)*	307
Wilt *(Ophiostoma, Ceratocystis, Venturia)*	308
Rust *(Mellampsora, Melampsoridium)*	302
Blight *(Botryosphaeri/Diplodia, Hypoxilon, Dothichiza)*	303
Cankers *(Cryphonectria/Endothiella, Pezicula, Stereum, Cytospora/Valsa, Nectria)*	309
Deacy and root rot *(Fomes, Ganoderma, Ungulina, Phytophthora)*	304
Deformations *(Taphrina)*	310
Other fungi (conifers and frondosas)	390
DIRECT ACTION OF MAN (500)	
Silvicultural operations or forest harvesting (540)	
Cuts	541
Pruning	542
Resin tapping	543
De-barking	544
Other treatments	545
ABIOTIC AGENTS (400)	
PHYSICAL FACTORS (420)	
Nutritional Disorders	411
Avalanche	421
Drought	422
Flooding/highwater table	423
Frost	42401
Late frost	42402
Hail	425
Lightning	427
Wind / Tornado	431
Snow/ice	430
Fire	600
OTHER FACTORS (800)	
Parasites, epiphytic, climbing plants	810
Bacteria	820
Virus	830
Nematodes	840
Competition	850

Other (known cause but not included on the list)	890
UNKNOWN ➔ take a picture	999

V.2. Material list

→ Locating plots : aerial photos and maps of the area (see mapping guide), GPS or a compass and ribbon, topofil

→ Materialization of the plot: maker poles

→ Marking trees: ink

→ Photographic camera

→ Dendrometric status: Forest compass or diametric ribbon, VERTEX or SUUNTO

→ Decomposition status of snags and logs : metallic stick 5mm thick and non sharpen point

→ Soil status: map with sample points (azimuth and distances), bowl of 30 x 30 cm, plastic bags, small pickaxes to materialize points, drill for sample extraction, a knife.

→ Data

→ Pencils and pens

V.3. Calculation of the total carbon stock on the forest ecosystems

There are 5 different types of deposits where the carbon can be accumulated on the forest ecosystem:

(1) In the Biomass above the soil
(2) In the Biomass bellow the soil (roots).
(3) In the Litter (non decomposed matter: leaves, shoots, seeds, etc.)
(4) In the Dead Wood
(5) In the soil (considered by the IPCC (1996) until a depth of 30 cm., given the fact that the soil changes affect mostly the first layers

(1) <u>On the Biomass above the soil</u>

Calculation of the existence of carbon:

There are direct and indirect methodologies to estimate the biomass on the forest:

- The *direct methodology* consists on cutting the tree and the understorey and to weigh the biomass directly, determining its dry weight. This method is not related with the objectives of the FORSEE project, so it will not be followed (except for some regions that will carry a specific study about this subject: Navarre, Portugal, Galicia e Ireland) to establish dedrometric equations.

- The *indirect methodology* consists on using equation and mathematic models calculated trough the analysis of the regression between variables collected on the field and in forest inventories (Brown, 1997). The biomass can also be estimated trough the volume of the stem using the basic density to determine the dry weight and using a factor of expansion to determine the total dry weight (total biomass of the tree). Both methods give us quite different estimations of biomass and accumulated carbon. The estimation of biomass and accumulated carbon using the volume gives us quite superior values of the ones obtained trough the application of the equations. It is likely that most of the difference is due to the fact that, usually, it is not reduced from the equation, the volume of rotten or defected matter.

•<u>Method of the biomass Expansion Factors (BEF) (to estimate the biomass from its commercial volume or from the stub)</u>

The biomass expansion factor (BEF) is the relation between the total biomass and the commercial biomass. It changes according to the degree of the forest intervention. Therefore, according to the literature, there is a smaller FE for closed and less modified forests and a higher FE for open and more modified forests (Brown and Lugo, 1984). However, certain studies show that it does not seem to be a clear relation between the BEF and the basement area, the medium quadratic diameter (DMC) or the amount of accumulated biomass. (Schlegel, Bastienne, *Estimación de la biomasa y carbono en bosques del tipo forestal siempreverde*, Work presented on the International Symposium Medición y Monitoreo de la Captura de Carbono en Ecosistemas Forestales. Valdivia, Chile 19-20 October 2001)

When it is necessary to do estimations of biomass or carbon with previous inventories, the biomass expansion factors can be used. With the BEF we can count the total aerial biomass in the forest, starting with the commercial volumes that were estimated. Actually, it is more current to know the commercial volumes of the forest than its total biomass. Therefore, knowing the proportion of the total aerial biomass by unity of the commercial volume, we can transform into biomass the commercial volumes of a forest and latter estimate the carbon mass in the trees' level (Brown, 2001).

We propose to use the data given by the different NFI of each region, together with the data obtained from FORSEE.

The procedure is the following:

1) Data to begin with: Volume[31] of the main biomass (Volume of Wood with Bark)

2) Going from the main volume of biomass to the total volume of biomass (branches and leaves). We apply a factor of biomass expansion (BEF), based on field experiences.

Wood volume with bark (m^3 or m^3/ha) x BEF = Volume of the total biomass

3) Afterwards this value will be reduced to dry matter and carbon multiplied by the factors 0, 5 and 0, 5 (IPCC, 1992).

Vol. total biomass (m^3 or m^3/ha) x wood basic density [32]= Weight total biomass

[31] Source : NFI of each region

Weight total biomass x C concentration on wood = C total content (tn or tn/ha)

This information is the first approach to the estimated number of Carbon taken from the biomass.

•Method of the alometric equations (estimating the biomass directly from the measurements of individual trees)

The accumulated carbon on the tree's vegetation can be indirectly estimated from the biomass equations (i.e., alometric relations), which establish a relation between a parameter of the tree and its total biomass (Brown, 2001). Usually, the parameter of the tree is the diameter on 1.3 m from the grown. The biomass equations improve its capacity to foresee when they consider at the same time the variables diameter and height.

The mathematic models that better assess the aerial biomass are of alometric type, which form is $Y= aX^b$ with logaritmic transformation. They present a high coefficient of determination adapted to a low standard mistake of assessment. However, there are several models that can be followed. The most convenient one shall be selected.

We propose to use data obtained from the FORSEE inventory.
Following there are several examples of series of alometric equations:

Nr.	Model
1	$Y = a X^b$
2	$Y= a + b X + c X^2$
3	$Y = a + b X + c (X^2 + H)$
4	$Y = a + b X+ c X^2 + d (X^2 H)$
5	$Y = a + b X^2 + c (X^2 H)$
6	$Y = a + b X + c H$
7	$Y = a X^b H^c$

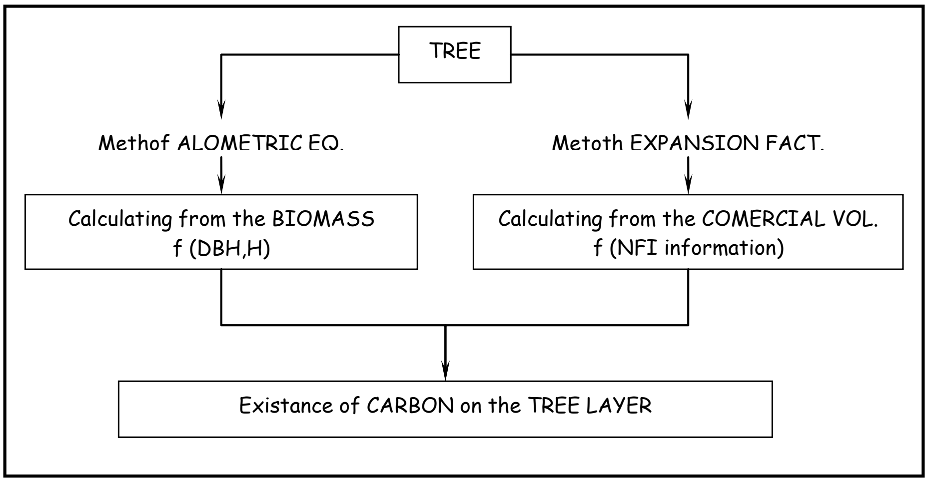
Table 8 Models of better adaptation to assess the aerial biomass in the forest according to the DBH and the total height (H)

Nr.	Model
1	LN(BT)=-1,835+2,291*LN(DAP)
2(*)	LN(BT)= -1,897+2,309*LN(DAP)
3(*)	LN(BT)=-2,647+2,104*LN(DAP)+0,502*LN(HT)

[32] Taking into account the the weight of wood changes with its himidity, the basic density is defined (D_b) as the relation between the dry matter (anhidra) and the volume of humidity on the sample.

4	LN(BT)=-1,624+2,235*LN(DAP)
5(*)	LN(BT)=-2,294+2,057*LN(DAP)+0,438*LN(HT)
6	LN(BT)=-2,041+2,340*LN(DAP)
7(*)	LN(BT)=-2,460+2,082*LN(DAP)+0,462*LN(HT)

Table 9 BT: Total biomass on the soil (aerial); DBH: diameter breast height; HT: total height. (*) the trees with DBH are considered ≥10cm, all the other equations consider trees with DBH >5 cm. (Schlegel, Bastienne, assessing the biomass and carbon on coniferous forest, Work presented on the International Symposium Measurement and Monitoring of the Carbon Sequestration on Forest Ecosystems. Valdivia, Chile 19th - 20th October 2001)



Picture 26

(2), (3), (4), (5) In the Biomass bellow the soil, litter, dead wood and soil.

• FORSEE Methodology

It is understood as the total sum of the amount of carbon that is find on the study area, using for its calculation the tree biomass, the understorey, the dead wood and the litter.

It will be done from the data obtained in the inventory of the pilot zones.

There are two ways to estimate the carbon:

a) Collecting data on the field, combined with the tree's inventory or the information supplied by the different NFI of each region. To do laboratory analysis of the humidity on the vegetal matter of each plot, to determine the biomass of the component, using reducing factors to determine the carbon.

b) The use of expansion factors calculated for the tree biomass to total biomass of the system, also available on other studies. This second option, indirect, shall be used with precaution given the different situations where it can be found and given the fact that the expansion factors that are created are characteristic of each place.

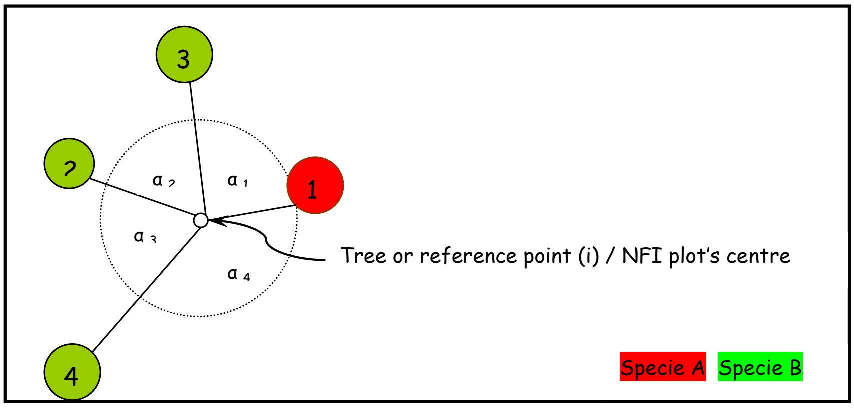
V.4. Structural indices calculation

a) **Aggregation status**: A point of reference is selected (i) (the INF's plot centre) and we measure the angle that is formed by the four trees that are closer to it, two by two ($\alpha_1, \alpha_2, \alpha_3, \alpha_4$).

The indices in question are obtained applying the following formula: $\boxed{W_i = (1/n)\ \Sigma\ \gamma_j}$, where $\gamma j = 1$ if $\alpha_n < \alpha_0$ [33] and $\gamma_j = 0$ on the other case.
The indices to be used will be **0.00, 0.25, 0.50, 0.75 y 1.00**

b) **Mixture of species**: The tree of reference is selected (i) and the four trees that are closer to it. We observe if they belong to the same specie as the sample tree.

The formula to be applied on that case is the following: $\boxed{M_i = (1/n)\ \Sigma\ \gamma_j}$, where $\gamma j = 0$ if they belong to the same specie and $\gamma_j = 1$ on the other case.
The indices to be used will be **0.00, 0.25, 0.50, 0.75 y 1.00**



Picture 27 Calculation of the structure indices on a stand

Aggregation status: Wi = (1+1+0+0) / 4 = 0.50 indices that indicate that two of the angles between the four that were measured is inferior to the ideal angle α_0

Species mixture: Mi = (1+0+0+0) / 4 = 0.25 indices which indicate that one of the four closer trees that belongs to another specie.

---

[33] $\alpha_0 = 72°$ is the angle that represents the ideal aggregation when there is a selection of the four trees that are closer to the reference tree.

V.5. BIODIVERSITY

V.5.1. Inventory of vascular plants (C.4.10.a)

The operator will:

- Select in the field an area which seems homogeneous for the flora and ecological factors (topography, aspect, slope…)

*Aquitaine The area is about 400m^2 in a forest stand (20mx20m).

- Avoid any "border effect".

- perform an exhaustive inventory of vegetation, per strata:

  A = layer of the trees h > 7 m
  B = shrubs 1 ≤ h ≤ 7 m
  C = herbaceous, non ligneous plants, generally less than h < 1 m.

- Note the % cover per stratum and the maximum height of trees and shrub layers (visually estimated)

- Assess the abundance of each species, using Braun-Blanquet index (tab following):

Coefficient	FCC
5	**> 75%**
4	**50-75%**
3	**25-50%**
2	**10-25%**
1	Several plants but **very low cover**
+	**Rare**, few individuals

V.5.2. **Carabs inventory** (C.4.10.b)

- Ground-dwelling carabids will be sampled with the pitfall trap method (e.g. Niemelä *et al.*, 1988; Spence and Niemela, 1994).

- In each stand 5 pitfall traps will located at least 10 m apart in a cross design and in the centre of the stand in order to avoid edge effects

- Each trap will have a volume of > 500 ml and will be filled with ethylene-glycol or formalin or a solution of quaternary ammonium diluted at 25 %. Quaternary ammonium solution is less sensitive to the evaporation caused by high summer temperatures and allows good specimen conservation.

-
- Each trap will be covered (for example with a small wood plate supported by four nails at 2 cm above the ground level) to be protected from rainfalls, debris and small mammal disturbances.
-
- Trapping period will go continuously from late April to mid-October (with a possible break during summer) and traps will be collected every 3 weeks (or 2 weeks if the captures are abundant).

V.5.3. Birds inventory (C.4.10.c)

The observer is located in the middle of the stand and records all birds heard or seen during 20 minutes within 5 h after sunrise, only on days without rain.

We advise the observers to use an "unlimited distance within the stand" to ensure that all birds recorded are located within the limits of the sampled stand, especially for long-distance singers such as woodpeckers or thrushes.

Each count includes two visits, the first during the early breeding season (mid-April to mid-May) and the second during the late breeding season (mid-May to mid-June).

Each singing male heard or breeding pair seen are recorded with a score of 1 and each non-singing bird heard or seen are recorded as 0.5 (Muller, 1997).

The scores of the different individuals are summed for a given species so that the abundance index is semi-quantitative and ranges from 0 to 5, because distinguishing more than 5 singers of the same species becomes indeed difficult for the observer.

Double counting the same individuals is avoided by drawing the approximate positions of birds in virtual concentric circles around the observer's position (Prodon & Lebreton, 1981).

Thus, bird species abundance used for further analysis is the highest score noted for each species among the two visits.

V.6.SOILS STUDY

V.6.1. Assessment of soils disturbances

Method of parallel transects

Along transects points will be evaluated at regular intervals. The length of transects, the distance between transects and the distance between points within transect should be organised to yield 100 points per stand, irrespective of plot area or shape.

A regular grid of points to be surveyed are laid out in the area to be reforested using parallel transect lines. They are laid out perpendicular to the maximum disturbance assessed visually.

The start point for the first transect if selected randomly. Other transects are parallel to this first one. Distance between transects and between the points that are going to be surveyed are calculated depending upon the surface of the area to be reforested.

• If the surface is smaller than 1.0 ha distance from point to point in each transect is 4 m and distance form transect to transect will be calculated to survey 100 points regularly.

• From 1 ha onwards the distance between points will be 5 metres and the distance between transects will be calculated to be 100 points

• In plots > 1ha, when recorded disturbance *is near a relevant threshold* or when more precision is required, additional transects will be conducted so the total nb. of points measured are 200 for 2ha plot, 300 for 3 ha plots… and a maximum of 500 for plots ≥ 5h. points.

Transects are walked and the disturbance category at each sampling point is **visually evaluated and recorded**. No samples are taken. If more than one category is identify, only the most severe one will be recorded.

With this procedure the total disturbed soil surface and its confidence limits can be assessed.

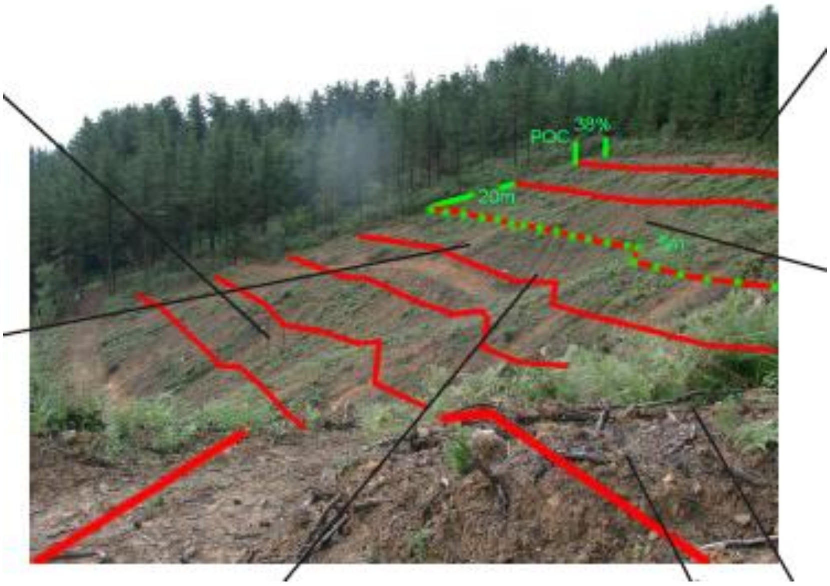


Photo 18 is the example of a survey at 1 hectare plot. The parallel transects are spread 20 m while points are measured every five meters. This way 100 pints are evaluated in this plot. At each point a visual estimation of disturbance is made.

Photo 19 Compact area

Photo 20 gouges

Photo 21 Impact by machinery wheels

Photo 22 scalps

Foot 23 Fire residues

Photo 24 Removed soil

Photo 25 Non disturbed soil

V.6.2. Evaluation of the surface occupied by permanent linear infrastructures

Linear Survey Procedure Method

The main characteristics of this method are the following:

- Are considered linear structures, for example, roads, fire-brakes or electrical lines. The landing areas are not considered linear structures.

- . Each linear structure present in the plot must be evaluated separately.

- If different roads differ in width more than 2 m they are also be considered as different structures, and as such they are surveyed.

- For each structure the whole horizontal length and at least **10** horizontal widths will be measured to estimate the area occupied by it. To do so, a visual estimation of the length of the structure to be surveyed is done.

- The first width to be measured is set up at half of this interval and afterwards the measures are done on the interval basis. At each point, the length of the measured interval, the longitudinal slope and its width are recorded.

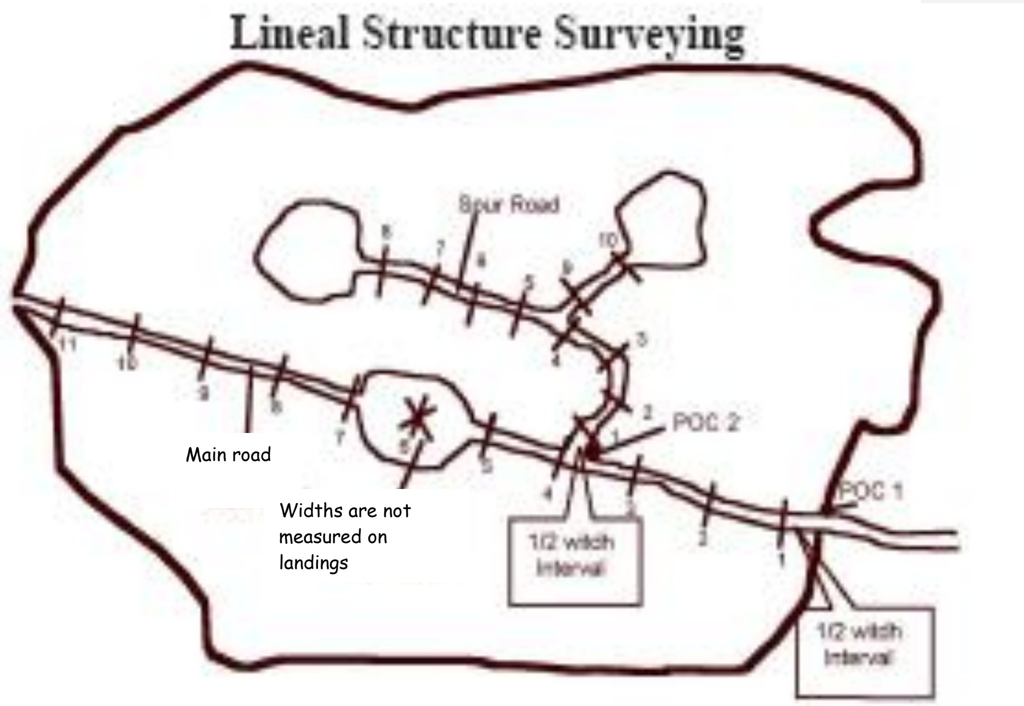
- The width is measured as the distance from the outer points of it considering as part of the structure the *upper part of the cut* and the end of the horizontal plane.

- The slopes are recorded in order to estimate the horizontal area of the structure and to be able to estimate the percentage of the stand's surface that is covered by such structures.

- When the interval for width measurement falls in a landing area it is not recorded and the length that falls in the landing area is not considered for lineal structure calculation.

- If it falls on a junction of structures the point for width measure is moved until the junction finishes and the width is measured there. The next width is the measure at the point where the interval falls.

- With the width values measured this way the width confidence interval can be calculated and thus the area error for the surface that each structure occupies.


Lineal Structure Surveying
Spur Road
POC 2
POC 1
Main road
Widths are not measured on landings
1/2 width Interval
1/2 width Interval

V.6.3. Evaluation of the surface occupied by non permanent linear infrastructures

V.6.4.

Non-Linear Survey Procedure Method

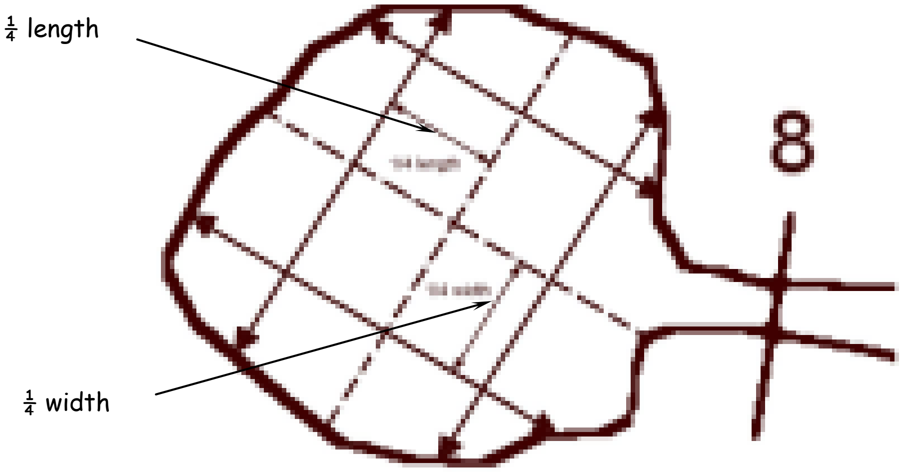
At each stand, EVALUATE the surface occupied by permanent non-linear structures and that is not forested (landing areas…), using the NON-LINEAR SURVEY PROCEDURE.

- Non-lineal structures are landing areas, logging areas... that are left unplanted.

- To estimate the area occupied by these structures, **four** measures are taken in each of them. The length of the structure is divided into quarters and the width at the first and third quarters along with their slopes are measured. The width of the area is also divided into quarters and the length of the area and their respective slopes at the first and the third quarter are measured.

- The mean of the horizontal lengths and of the horizontal widths are calculated and the area is estimated as the product of these figures for each of them that can afterwards be added up to estimate the percentage area occupied by these structures.

Non-lineal Structure Surveying



V.6.5. Proposal for sample analysis in laboratory

Sample's depth	Analysis and calculations	Criterion
0-60 cm.	C total (after decarbonisation) Texture Apparent density: calculation f =(texture, C) Water retention capacity: calculation f =(texture, C)	C1.4/C5.3.5 C1/C5 C1/ C5.3.4
0-30 cm.	Cationic interchange (alkaline) $Na+$, $K+$, $Ca2+$, $Mg2+$ ($NH4+$ imp. Soils acidification) Cationic interchange (acids) $Mn+$, $Al\ 3+$, $H+$ C total (after decarbonisation) and N total P assimilated pH water **(*)** CEC and BS (calculation) C/N ratio (calculation)	C 5.3.2 C 5.3.2 C 5.3.5/C 5.3.6 C 5.3.2 C 5.3.1 C 5.3.3 C 5.3.7

(*) It is proposed:

- soil volume: humus: 0-15; 15-30 cm
- repetitions: n=10 for humus y 0-15; 15-30 cm
- stratified sample depending on the distance between the lines in plantations
- random sample on the other cases

- The **methods to be followed**: it is proposed to unify the criterions between the ISO (International) norms and the NF (France) norms. The information can be found online:

ISO methods www.iso.org	
AFNOR methods http://www.afnor.fr/portail.asp?Lang=English:	

	Analysis and calculations	Norm
Methods	C total (after decarbonisation)	ISO 11694
	Texture	NF X 31-107
	Total P, K, Ca, Mg	**(*)**
	N total	ISO 13878
	P assimilated	**(**)**
	pH water	ISO-10390
	CEC	ISO-23470
	Mineralization N potential	**(***)**

(*) It is proposed:

a) Solubilisation by acid attack: NF X 31147
b) Determining elements: ISO 11885
c) Other methods: alkaline fusion

(**) Method to be decided. Proposed:

a) For local use and on all samples: ISO 11263

b) For a subgroup of samples with the purpose of establishing comparisons between the regions:

- Composed with a minimum of 1 g of soil (dried and sifted on 2 mm) on suspension (deionised water, quotient 1:10)
- "Shaking" for 16H
- Filtration
- To quantify following the colorimetric method (ej. *Van Veldhoven, Manaerts. 1987. Inorganic and organic phosphate measurements in the nanomolar range. Analytical Biochemistry, 161: 45-48).*

(***) Free choice: each area will use the method that they consider the most accurate. Nevertheless, we propose:

a) *in situ*:

- Raison, Connell, Khanna. 1987. Methodology for studying fluxes of soil mineral-N in situ. Soil Biol. Biochem., 19: 521-530.)

b) In laboratory:

- Bauhus, J. 1996. C and N mineralization in an acid forest soil along a gap-stand gradient. Soil Biol. Biochem., 28: 923-932

- Cote, L., Brown, S., Pare, D., Fyles, J., Bauhus, J. 2000. Dynamics of carbon and nitrogen mineralization in relation to stand type stand age and soil texture in the boreal mixedwood. Soil Biol. Biochem., 32: 1079-1090.

- Also, the following are considered as **optional indicators**:

  - The soil's nutritive status: Total N, Ca, Mg, P, K

  - Biologic proprieties: mineralization N potential

  - For disturbances: apparent density, resistometry, total C

V.7. Basic Notions about locating points with GPS

- The coordinates of the points to be followed (waypoints or points to reach) can be introduced on the device before leaving the field, after being calculated on **stage 1**

-Once we are located on the starting point, where the route will start from, we will connect the GPS receiver system and we will continue by selecting the waypoints points that we shall follow and that have been previously introduced.

-The GPS receiver system will inform us about the distance that there is between the point that we will follow and the azimuth.
-Continuing, we will fix the itinerary that seems the most accurate.

-When the GPS will be in a distance inferior to 5m from the point to be studied and the coordinates have stabilized we will consider that we have reached our point.

-If, as a consequence of the environment conditions (forestry cover, signal transmission, satellites arrangements…), the reception will be defective and there isn't a constant information, moving us away from the point where we are in about 10m, all we have to do is find a close place where the information will be stable and from it we will finalize the route by using a compass and a ribbon, in a traditional way.

V.8. FORSEE LIST OF INDICATORS

FORSEE INDICATORS LIST (Version 8)

List of indicators considered as interesting for FORSEE test by the experts groups

FORSEE Indicator Code	Criteria	Short description	Origin			Type of work requested		
			Process	ID in process	Type	Map (T2,1)	Field (T2,2)	Enquiry (T2,3)
C1.1	1	Forest area – Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area	MCPFE Vienn	1.1	Indicator	X		
C1.2	1	Growing stock – growing stock on forest and other wooded land, classified by forest type and by availability for wood supply	MCPFE Vienn	1.2	Indicator	X		
C1.4	1	Carbon stock (EXPANSION FACTORS)	MCPFE Vienn	1.4	Indicator	X		
C1.4.1	1	Carbon stock in the woody biomass (above and below ground)	MCPFE Vienn	1.4.1	Indicator	X	X	X
C1.4.2	1	Carbon stock in the soils	MCPFE Vienn	1.4.2	Indicator		X	
C1.4.3	1	Carbon in the dead wood stock	IPCC	1.4.3	Indicator		X	
C1.4.4	1	Carbon in the litter stock	IPCC	1.4.4	Indicator		X	
C1.4.5	1	Carbon in the understorey	IPCC	1.4.5	Indicator	X	X	
C2.4	2	Damages	MCPFE Vienn	2.4	Indicator		X	
C2.4.a	2	Key factors for damages	Expert group proposal		Verifiers		X	
C3.1	3	Increment and fellings	MCPFE Vienn	3,1	Indicator	X		
C3.2	3	Roundwood harvested (Value and volume)	MCPFE Vienn	3,2	Indicator		X	X
C3.3	3	Non Wood Products	MCPFE Vienn	4,2	Indicator			X
C3.5	3	Forest under management plans	MCPFE Vienn	3,5	Indicator	X		X
C3.6	3	Accessibility	MCPFE Lisbo:	3,6	Indicator	X		X
C3.7	3	Harvestability	MCPFE Lisbo:	3,6	Indicator	X		
C4.1	4	Tree species composition	MCPFE Vienn	4.1	Indicator	X		
C4.10a	4	Vascular plant diversity	Expert group proposal		Verifiers		S	
C4.10b	4	Carabid diversity	Expert group proposal		Verifiers		S	
C4.10c	4	Birds diversity	Expert group proposal		Verifiers		S	
C4.11	4	Habitat parameters	Expert group proposal		Verifiers		X	
C4.2	4	Regeneration	MCPFE Vienn	4.2	Indicator	X		
C4.3	4	Naturalness	MCPFE Vienn	4,3	Indicator	X		
C4.4	4	Introduced tree species	MCPFE Vienn	4,4	Indicator	X		
C4.5	4	Deadwood	MCPFE Vienn	4,5	Indicator		X	
C4.7	4	Landscape pattern	MCPFE Vienn	4,7	Indicator	X		
C5.1.1	5	% and length of stream length with appropriate riparian buffer	Expert group proposal		Indicator	X		
C5.1.2	5	Potential erosion risk	Expert group proposal		Indicator	X		
C5.1.3	5	Road/Trail density in the riparian areas	Expert group proposal		Indicator	X		
C5.3.1	5	Carbon soil stock and Water Holding Capacity	MCPFE Vienn	1.4.2r	Indicator		X	
C5.3.2	5	Nutritive Status / total depth- water table depth	MCPFE Vienn	2.1	Indicator		X	
C5.3.3	5	Total nutrient stocks & nutrient Balance	Expert group proposal		Indicator		X	
C5.3.4	5	Fast visual assessment of soil disturbance	Expert group proposal		Indicator		X	
C5.4.1	5	Soil disturbance related to standard forest management activities	Expert group proposal		Indicator		S	
C5.4.2	5	Physical characterisation of soil disturbance categories	Expert group proposal		Verifiers		S	
C6.01	6	Forest holdings	MCPFE Vienn	6,1	Indicator			X
C6.03	6	Net revenue	MCPFE Vienn	6,3	Indicator			X
C6.04	6	Expenditure for services	MCPFE Vienn	6,4	Indicator			X
C6.05	6	Forest sector workforce	MCPFE Vienn	6,5	Indicator			X
C6.06	6	Occupational safety and health	MCPFE Vienn	6,6	Indicator			X
C6.10	6	Accessibility for recreation	MCPFE Vienn	6,10	Indicator			X
C6.12	6	Total economic value of forest production	Expert group proposal		Indicator			X

S : Special field activity not using always the same plots as the others indicators

FORSEE INDICATORS LIST (Version 8)

List of indicators considered as interesting for FORSEE test by the experts groups

FORSEE Indicator Code	Criteria	Short description	Priority for evaluation on the pilot zone								
			Ireland	Aquitaine	Navarra	Euskadi	Cantabria	Castilla y Leon	Galicia	Portugal N	Portugal C
C1.1	1	Forest area – Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area	1	1	1	1		1	1	1	1
C1.2	1	Growing stock – growing stock on forest and other wooded land, classified by forest type and by availability for wood supply	2	1	1	1		1	1	1	1
C1.4	1	Carbon stock (EXPANSION FACTORS)	1	1	1	1		2	1	1	1
C1.4.1	1	Carbon stock in the woody biomass (above and below ground)	1	1	1	1		1	1	1	1
C1.4.2	1	Carbon stock in the soils	1	1	3	1		2	1	1	1
C1.4.3	1	Carbon in the dead wood stock	2	1	3	1		2	2	1	1
C1.4.4	1	Carbon in the litter stock	2	1	3	1		2	2	1	1
C1.4.5	1	Carbon in the understorey	1	1	3	1		2	2	1	1
C2.4	2	Damages	1	1	1	1		1	1	1	1
C2.4.a	2	Key factors for damages	1	1	1	1		1	1	1	1
C3.1	3	Increment and fellings	2	1	1	2		1	1	1	1
C3.2	3	Roundwood harvested (Value and volume)	2	1	2	2		1	1	1	1
C3.3	3	Non Wood Products	2	2	2	1		2	2	1	2
C3.5	3	Forest under management plans	1	1	1	1		1	1	1	1
C3.6	3	Accessibility	1	2	3	1		1	1	1	2
C3.7	3	Harvestability	1	2	3	1		2	1	1	2
C4.1	4	Tree species composition	1	1	1	1		1	1	1	1
C4.10a	4	Vascular plant diversity	3	1	3	1		2	2	2	2
C4.10b	4	Carabid diversity	3	1	3	3		2	3	3	1
C4.10c	4	Birds diversity	3	1	3	3		3	3	3	1
C4.11	4	Habitat parameters	3	1	3	2		1	2	3	1
C4.2	4	Regeneration	1	1	2	1		2	2	1	1
C4.3	4	Naturalness	1	1	2	1		2	1	2	1
C4.4	4	Introduced tree species	1	1	2	1		1	1	2	1
C4.5	4	Deadwood	2	1	2	1		2	2	2	1
C4.7	4	Landscape pattern	2	1	3	1		1	1	3	1
C5.1.1	5	% and length of stream length with appropriate riparian buffer	1	1	1	1		1	1	3	1
C5.1.2	5	Potential erosion risk	2	1	1	1		1	1	3	1
C5.1.3	5	Road/Trail density in the riparian areas			1						
C5.3.1	5	Carbon soil stock and Water Holding Capacity	1	1	1	1		1	1	1	1
C5.3.2	5	Nutritive Status / total depth- water table depth	3	1	2	1		1	1	1	1
C5.3.3	5	Total nutrient stocks & nutrient Balance			3						
C5.3.4	5	Fast visual assessment of soil disturbance	3	2	1	1		2	1	3	1
C5.4.1	5	Soil disturbance related to standard forest management activities	2	2	3	1		1	1	3	2
C5.4.2	5	Physical characterisation of soil disturbance categories			3						
C6.01	6	Forest holdings	1	1	1	1		1	1	1	1
C6.03	6	Net revenue	1	2	2	2		2	2	1	1
C6.04	6	Expenditure for services	1	2	3	2		2	2	1	1
C6.05	6	Forest sector workforce	1	1	2	2		2	1	1	1
C6.06	6	Occupational safety and health	2	2	2	2		2	2	1	1
C6.10	6	Accessibility for recreation	2	2	2	1		1	2	1	1
C6.12	6	Total economic value of forest production	2	2	3	2		2	2	1	1

S : Special field activity not using always the same plots as the others indicators

1 : This indicator will be evaluated on the pilot zone
2 : We will try to evaluate this indicator on the pilot zone
3 : We probably won't try to evaluate this indicator on the pilot zone