FIELD INSTRUCTION
FOR THE

NATIONAL INVENTORY OF THE LANDSCAPE IN SWEDEN

NILS

YEAR 2007

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1. GENERAL

1.1. INTRODUCTION TO THE MANUAL

The manual begins with a general description of the National Inventory of the Landscape in Sweden (NILS), followed by detailed information about the field inventory. Each inventory module starts with a short explanation of the criteria that needs to be met in order to register the object, and an overview of the procedures. This is followed by a detailed description of how the different variables are to be registered. The program in the field computer has different sub-menus depending on the type of inventory object, i.e. some variables are flow directing. Because of this, the order in the manual is not always the same as that in the computer program. In order to facilitate work with the field computer, there is a flowchart for every inventory module. The Appendices contain definitions, technical instructions, species lists and other information.

The following people have contributed with text and viewpoints to the manual: Åke Bruhn, Hans Ivarsson, Hans Kallur, Nic Kruys, Lars Lundin, Per Löfgren, Ronny Löfstrand, Jon Moen, Björn Nilsson, Torgny Nilsson, Anki Weibull and Örjan Östman. The field inventory members have continuously supplied valuable opinions and additions. Revision of the 2007 edition has been made by Åsa Gallegos.

1.2. DESCRIPTION OF NILS

The aim of NILS is to map the biodiversity from a landscape perspective and to study the changes over time. The main aim of the survey is to monitor conditions for biodiversity and factors that influence biodiversity. Special focus is aimed at conditions and changes in land use and land cover and sizes and distributions of different types of ecosystems in the landscape.

The main financier for NILS is the Swedish Environmental Protection Agency (EPA). NILS is part of the EPA's national environmental monitoring and is included in the program area Landscape. The inventory includes all terrestrial environments in Sweden – agricultural land, wetlands, populated environments, forests and alpine areas. The results are used in the follow-up of national environmental objectives as well as in the follow-up of Natura 2000 habitats. NILS is based on a combination of aerial photo interpretation and field inventory. The aerial photo interpretation is carried out on infrared aerial photos with a scale of 1:30 000. Through the aerial photo interpretation both a rough estimate of the landscape and data for formal estimates of conditions and changes where field data is included can be gained. This is called a two-phase estimate. This way, NILS does not depend on using the same kind of aerial photo interpretation through the duration of the program. If new, more effective remote analysis methods are developed, they can replace the methods used at this time. It is therefore essential that field inventory is performed in a uniform manner during the entire program.

As of year 2006 an inventory of a sample of pastures and meadows is included in NILS, based on the inventory of semi-natural pastures and meadows performed by the Swedish Board of Agriculture and the County Administrative Boards in 2001-2004. This addition to NILS is financed by the Swedish Board of Agriculture. The aim is to follow the qualitative changes in semi-natural pastures and meadows in a way that describes their value for

biological diversity.

NILS consists of the following parts:

- General aerial photo interpretation within a 5x5 km square (the “landscape square’).
- Detailed aerial photo interpretation within a central 1x1 km square of surface objects (comprehensive surveying of land cover based on a detailed class system) with linear elements and point elements.
- Field inventory within a 1x 1 km square as well as in selected semi-natural pastures and meadows within the NILS landscape square, comprising the following components:
    - Sample plot inventory, with detailed description of land cover, land use, measures, ground type and vegetation.
    - Line intercept sampling of linear elements:
        - Water courses, ditches, roads, fences, forest edges etc.
        - Linear ground disturbance, tire tracks, paths etc.
        - Water environments in proximity to ditches, streams and shore areas.

1.3. OVERVIEW OF INCLUDED MODULES

During the NILS photo interpretation, the content of demarcated, homogeneous polygons is interpreted according to a detailed instruction (Allard et al 2003). The interpretation creates a base for type of nature classification and area estimates. Long and narrow objects visible in the aerial photo that are too narrow or that cover too small an area for demarcation are described as linear elements.

The field inventory is tied as closely as possible to the aerial interpretation. The positions of the sample plots and linear elements are determined in relation to the interpreted areas and elements. In addition the same variables and definitions are used where possible. In field inventory a large amount of variables are also registered that are impossible to register in aerial photo interpretation. The information from the field inventory is collected in a fixed grid of permanent sample plots and in linear elements encountered during line inventory (Figure 4.4).

The sample plots constitute the basis for calculations of quantity, condition and changes of the different types of ecosystems cover the area. They form a representative random sample of the total Swedish land area. The size of a sample plot corresponds in principal with the smallest mapped unit in the aerial photo interpretation, which results in a comparable ‘spatial resolution’ of the data collected. If a distinct border in land use or land cover traverses the sample plot area (and each section is part of a larger, similar area), the sample plot is divided and each section is described separately. Both the aerial photo interpretation and the sample plot inventory are based on the assumption that the landscape consists of a number of homogenous units (patches). They are described separately if they are at least 0.1 hectare in size, or at least 0.05 hectare if both land use and land cover differ from the conditions in the surrounding area.

Sample plot inventory within a 1x1 km-square consists of 12 systematically designed sample plot blocks (see Table 1.1). Each block consists of concentric sample plots with radiuses of 3.5 m, 10 m and 20 m (Figure 1.1). Furthermore, each block contains three small vegetation plots (0.25 m^2) for detailed vegetation monitoring. In semi-natural pastures and meadows additional sample plots are located in a regular pattern (Figure 4.5). The amount of sample plots depends on the size of the pasture or meadow; it can vary from 1-10 (Table 4.3). In addition to the regular sample plot method, registration of indicative vascular plants is made, according to a separate list, in a total of 9 small vegetation plots per block (Figure 1.1).

The inventory of butterflies, bumble bees, large trees and lichens in semi-natural pastures and meadows is carried out by a separate group of inventory personnel. This inventory is described in a separate field manual, and is therefore not described here any further.

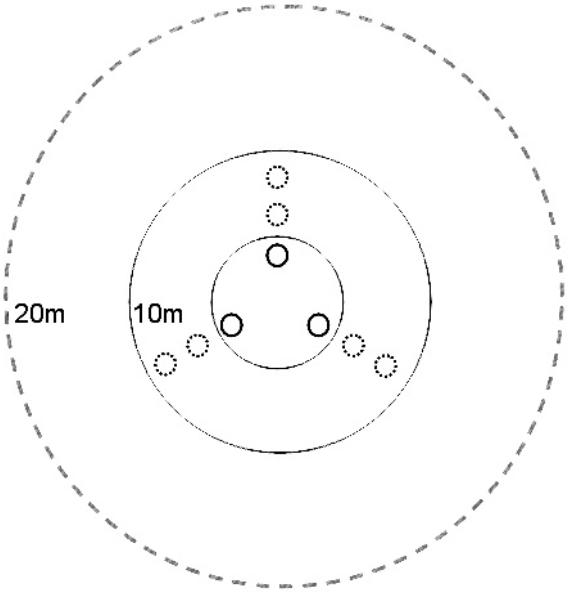


Figure 1.1. A concentric sample plot block in NILS. The perimeter of the 20 m sample plot is diffuse, while the 10 m and 3.5 m sample plot perimeters are strict. The dotted small vegetation plots are only inventoried in semi-natural pastures and meadows (chapters 4.3 and 4.12).

Table 1.1. Inventory modules in NILS sorted by size of the circular sample plot.

20 m radius 1257 m^2	10 m radius 314 m^2	3,5 m radius 38.5 m^2	0.28 m radius 0.25 m^2
Land cover: main type	Land cover: shrubs	Detailed tree data	Field layer
Land cover: trees	Land cover: field layer	Presence: droppings	Bottom layer
Activities/Disturbance	Bottom layer		Presence: vascular plants
Type of Natura 2000 habitat	Ground description		Presence: bryophytes
	Detailed tree data		Presence: lichens
	Lobaria pulmonaria/ Lobaria scrobiculata		

* Only performed in sample plots that are not forest land according to the FAO definition (chapter 4.5), in mountain birch forest (chapter 4.10) and on disused agricultural land.

By using line intersect sampling of a number of different types of linear elements that cover a relatively small area and thus cannot be captured in a satisfactory way in the fixed sample plots, random samples can be obtained. These elements are not permanently marked in the same way as the sample plots for practical reasons; they are instead registered as objects encountered along the inventory lines. This random sample procedure makes it possible to efficiently estimate a large amount of linear elements in the landscape. Many variables are the same as for the sample plot inventory, while others are specific for each type of linear element.

1.4. CHANGES FOR YEAR 2007

Disposition of the Field manual

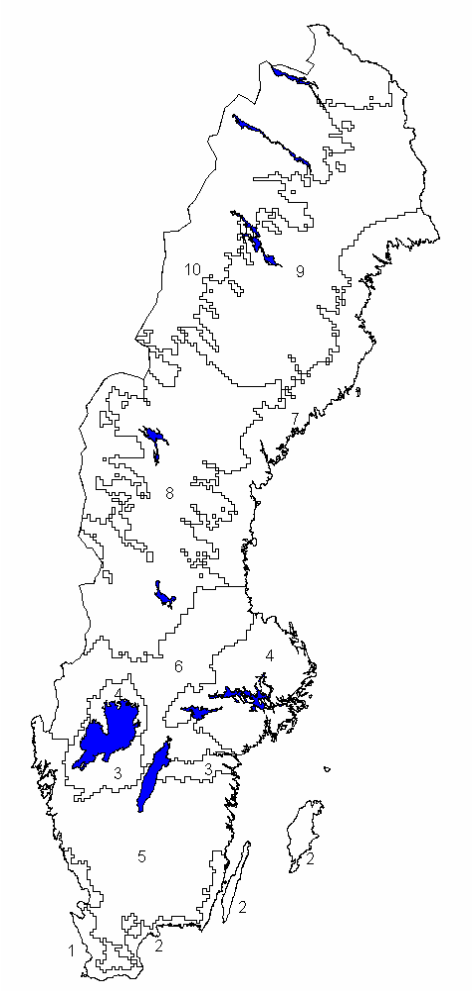
- Several clarifications have been added, especially for inventory in semi-natural pastures and meadows.
- Figure 1.1. has been added as description of a sample plot block.
- Figure B8 has been added as description of the correct structure of folders when inventory of a landscape square is completed.
- Appendix 1: Routines for starting inventory of a new landscape square, has been added
- Appendix 2: Routines when inventory of a landscape square is completed, has been added.
- Appendix 3: Routines at the end of the field season, has been added.
- Appendix 15: Glossary, has been added.
- Appendix 16: Index, has been updated.
- Some figures and figure texts have been modified, with retained content.

NOTE: In this English translation, appendix 16: Index, has been omitted.

1.5. LANDSCAPE SQUARES

Strata

NILS consists of 631 permanent landscape squares that are inventoried on a 5 years rotation schedule. For the layout of the squares, Sweden has been divided into geographical strata. Partly to be able to place squares with different density in different parts of Sweden, but also to be able to adapt the content of the inventory to specific conditions in different parts of Sweden. In the southern and middle parts of Sweden the strata are based on the eight agricultural yield areas according to the Swedish Board of Agriculture. This means that the yield areas 1-6 form strata 1-6 in NILS. In northern Sweden, the mountains and the alpine forests are treated as one stratum according to the Nature Conservation Boundary defined by the Swedish Society for Nature Conservation. The highest coast line (HCL) defines the coast of Norrland as a separate stratum in order to be able to capture agricultural land in Norrland. The HCL line follows, to a large extent, the agricultural land but stretches further inland in several places. The boundary has therefore been modified in shorter sections. The inland of Norrland is divided into two strata based on the boundary between counties Jämtland/Ångermanland and Västerbotten. There is a total of 10 geographical strata in NILS (see Figure 1.2).



Areas (strata):

01 Götaland's southern plains
02 Götaland's middle districts
03 Götaland's northern plains
04 Svealand's plains
05 Götaland's forest districts
06 Mid-Swedish forest districts
07 Norrland's coast
08 Southern Norrland's inland
09 Northern Norrland's inland
10 Alpine and sub-alpine area

Figure 1.2. The 10 geographical strata of Sweden.

Location of Landscape squares

The landscape squares are located in coordination with the routes of the Breeding Bird Survey, which are distributed in a systematic pattern with a constant density all over the country. Sweden has been divided into non-overlapping 5x5 km squares, based on the economic mapping system. Each NILS square belongs to the stratum in which the majority of the 1x1 km central square (in the 5x5 km center) is located. The distribution of the NILS squares is denser in some strata and sparser in others compared to the Breeding Bird Survey (Figure 1.3). The condensation or thinning out was performed in a systematic pattern with an randomized starting point.

The total amount of NILS squares and their distribution between different strata were determined from an analysis of statistical power of change estimates for selected core variables. This led to a denser distribution of the sample squares in strata 1 - 3 and a sparser distribution of the sample in strata 6 - 9 (Table 1.2). In total, NILS consists of 631 landscape squares enumerated from south to north. All squares that contain land area within the 5x5 square according to the blue map (economic map) are included. For practical reasons, squares with insufficient land area are not photographed. Squares along the coast are not photographed if less than 5% of the 5x5 km square is land, and if at the same time there is no land within the 1x1 km square (less than 1 ha). Squares bordering Norway are not photographed if less than 15% of the square is covered by Swedish land. The amount of squares in question and their respective strata are shown in Table 1.2.

Table 1.2. Amount of random sample squares in NILS and concentration/scarcity compared to the Breeding Bird Survey.

Strata	Concentration/ Scarcity	Number of NILS squares	No aerial photo	No field inv.*
1	150%	13	1	2
2	150%	37	1	5
3	150%	33	3	3
4	100%	63	3	5
5	100%	99	3	5
6	80%	52	1	3
7	80%	60	5	8
8	50%	66	1	2
9	50%	64	-	-
10	100%	144	7	15
Total		631	25	48

* Squares with no land in the 1x1 km square

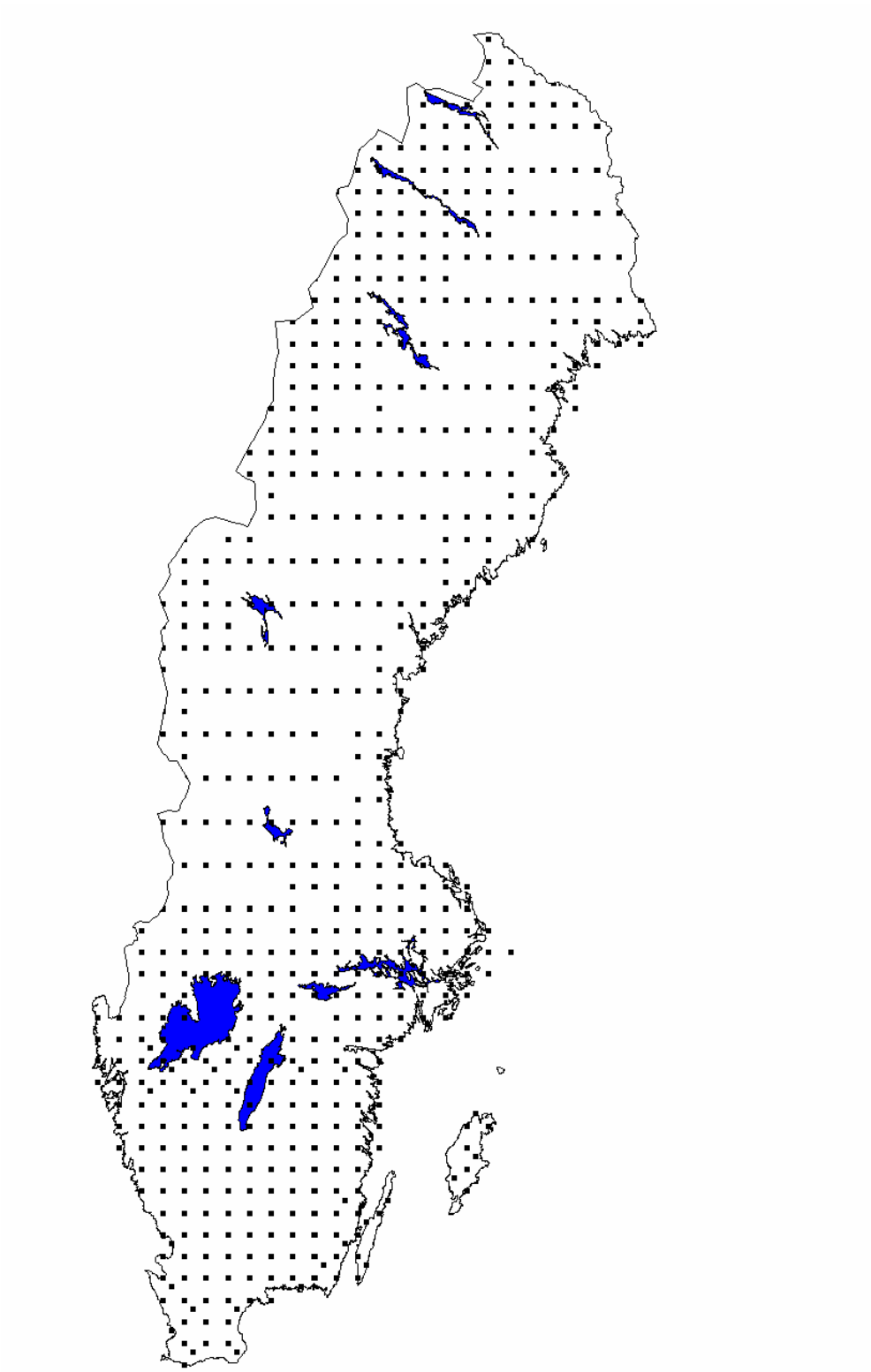


Figure 1.2: Location of NILS random sample square.

2. TECHNICAL INFORMATION

2.1 INVENTORY TEAMS

There are eight inventory teams during the field season of 2007. Each team consists of two people. Both are research assistants and are equally responsible for the results and make decisions together. However, it might be convenient to designate some tasks to a specific team member, in order to keep track of all elements of the job. E.g., one person can be responsible for the electronic equipment; making backup of the collected data and all other computer tasks, while the other team member is responsible for the field equipment; keeping it functional, charging the batteries etc. These tasks may be switched on a weekly basis.

2.2 NAVIGATION, POSITIONING, LINE MEASURING

To find your way and navigate in the field is an essential part of the field work. All positioning information and maps used within NILS are in the RT90 format (Swedish Grid). For a detailed description of how RT90 works, see appendix 13, where it is also explained how to navigate using a compass and a map. Please note that X coordinates indicate north-south positions, while Y coordinates indicate east-west positions. For instructions on how to use the GPS, see appendix 12.

The theoretical coordinates for each sample plot center are shown in Figure 4.4 and Table 4.2. There are also theoretical starting and stopping points indicated for every inventory line (Figure 4.4, Table 5.2). Numbering of sample plots and lines as well as local coordinates (the last three digits in the X and Y coordinates) are the same in all km squares (with the exception of so called “flagships’). All coordinates for sample plots or inventory lines are stored in a file in the inventory team's laptop computer. Coordinates for the area are downloaded to the GPS before setting out in the field (see appendices 1 and 12).

Navigating to the center of a sample plot

Normally a GPS is used to find the center of a sample plot. GPS navigation comes to a halt when the sample plot center is approximately 20 m away. At this point, direction and exact distance to the sample plot center are visible on the GPS display. Make sure that the GPS has good contact with as many satellites as possible when determining this information. Try to find a somewhat open space within the terrain.

The direction to the sample plot center is then determined by using a sighting compass (NOTE: Without correction for deviation or convergence, appendix 13), and a tape measure. NOTE: Even if the field map makes it possible to determine that the point reached is not the theoretical point, no corrections are allowed under any circumstances. Independent subjective adjustments of the sample plot's position carry a great risk for systematic errors!

If the GPS loses contact with the satellites during navigation one of the following steps are taken:

- If far from the sample plot center, continue walking in the approximate direction of the sample plot using a compass until satellite connection can be made.
- If close to the sample plot center, move to a point where, depending on local conditions, re-connection can be made. From this point a conventional compass walk and line measurement with a tape measuring is made to the plot center. Alternatively, look for a different starting point in the terrain that can easily be found on the map and continue the compass walk and measuring from there.

The normal procedures for navigation between the sample plots 1-12 and along the inventory lines 1-12 are as follows:

- When the inventory of a sample plot is finished, proceed with a tape measure and compass 25 m to the starting point of the inventory line. NOTE: It is always assumed that the sample plot position is correct, in other words, the GPS is not used to determine the distance and direction to the starting point of the line inventory.
- The line inventory is performed with compass navigation and tape measure for 200 meters (for more information, see below).
- At the end of the inventory line, the GPS is used to determine the distance and direction to the next sample plot. The sample plot center is then located with compass navigation and a tape measure as described above.

The inventory is always performed clockwise. Only if great advantages can be reached by working in the opposite direction is this allowed. The direction is entered in the computer.

TIP: Press GOTO on the GPS, select ‘Go To Point < Waypoints’ (see appendix 12). Select the correct sample plot center and navigate toward it. The GPS will now show, among other things, distance and direction to the chosen point. When getting close to the sample plot, follow the instructions above.

Registering the Center Point

As soon as the sample plot center is marked, register the actual coordinates as follows:

- Stand at the center point, press and hold the ‘Enter’ button on the GPS until the “Mark Waypoint’-page opens.
- Note the Waypoint number and register this in the handheld computer, then press the menu button, select ‘Average Location’ and place the GPS at the center point.
- During the time the GPS is placed at the center point it will receive one signal per second, let it receive **at least 300 signals**. These will be used by the GPS to estimate an average whereby a more exact position of the sample plot center is established. NOTE: Only the coordinates of the average north- south coordinates are registered in the field computer (the last 4 digits).

Navigation during line inventory

The procedures at line inventory are described in Chapter 5. Sample plots and lines are shown in the RT90-system. Orientation with a compass along a given line in this system presents two problems (see also appendix 13):

- The compass has a certain deviation, i.e. it does not point toward the geographical North Pole.
- The RT90-system meridians do not have the same directions as the 'global' meridians. Therefore, the RT90-system meridians do not point toward the North Pole.

These two factors together lead to that if one wants to go ‘north’ according to RT90, one can not turn the compass to 0 degrees. The total error and appropriate correction has been calculated for all NILS landscape squares. NOTE: Each field map shows information of to what degree the compass should be set when moving toward north according to the RT90 system. For other points, calculate the degree by yourself. If, e.g., you use four degrees correction to head north, corresponding degrees have to be added to head west, south or east. Note that the corrections vary between different parts of Sweden (see appendix 13).

While navigating with the help of a compass, please note that local differences can occur due to strong magnetic fields in the ground, for example in ore rich areas, in the mountains or in Bergslagen. Also remember that items within approximately one half meter of the compass can also strongly influence the compass needle. Metal objects should therefore not be carried by the compass user.

All distances along the line refer to horizontal distances. In mountainous areas with good GPS contact, the GPS can be used to determine distances along the line instead of using the tape measure. On somewhat level ground the above described method with tape measure is to be used. Table 2.1 can be used for corrections in slopes if a tape measure is used. The first number in the table represents the average vertical distance for every 20 m of horizontal distance. Suunto height measuring gauge (appendix 8) is used to determine the vertical distance (i.e. angle) for the 20 m horizontal distance. NOTE: All registered distances along the line should be considered horizontal distances. While using a tape measure in hilly areas, add distance according to Table 2.1. and revise the distance measured on the tape.

Table 2.1: Distance additions for line inventory in hilly areas. The addition for a 25 m tape is half of the addition for a 50 m tape measure.

Vertical distance per 20 m horizontal distance	Added distance when 50 m tape measure is used
0-3	0 m
4-7 m	2 m
8-11 m	5 m
12-15 m	10 m
16-20 m	17 m

If the Sample Plot Center or Line position is off

Hopefully, the discrepancy between the theoretical and actual sample plot and inventory line coordinates will be minimal. If, at the end of an inventory line, one can verify by consulting the field map that one is more than 30 m off target, make a special note of this on the form ‘sample plot center’, that corresponds to the sample plot with the same number as the inventory line. Also, try to determine the reason why the error occurred and make appropriate corrections in future line inventory. Maybe there is a problem with the equipment? NOTE: If one ends up more than 50 m off at the end of the 200 m line compared to the theoretical position, the inventory of the line must be redone. The data for registered linear and point elements must be corrected or deleted, depending on the position of the new line.

2.3. WHICH SAMPLE PLOTS ARE TO BE INVENTORIED?

All sample plots within the km square and semi-natural pastures and meadows are to be documented and recorded in the hand held computer!

NOTE: This also means sample plots located in water, fields, urban areas, highways, etc. All sample plots within semi-natural pastures and meadows that are marked on the field map and entered in the GPS are registered in the same way, with minor changes in what menus are registered.

Sample plots within semi-natural pastures and meadows should be recorded and registered even if the area is not currently used for grazing or hay-making. If the sample plot is located on the edge of a pasture or meadow, see rules for division of a sample plot in Chapter 4.2, Division of a sample plot in semi-natural pastures and meadows.

Inventory is done in different ways:

- **Regular field inventory:** The sample plot (or section of a divided sample plot) can be entered by the inventory team. All inventory modules are performed. Some modules occur in certain strata only.
- **Field inventory from a distance:** The sample plot/section can not be entered, but is for the most part clearly visible. Inventory from a distance is also made from the edge of homogenous biotopes where the state of the sample plot can be estimated, even if the sample plot itself can not be observed. This concerns fields, pasture banks, certain wetlands, aquatic areas close to shores, private property, urban areas and certain

other artificial areas. NOTE: Only land cover and land use is registered. The reason that the sample plot is not approachable is noted in the hand held computer under the module Land cover. See Chapter 4.5 for more information.

- **Inventory from a map:** The sample plot can not be visited nor seen. This occurs mostly in aquatic areas and steep inaccessible alpine areas etc. NOTE: Only land cover and land use is registered. The reason that the sample plot is not approachable is noted in the hand held computer under the module Land cover. See Chapter 4.5 for more information.

The following areas should generally not be visited in field

- Steep terrain (average angle over 25 degrees if dominated by stones, boulders and bare bedrock, over 35 degrees in other cases).
- Areas with obvious risk for landslide, erosion, etc.
- Impassable wetlands, quagmires, etc.
- Areas with a water depth of more than 30 cm at the time of inventory.
- Non-arable land in the middle of fields with growing crops. If it can be reached by walking along the edge of a ditch etc, it is inventoried.
- Areas with no trespassing, military areas.
- Private property, populated areas and “free zones’ around these areas (see below).
- Land with growing crops.
- Glaciers.

In populated areas, all sites with public access are inventoried. NOTE: The rule is that clearly demarcated private property also constitutes a field inventory boundary. In some cases there are no clearly marked property boundaries, e.g. next to certain agricultural or recreational buildings. In these cases the following principles apply:

- In open areas around private homes, recreational buildings and heavily visited farm buildings, field inventory is done up to 40 m from the building in question.
- In forests, areas dominated by brush and/or cliffs, field inventory is done up to 20 m from the building.
- Within densely populated areas, field inventory is done only in publicly accessible areas larger than 0.05 hectare (clearly defined). Aluminum markers are normally not used in these areas.

3. LANDSCAPE SQUARE

3.1. LANDSCAPE SQUARE IDENTIFICATION

Introduction

The identification of a landscape square is a group of variables that describes the square and its location.

Menu Square - variables

Square Number
001-999

The number of the NILS square according to distributed lists and

Figure 3.1. NOTE: Make sure to enter the correct square number.

It can not be changed later! If the wrong number is entered a written report must be sent to the person responsible for the databases. The variable creates an identity post for the menu Square..

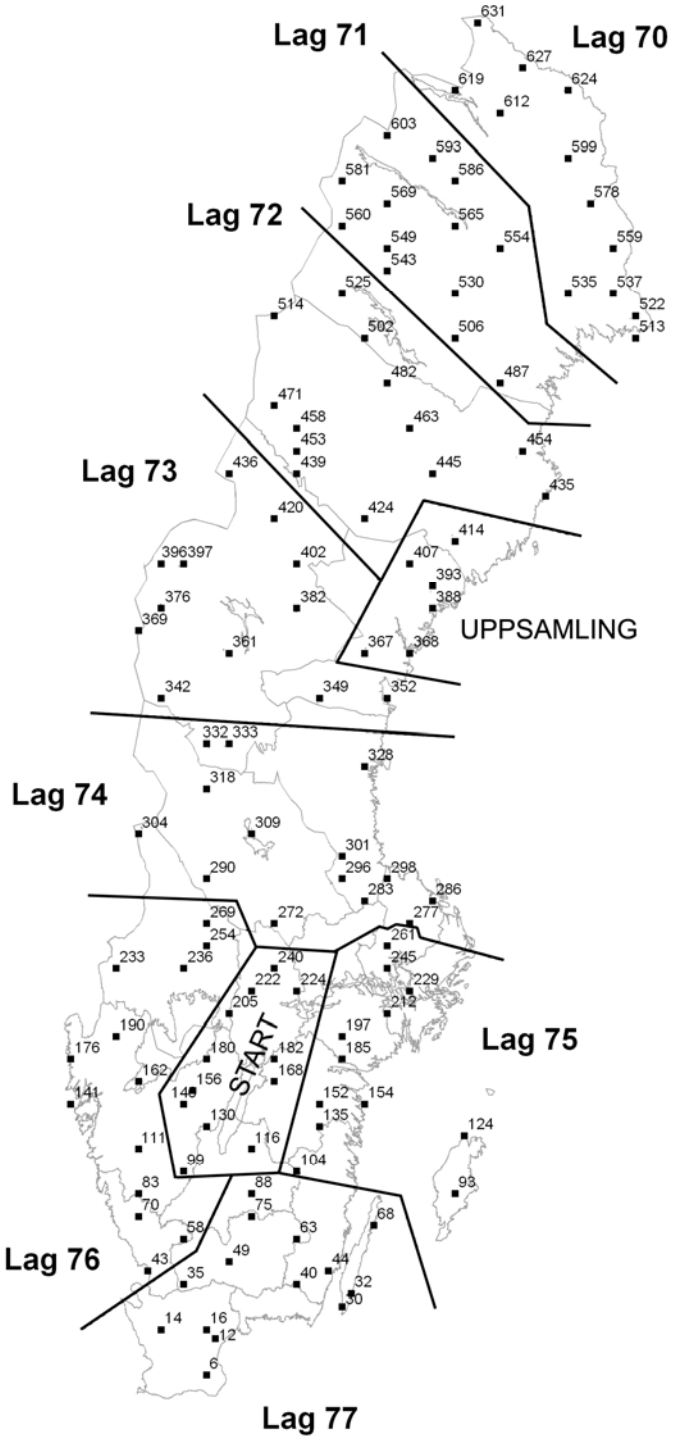
Inventory Type
1 Normal Inventory
2 Control Inventory
3 Flagship Inventory

Type of inventory in the square.

Stratum
01 Götaland's southern plains
02 Götaland's middle districts
03 Götaland's northern plains
04 Svealand's plains
05 Götaland's forest districts
06 Mid-Swedish forest districts
07 Norrland's coast
08 Southern Norrland's inland
09 Northern Norrland's inland
10 Alpine and sub-alpine area

The stratum of the current NILS square according to distributed list.

NOTE: Do not refer to Figure 1.2, mistakes can occur due to ‘enclaves“.



Start-up areas

Team 70: Area 222, 224 and 240

Team 71: Area 168 and 182 (257)

Team 72: Area 130 and 205

Team 73: Area 156

Team 74: Area 180

Team 75: Area 116

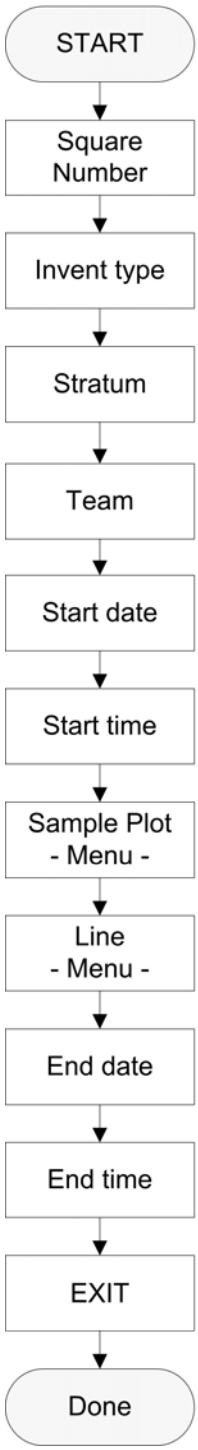
Team 76: Area 146

Team 77: Area 99

Figure 3.1: Landscape squares and inventory teams, NILS year 2007.

Team 01-99	Team Number
Start Date Month 01-12 day 01-31	Date when field inventory of the landscape square starts. 05 = May, 06 = June, 07 = July, etc.
Start Time Hour 00-23 minutes 00-59	Time of arrival at the square, prior to inventory.
Sample Plot	Start of sample plot inventory. This also includes sample plots in semi-natural pastures and meadows. Open menu **Sample Plot.**
Line	Start of line inventory. Open menu **Line.**
End Date Month 01-12 day 01-31km	Date when all inventory modules in the field are completed in the square. NOTE: Don't forget to change this post to the current date on the last field day.
End Time Hour 00-23 minutes 00-59	Time when all inventory modules in the field are completed and return to vehicles or base camp starts. NOTE: Don't forget to change this post to the actual time when the square is completed.

Square



Square Number
000 - 999

Invent type
1 Normal inventory
2 Control inventory
3 Flagship inventory

Stratum
01 Götaland's southern plains
02 Götaland's middle districts
03 Götaland's northern plains
04 Svealand's plains
05 Götaland's forest districts
06 Mid-Swedish forest districts
07 Norrland's coast
08 Southern Norrland's inland
09 Northern Norrland's inland
10 Alpine and sub-alpine area

Team
00 - 99

Start date
0000 - 9999 mon day

Start time
0000 - 9999 hr min

End date
0000 - 9999 mon day

End time
0000 - 9999 hr min

EXIT
1 Back to previous menu
2 Erase menu on screen
3 Save menu in the database
4 Erase menu in the database

4. SAMPLE PLOT INVENTORY

4.1. MARKING AND DOCUMENTING SAMPLE PLOTS

The sample plots in NILS are permanent and the center is therefore marked and documented in order to make repeated inventory possible. The form, ‘sample Plot Location’, contains descriptions of each sample plot's markings, fixed points and other distinctive features (Figure 4.1). See also Chapter 4.3 for instructions of how to enter this data into the field computer.

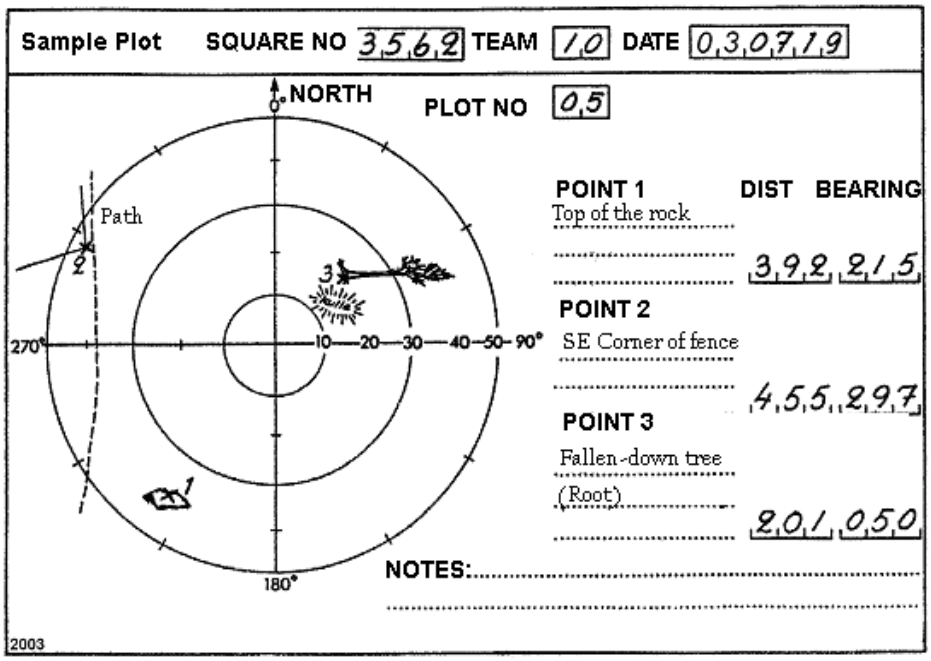


Figure 4.1: Example of completed form ‘Sample Plot Location’.

Marking the center of a sample plot

Mark the center of a permanent sample plot in one of the following ways:

- Normally, a short aluminum marker is placed in the ground. The marker should be positioned no higher than 20 cm above ground and the top should be covered with a plastic ‘cap’. See below for cases when the aluminum marker is not placed in the plot center, but in a different place within the sample plot.
- If the sample plot center is located on a large stone slab or bare bedrock, carve out a cross and mark it with paint.
- No center marking: In certain cases it is necessary to use an aluminum marker in a different place than the sample plot center. In these cases, the marker itself is described as a fixed point in relation to the actual plot center. At least three different fixed points are described (see below and Figure 4.2).
- Do not use aluminum spikes in areas close to densely populated areas, lawns, pastures or meadows. In these cases, the center is simply measured from the fixed points. NOTE: Aluminum markers are never used in semi-natural pastures and meadows.

- In rare cases where a suitable fixed point can not be located in the vicinity of the plot center or a marker can not be placed as a fixed point, only distant fixed points are used. At least three points are described (see below).

Fixed points in the area

Every marked sample plot is supplemented descriptions of fixed points. At least three points are described and marked with paint, if possible with the marking clearly visible from the sample plot center.

NOTE: Always place the paint markings so that they are protected from the elements.

A fixed point is an object that differs as much as possible from the surrounding environment (Figure 4.2). Fixed point should not be located within 10 m from the center, partly to make it harder for passersby to locate the aluminum marker, partly because the margin of error for directional information increases in short distances. However, fixed points marked with paint should not be located too far away, as they will then be too difficult to find from the sample plot center. It is therefore of extra importance to clearly describe far-away fixed points on the form (Figure 4.1).

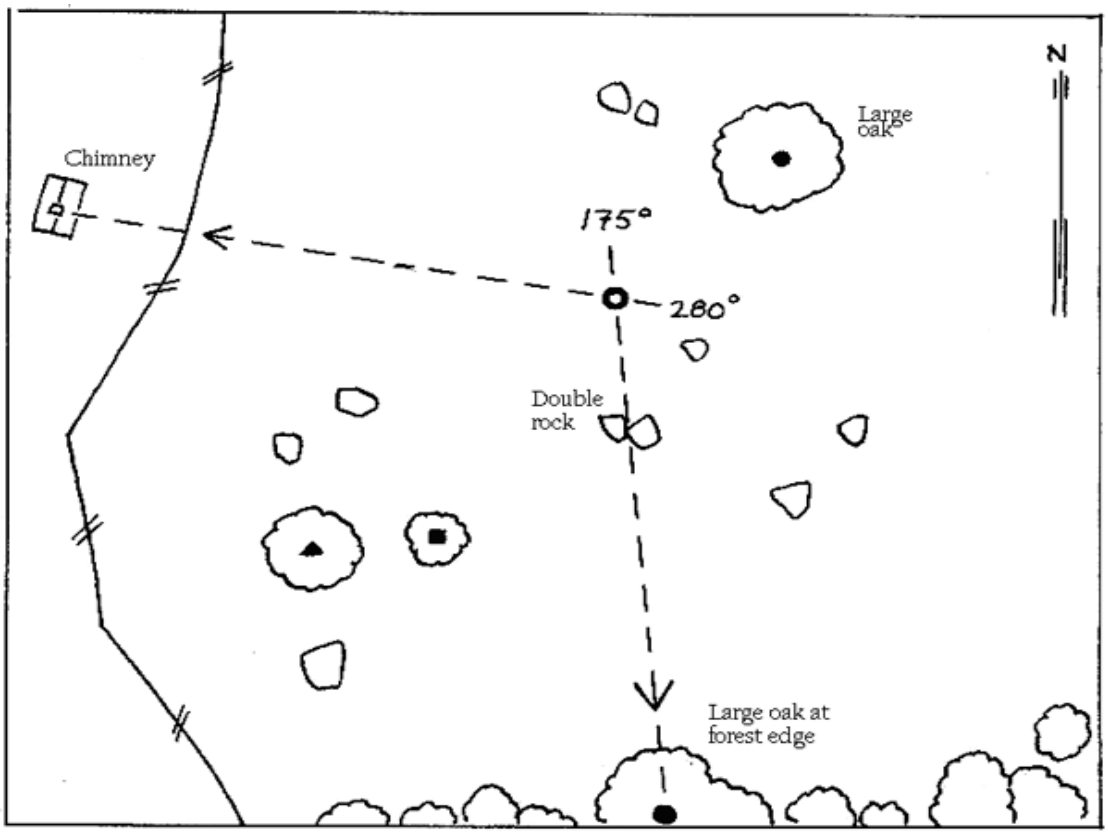


Figure 4.2: Example of fixed points for the sample plot center. In this example, the smaller stones close to the center point have not been used as fixed points since they can easily be moved or can disappear from the area.

If possible, trees should be avoided as fixed points. If there is no other choices for fixed

points, choose either the largest trees of a different species than the dominant one, or trees that in some way are different from the rest. Place paint markings below stump level, and note tree species and stump diameter on the “Sample Plot Location’ form.

The location of the fixed points is determined by noting the distance in dm and the direction from the sample plot center to the fixed point in question. While describing the fixed point it is important to carefully indicate which point of the object the information refers to, i.e. the highest tip of the stone or the North West point of the boulder. If possible, mark the object in this place. Even objects too far away to be measured, except for on the map, can many times be excellent fixed points, i.e. TV pylons or chimneys. Always enter specific characteristics on the form. Indicate on the outline additional characteristics of the fixed points. If there is important additional information, i.e. paths, streams, stone walls or permanent borders in the area, these are also outlined on the form (Figure 4.1).

NOTE: All directional measurements within the sample plot is performed without corrections for variations and meridian convergence (appendix 13).

4.2. DIVIDING SAMPLE PLOTS

General Information

If a 10 m sample plot contains areas of different types of land use or land cover and each area covers more than 0.1 hectares, the sample plot is divided and each area is described separately. Different types of land use normally qualify for division if the border is easily discernible and can be clearly defined in the field.

NOTE: If a clearly defined border is present where both land use and land cover differ from the surrounding area (i.e. small pools of water, field islets etc.), the smallest area of demarcation is 0.05 ha.

When performing cover estimates within a divided sample plot, always estimate the cover for the section in question.

Divide the plots in the following cases:

- The sample plot has been has been divided in the aerial photo. (NOTE: Non-applicable if no aerial photo is present). If a polygon border is estimated to cut though the sample plot according to the aerial photo interpretation, divide the sample plot in the same way as the aerial photo. However, there might be minor differences between the polygon lines in the aerial photo and the appropriate division lines in the field, e.g. if a border between field and forest is considered a few meters off in the aerial photo interpretation, the division line in the field is drawn according to the actual state in the field. NOTE: Polygon lines in the aerial photo that refer to diffuse borders in field (e.g. eco-tones) should not be considered directives for division in field. In these cases the entire sample plot is then included in the polygon where the sample plot center is located. NOTE: If the field maps do not include any interpreted polygon borders, divisions shall be made according to criteria below.

- Divisions are made between different types of land cover and land use when these borders are easily defined and each section belongs to an area of at least 0.1 hectare (in certain cases 0.05 hectare, see above). If the entire sample plot is located in an eco-tone (gradual transition) area, no division is made. Additional outlines about prerequisites for division (e.g. differences in land cover) of a sample plot can be found in Table 4.1.

NOTE: The small vegetation plots are never divided. If a small vegetation plot is located exactly on a border line between two sections, it is moved until it is totally within the section where the small vegetation plot’s center point is located (see Figure 4.14), i.e. the peripheral margin of the small vegetation plot should have contact with the division line. On the contrary, the 3.5 m sample plot that is used when trees are measured in non-forest areas is divided if necessary. The division is made according to the division of a 10 m plot. Note that the entire 3.5 m sample plot sometimes will be located entirely within a certain section of the 10 m plot.

Table 4.1: Guidelines for division of sample plots depending on different land use and land cover. The criteria are given in order of priority, with the most important first.

Land use border	Divide the sample plot between areas with different land use.
Substrate border	Divide the sample plot between land covered with vegetation and substrate ground (bare ground) and between different types of substrate ground.
Tree layer border	Divide the sample plot between areas covered with different species of trees (or distinct differences in the composition) and between areas with trees of different height. In the later alternative, the differences in tree height has to be more than 5 m.
Shrub layer border	Divide the sample plot if there are significant differences in the cover or species composition of shrubs.
Field layer border	Divide the sample plot only if there are considerable differences in the field layer composition.
Bottom layer border	Differences in the composition of the bottom layer are normally not grounds for a division, except for borders between semi-aquatic and terrestrial land (i.e. at the high water mark, chapter 6.5, and between wetlands and solid ground, chapter 4.9).

Instructions for division in unusual circumstances:

- Long and narrow areas that are no more than 5 m wide (e.g. paths, narrow roads, water courses etc.), are not normally considered as separate plot sections and the sample plot is not divided even if the areas cover 0.1 hectare or more in total (in some cases 0.05 hectare). These areas are incorporated with the surrounding areas according to the instructions below. The same rules apply for non-linear features smaller than 0.1 hectare.
- If the area is completely surrounded by an area of a different kind it is included in the surrounding area. This applies to for instance roads or ditches on agricultural land, small field islets, or small wetlands in forests. (There is no division).
- Shore areas (up to the normal high water mark) are added to the aquatic part (but are described, of course, as areas of their own if they are wider than 5 m).
- Populated and planned areas including roads are included in other populated or planned areas if possible. Especially note that roads are never distinguished as separate areas within populated areas.
- Roads and water courses in borders between forest and agricultural land are included in the agricultural land. However, if there is a row of trees between the road or water course and the agricultural land, the area is included in the forest.
- Roads and water courses between wetland and agricultural land are included in the agricultural land.

- Roads and water courses between wetland and forest are included in the forest.
- In cases not covered above, merging of areas is made so that the largest similarities possible are reached from similarities (in hierarchic order) in land use, bare substrate, tree cover, shrub cover and field and bottom layer vegetation.

Complicated cases occur where several long and narrow areas run parallel to each other, e.g. in areas cleared to gain visibility along roads and railroads, and areas with deviating vegetation along ditches and water courses. In these cases, divide for each single linear area wider than 5 m (roadways, cleared areas, water courses, vegetation strips around water courses). Furthermore, division is made if the total width of the parallel linear areas exceeds 5 m. Classify the area by the dominant land cover type. If, for example, a road area is 9 m wide, but the road itself is only 4 m, the area is described in accordance with the surrounding cleared area.

It can often be difficult to discern exactly where a division line is to be drawn, for instance between the substrates bare bedrock/boulders and the surrounding areas, since this type of border often is diffuse. The line must therefore often be generalized to some sort of average.

Division in semi-natural pastures and meadows

If a sample plot is located on the edge of a semi-natural pasture or meadow, it will need to be divided. In this case, only the section located within the semi-natural pasture or meadow is registered and described normally. The section outside the semi-natural pasture or meadow is registered as “16 No, other reason - file report’ in menu Land cover (chapter 4.5). NOTE: If a section of the sample plot is located outside the semi-natural pasture or meadow area, a discrepancy report (blue form, appendix 2) should always be written and sent in with all other data from the landscape square.

Technical instructions for division

A sample plot section should be large enough that some part of it reaches more than 1.5 m within the 10 m periphery. If not, the plot is considered undivided. The division line is based on a series of division points, “train’, defined by compass direction (degrees) and distance from the sample plot center, so called polar coordinates. NOTE: All compass directions within the sample plot are noted without correction for deviation and/or meridian convergence (appendix 13). The division points are marked on the ground with wooden sticks that are removed when the inventory is completed. Every section is described as a train, except one that becomes the remaining section (Figure 4.3).

For description of the sections the following applies:

- Some part of every section must border the circular sample plot periphery.
- The first and the last point of the train must be located on the circular sample plot periphery.
- The division points must be indicated clockwise.
- The first line of the train can not be a circular arc.
- If two division points between the first and the last breaking points are located on the circular periphery, the line between them must be a circular arc. If not, one of the

points must be moved toward the center 1 dm, so the distance to the point is not the same as the sample plot radius.

- The maximum number of division points per train is 6.
- The sample plot can be divided in no more than 5 sections.

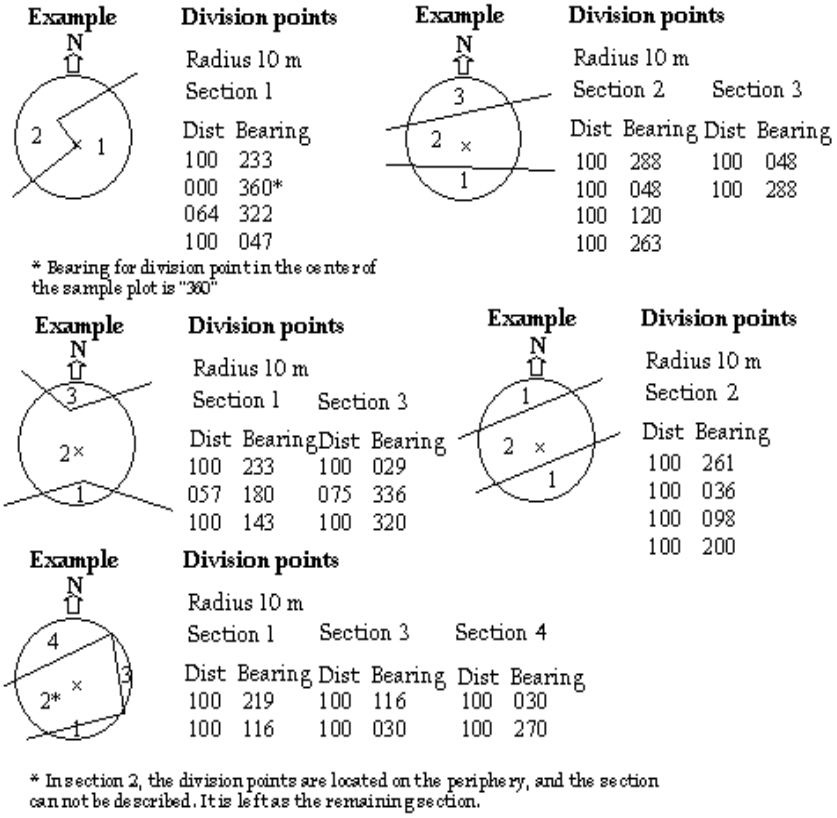


Figure 4.3: Examples of divided sample plots.

The sections are enumerated 1, 2, 3 etc. in the order they are encountered from south to north. If two or more sections are encountered simultaneously, they are numbered from west to east. A section does not need to be physically joined in the sample plot. If, for instance, a road that is wide enough to be divided cuts through a sample plot and leaves similar sections on both sides, both sections are given the same section number. In this case, only the section that constitutes the road is indicated as a division train. NOTE: Do not include them in the same section if the different sides of the road belong to different polygons on an aerial interpreted field map. NOTE: The number of division trains registered is always one less than the total number of sample plot sections. It is up to the field personnel which section to leave as the remainder.

4.3. SAMPLE PLOT IDENTITIES

This variable group describes the sample plot, location and way of marking, divisions and documentation.

Menu Sample Plot - variables

Sample plot number

01-12 (km square) XX-YY (semi-natural pastures and meadows)	The sample plot number (identity) according to Figure 4.4. The number shown after the sample plot is the theoretical north (X) and east (Y) coordinates. NOTE: The theoretical coordinates and numbering of sample plots in semi-natural pastures and meadows are noted on the corresponding field maps. The number of sample plots in semi-natural pastures and meadows vary depending on the the size of the pasture/meadow. For examples, see Figure 4.5 and Table 4.3.

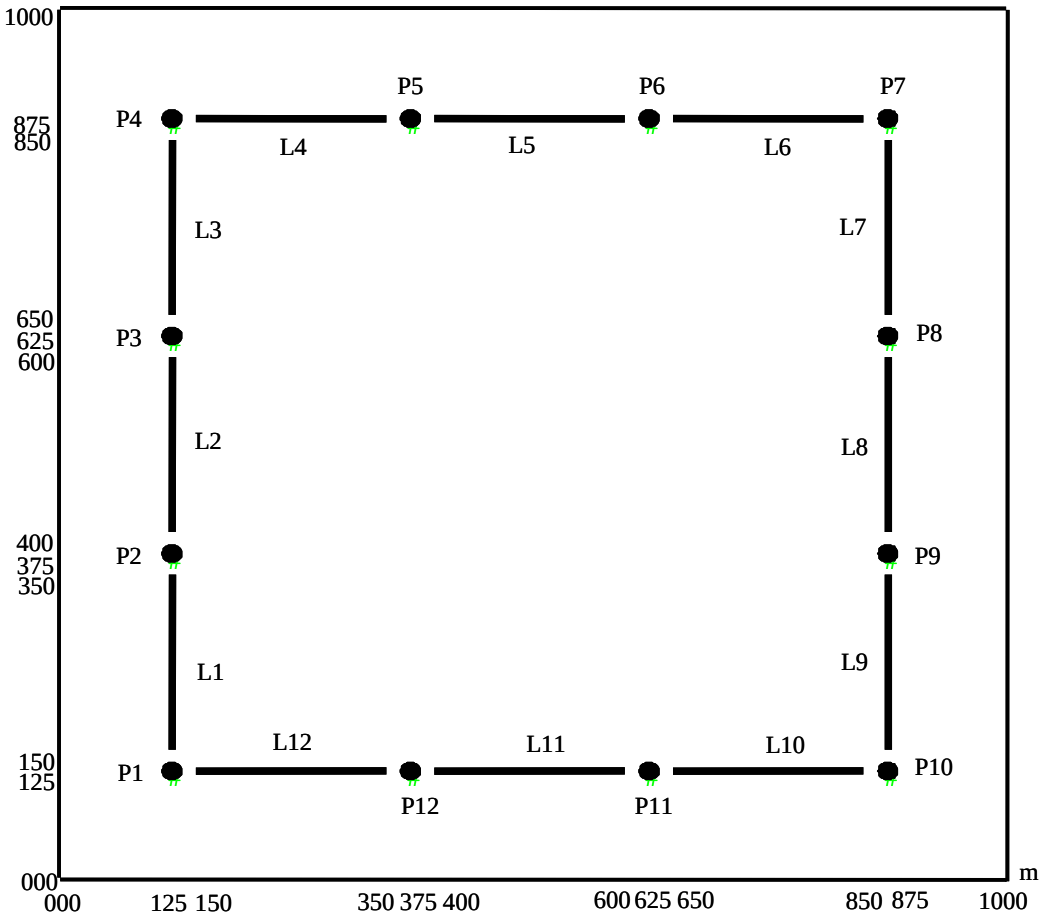


Figure 4.4: The location of sample plots and inventory lines within the km-square. P1-P12 indicate sample plot numbers and L1-L12 indicate line numbers.

T*able 4.2: The theoretical coordinates of the sample plot in relation to the km-square's bottom left corner.*

Sample Plot	North coord X	East coord Y
1	125 m	125 m
2	375 m	125 m
3	625 m	125 m
4	875 m	125 m
5	875 m	375 m
6	875 m	625 m

Sample Plot	North coord X	East coord Y
7	875 m	875 m
8	625 m	875 m
9	375 m	875 m
10	125 m	875 m
11	125 m	625 m
12	125 m	375 m

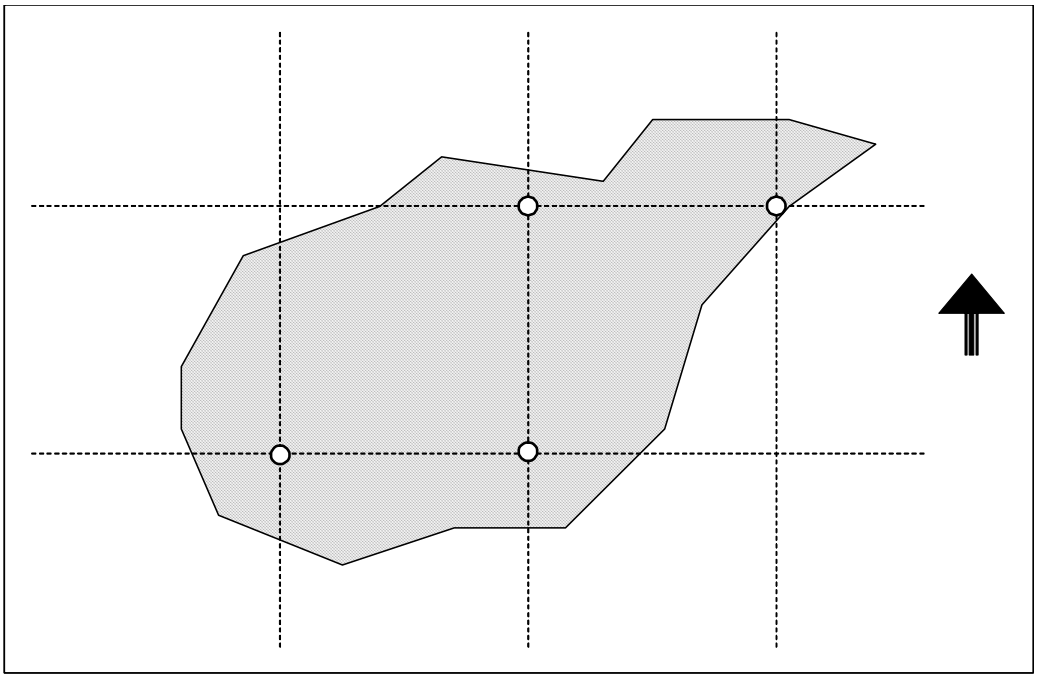


Figure 4.5: *Example of a sample plot grid in semi-natural pastures and meadows. Coordinates have been chosen from an even square pattern with a randomized starting point.*

Table 4.3: Number of sample plots in different sizes of semi-natural pastures and meadows.

Area Class	No of Sample plots
0 – 1 ha	1
1 – 3 ha	2
3 – 10 ha	4
10 – 30 ha	6
30 – 100 ha	8
> 100 ha	10

Invent Type	Type of sample plot inventory
1 Field inventory, visited	Normal field inventory. The entire sample plot or at least one section can be visited.
2 Inventoried from a distance/map	Used only when the entire sample plot is inventoried from a distance or from a map (i.e. non-divided sample plots). The sample plot is not visited and is only described in short.

When taking **inventory from a distance** the entire sample plot or section can be seen or its condition can be established from the edge of a homogenous area (e.g. edge of a field, water, or glacier). NOTE: Only land cover and land use are inventoried. Markings, division, photographing and small vegetation plots are omitted. Indicate the reason that a sample plot is not visited in menu Land cover (chapter 4.5).

Photo	Opens the menu **Photo**.

GPS Number	GPS Waypoint number for the sample plot center.
000-999	State the three last digits on the display. “999’ is used if the GPS is malfunctioning or the sample plot is not visited.
GPS north X	Distance according to the GPS in the north-south direction, from the sample plot center to the southernmost edge of the 1 km-square, in other words the closest 1000 m grid line.
0000-9999 m	State the 4 last digits on the display. “9999’ is used if the GPS is malfunctioning or the sample plot is not visited.
GPS east Y	Distance according to the GPS in the east-west direction, from the sample plot center to the left edge of the 1 km-square, in other words the closest 1000 m line.
0000-9999 m	State the 4 last digits on the display. “9999’ is used if the GPS is malfunctioning or the sample plot is not visited.

Mark the waypoint in the GPS. Procure an average location before registering the coordinates (at least 300 signals, further instructions in chapter 2.2, Registering the Center Point). NOTE: Please remember that X is north and Y is east in the **‘**Swedish Grid**’** (RT90). Double-check that the theoretical sample plot coordinates match the field map.

Marker — Marking of the sample plot using an aluminum marker (chapter 4.1). NOTE: A marker is never used in sample plots within a semi-natural pasture or meadow. In these cases, always use alt. 3.

1 Marker at plot center

2 Marker in a different place

3 Marker absent

Marker Number — GPS waypoint number for marker in a different place than the plot center.

000-999 — State the three last digits on the display. “999’ is used if the GPS is malfunctioning.

Marker North X — Distance according to the GPS in the north-south direction, from the sample plot center to the southernmost edge of the 1 km-square, in other words the closest 1000 m grid line.

0000-9999 m — State the 4 last digits on the display. “9999’ is used if the GPS is malfunctioning or the sample plot is not visited.

Marker East Y — Distance according to the GPS in the north-south direction, from the sample plot center to the southernmost edge of the 1 km-square, in other words the closest 1000 m grid line.

0000-9999 m — State the 4 last digits on the display. “9999’ is used if the GPS is malfunctioning or the sample plot is not visited.

Distance from Marker — The distance between the aluminum marker and the sample plot center.

000-999 dm

Direction from Marker — Direction ***from*** the aluminum marker ***towards*** the sample plot center. Stand at the marker and measure toward the center.

000-360 degrees

Divided?

0 Undivided sample plot — The sample plot is undivided in the field

1 Divided sample plot — The sample plot is divided in the field.

Number of Sections The number of sections the sample plot is divided into (maximum 5).

2 Two-part division
3 Three-part division
4 Four-part division
5 Five-part division

Division/Computer Indicate if this field computer is used to describe the divisions, or if the division trains are registered in the other tam member's computer.

0 No Division trains registered in the other computer.
1 Yes Division trains registered in this computer

Division Opens the menu **Division**

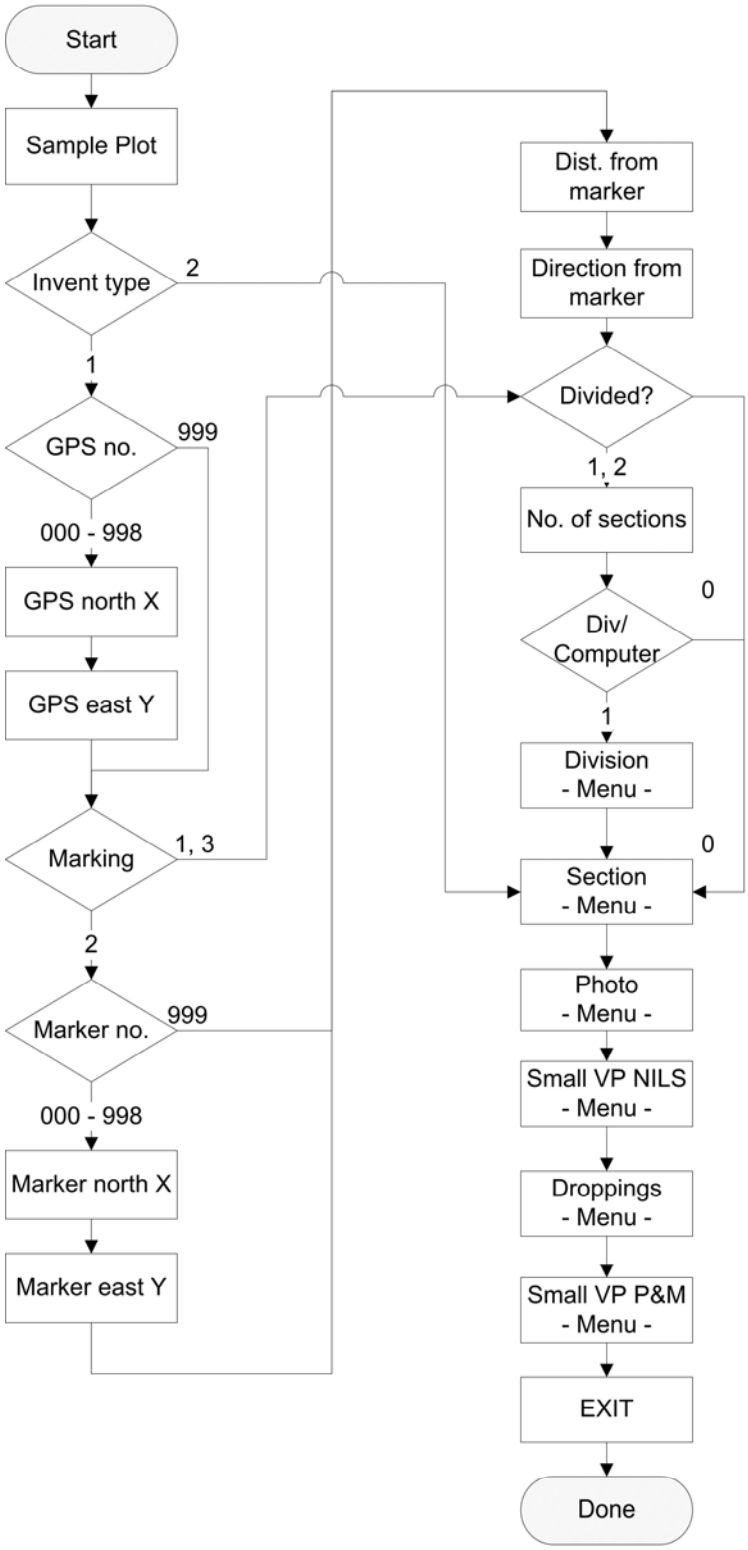
Section Opens the menu **Section** (see chapter 4.4).

Small VP NILS Opens the menu **Small Vegetation plot** (see chapter 4.12).
NOTE: Only in the NILS km-square.

Droppings Opens the menu **Droppings.** NOTE: Inventory of droppings is
Not performed in semi-natural pastures and meadows.

Small VP P&M Opens the menu **Small Vegetation Plot Semi-Natural Pastures and Meadows** (chapter 4.12).
NOTE: Only done in semi-natural pastures and meadows.

Sample Plot



Sample Plot
01 N 125 m, O 125 m
02 N 375 m, O 125 m
03 N 625 m, O 125 m
04 N 875 m, O 125 m
05 N 875 m, O 375 m
06 N 875 m, O 625 m
07 N 875 m, O 875 m
08 N 625 m, O 875 m
09 N 375 m, O 875 m
10 N 125 m, O 875 m
11 N 125 m, O 675 m
12 N 125 m, O 375 m

Invent type
1 Field inventory
2 Inventory from a distance/map

Divide/Computer?
0 No, other computer
1 yes, this computer

GPS no.
999 GPS not functioning
000 - 998

GPS north X
000 - 999 m

GPS east Y
000 - 999 m

Marker
1 Marker at plot center
2 Marker in a different place
3 Marker absent

Marker no.
999 GPS not functioning
000 - 998

Marker north X
000 - 999 m

Marker east Y
000 - 999 m

Dist. from marker
000 - 999 dm

Direction from marker
000 - 360 degrees

Divided?
1 Un-divided sample plot
1 Divided in photo and field
2 Divided only in field

Menu Photo - variables

If weather conditions allow, photographs of the center pole and one small vegetation plot are taken (appendix 9). Remember to keep the camera still until the picture is taken, especially in poor light. One picture is taken in each direction (north, south, east and west) from about 4 m behind the sample plot center facing each direction. Use the automatic flash setting (exceptions, see appendix 9). Check the quality of each photo on the monitor. Re-take a photo if needed. However, a bad photo is better than no photo at all.

Photo date Date of photograph
Mon 01-12, Day 01-31

Photo North Image number for photo facing north, toward the center of the sample plot, see appendix 9.
0001-9999

Photo East Image number, photo facing east
0001-9999

Photo South Image number, photo facing south
0001-9999

Photo West Image number, photo facing west
0001-9999

Small Sample Plot Image number, photo of small vegetation plot 1 (north)
0001-9999

The image number refers to the number in the digital camera, i.e. the four last numbers in the file number (XXXX-0001). The fields are left blank if no photos are taken.

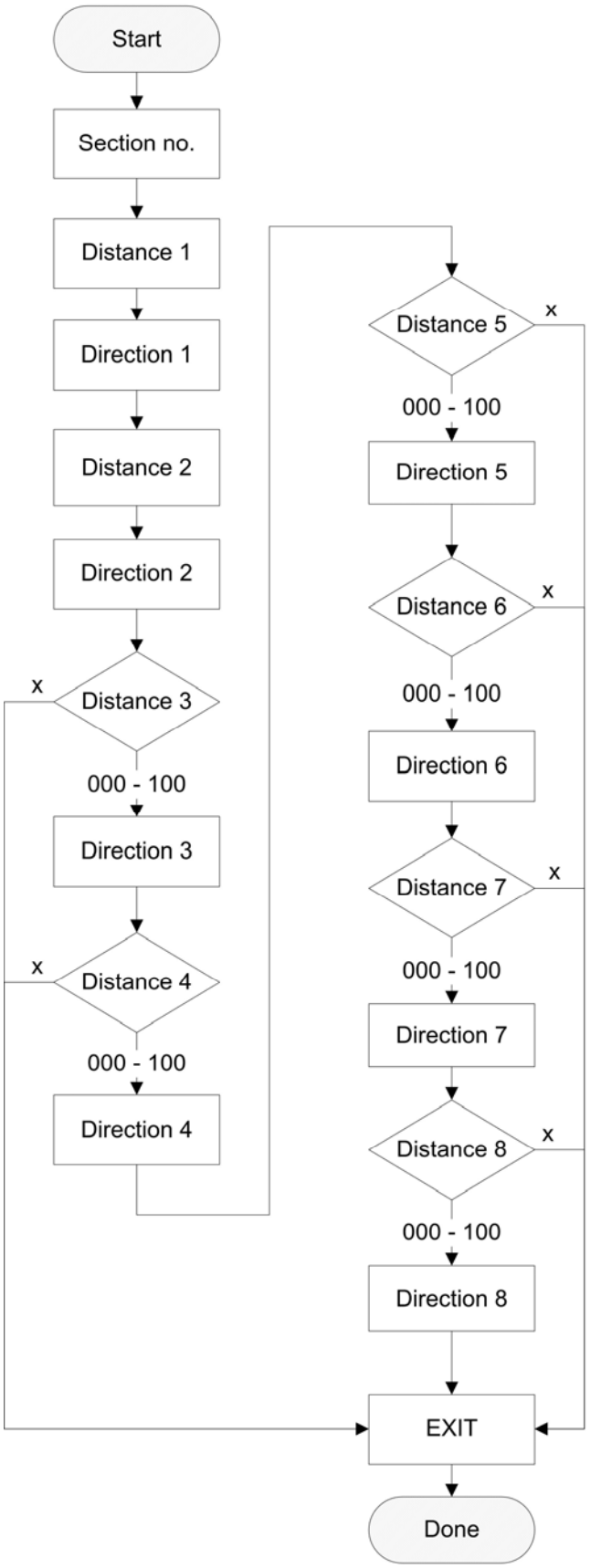
Menu Division - variables

Distance and direction from the sample plot center to the division points. Always indicate at least two points (Figure 4.3). The number of division trains is always one less than the number of sections. The first and the last point must always be on the periphery of the circular sample plot; i.e. a distance of 100 dm. Write ‘X’ in the following data field after the last point in the division train has been registered. NOTE: First fill out the paper form (chapter 4.2).

Section No.	The number of the section described in the division.
1-5	
Distance 1	000-100 dm
Direction 1	000-360 degrees
Distance 2	000-100 dm
Direction 2	000-360 degrees
Distance 3	000-100 dm, x = section done
Direction 3	000-360 degrees
Distance 4	000-100 dm, x = section done
Direction 4	000-360 degrees
Distance 5	000-100 dm, x = section done
Direction 5	000- 360 degrees
Distance 6	000-100 dm, x = section done
Direction 6	000-360 degrees
Distance 7	000-100 dm, x = section done
Direction 7	000-360 degrees
Distance 8	000-100 dm, x = section done
Direction 8	000-360 degrees

NOTE: After saving the division menu you are able to see a digital image of the recorded divisions of the sample plot by pressing the function button F4. Press the ESC button to close the sample plot view.

Division



Section no.
1 - 5 Number of section

Distance
000 - 100
x Section complete

Direction
001 - 360

Menu Droppings - variables

Register presence of droppings in the 3.5 m plot, the same area as small dimensions and caliper trees less than 100 mm.

Never divide the droppings area, register all droppings within the 3.5 m. radius.

Presence of droppings from the following species:

Moose
Hare
Black Grouse
Capercaillie
Black Grouse or Capercaillie

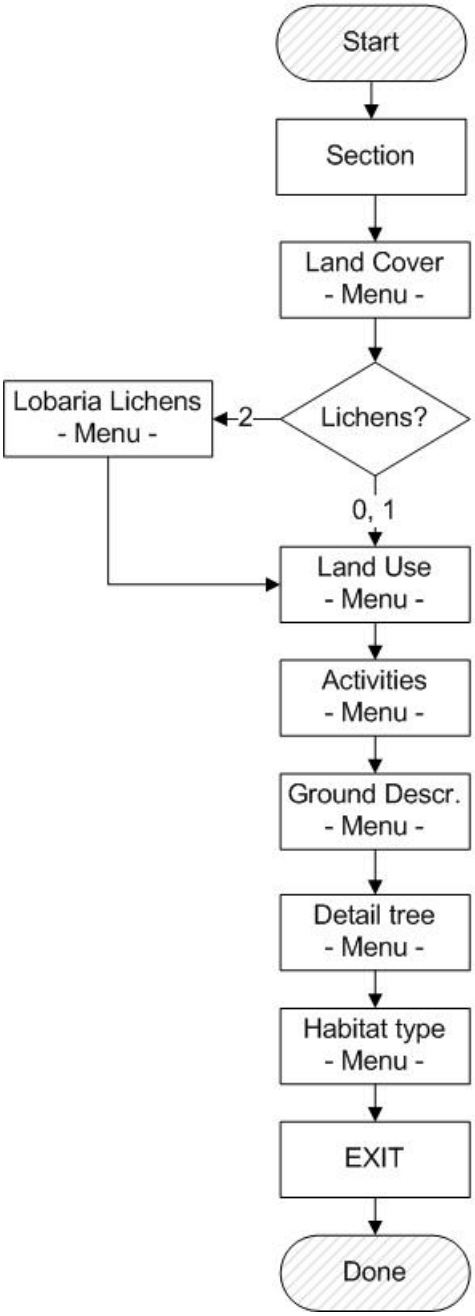
Menu Vascular plants P&M - variables

Species list, see appendix 14.

4.4. INVENTORY OF A SAMPLE PLOT OR SECTION

Menu Section - variables

Section 0 Entire sample plot 1 Section 1 2 Section 2 3 Section 3 4 Section 4 5 Section 5	The variable creates an identity post for the section or the entire sample plot. NOTE: Check that the number of the section is correct and in accordance with the paper form (chapter 4.1 and 4.2). Also make sure all sections are inventoried. The alternatives shown depend on the information given earlier, in menu Division and variable No. of Sections.
Land cover	Opens menu **Land cover** (chapter 4.5)
Land Use	Opens menu **Land Use** (chapter 4.7)
Activities	Opens menu **Activities** (chapter 4.8)
Ground Description	Opens menu **Ground Description** (chapter 4.9)
Detail Tree	Opens menu **Detail Tree** (chapter 4.10)
Lichens on deciduous trees?	Indicate if *Lobaria pulmonaria* and *Lobaria scrobiculata* should be registered on deciduous trees.
0 No deciduous trees > = 10 cm	No trees or diameter less than 10 cm
1 Trees without *Lobaria* lichens	At least one live or dead deciduous tree with a diameter of at least 10 cm must be found within the sample plot or section.
2 Trees with *Lobaria* lichens	At least one deciduous tree with a diameter of at leats 10 cm with *L. pulmonaria* or *L. scrobiculata* must be found within the sample plot or section.
Lobaria lichens	Opens menu Lobaria lichens (*Lobaria pulmonaria* and *Lobaria scrobiculata*) (chapter 4.6).
Habitat type	Opens menu **Habitat type** (see chapter 4.11)



Section

Section
1 Section 1
2 Section 2
3 Section 3
4 Section 4
5 Section 5

Lichens?
0 No deciduous trees = 10 cm
1 Trees without Lobaria lichens
2 Trees with lobaria lichens

4.5. LAND COVER

Aim

The aim of this inventory module is to describe components of the landscape; e.g. different types of forests, lakes, wetlands, grasslands, built-up areas etc., which can explain the presence of several species of plants and animals. The inventory also provides a base for studies of quantitative changes in particular components of the land cover. Land cover is also a internationally common type of classification, and is therefore important for comparisons between countries.

The classification of land cover within NILS is not based on a number of pre-defined (*a priori*) classes of landscape types arranged in some sort of hierarchic classification system. Consequently, there is no system for registration of complex landscape types. Instead, a so called ‘smorgasbord’ model is used, where the variables are registered without an internal priority order. This allows for greater freedom when analyzing the data and makes it possible to afterwards *(a posteriori*) use several different systems to classify complex types of landscapes. This is important in order to satisfy the needs of different interested parties, especially for international reports. This also facilitates integration of NILS-data with future systems of landscape classification.

First, aquatic- and land environments are separated from each other. Next, the different components of vegetation (layers, life-forms) are described through quantitative or categorical variables, which can be used as a basis for an array of different classification systems. Most of the variables included in the land cover classification are registered through visual estimation, i.e. an estimation made without actual measurements. It is therefore important that the inventory team regularly calibrate their estimations; both internally and against carefully pre-measured sample plots, in order to make the estimations as reliable as possible. The principles for estimating vertical cover are described in appendix 4.

Criteria for registration

- Land cover is registered in all sample plots visited in field. In addition, land cover is registered for sample plots inventoried from a distance or from a map (for example agricultural land, built-up areas, water, glaciers, etc.), though in these cases only the most basic classifications are made.
- Variables are registered for the entire sample plot, or separately for each section, if the sample plot is divided. Divisions into sections must therefore already have been made (chapter 4.2).
- Register main type of land cover and tree layer in the 20 m sample plot.
- Register shrub layer, field layer and bottom layer in the 10 m sample plot.

Procedures

- Determine type of inventory (in field, from a distance or from a map) and main type of land cover.
- Try to get a good overview of the entire sample plot or the section to be inventoried. It is very important to walk around in the periphery of the sample plot since that is where most of the area of a circle is located. In a 10 m sample plot, 51 % of the area is found more than 7 m from the center. In a 20 m sample plot, 51 % of the area is found more than 14 m from the center.

NOTE: The 20 m plot is not to be treated as a circle of strict size in the same way as the 10 m plot (Figure 1.1). It marks the size of the rough 'reference area' for estimation of tree layer and land cover. When determining land cover and tree layer composition, only consider the section of the 20 m plot similar to the 10 m section.

- Estimate cover of exposed substrate, species and groups of species in the 10 m plot (or section within the 10 m plot). Register all plants that have some live part of the shoot inside the plot, as seen from above. Pay careful attention to the fact that estimated cover refers to the vertical projection of the plant (see appendix 4 for estimating cover).
  NOTE: It may be a good idea to register the menus bottom layer and field layer in the 10 m plot early on, since too much trampling in the sample plot may cause changes in the true cover of the field layer.
- Estimate total cover of live shrubs. Register all species if the total cover it is at least 1 %.
- Estimate tree layer variables in the 20 m plot or in sections therein. In addition to cover estimations, basic descriptions of other forest variables (basal area, number of stems, height and constitution of species) are made.
  NOTE: All individual trees are taken into account while estimating tree cover. For all other registrations, only individual trees higher than 0.5 m are included.

Important to note

- Cover estimation refers to **strict cover** for bottom layer, field layer and shrubs (appendix 4).
- Cover estimates refer to **diffuse cover** fort he tree layer (appendix 4).
- For cover of **individual species** blank format is always used. This means that if the species is not found, the data field is left blank (appendix 4). If the species is found within the area with a maximum cover of 0.4 %, enter "00' in the data field. In a non-divided 10 m plot this amounts to a maximum of 1.5 m^2 of cover.
- For cover of different types of variables for **land cover** and **measures**, enter "00' if the type is not found or if the maximum cover is 0.4 %. In a non-divided 10 m plot this amounts to a maximum of 1.5 m^2 of cover (5 m^2 in a non-divided 20 m plot).
- For variables in the **field- and bottom layer** registered in the cover menu on the right hand side (inventory modules Land cover and Small Vegetation Plots), use blank format. Enter '00' for maximum cover of 0.4 % (1.5 m^2 in the 10 m plot). However, do not spend a lot of time to searching the entire 10 m plot for very small occurrences of these variables.
- Do not use even 10% classes, with the exception of proportions of tree species. In international data systems 10, 30, 50, 70 and 90% constitute limits between so called *a priori* classes.
- The description of the vegetation layers refer to the actual state of vegetation cover in the sample plot at the time of inventory.
- Remember to register all menus in question.

Table 4.4: Table for conversions between cover in % and m^2 for non-divided sample plots. Round off the cover % according to: 01% = 0.5-1.4 % etc.

10 m plot (314 m2)		
Percent	m^2 mean	m^2 interval
00		0.0-1.5
01	3.1	1.6-4.6
02	6.3	4.7-7.8
03	9.4	7.9-10.9
04	12.6	11.0-14.0
05	15.7	14.1-17.2
06	18.8	17.3-20.3
07	22.0	20.4-23.5
08	25.1	23.6-26.6
09	28.3	26.7-29.7
95	298	
99	311 (314)	

20 m plot (1257 m2)		
Percent	m^2 mean	m^2 interval
00		0-5
01	12.6	6-18
02	25	19-30
03	38	31-43
04	50	44-56
05	63	57-68
06	75	69-81
07	88	82-93
08	101	94-106
09	113	107-118
95	1194	
99	1244 (1257)	

Menu Land cover - variables

Main Type	Main type of land cover
1 Terrestrial/semi-aquatic	Dry to wet land that is very seldom or never flooded. Also included in this category is temporary water-covered land and nival snow patches.
2 Aquatic permanent fresh water	Permanent fresh water-covered habitat, including shores that are too narrow to be considered individual sample plot sections.*
3 Aquatic permanent salt/brackish	Permanent salt- or brackish water covered land including shored too narrow to be considered individual sample plot sections.*
4 Glacier - permanent core of ice	
5 Permanently snow covered land	

*The border between terrestrial/semi aquatic land and aquatic environments are theoretically indicated by the low water mark, i.e. the lowest level that the water reaches during a normal year. However, if the shore zone is too narrow to qualify as a sample plot section (less than 5 m wide, see division instructions in chapter 4.2), it is included in the aquatic area. In this case, the border is instead indicated by the high water mark (definition in chapter 6.5).

Inventory?	Type of inventory on the plot.
01 Yes, normal inventory	The sample plot is visited. All modules inventoried.
02 Yes, temporarily snow	The sample plot/ section can be visited. Area covered with so much newly-fallen snow that inventory of field and bottom layer is impossible. Field and bottom layer and small vegetation plots are not inventoried. Shrub- and tree layers as well as all other modules are inventoried.
03 Yes, temp water <10cm	The sample plot/section can be visited. Small vegetation plots are not inventoried. All other modules inventoried.
04 Yes, temp water >10-30 cm	The sample plot/section can be visited. Field- and bottom layer and small vegetation plots are not inventoried. Shrub- and tree layers as well as all other modules are inventoried.
05 No, temp water >30 cm	The sample plot/section can not be visited. No further inventory.
06 No, inaccessible wetland	The sample plot/section can not be visited for safety reasons, (quagmire etc.), determined from the edge of the sample plot/section. No further inventory.
07 No, field with annual crops	Growing or newly seeded annual crop or recently plowed. The sample plot/section can not be visited. No further inventory.
08 No, hayfield	Field with seeded hay crop, regularly plowed, harvested (not grazed). The sample plot/section can not be visited. No further inventory.
09 No, inaccessible non-arable outcrop	The sample plot/section can not be visited. No further inventory.
10 No, island less than 0.1 ha	The island is not visited. No further inventory.
11 No, inaccessible steep terrain	Steep or impassable terrain. More than 25 degree angle for areas with rocks, bare bedrock etc. More than 35 degree angle for overgrown well rooted perennial vegetation.
12 No, risk of landslide	Land with obvious risk of landslide or erosion etc.
13 No, industrial site	Fenced in or in other ways privately owned land close to housing or other construction, industrial land etc. that can not be visited.
14 No, no trespassing	Land with no trespassing, e.g. military areas.
15 No, not in Sweden	
16 No, other reason – file report	A written report must be filled out (blue form, appendix 2).
Water level	Water level at the time of inventory.
1 Low water level	Water level is clearly lower than normal with a distinct, often wide, shore zone.

2 Normal water level	Water level is normal. In a body of water with a very stable water level this corresponds to the high water mark, but in other cases there is a dry shore zone.
3 High water level	Water level is higher than normal and the actual water level is close to the high water mark.
4 Extremely high water level	Water also covers terrestrial vegetation.

Water level Temporary — The water level for temporary water covered land at the time of inventory.

1 Low water level	Water level is clearly lower than normal with a distinct, often wide, shore zone.
2 Normal water level	Water level is normal. In a body of water with a very stable water level this corresponds to the high water mark, but in other cases there is a dry shore zone.
3 High water level	Water level is higher than normal and the actual water level is close to the high water mark.
4 Extremely high water level	Water also covers terrestrial vegetation.

Field Total % — Total cover of the field layer, which includes all herbs, ferns, dwarf-shrubs and graminoids. Regard all live leaves and shoots, as well as recently yellowed/dead parts. NOTE: Graminoid litter is not included.

Field Layer — Opens menu **Field layer**

Large Species — Opens menu **Large species**

Graminoid litter %
00-99% — Cover of graminoid litter, i.e. last year's litter and older grasses, sedges, rushes and bulrush.

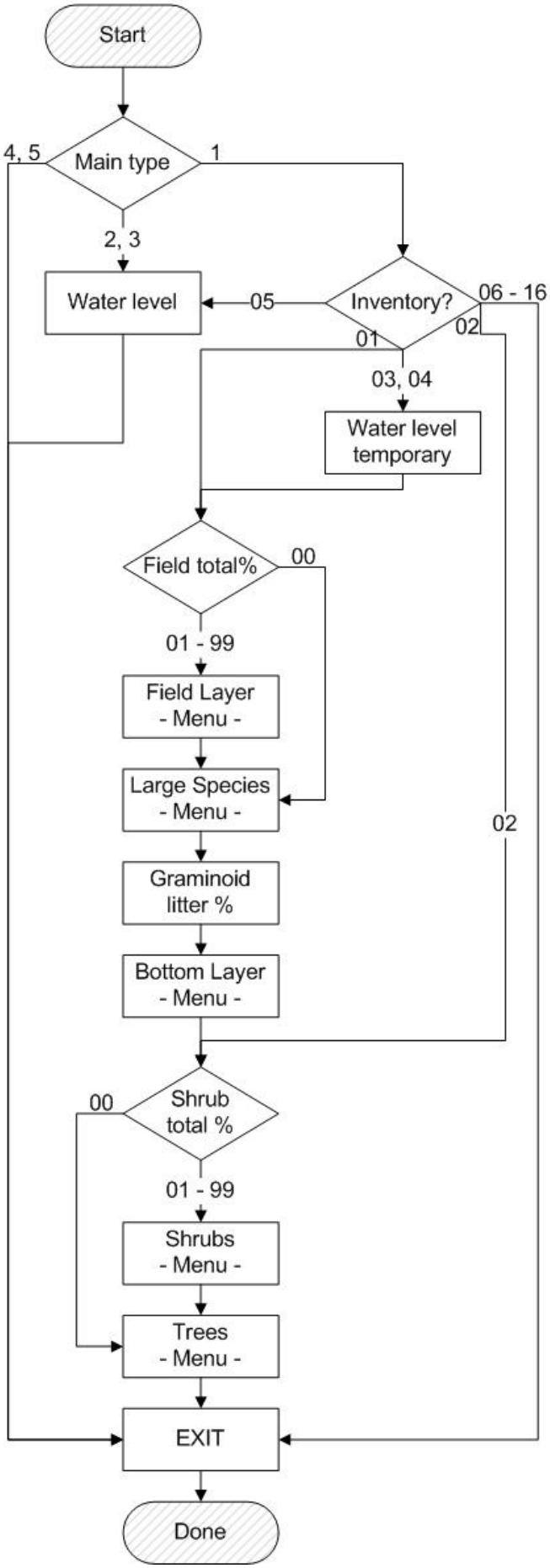
Bottom layer — Opens menu **Bottom layer**

Shrub total %
00-99% — Total cover (strict) of all live shrubs within the 10 m plot/section. Consider only live leaves/needles (including damaged/dead parts of otherwise live shrubs), trunks and branches. Completely dead shrubs are not included, but are estimated separately.

Shrubs — Opens menu **Shrubs**

Trees — Opens menu **Trees**

Land Cover



Main type
1 Terrestrial/semi-aquatic
2 Aquatic perm fresh water
3 Aquatic perm salt/brackish
4 Glacier - perm core of ice
5 Permanently snow covered land

Inventory?
01 Yes, normal inventory
02 Yes, temporarily snow
03 Yes, temp water <10cm
04 Yes, temp water >10-30 cm
05 No, temp water >30 cm
06 No, inaccessible wetland
07 No, field with annual crops
08 No, hayfield
09 No, inaccessible non-arable outcrop
10 No, island less than 0.1 ha
11 No, inaccessible steep terrain
12 No, risk of landslide
13 No, industrial site
14 No, no trespassing
15 No, not in Sweden
16 No, other reason – file report

Field total %
00 00 %
01 - 99 %

Shrub total %
00 00% 10 m yta
01 - 99 10 m yta

Menu Field Layer - variables

All variables refer to strict cover in the 10 m sample plot. BF indicates blank format. Enter '00' if the species is present in small quantities (maximum 04 %, i.e. 1.5 m^2).

0-100% BF	Broad-leaved Herbs	All vascular plant species except ferns, dwarf shrubs, graminoids, willows, trees and shrubs and last year's litter.
0-100% BF	Ferns	All vascular cryptogams, i.e. club moss, equisetums and ferns.
0-100% BF	Dwarf shrubs	Al live shoots of dwarf shrubs in the genus *Ericaceae*. NOTE: *Cassiope hypnoides* is included in *Ericaceae* and is therefore considered in this variable.
0-100% BF	S.reti/herb/polaris	*Salix reticulata, Salix herbacea, Salix polaris*
0-100% BF	Graminoids	All graminoids, i.e. grass (*Poaceae*), sedge (*Cyperaceae*), rush (*Juncaceae*) and bulrush (*Typhaceae*), including dry leaves from current year. Last year's litter and older is not included.

Control: The sum of the cover of herbs, ferns, dwarf shrubs, *S. reticulata, S. herbacea, S. polaris* and graminoids must equal at least **Field layer Total %.**

Menu Large Species - variables

Species list, see appendix 14.

- Register cover of large species of ferns, herbs and graminoids according to the species list, appendix 14.
- Cover refers to strict cover in the 10 m sample plot.
- Enter "00' if the species is present and has a maximum cover of 0.4 % (i.e. 1.5 m^2 in a non-divided 10 m sample plot). NOTE: Always leave the data field blank if the species is not present.

Menu Bottom Layer - variables

All variables refer to strict cover in the 10 m sample plot. BF indicates blank format Enter '00' if the species is present in small quantities (maximum 04 %, i.e. 1.5 m^2).

For definition of species, see Weibull (2004) and Hylander & Esseen (2005).

0-100% BF	Peat mosses	All species within the *Sphagnum* family, Weibull (2004)
0-100% BF	*P. commune*	*Polythricum commune*, Weibull (2004)
0-100% BF	Other bryophytes	All other species of mosses and liverworts in the bottom layer.
0-100% BF	*Cladina*	All species in *Cladonia*, group *Cladina*, Hylander & Esseen (2005) NOTE: Thorn-cladonia (*C. uncialis*) is not included
0-100% BF	Other fruticose lichens	All other fruticose lichens in the bottom layer e.g. *Cetraria islandica, Stereocaulon paschale,* and all *Cladonia* species except Reindeer-lichens, Hylander & Esseen (2005). NOTE:
0-100% BF	Ground-living foliose lichens	All foliose lichens living on the ground, mainly *Peltigera sp.*, *Nephroma sp*., *Solorina sp.*, Hylander & Esseen (2005). NOTE: Do not count litter of epiphytical lichens on the ground.
0-100% BF	Foliose lichen on rock	All foliose lichens living directly on rock (stones to bare bedrock), mainly *Umbilicaria sp*.**,** *Melanelia sp*., *Caloplaca sp*., *Physcia sp*., but sometimes also *Platismatia sp*. and *Hypogymnia sp*., Hylander & Esseen (2005).
0-100% BF	stone/boulder/ bedrock >20 mm	Bare stones, boulders or bare bedrock (larger than 20 mm) not covered by vegetation , or only with crustose lichens present. Only areas lacking humus layer are included in this category.
0-100% BF	Mineral soil/ gravel <20 mm	Exposed mineral soil (particle size less than 20 mm) that is bare or covered with ruderal crustose lichens or an extremely thin and diffuse layer of disturbance tolerant bryophytes (mainly in mountain areas). Included only if humus layer is lacking. Exposed brown forest earth is included
0-100% BF	Humus/peat	Exposed humus/peat, i.e. substrate mainly dominated by degradable organic matter where parts of plants etc. have lost most of their original quality.
0-100% BF	Hard/coated ground	Ground with cover that deters plant growth. Mainly asphalt, but also pavement, gravel/macadam or

		cement.
0-100% BF	Water	Permanent water surface within the sample plot. Small lakes and ponds are also included.
0-100% BF	Other, left to 100%	Cover of all other materials in the bottom layer that, together with all of the above, adds up to 100%. This includes, for example, leaves- and tree needle litter**,** dense grass clumps, twigs/branches, and artificial features (deposited objects etc.).

Control: The sum of cover in the bottom layer must equal 100%.

Menu Shrubs - variables

Species list, see appendix 14.

- The cover refers to strict cover in the 10 m sample plot.
- Blank Format: Enter “00’ if the species has a maximum cover of 0.4 % (i.e. 1.5 m^2 in a non-divided 10 m sample plot).
- A data field for height will pop up automatically for certain species of shrubs when the cover for the species is entered (cover of ‘00’ or more). These shrubs are live juniper, *Salix glauca, Salix lanata, Salix lapponium**, Salix sp.**, Rosa rugosa*, *Rosa sp.*, hawthorn (*Crataequs spp.*), blackthorn (*Prunus spinosa*) (00-99 dm) and hazel (*Corylus avellana*) (100-150 dm). Height refers to the highest live individual shrub of the species within the 10 m sample plot and is measured to the closet dm. NOTE: Height refers to height from the ground (not along the trunks).
- NOTE: Always check that the sum of all live shrubs is at least as high as **Shrub total %.** It can be higher if different species overlap.

Definitions of Tree variables

Basal area

The term basal area is often used as a measure of density when describing a stand of trees. The basal area states the amount of area covered with tree trunks, and is usually stated in m^2/hectare (i.e. square meters of trunk-covered area per 10 000 square meter total area). In NILS, basal area complements estimations of tree cover (and sometimes trunks counts) to characterize the density of the forest. Measurements of basal area are widely used in forestry and the NILS-data can therefore easily be compared to data from other forest inventories.

The basal area is easily measured with a relascope. The principle is to systematically observe all trees in the area from a given point (usually the center of the sample plot) and note if they are wider than the relascope sighting notch, while aiming at breast height (1.3 m trunk height). Count only trees that fill the sight notch completely and multiply this number with the factor of the relascope (usually 1 or 2) in order to obtain the basal area of the stand. When using the relascope, please note:

- Some trees may be blocked by other trees, boulders etc. In these cases, shift sideways to try to determine if these trees should be counted or not.
- Many trees will be “borderline trees’; their diameter and distance from the point of measuring make it difficult to decide if they should be counted or not. To correctly measure borderline trees takes a lot of training. By measuring the distance to the borderline tree and its diameter at breast height, one can learn to estimate if the tree is to be counted. The diameter at breast height (in cm) should exceed the double distance (in meters) to the tree, multiplied by the square root of the calculating factor (1 if the calculating factor 1 is used). A 20 cm diameter tree can, at the most, stand 10 meters away in order for it to be counted, if the calculating factor 1 is used.
- If one is standing close to the edge of a forest (less than 10-20 meters when the calculating factor 1 is used) the basal area obtained will be much too low. In these cases, the following principles apply:
    - If you are at, or close to (less than 10 meter from), a somewhat straight forest edge, stand at the edge and measure only in the direction toward the area in question and double the basal area obtained.
    - If you are at a 10-20 meter distance from the edge, just move a few steps into the forest until you think that the edge will not cause any miscalculations.
- Normally a factor 1 relascope is used. Factor 2 is used if the trees are so thick that problems occur with blocked trees and long distances to trees that are to be included (if many trees are thicker than 30 cm at breast height). In non-divided sample plots the measurements are performed from the sample plot center (except for cases mentioned above). In divided sample plots, measurements are normally carried out according to the first principle in the above list.

Basal area weighted mean

Basal area weighted mean refers to a weighted mean value. The weight is the basal area of the individual tree – its cross-section area at breast height. This type of mean is implemented instead of the arithmetic mean in order to more accurately describe the mean for the larger trees, rather than the mean of the sometimes abundant undergrowth, which is neither ecologically nor economically as interesting as the larger trees.

A convenient feature with basal area weighted mean is that it represents the arithmetic mean for the trees counted with the relascope measurements. A practical way to determine a basal area weighted mean for any variable is then to only measure trees included in the relascope count. In order to save time, only choose a couple of these trees for careful measurement.

Registering the tree layer in the 20 m plot

Tree height and stand stratification direct the flow in menu “Trees’. The stand status is indicated by the variable Presence of Trees (see flow chart below for procedures and which variables to register). For live trees, register basal area or number of tree trunks depending on basal area weighted mean height. For dead trees, register total basal area or total number of trunks depending on tree height. Species composition of dead trees is specified only for basal area***,*** i.e. larger trees. Only a few measurements are taken when describing the tree layer. NOTE: When registering tree cover, all individual trees are taken into account regardless of height. When registering average height and number of trees, only trees higher than 0.5 m are included.

Goat willow (*Salix caprea*) and other willow trees with a diameter exceeding 20 mm (at breast height) are considered trees - if they are smaller they are considered shrubs. Rowan (*Sorbus aucuparia*) is always considered a tree, regardless of size. On the other hand, hazel (*Corylus avellana*) is always considered a shrub. A complete list of species and their designated numerical codes can be found in appendix 14.

Menu Trees - variables

Tree Total % 00-99%	Total canopy cover (diffuse) of all live trees on the 20 m sample plot/section. In a divided sample plot, only the current section is considered. All trees regardless of height are included, as well as partially dead crowns of live trees. NOTE: If there are trees with a maximum cover of 0.4 %, enter “00’.
Tree Cover	Opens menu **Tree Cover.**

Presence of Trees

0 No trees, not clear-cut < 0.5 m	Forest plants/small trees shorter than 0.5 m allowed. Not in a clear-felled area.
1 Clear-cut, trees < 0.5 m	Clear-felled area, forest plants/small trees shorter than 0.5 m allowed.
2 Only plant layer (0.5 -< 1.3 m)	Live trees are described. No live trees higher than 1.3 m are allowed.
3 Trees > = 1.3 m	Live and dead trees are described. At least one tree is higher than 1.3 m, or at least one dead tree has a diameter of at least 10 cm at breast height, and is at least 1.3 m high (if broken).

Presence of trees includes both live and dead standing trees. Estimates are made within the 20 m sample plot.

Mean Height Mean height of the stand of trees.
005-500 dm

Mean height is measured either as a basal area weighted mean or an arithmetic mean height. If the basal area weighted mean is over 7 m, the height is measured as basal area weighted mean. If the basal area weighted mean is 7 m or less, the height is measured as an arithmetic mean. NOTE: All live trees higher than 0.5 m are included, as well as dead trees with a diameter of at least 10 cm at breast height. The height is normally obtained by measuring one or more representative trees. NOTE: In planted or young forests where a sparse layer of seed trees or trees important for biodiversity are left, these are not included in height measurements (unless most of the young trees are shorter than 0.5 m – in which case the height is decided only from the remaining tall trees).

Basal Area Dead Basal area of dead trees of all species per hectare in the stand. NOTE: If the mean height of dead trees is 70 dm or higher, total basal area is registered. If dead trees are abundant, use a relascope. If dead trees are scarce, the basal area is estimated.
00-99 m^2/ha

Proportion Dead Trees Opens menu **Proportion Dead Trees**

Basal Area Live Basal area of live trees of all species per hectare in the area. If the mean height is 7 m or higher, the total basal area of live trees is registered. Normally this is measured with a relascope as seen above. If there only are a few trees, the basal area is estimated.
00-99 m^2/ha

Number of Dead Trunks Number of dead trees per hectare in the stand.
0000-9999 no./ha

If the mean height is less than 7 m, the number of dead standing trunks per hectare is registered. NOTE: All dead individual trees higher than 0.5 m are counted (a clump is counted as one). Normally a representative smaller area is measured, and the result is adjusted for one hectare. In practice, the number of trunks is stated in hundreds. A circular area with a 5.64 m radius (area =100 m^2) is multiplied by 100. A circular area with 1.78 m radius (area = 10 m^2) is multiplied by 1000. The number of trunks can also be estimated from square spacing (Table 4.5). For dead trunks only the total number of trunks is stated, no species constitution.

Table 4.5: Relation between square spacing and number of trunks per hectare.

Square spacing (meter) = Number of trunks per hectare			
1.0 = 10000	1.6 = 3900	2.2 = 2100	3.5 = 820
1.1 = 8300	1.7 = 3500	2.3 = 1700	3.75 = 700
1.2 = 6900	1.8 = 3100	2.5 = 1600	4.0 = 625
1.3 = 5900	1.9 = 2800	2.75 = 1300	4.5 = 500
1.4 = 5100	2.0 = 2500	3.0 = 1100	5.0 = 400
1.5 = 4400	2.1 = 2300	3.25 = 950	

Plant Height Mean height of plant layer , 5-13 dm height

05-13 dm

Number of Live Trunks Number of live trees per hectare in the stand.

0000-9999 no./ha

If the mean height is less than 7 m, the number of live trunks per hectare is registered. NOTE: Count all live trees higher than 0.5 m (a clump is counted as one). Normally a representative smaller area is measured, and the result is adjusted for one hectare. In practice, the number of trunks is stated in hundreds. A circular area with a 5.64 m radius (area =100 m^2) is multiplied by 100. A circular area with 1.78 m radius (area = 10 m^2) is multiplied by 1000. The number of trunks can also be estimated from square spacing (Table 4.5). NOTE: If the number of trunks is higher than 10 000 enter it as 9999.

Proportion Live Trees Opens menu **Proportion Live Trees**

Mean Age Basal area weighted mean age at breast height (1,3 m).

001-999 yrs

The mean age of the stand is stated as age at breast height. The mean age is estimated by drilling into one or two representative trees on or outside the sample plot. In planted or young forests with sparse seed trees or trees important for biodiversity, these trees are not considered when estimating mean age (compare mean height above). If the tree layer is very sparse or varied, the age is estimated without drilling. The same applies to forests that are very valuable (e.g. oak stands). In a young forest the age at breast height can often be determined by counting yearly shoots. NOTE: If tree height is less than 1.3 m, enter “999’. NOTE: Do not measure age in mountain birch forests. Enter code “999’ (=not estimated). This code may also be used in other ‘impossible’ situations.

Canopy Layers Number of canopy layers in the stand.

1 One layered stand

2 Two layered stand

3 Multilayered stand

4 Full layered stand

A canopy layer consists of trees of approximately the same height, whose height at the same time differs from trees in other strata. In order to identify a layer, the mean difference in height must be at least 1/3 of the mean height of the higher layer. If the highest layer is lower than 10 m, only one layer is registered or the stand is considered full layered. A layer must consist of a basal area of at least 5 m^2/hectare, or a minimum 1,000 trunks/hectare. For standard trees (seed trees, trees important for biodiversity, older trees in pastures etc., over 10 m high), only 10 trees per hectare are required for a layer to be distinguished. Sparse trees should be somewhat evenly distributed in the area. A layer can often consist of several different tree species. NOTE: Only live trees in the layer are considered. If the height difference between the layers is too small, combine the layers as one.

Where number of trunks is very low, consider the stand as one layered, even if there are trees of different sizes. If there are more than two layers, consider it “multilayered’. A full layered forest is a special type of stand. In order for a stand to qualify as full layered, the following must apply:

- Trees of all diameter classes (Dcl1- Dcl4) are present according to Figure 4.6. The diameter of the thickest tree (Dmax) is at least 2 dm.
- The number of trunks (n1 - n4) in the different diameter classes relates to one another as n1 > n2 > n3 > n4 > 0. Also, the volume density is at least 0.5 (appendix 7).

In a full layered forest the variation in dimensions and height must be very large. Groups of similar trees occur regularly. A typical selection forest (uneven-aged forest) should be fully layered.

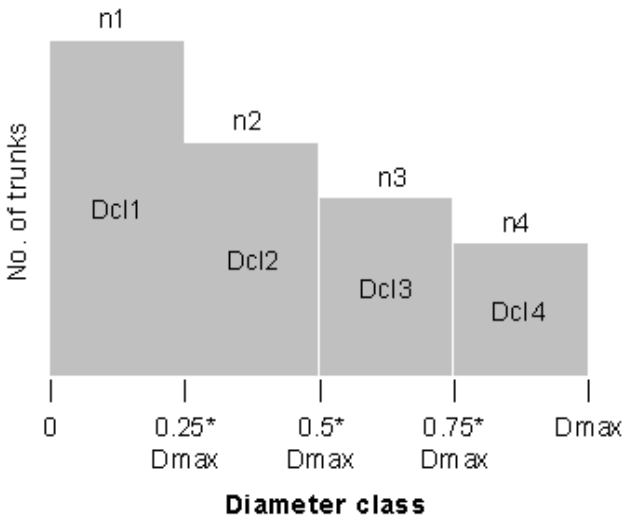


Figure 4.6: Diameter classes in a full layered stand.

Forest Swedish Forest according to Swedish definition.

0 No
1 Yes

According to the Swedish definition of forest, the site must be able to produce on the average at least 1 m^3 forest per hectare and year (trees in a somewhat consistent stand of about 10 m mean height, 12 m in mountain birch forest). There can be no other main use of the area. Thus a clear-cut is considered forest land. Wooded grazing areas are not considered to be forest. However, abandoned fields are considered forest according to this definition if there has been no farming within the last three years, and it is obvious that the land is not in fallow. This category is also used within nature preserves.

Forest FAO Forest land according to the definition of FAO.

0 No
1 Yes

Land that is not used for any other purpose (e.g. grazing), with more than 10% canopy cover of trees (tree species according to NILS) and a minimum mean height of 5 m. However, this refers mainly to potential rather than current conditions. In areas that have not been affected by forestry for a long period of time, estimation is based on the current conditions.

Tree/Shrub FAO Other wooded land according to the definition of FAO.

0 No
1 Yes

Land without any obvious use that can not be attributed to any of the earlier categories, where cover of trees and shrubs higher than 0.5 m is 10%, or cover of trees (tree species according to NILS) that can reach at least 5 m in height is 5-10%. This also refers to potential rather than current conditions. In areas that have not been affected by forestry for a long period of time, estimation is based on the current conditions.

Menu Tree Cover – variables

Species list, see appendix 14.

- Cover refers to diffuse cover in the 20 m sample plot, of all live trees regardless of height.
- Enter “00’ if the species is present with a maximum cover of 0.4 % (i.e. 5 m2 in a non-divided 20 m plot). NOTE: Leave the data field blank if the species is not found
- All species present should be registered, but inappropriate amounts of time should not be spent on registering small trees of low occurrence. However, all species that

cover more than a couple of square meters (1 %) must be registered.

NOTE: Always check that the total cover of all species is at least as high as the total tree cover, **Tree Tot %.** It may be higher if tree species are overlapping.

Menu Proportion Dead Trees – variables

Amounts of dead tree species, percent of basal area***,*** sum= 100%. NOTE: Leave the data field blank if the species is not found.

0-100%	Percent Scots pine (*Pinus sylvestris*) dead
0-100%	Percent *Pinus contorta* dead
0-100%	Percent Norway spruce (*Picea abies*) dead
0-100%	Percent other conifers
0-100%	Percent Birch (*Betula pendula*, *B. pubescens*) dead
0-100%	Percent Aspen (*Populus tremula*) dead
0-100%	Percent other trivial deciduous trees dead
0-100%	Percent Oak (*Quercus robur*) dead
0-100%	Percent Beech (*Fagus sylvatica*) dead
0-100%	Percent other temperate deciduous trees dead (Ash, elm, linden, hornbeam and wild cherry).

Tree species composition for dead trees is noted only if the average height of exceeds 7 m and the basal area of dead trees is at least 1 m^2/ha. NOTE: Amount refers to the species' basal area percentage in the entire 20 m plot (or section). Each tree species percentage is estimated visually, based on the measured basal area. NOTE: Percent is stated as accurately as possible, but 5% and 10% classifications are allowed. NOTE: Check carefully that the sum of all tree species always adds up to 100%.

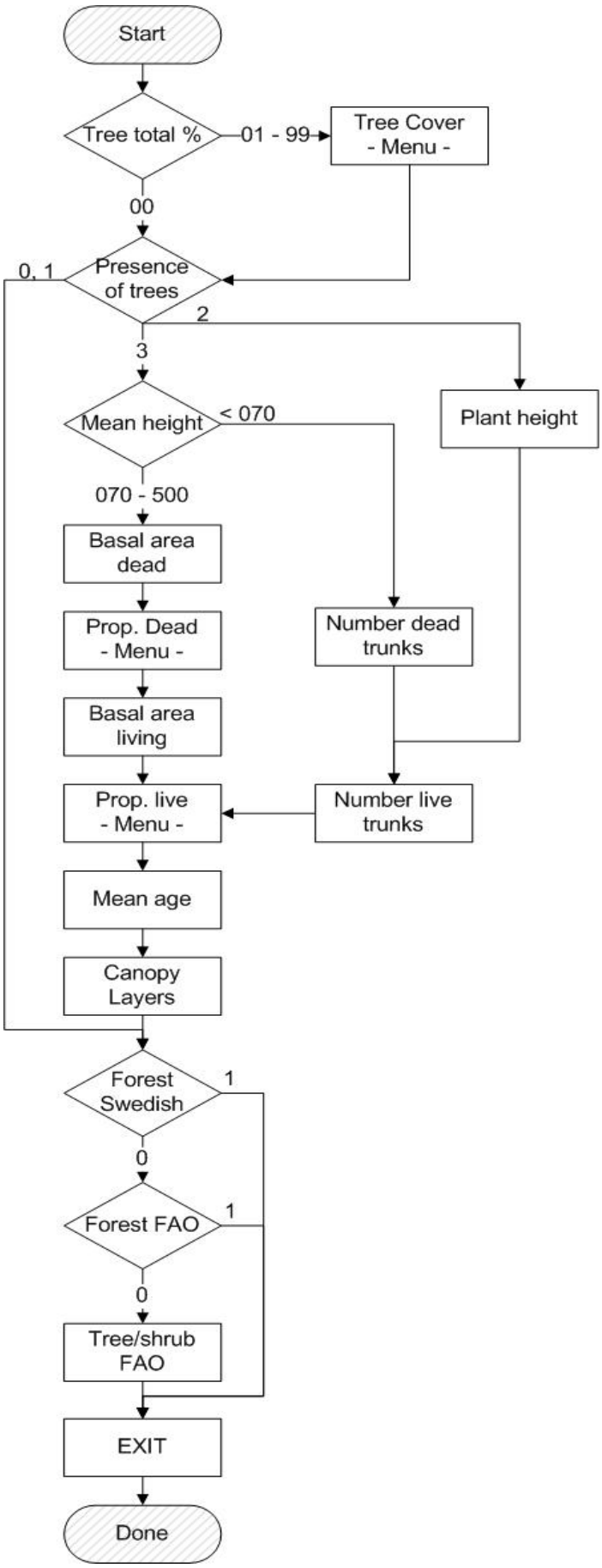
Menu Proportion Live Trees - variables

Amount of live tree species, percent of basal area or number of trunks (see below), total = 100%. NOTE: Leave the data field blank if the species is not found.

0-100%	Percent Scots pine (*Pinus sylvestris*) live
0-100%	Percent *Pinus contorta* live
0-100%	Percent Norway spruce (*Picea abies*) live
0-100%	Percent other conifers
0-100%	Percent Birch (*Betula pendula*, *B. pubescens*) live
0-100%	Percent Aspen (*Populus tremula*) live
0-100%	Percent other trivial deciduous trees live
0-100%	Percent Oak (*Quercus robur*) live
0-100%	Percent Beech (*Fagus sylvatica*) live
0-100%	Percent other temperate deciduous trees live (Ash, elm, linden, hornbeam and wild cherry).

Enter the percent for each tree species in the entire 20 m plot or section. If the mean height exceeds 7 m, tree species percent refers to percent of the basal area***.*** If the mean height is lower than or equal to 7 m, tree species percent refers to percent of the

total number of stems. Each tree species percentage is estimated visually, based on the measured basal area or the number of trunks. NOTE: Percent is stated as accurately as possible, but 5% and 10% classifications are allowed. NOTE: Check carefully that the sum of all tree species always adds up to 100%.



Trees

Tree tot %
00 - 00 %
01 - 99 %

Presence of trees
0 No trees, not clear-cut < 0.5 m
1 Clear-cut, trees < 0.5 m
2 Only plant layer (0.5 -< 1.3 m)
3 Trees > = 1.3 m

Plant height
05 - 13 dm

Mean height
005 - 069 dm
070 - 500 dm

Number of dead trunks
0000 – 9999 /ha

Number of live trunks
0000 – 9999 /ha

Basal area dead
00 99 m2/ha

Basal area live
00 99 m2/ha

Canopy Layers
1 One layered stand
2 Two layered stand
3 Multilayered stand
4 Fully layered stand

4.6. LOBARIA LICHENS

Aim

Lobaria pulmonaria and Lobaria scrobiculata are two signal species that indicate bio-diversity in forests. Both species grow primarily on deciduous trees and are good environmental indicators. Their presences indicate, among other things, good air quality, high natural value and long forest continuity. The aim of this module is to determine the conditions of the epiphyte vegetation in the area.

Criteria for registration

- Register each section within the 10 m sample plot in all sample plots that contain trees.
- Register presence of *L. pulmonaria* and *L. scrobiculata* only on deciduous trees with a diameter of at least 100 mm. The center of inventoried trees must be within the 10 m plot and the trunk can lean no more than 45 degrees.
- Register presence of *L. pulmonaria* and *L. scrobiculata* from the base of the tree up to 1.8 m above ground, including branches less than 1.8 m above ground, and similarly between 1.8 and 4 m above ground. The ground level is defined as the tree's growing point.
- Register only lichens growing on the tree and the tree base. Do not register lichens growing on the buttresses.
- The area of the lichen thalli must exceed 1 cm^2 in order to be registered.
- Register only healthy, live thalli. Dead, fragmented, often gray or pink colored individuals are not registered. Register also lichens that are discolored but considered live**.**

Procedures

- Examine all deciduous trees with a minimum diameter of 10 cm carefully for *L. pulmonaria* and *L. scrobiculata*. NOTE: These lichens are normally very scarce on birch trees. There is no need to examine all smaller birches (random sampling is enough). However, all larger trees are to be thoroughly searched.
- All trees with at least one occurrence of *L. pulmonaria* or *L. scrobiculata* are registered. Deciduous trees with no presence of these lichens are not registered. Remember which trees that have already been examined. If needed, mark trees with presence of lichens with a paper-strip. Remove the strips after inventory is completed.

Menu Pulmo/Scrob - variables

Tree No.

This menu automatically designates individual numbers for all trunks with presence of at least one of the relevant lichen species. If no lichen is found, no data is entered and inventory continues on the next tree. Tree number is an identity and creates a new post in the database. If a tree has several trunks, the following applies:

- If the tree-trunk splits into two or more stems branches above 1.3 m it is registered as one tree trunk.

- If the tree-trunk splits into two or more stems branches below the 1.3 m line, each trunk with lichen is registered separately. Lichen growing on the joint part of the trunk is registered as growing on the thickest trunk (in other words, no double registration).

BF indicates blank format in the cover estimations below.

Tree Species

30-97 Live deciduous tree	Species and codes according to tree species list (appendix 14).
01 Dead, species known	
03 Dead, species unknown	

Tree Species Dead	Register if **Tree Species** = 01 above
30-97 Dead deciduous tree	Species and codes according to tree species list (appendix 14).

Diameter	Measure with the caliper ruler pointing toward the center of the sample plot.
0100-9999 mm	

L. pulmonaria dm^2 0-1.8	Cover (dm^2) of *Lobaria pulmonaria* 0 - 1.8 m high.
000-999 dm^2 BF	000: Cover from 1 cm^2 to max 0.5 dm^2
	001: Cover from 0.5 to max 1.4 dm^2 etc

L. pulmonaria dm^2 1.8-4	Cover (dm2) of *Lobaria pulmonaria* 1.8 - 4 m high.
000-999 dm^2 BF	000: Cover from 1 cm^2 to max 0.5 dm^2
	001: Cover from 0.5 to max 1.4 dm^2 etc

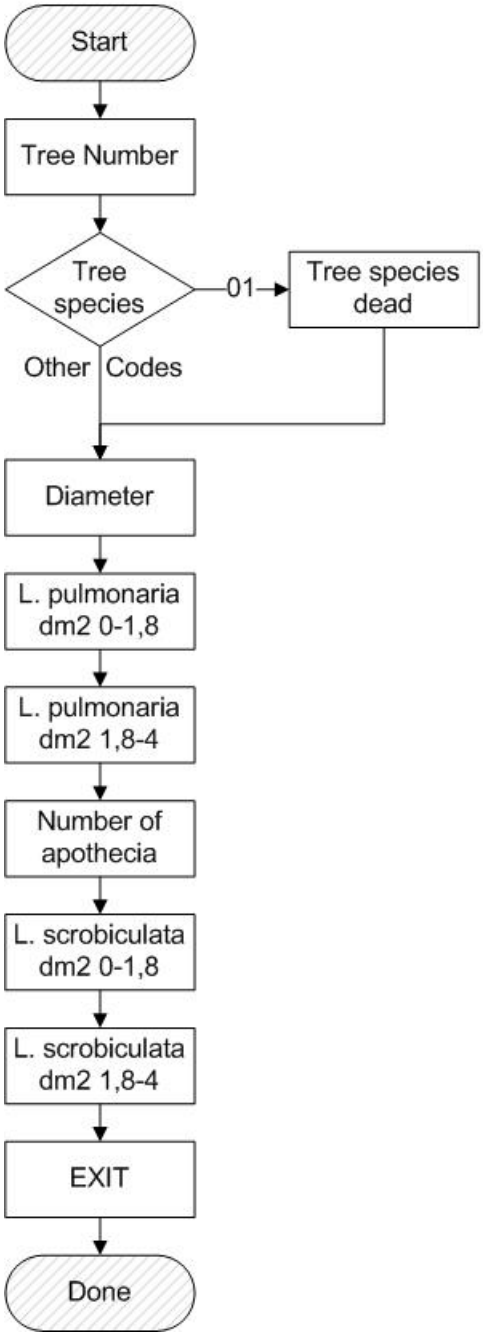
Total cover in dm^2 of *Lobaria pulmonaria* (summed up around the entire trunk) from the tree base up to 1.8 m, and between 1.8 and 4 m above the growing point of the tree. This refers to cover in dry or somewhat moist conditions. Completely wet lichen thalli may have a 1.5-2 times larger surface. NOTE: If no lichen is present, leave the data field completely blank (blank format - ‘00’ means that lichen is present in very small quantities).

Number of Apothecia	Total number of apothecia of *L. pulmonaria* between 0-1.8 m.
000-999	

The apothecia of *L. pulmonaria* are reddish brown (p. 175 in Natura 2000, ‘Indicator Species“). The apothecia may be hard to distinguish from a lichen parasite that looks like small, black, slice-like formations. If uncertain, consider them apothecia. If many, an estimation of the total number is made.

L. scrobiculata dm^2 0-1.8	Cover (dm^2) of *L. scrobiculata* 0-1.8 m high.
000-999 dm2 BF	000: Cover from 1 cm^2 to max 0.5 dm^2 001: Cover from 0.5 to max 1.4 dm^2 etc
L. scrobiculata dm^2 1.8-4	Cover (dm^2) of *L. scrobiculata* 1.8-4 m high.
000-999 dm^2 BF	000: Cover from 1 cm^2 to max 0.5 dm^2 001: Cover from 0.5 to max 1.4 dm^2 etc

Lobaria Lichens



Deciduous trees
30 Betula sp.
41 Populus tremula
42 Populus sp.
51 Quercus robur
61 Fagus sylvatica
62 Aesculus hippocastanum
71 Fraxinus excelsior
72 Ulmus sp.
73 Tilia cordata
74 Acer platanoides
75 Carpinus betulus
76 Prunus avium
82 Salix (Willows)
83 Malus domestica
84 Pyrus communis
85 Castanea sativa
91 Alnus glutinosa
92 Alnus incana
93 Acer pseudoplatanus
94 Salix caprea
95 Sorbus aucuparia
96 Sorbus intermedia
97 Other deciduous trees
01 Dead, species known
03 Dead, species unknown

4.7. LAND USE

Aim

Land use registrations complement descriptions of land cover and give an accurate description of how the land is used. Knowledge of the current situation and how the land use changes is interesting in itself, and it also contributes to the explanation of why, e.g., the vegetation develops in a certain way.

Criteria for registering

- Current land use is registered in all sample plots/sections, plots visited in the field as well as plots inventoried from a distance or map.
- Determine land use for the entire 20 m sample plot, or for each section. While determining land use, consider the entire 20 m plot or section thereof.
- If several different types of land use are present within the sample plot, state the dominant type, i.e. the type that has the most influence on the vegetation and natural value of the plot. Most often this refers to the land use type with the most cover, but intensity may also be considered.
- Current land use normally refers to land use for the present or previous year, or when it is obvious that the type of use will continue. If an essential condition has changed, the land use is considered discontinued (i.e. “historic’), e.g. if fencing has been removed from a grazing area.
- Historic land use refers to discontinued use, where there are still obvious and visible signs within the plot. If several historic land uses can be detected, the most recent is normally specified.
- Nature reserves are not indicated in land use. This information is obtained from maps later on.

Procedures

- Determine main type for the sample plots/section. Consider the entire 20 m plot/section. See definitions above.
- Register current land use under main type.
- Register amounts of low- medium- and high growing vegetation only in maintained areas. A rising-plate meter is placed on top of the vegetation and its height above ground is measured. Calibrate the estimations!
- Register historical land use if obvious traces are found.

Definitions

Land use means, in this case, continuing human use of the land in a way that visibly influences the character of the area (e.g. forestry, but not the activity of logging). Temporary land use that does not leave visible traces (recreation in the form of e.g. berry picking) is not registered. However, areas that are clearly delimited for e.g. recreational use are registered. In order to simplify registration of land use, a number of ‘main types’ are available. These main types are defined first and foremost by the types of land use that are included within each main type. However, the descriptions below are in broad terms comparable to the definitions of ‘forest’, ‘man-made land’, ‘agricultural land’ etc. in other inventory modules.

Arable land
Land that is regularly plowed and used for cultivation, including annual crops, hay fields/leys and grazed leys. This also includes cultivation on previously plowed areas, such as energy forest and commercial fruit and berry plantations. Small cultivated areas on building sites or lots, e.g. potato fields, are therefore registered as man-made land. NOTE: Former arable fields planted with forest trees are not considered fields, but forest. Periodically plowed pasture-land (included in crop rotation) is considered a field. NOTE: However, permanently grazed land is not considered arable land (type other/natural land, see below). This can be determined by the fact that there are no visible traces of plowing in the area.

Man-made/paved land
Terrestrial land where there has been excavation, e.g. building sites, homes, parks, shoulders and ditches along transportation routes, and small fields. Seeded and planted vegetation as well as naturally established vegetation can be found. It can also refer to disturbed substrate land where vegetation can spread if the land use changes. Small cultivation areas in proximity to other types of man-made land or built-up areas, and can not be counted as agricultural land, are registered here, e.g. allotment gardens and flower beds. Paved land has some sort of pavement that deters vegetation, but often also infiltration of water, e.g. buildings, asphalt or gravel. Man-made and paved land are combined as one category, as they often appear together, e.g. at building sites, recreational facilities, and other types of exploited land. Cemented or tiled pools without any kind of vegetation or plant substrate (swimming pools, treatment plants) are also included here.

Forest
Forest that is or could be used for forestry and is not strongly characterized by other types of land use. NOTE: Unlike the formal definition (Swedish, chapter 4.5 Land cover), discontinued agricultural land is not considered forest if not actively planted and where natural establishment of forest trees has not yet reached 10% cover and 5 m height (compare chapter 4.10 Detailed tree data). Also included in this category are forest reservations, clear-cuts and seed orchards. Forests also includes certain types of grazed forest, where the tree layer and ground vegetation still is of forest character, cleared power line corridors and small areas for recreation (rest areas, jogging tracks) in a forest environment, and planted forest on land previously used for agriculture.

Other/natural land
Land that is kept open by other means than forestry or plowing. Abandoned farming land with a maximum of 10% tree cover or with trees no higher than 5 m is also included. This category includes land that is mainly used for animal husbandry. NOTE: However, grazed forest (type Forest) or pasture (type Agricultural land) is not included here. This type of land use also includes peat workings, sand pits, deposits and different impediments such as open wetlands, bare bedrock and mountain areas above the tree line.

Water
Area with permanent water; sea/ocean or water course, including the water influenced shore zone. NOTE: Riparian forests (type Forest) and riparian meadows (type Other/natural land) are not counted here even if they are covered with water during short periods of the year. Dams in densely populated environments or large recreational areas, made for fishing or as decorative ponds are included, as well as dug out ponds on golf courses and in parks. NOTE: Cemented or tiled pools are not included in this type, but are included in type Man-made/paved land.

Recreation

Recreation is only registered for clearly defined, man-made or in other ways arranged areas for recreational purposes, e.g. parks, bathing areas, golf courses, camping grounds, ski slopes and other outdoor recreational environments. NOTE: Occasional jogging tracks, park benches, etc. in an otherwise wooded area are not considered as recreation unless they are part of a larger, defined recreational area. Small “natural’ areas between golf holes, ski slopes and lifts are also considered to belong to the recreational area. Recreational areas can be found in different types of land and type of recreation can therefore be entered regardless of main type of land use. Within a recreational area (e.g. park or a camping area) it is possible to classify man-made areas, forests, and water or natural/open areas. Smaller recreational areas, where no earth has been excavated and at the most a layer of material has been added (like a jogging track or a rest area), are noted as recreational areas under main type of land (forest or other/natural land). Planted/seeded grasslands, shrub areas, and tree stands in connection with buildings or built-up areas are considered as sub-type recreational area in man-made land, while larger preserved groves in recreational areas are included in Forest or Other/natural land.

Menu Land Use - variables

Main type	See definitions above.
1 Arable land	
2 Man-made/paved land	
3 Forest	
4 Other/natural land	
5 Water	
Arable land	Current land use for main type Arable land.
0 Fallow/no visible land use	Unused/abandoned fields or land that has been fallow for several years.
1 Recently plowed/seeded	Recently plowed or seeded fields with bare substrate where type of crop can not be determined.
2 Annual crops	Grain, oil plants, root crops or fodder. Hay field plants may be seeded together with the crop.
3 Hay field/ley	Non-grazed fields with seeded, perennial pasture crop. Obvious traces of plowing (at least within the last 5 years).
4 Grazed ley	Fenced-in arable field currently with grazing animals. Clear traces of plowing. Seeded hay-field plants. Often a harvested hay-field where animals graze after the harvest.
5 Energy forest	Intense planting of species *Salix* and *Alnus.*
6 Fruit/berry plantation	Large commercial orchards and berry plantations on agricultural land.

Man-made/paved land	Current land use for main type man-made or paved land.
0 No visible land use	Man-made land where the land use has been discontinued, for example abandoned building lots or ruderal land.
1 Allotment garden	Small scale household garden in allotment area. Considered man-made land since it often consists of a mix between planned areas and other vegetation cover, and is not commercially cultivated land.
2 Recreation (man-made)	Man-made green areas and flowerbeds in parks, open air areas, golf courses, etc. larger than 0.1 ha.
3 Residential area	Less than 5 houses together, including clearly defined private property.
4 Urban area	Several houses (at least 6) in proximity, including adjacent roads, shops and green areas less than 0.1 ha etc.
5 Farm buildings	Outbuildings, courtyards, dung wells, etc. within the farm (including occasional residential homes).
6 Industrial park	If an industrial area is fenced in, the entire area applies to this category, including adjacent storage areas etc.
7 Transport	Mainly roads and railroads with parking lots, depots etc. Include also cleared areas around the roads.
8 Current exploitation/ road/ building site	Recently excavated land, for example, road building or other exploitation. If the land is almost ready for use, and the purpose is obvious, enter it under respective use.
Forest	Current land use for main type forest.
0 Pot. forestry, no signs	Forest suitable for forestry that is not used for any other purpose and with no traces of forest management. Forest reserves where no forestry is allowed are also included.
1 Forestry	Forest with signs of forest management.
2 Forestry, conservation area	Forest that has been saved for, among other things, environmental reasons, after logging in the area.
3 Clear-felled area	Recently harvested forest, including planted forest with average height lower than 1.3 meters.
4 Seed orchard	Often fenced in areas with sparsely planted and pruned (thick crowns) pine or spruce.
5 Power line corridor	Cleared corridors for electrical power lines in the forest. Trees and shrubs are cleared, but ground vegetation is normally not affected.
6 Forest grazing (+forestry) included.	Wooded area suitable for forestry, but used as grazing area for domestic animals (cattle, sheep etc.). Tree layer with forest characteristics, but not recently over-grown areas.

7 Recreation (+forestry)	Wooded area in open air or camping areas, park or land within an urban setting.
8 Newly planted field	Agricultural field recently planted with trees with average height lower than 1.3 meters.
Other/natural land	Current land use for main type other/natural land.
0 no visible land use	Land use unknown or minimal.
1 Animal husbandry (natural)	Unfertilized and unmodified land, often with stones and boulders, where the vegetation is clearly affected by grazing or trampling.
2 Animal husbandry (fertilized)	Fertilized land where stones are removed. Also included is land that previously was cultivated in e.g. a mosaic with natural land.
3 Hay-making/mowing	Hay-making areas, or mowing on natural land.
4 Recreation (natural)	Natural areas on recreational land, for example parks or open air areas.
5 Residential area (natural)	Natural areas within clear property boundaries, maybe cleared, but not dug out or excavated.
6 Excavation	Sand pits, gravel pits, stone pits and peat cuttings with ongoing mining.
Animal Type	Main type of animal.
1 Cattle	Cows, heifers, steers, calves, etc.
2 Sheep - incl. wild sheep	Sheep, including wild sheep
3 Horses	Horses
4 Deer	Deer, fenced in
5 Reindeer-fenced in	Reindeer, fenced in
6 Pigs	Domesticated pigs
7 Domesticated birds	Hens, geese and ostrich
8 Other	Other animals (fenced in wild boars etc.).
Vegetation % <5 cm 000-100%	Cover of low vegetation in grazed areas, average vegetation (except occasional flower stalks etc.) no more than 5 cm high. Vegetation on dry grazed land that is naturally low is also included.
Vegetation % 5-15 cm 000-100%	Cover of moderately high vegetation on grazed land, average vegetation (except occasional flower stalks, etc.) between 5 to 15 cm high.
Vegetation % >15 cm 000-100%	Cover of high vegetation in grazed areas, average vegetation (except occasional flower stalks, etc.) over 15 cm high.
Vegetation % Grass	Cover of dense, distinct tussocks of grass or sedge

Tussocks 000-100%	that are notably elevated. Mostly found in damp or wet areas. Included in this category is mainly tufted heads of *Deschampsia cespitosa*, *Carex cespitosa*, etc

The best way to calibrate the height of the vegetation is to use a rising plate meter. It consists of a 30x30 cm disc and weighs 430 gr. The disc is placed on the vegetation and the distance to the ground is measured with a measuring stick. The result is a kind of average height, where occasional leaves or stalks sticking up are not included. The rising plate meter is easy to use, and many measurements can be made in order to calibrate estimations of vegetation height within the sample plot. The rising plate meter is a commonly used standard method, and data are easily compared to results from other studies.

Measurements of vegetation height refer to the height of the field layer above the moss layer. If careful measurements are taken while thoroughly pressing down the moss layer, the vegetation can sometimes reach over 5 cm even if there is almost no field layer at all, but this is not what is intended in this class. With ‘vegetation in grazed areas’, land that has been shaped by grazing is implied, and areas with dense moss layers and relatively sparse field layers may be included. However, bare bedrock, stones, trampled areas or areas without vegetation under spruce trees and dense brushes are not to be included. If these kinds of areas are present in the sample plot/section, the total cover of vegetation %-variables may be less than 100%. In order to include the ‘Veg. % grass tufts’, the tufts must be dense and distinct. If lightly stepped on, a distinct elevation should be noticed.

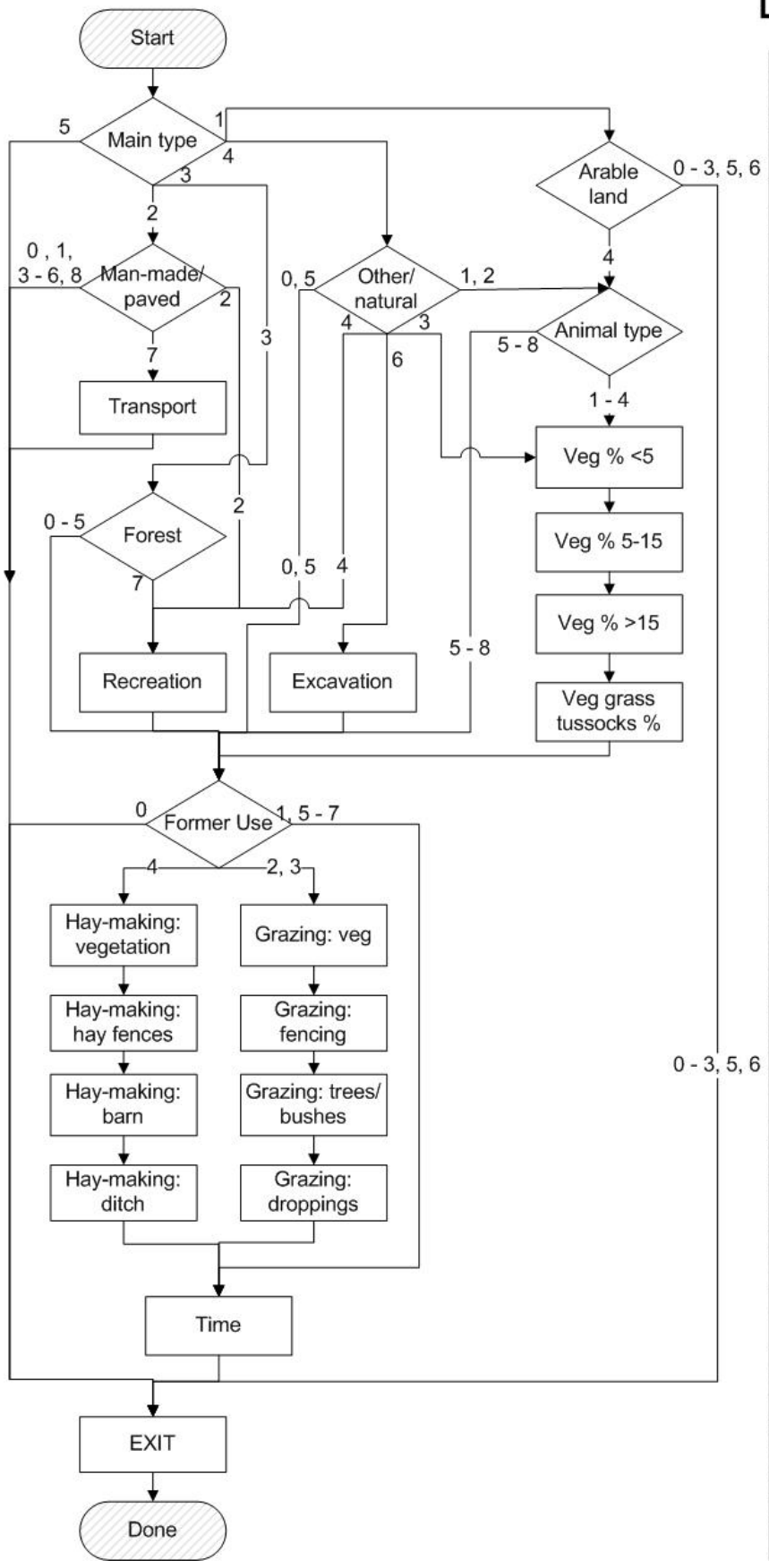
Recreation	Type of recreational area.
1 Bathing site	Cleared natural ground, man-made and/or paved ground in a fenced in area, or area frequently used for bathing.
2 Golf Course	Cleared natural area, man-made and/or paved ground within a golf course.
3 Camping site	Commercial or otherwise designated site used for camping, e.g. nature reserve or open air area.
4 Ski slope	Cleared or man-made area used for downhill skiing, often with ski-lifts.
5 Other sport/exercise area	Other sport or exercise area, such as jogging tracks, soccer fields or tennis courts.
6 Park	Large green recreational area close to built-up area or manor house that often contains different sizes of man-made areas, lawns, planted trees etc.
7 Other recreational area	Other area permanently reserved for recreational use.

Excavation	Type of excavation.
1 Peat workings	Peat workings in bog (land with no more than 30 cm peat moss).
2 Sand/gravel pit	Sand or gravel pit (no more than 20 mm grain size),

	mineral soil, often glacio-fluvial material, e.g. ridges.
3 Quarry	Quarry in bedrock.
4 Mould pit	Vegetable mould pit, top soil pit.
5 Other excavation	
Transportation area	Type of transportation area.
1 Parking lot/road	Land used for traffic or parking.
2 Railroad/depot	Land used for railroads, including stations, platforms etc.
3 Ports	Land used for sea traffic and related activities, both recreational and other.
4 Airports	Defined or fenced-in area adjacent to airport. Roads and parking lots for private cars are not included.
5 Other transportation areas	
Former Use	Type of former land use. Obvious traces must be found.
0 Not relevant	
1 Former agricultural land	Level ground without stones or trees, often ditches and plowed furrows along the boundary, not cultivated pasture land (see below).
2 Former grazing, natural	Formerly grazed land that is not prepared, plowed, fertilized or seeded.
3 Former grazing, cultivated	Formerly grazed land that has been fully or partially prepared, plowed, fertilized and cleared of stones.
4 Former hay-making	Mainly used for hay-making**,** e.g. abandoned forest meadows or hay-making wetlands. Do not include areas used for hay-making in historic times that have subsequently been grazed for an extended period of time.
5 Former forestry	Obvious signs of forestry, remaining tree stumps etc. The area has later been used for a different purpose (e.g. grazing).
6 Former excavations	Overgrown or restored. May be large scale gravel pits, lime stone quarries etc., or small vegetable mould pits, (peat, marl etc.)
7 Former industry/ building sites/ lots	Dilapidated industrial parks, abandoned building sites etc.
Grazing: Vegetation 0 No, no traces in veg. 1 Yes, traces in veg.	Traces of grazing in the ground vegetation. Field and bottom layers show visible traces of grazing. Often dense, low growing vegetation, dominated by grasses, even in moist areas. Remaining tolerant plants (*Agrostis capillaris*, *Alchemilla* sp., *Primula veris*, *Succisa pratensis***,** *Trifolium repens*, *Ajuga pyramidalis* etc.). In moist or wet areas the tufts are often reinforced by grazing, due to increased

	trampling between the tufts.
Grazing: Fencing 0 No, no fencing 1 Yes, older fencing found	Traces of grazing in the form of fencing. Remaining fencing that seems to have been surrounding the area, e.g. wire and posts for barbed wire, remaining wooden fences.
Grazing: Trees/Shrubs 0 No, no signs of grazing 1 Yes, trees and shrubs affected by grazing	Traces of grazing on trees and shrubs. Direct signs of grazing, e.g. ‘grazing horizon’ on deciduous trees, spruce and juniper (branches grazed up to 1-1.5 m height). Gnarly, earlier grazed small shrubs and trees. However, more indirect traces of previously open land are not considered (e.g. dying junipers or oaks within dense forests).
Grazing: Droppings 0.No, no droppings 1.Yes, older droppings found	Traces of grazing in the form of droppings. Remaining detectable droppings from cattle, sheep or horses that have not been completely covered by vegetation.
Hay-making: Vegetation 0 No, no sign of hay-making 1 Yes, signs of hay-making in vegetation	Field and bottom layer obviously affected by hay-making. Dense, low growing grassy vegetation with tolerant plants (compare grazing). Sometimes difficult to distinguish from grazing, which is entered if unsure. Together with additional signs, a general indication of hay-making is enough. S*corzonera humilis* a good indicator of hay-making on mesic ground.
Hay-making: Hay fences 0 No, no hay racks 1 Old hay racks present	Signs of hay-making in the form of leftover hay-drying racks within sight or within an area obviously connected to the sample plot, so that the land use ought to have been the same. Also consider poles in the vicinity that may have been used as hay-drying racks and have been left leaning against a tree or wall etc. The hay fences or the poles can be partially overgrown or have fallen down.
Hay-making: Barn 0. No, no hay-barns 1. Yes, older hay-barns exist	Signs of hay-making in the form of abandoned hay-barns within sight or within an area obviously connected to the sample plot, so that the land use ought to have been the same.
Hay-making: Ditch in flooded meadow 0. No, no ditches 1 Yes, older ditches exist	Signs of hay-making in sloping, wet meadows, in the form of small, shallow ditches that often run in the perpendicular to the angle of the ground, in order to let water flow evenly across the area.

Time	Estimated point of time when previous (historic) land use was discontinued.
00 This year	
01 1 year ago	
02 1-2 years ago	
05 2-5 years ago	
10 5-10 years ago	
25 10-25 years ago	
50 25-50 years ago	
99 >50 years ago	“99’ is only entered when very apparent signs of previous land use are detected.



Land Use

Main type
1 Arable land
2 Man-made/paved land
3 Forest
4 Other/natural land
5 Water

Agricultural land
0 Fallow/no visible land use
1 Recently plowed/seeded
2 Annual crops
3 Hay field/ley
4 Grazed ley
5 Energy forest
6 Fruit/berry plantation

Man-made/paved land
0 No visible land use
1 Allotment garden
2 Recreation (man-made)
3 Residential area
4 Urban area
5 Farm buildings
6 Industrial park
7 Transport
8 Current exploitation/ road/ building site

Forest
0 Pot. forestry, no signs
1 Forestry
2 Forestry, conservation area
3 Clear-felled area
4 Seed orchard
5 Power line corridors
6 Forest grazing (+forestry)
7 Recreation (+forestry)
8 Newly planted field

Other/natural land
0 no visible land use
1 Animal husbandry (natural)
2 Animal husbandry (fertilized)
3 Hay-making/mowing
4 Recreation (natural)
5 Residential area (natural)
6 Excavation

Animal Type
1 Cattle
2 Sheep - incl. wild sheep
3 Horses
4 Deer
5 Reindeer-fenced in
6 Pigs
7 Domesticated birds
8 Other

Former use
0 Not relevant
1 Former agricultural land
2 Former grazing, natural
3 Former grazing, cultivated
4 Former hay-making
5 Former forestry
6 Former excavations
7 Former industry/ building sites/ lots

4.8. MANAGEMENT ACTIVITIES AND DISTURBANCE

Aim

In this module, human factors, unintentional effects and certain natural processes that influence nature are registered. The results make it possible to understand the causes and reasons for trends in the development of the landscape. It also acts as a basis for estimating how regulations from the society have led to changed behavior. This module is a complement to the Land Use, but with primary focus on single factors or events (e.g. clearing), rather than the long term or overall use of the land (e.g. forestry).

Criteria for registration

- Management activities and disturbance is registered for each sample plot or section, but activities in the entire 20 m plot are considered if they occur in the polygon in question. Cover estimates for activities and disturbances are, however, made for the 10 m plot (‘diffuse cover’ for the section in question, compare Figure B1), in order to be able to compare activities with type of land cover.
- Only register presence of deposition/accumulations within the 10 m sample plot.
- Do not register minor disturbance. As a rule, disturbance is not registered unless at least 5% of the sample plot is affected.
- Estimate if obvious signs of listed activities have taken place during the last 5 years, except draining, where the activity is registered even if it occurred a long time ago. Draining is very easily detected and renders fundamental consequences even if it was done much more than 5 years ago. Type of activity or disturbance can sometimes be difficult to determine and strict guidelines can not be given ahead of time. NOTE: Do not over-analyze disturbances on the condition of the area if there are no clear signs that activities actually have taken place.

Procedures

- Consider every type of activity or disturbance for every sample plot or section that is visited in field. Also consider the polygon in question up to a radius of 20 meters.
- State type of activity/disturbance.
- State tree- or shrub species in the planted areas.
- Estimate cover and time for the most recent main type of activity/disturbance.

Definitions

Logging/clearing/thinning

All activities to actively remove or clear trees and shrubs.

Ground disturbance/soil scarification

An area is considered affected if mineral soil, humus or litter (including rocks and roots) are exposed as a result of an activity or if a recently disturbed area is overgrown with ruderal plants (e.g. *Plantago major*, *Poa annua*, ruderal mosses or ruderal lichens). NOTE: If there are patches of bare soil or areas in other ways similar to what has been described above but with no evidence of disturbance or activities, do not register the plot as disturbed or affected.

Natural accumulation
This includes non-organic material (e.g. rocks, gravel or sand) that in a natural way have covered the existing area, normally through landslide or sedimentation.

Menu Activities - variables

Draining	Presence of ditches within the 20 m sample plot. Natural water courses are not considered except if they are clearly straightened or dug deeper to increase their draining effect.
0 No draining	No ditches
1 Ditch in mineral soil (firm ground)	Ditch dug out in mineral soil, with other substrate than peat, for example mineral soil or gray brown podzol/cultured soil.
2 Ditch in peat soil	Ditch dug in wetland, i.e. peat substrate deeper than 30 cm.
3 Road side ditch or similar	Ditch dug along a man-made road in order to drain the road.
4 Filled ditch	Ditch that has been filled in with soil, etc.
Draining - Time	Time of draining.
00 This year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	
10 More than 5 years ago	
Disturbance	Presence of ground disturbance/soil scarification within the 20 m plot.
00 No disturbance/scarification	
01 Patch scarification	The ground is disturbed in patches, unlike harrowing/plowing. Normally the patches are 2 meters apart.
02 Harrowing/plowing, linear scarification in forests	Linear soil scarification in forests or other harrowing/plowing outside agricultural fields.
03 Other digging activity	
04 Soil disturbance by vehicles	Ground disturbance by vehicle traffic, including snow mobiles and tractors. NOTE: Built roads are not included.
05 Soil disturbance, humans	Ground disturbance caused by trampling of humans.
06 Soil disturbance, domestic animals	Trampling by domestic animals, e.g. cattle, horses and sheep.
07 Disturbance, reindeer	Trampling by reindeer.

08 Soil disturbance, wild boars	Trampling and rooting by wild boars.
09 Soil disturbance, other animals	Trampling and rooting by other wild animals.
10 Wind erosion	Wind erosion in mountains or sand dunes etc.
11 Combined trampling and wind disturbance in mountains	Ground disturbance by a combination of wind disturbance and trampling, e.g. wind erosion in areas trampled by reindeer, tourists etc.
12 Exposed soil by uprooted tree	Disturbance caused by uprooting of trees.
13 Water erosion - traces	Area is disturbed by water erosion.
14 Landslide erosion	Area is affected by landslide (including banks in proximity to shores).

Disturbance Time — Time of ground disturbance/scarification

00 This year or season
01 Last year or season
02 Year or season 2
05 Year or season 3-5

Disturbance% — Cover of ground disturbance/soil scarification. NOTE: Cover within the 10 m sample plot.
000-100%

Burning — Presence within the 20 m plot. Obvious signs of burning (soot, charcoal, burned materials etc.) in field- and bottom layer.

0 None	
1 Controlled burning	Burning in clear-felled area.
2 Patch burning, e.g. after clear-cutting	The southern-most part of the burned patch must be situated within the 10 m plot.
3 Other type of fire	

Burning Time — Time of burning.

00 This year or season
01 Last year or season
02 Year or season 2
05 Year or season 3-5

Burning% — Cover of burning. NOTE: Cover within the 10 m plot.
000-100%

Planting — Presence of planted trees and shrubs within the 20 m plot. Register only if the density exceeds 200 plants per hectare (i.e. average distance between

0 No planting
1 Re-planting on clear-

felled area

2 Tree planting in agricultural fields/ grazing fields

3 Other tree plantings

4 Planting of shrubs

plants 6 m). Supplementary planting is included, i.e. when new plants are planted to fill in gaps in a less successful previous planting. NOTE: Plantings in rows of trees, borders, hedges etc. are not included.

Planted Tree Species

11-97 Tree species

Species of planted trees. Tree species and codes according to species list (appendix 14).

Time of Tree Planting

00 This year or season

01 Last year or season

02 Year or season 2

05 Year or season 3-5

Time of tree planting.

Planted Shrub Species

00-99

Species of planted shrubs. Shrub species and codes according to species list (appendix 14).

Time of Shrub Planting

00 This year or season

01 Last year or season

02 Year or season 2

05 Year or season 3-5

Time of shrub planting.

Cutting

Traces of cutting, clearing or thinning of trees within the 20 m plot.

0 No cutting

1 Clear-cutting

Rejuvenation of the forest by clear-cutting. Seed trees or trees important for biodiversity may be saved. Indicate clear-cutting if trees have been removed in order to change current land use. However, in these cases volume density before the cutting must have exceeded 0.3, and be below 0.3 after cutting (appendix 7). This class is also used if a low layer of young forest remains (planted or young forest) with a higher volume density than 0.3.

2 Thinning

Thinning mainly of trees with a minimum diameter of 10 cm at breast height. After thinning, a stand with a greater volume density than 0.3 is left (appendix 4). At least 10% of the original basal area has been removed.

3 Selection cutting

Equivalent to thinning, but trees of all dimensions have been removed, resulting in a greater diameter spread among the remaining trees. However, a large number of the largest trees may have been removed. Normally performed only in spruce forest,

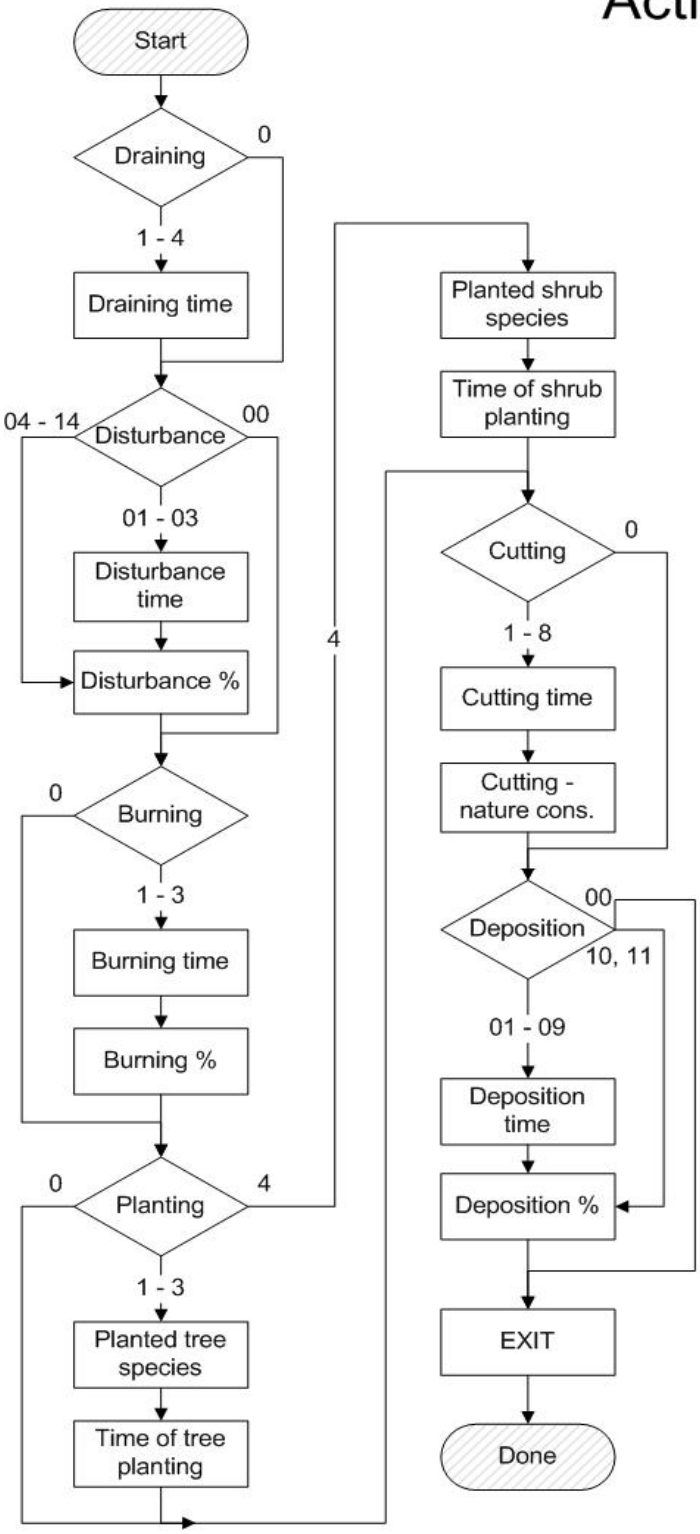
	and should not be confused with so called 'high grading' that is often carried out in pine forests. In a selection forest, the area has a continuous tree cover, as opposed to clear cutting and/or high thinning.
4 Cleaning	Clearing and thinning of young forest in order to preserve and protect the stand (most removed trees are less than 10 cm).
5 Clearing in older forest	Small trees growing under larger/older trees have been removed. Can be performed in forests (normally before clear-cutting) as well as in pastures and parks.
6 Clearing of shrubs	Equivalent to clearing, but mostly shrubs have been removed. If both trees and shrubs have been removed, the activity that corresponds to the greatest changes in vegetation cover, or 'canopy cover', is stated.
7 Misc. cutting	Cutting that does not fit in under any of the above categories, for example removal of a few larger trees in pasture land.
8 Cutting of standard trees	Isolated large trees from an earlier generation have been removed in young forests.
Cutting - Time	Time of cutting, clearing or thinning.
00 This year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	
Cutting for Nature Conservation	NOTE: Presence of cutting for the purpose of nature conservation within the 20 m plot.
0 No	
1 Yes, to a certain degree	Cutting that obviously favors the environmental values, even if the primary reason was economic (for example if several coniferous trees have been saved as standard trees). Also includes cutting for recreational reasons.
2 Yes, to a high degree	Done primarily for environmental reasons, for example removal of spruce in an oak grove or removal of trees around a large, deciduous tree.
Deposition	NOTE: For deposition/accumulation, only presence within the 10 m plot is registered. The affected area must be at least 0.25 m^2. At least some material must have been deposited within the last 10 years.
00 No deposition	No deposition over 0.25 m^2 present.
01 Household garbage	Food scraps, plastic, bottles, tin cans etc. intended for household use.

02 Scrap metal	Large metal products, e.g. tools, bikes and machines.
03 Chemical waste	Containers used for fertilizers, detergents, oil products, etc.
04 Rocks	Newly deposited rock products, for example leftover material from blasting or building.
05 Digging deposition	Soil etc. deposited after digging.
06 Building deposition	Leftover materials from building sites or demolition of buildings, e.g. plaster, cement and wood products.
07 Cutting/clearing deposition	Large piles of branches, brush etc., leftover from cutting or clearing.
08 Other deposition, misc.	Mix of the above and/or other kinds of waste (discarded animal feed, leftover materials from industrial activity, slag, ashes, etc.).
09 Other deposition, unspecified	Other types, unspecified. Paper form must be filled out (blue form, appendix 2).
10 Natural accumulation, fine matter	Natural accumulation of fine matter such as sand fractions or smaller (grain size, less than 2 mm). Thickness of accumulated layer least 5 cm, cover more than 5% of the area.
11 Natural accumulation, course matter	See above. Coarse material refers to gravel and larger fractions (over 2 mm grain size).

Deposition - Time	Time of deposition/accumulation. NOTE: Most recent time of deposit.
00 This year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Deposition%	Cover of deposition/accumulation. NOTE: Cover within the 10 m plot.
001-100%	

Activities/Disturbance



Draining
0 No draining
1 Ditch in mineral soil (firm ground)
2 Ditch in peat soil
3 Road side ditch or similar
4 Filled ditch

Disturbance
00 No disturbance/scarification
01 Patch scarification
02 Harrowing, plowing, linear scarification in forests
03 Other digging
04 Soil disturbance by vehicles
05 Soil disturbance, humans
06 Soil disturbance, domestic animals
07 Soil disturbance, reindeer
08 Soil disturbance, wild boars
09 Soil disturbance, other animals
10 Wind erosion
11 Comb trampling/wind in mountains
12 Exposed soil by uprooted tree
13 Water erosion traces
14 Landslide erosion

Burning
0 None
1 Controlled burning
2 Spot burning, e.g. after clear-felling
3 Other type of fire

Planting
0 No planting
1 Re-planting on clear-felled area
2 Tree planting in fields/ grazing fields
3 Other tree plantings
4 Planting of bushes

Cutting
0 No cutting
1 Clear-cutting
2 Thinning
3 Selection cutting
4 Cleaning
5 Clearing in older forest
6 Clearing of bushes
7 Misc. cutting
8 Cutting of standard trees

Cutting for nature conservation
0 No
1 Yes, to a certain degree
2 Yes, to a high degree

Deposition
00 No deposition
01 Household garbage
02 Scrap Metal
03 Chemical Waste
04 Rocks
05 Digging deposition
06 Building deposition
07 Felling/cleaning deposition
08 Other deposition, misc.
09 Other deposition, unspec.
10 Natural accum, fine matter
11 Natural accum, course matter

4.9. GROUND DESCRIPTION

Aim

The aim is to describe the ground characteristics of sample plots on solid ground as well as on peat soil. On peat soil, different types of wetland vegetation are also described. Knowledge of ground conditions makes it easier to understand changes in the vegetation composition, structure, disturbances, influences and landscape composition. The ground variables are important background data when evaluating other variables.

Criteria for registering

- Ground description variables are registered on all sample plots (10 m radius) that are visited in the field. Registration is made separate for each section of a divided sample plot.

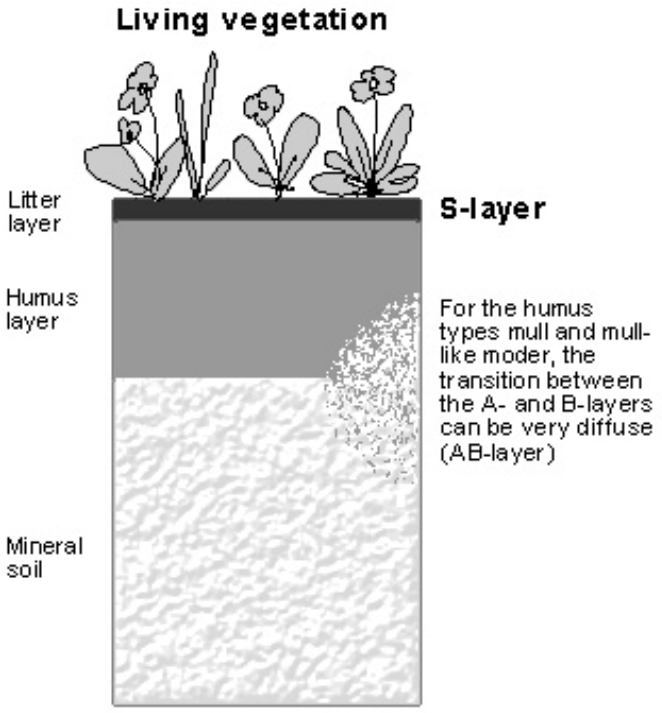


Figure 4.7. Soil profile where different layers and horizons are illustrated. Modified after the Swedish National Encyclopaedia.

Procedures

- Determine soil moisture.
- Measure slope angle and slope direction.
- Take samples with soil probe/spade and establish soil type and ground type.
- For mineral soil, determine thickness of the humus layer, soil type, texture, soil depth and boulder frequency.
- For peat, estimate possible cover of lawn, swamp, carpet, mud-bottom and other types of peat soil.

Menu Ground Description - variables

Soil moisture	Soil moisture
1 Dry soil	Level ground on glacial river deposition. Hills, pronounced summits and ridges. Plateaus and flats, terrain at high altitudes with bare bedrock or coarse texture. No moving groundwater. Groundwater deeper than 2 meters.
2 Mesic soil	Level ground and slopes. No pools of water in the area. One should be able to walk everywhere without getting one's shoes wet even after a rainfall or shortly after the snow melt. Groundwater is 1 to 2 meters below ground surface.
3 Mesic-moist soil	Level ground in a relatively low areas. Middle or lower part of long slopes. Level ground next to higher stretches. In the summer, one should be able to easily walk without getting one's shoes wet, except after a heavy rain. Trees often grow on plinths. Minor swamp hummocks are often present. Groundwater is found less than 1 meter below the surface.
4 Moist soil	Level ground in low areas. Lowest part of gentle slopes. Level ground next to larger hills. In the summer one should be able to walk without getting one's shoes wet by stepping on tussocks. Trees often grow on plinths. Often covered with swamp mosses. Groundwater depth is less than 1 meter below the surface and usually visible in hollows.
5 Wet soil	It is not possible to walk without getting wet shoes. Pine and spruce can only in exceptional cases exist in clumps. Groundwater forms pools at ground level.

After heavy rains or snow melt, the sample plot can be partly or totally covered by water, especially where the soil texture is fine or when there is still ground frost. This does not mean that the ground should be considered wet, it is the average degree of moisture during the vegetation period that is the determining factor for classification. If unsure, do not be afraid to enter the extreme class, e.g. dry if hesitating between dry and mesic, moist if hesitating between mesic-moist or moist, wet if hesitating between moist and wet.

Lateral water movement	Lateral soil water movement. Classification according to the sample plot's position in the terrain as seen in Figure 4.8. NOTE: Distances are measured from the summit to the center of the sample plot.
0 Lat water, missing-rarely	
1 Lat water, shorter periods	
2 Lat water, longer periods	

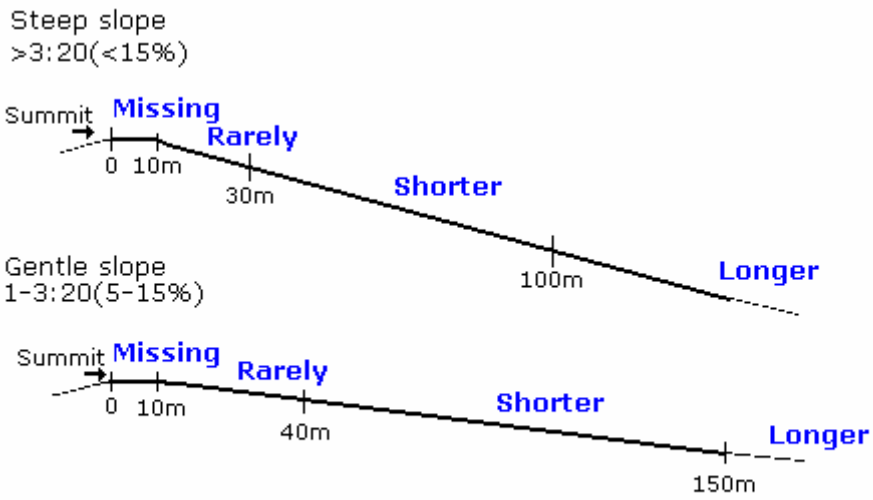


Figure 4.8: Classification of lateral soil water movement from a topographic point.

Water influence	The influence of the water describes how the area is affected by water in addition to what can be gained from the variables 'soil moisture' and 'lateral soil water movement'.
0 No water influence	
1 Broad irrigation	When surface water or groundwater floods over the ground. This happens naturally in sloping peat mires such as mixed mires or back mires. Broad irrigation can also take occur downstream from a natural spring, or if the groundwater locally reaches ground level at the top of a slope.
2 Spring influence	Outpouring of water from the ground, or a pool of water created in such a place.
3 Occasionally flooded	Vegetation or substrate that shows obvious signs of occasional flooding, even if the area is dry at the time of inventory.

Inclination	Measure the inclination of the sample plot.
00-99 degrees	

The inclination is measured with a special instrument (or Suunto Height Meter appendix 8) on the 20 m scale. The inclination is measured at the steepest point that can be found between two diametrically placed points on the periphery of the 20 m sample plot. Disregard smaller pits, rocks etc. When measuring a section of a divided sample plot, make the estimation on the part of the 20 m plot that shares the same land cover as the section in question. The ground inclination represents an average of the whole 20 m plot.

Direction of Slope	Indicate the slope direction if the inclination of the slope exceeds 3 degrees, i.e. the direction it faces.
000-360 degrees	

999 undecided	NOTE: Enter 999 when the sample plot or section slopes in many different directions, i.e. on top of a hill or in a hollow.

Soil type

1 Brown forest soil/cultivated soil	The humus form is mull or mull-like moder (appendix 5).
2 Podsol with bleached horizon	Podsol with eluviated minerals, but no organic matter accumulation.
3 Swamp soil, no bleached horizon	No eluviated minerals (E-horizon) found. Use also when peat layer is too thick to determine the underlying soil type.
4 Other soil	All other types of soil (transition types, not cultivated, shallow soil “lithosole’**,** boulder soil, bare bedrock or disturbed soil).

Brown forest soil: Is formed in clay rich areas. The soil is constantly mixed by mostly worms and other digging animals. The humus form is mull or mull-like moder. In patches it may even be moder but not mor, peaty mor or peat (appendix 5). The soil profile is characterized by a thin layer of organic matter and a thick mull horizon which is decomposed and leached of, among other things, iron and aluminum. Clay particles are sometimes partly transported down from the upper mull horizon, but it is not very weathered. Brown forest soil has a dark colored top horizon that gets lighter further down.

Cultured Soil: The soil is a previously ploughed arable soil with a distinct boundary between the topsoil (Ap horizon) and the subsoil. The topsoil (Ap horizon) is generally approx. 20 cm thick. Under the Ap horizon, the B horizon is generally present. However, there may be relics of a former bleached horizon that was present at the time the soil was first ploughed (the plough did not reach so deep that the entire bleached horizon layer was ploughed in). This “old’, bleached horizon is not considered in the soil classification. NOTE: Cultured soil where the previously tilled land is on top of pure peat is not included.

Podsol: Is the most common soil in Sweden and covers 70% of the land area. On top is a mor horizon (O-horizon, appendix 5), and underneath as a rule a gray/white ash colored layer of bleached soil (E-horizon, ash soil, eluviated minerals, bleached horizon) followed by a rust colored enrichment horizon (B-horizon), rust soil, that deeper down gradually takes on the color of the original soil.

Swamp Soil: Is formed when mineral soil during a large part of the year is saturated with water up to, or almost up to, the surface of the mineral soil. It is characterized by reduced conditions more or less all the way to the ground surface, which gives a blue or greenish color to the soil. The humus form is often peat (appendix 5). Swamp soil is distinguished by the lack of podsol (bleached horizon) under the peat. NOTE: Peat that has been plowed farm land is not included in swamp soil, but is considered ‘other soil’.

Thick humus layers can form in water-rich areas in slopes, in connection with brooks, in very productive tall herbs and fern vegetation in the alpine region (but also, rarely, in low land). This type of soil is normally classified as swamp soil (if the humus type is peat), but as brown forest soil if the humus type is mull or mull-like moder (appendix 5). Signs that animals have been mixing the soil can be found. If the humus layer is more than 30

cm thick, the ground type is peat regardless of underlying soil type.

Ground Type

1 Mineral soil (firm ground), 0-30 cm humus

2 Peat, biological definition, 30-50 cm humus

3 Peat, geological definition >50.5 cm humus

Ground type is determined from the average thickness of the humus layer (3 to 5 samples with the soil probe) irregardless of soil type. Small amounts of boulders, rocks or mineral soil are allowed for peat. While measuring the thickness of the peat layer it can sometimes be difficult to detect the boundary of the mineral soil, especially if is made up of clay or muddy clay (soil types with fine texture). These fine textures of soil can stick to the end of the soil probe. In uncertain cases, feel the particles stuck to the lower part of the probe. Soil types that contain sand and gravel can easily be heard when the probe hits the mineral soil edge. Do not register soil type, texture etc. in peat soil.

Variables on solid ground

Humus thickness The thickness of the humus layer.

00-30 cm

Refers to the average thickness of the humus layer up to 30 cm. The upper boundary of the mineral soil is normally identified with the help of a small spade that is dug in along the probe. The mineral soil can be found by careful breaking away the humus, and the thickness of the humus layer is measured with a ruler or a tape measure. In massive humus layers, only the probe is used. Do not include e.g. coal beds in old mines in the humus layer. On disturbed soil (scarified areas etc.) or if several layers of humus are found, their thickness is added together if they are in direct contact with each other. If, on the other hand, there is a mineral layer between the two, measure only the upper-most layer. This variable is only registered on solid ground (variable **Ground Type**), in other words, humus layers with a maximum depth of 30 cm.

Soil Parent Material

1 Sediment - sorted incl. Mud	Sorted mineral soil.
2 Till	Unsorted mineral soil that most often contains all grain sizes from blocks to clay (also called till).
3 Bare bedrock < 10 cm mineral soil	Bedrock with mineral soil layer of less than 10 cm.

Sediment

Sand and gravel particles with rounded edges and finer fractions feel ‘smooth’. In sediments with a low degree of sorting, the soil can resemble till, but the mineral soil grains are often more rounded and the location in the terrain is often different. This is particularly true in surge sediment. Mud is often deposited in open water and consists of more or less broken up pieces of dead organisms. The weight percentage of organic material is more than 20%. Where mud forms a surface layer, it has usually come to the surface as a result of land elevation or decrease of the water level.

Till

Unsorted mineral soil that most often contains all grain sizes from boulders to clay. Sand and gravel fractions are sharp-edged and the finer material scratches between the fingers.

Rock outcrop

This is in reality not a soil type. Bare bedrock is classified as ground with a mineral soil layer thinner than 10 cm. Rubble, frost-shattered mountain and boulder pits shaped by freezing are also included. NOTE: If the mineral soil layer is thicker than 10 cm, the soil type is not bare bedrock.

Soil Texture See Table 4.6., and appendix 6.

1 Rocky till/Rocks
2 Gravelly till/Gravel
3 Sandy till/Coarse sand
4 SANDY - Silty till/ sand
5 Sandy- SILTY till/fine sand
6 Coarse silty till/coarse silt
7 Silty till/Silt
8 Clayey till/ Clay

Soil texture is identified by the size of the grains in the mineral soil, and refer mainly to the dominant size of particles with a diameter of 2 cm or less. In the sample plot center of an entire plot, or in the middle of a section, samples are collected with a probe. The sample must be taken from soil deeper than the bleached horizon, i.e. normally from the rust layer. In cases where there is no bleached soil horizon, the sample should be taken from a depth of at least 20 cm, counting from the lowest boundary of the humus layers. If boulders and stones are present at the sample plot enter in such amounts that it is impossible to retrieve any mineral soil, probe in a spiral pattern outward from the center until a sample can be retrieved. If a sample can not be obtained in this way, the texture is registered as rocky till. If the soil type is bare bedrock, no texture is registered. Classification of texture is performed according to the chart in Table 4.6. See appendix 6 for instructions of how to classify soil texture in the field.

Table 4.6: Table for soil texture classification of till and sediments.

Code	MORAINE	Form/rolling test (thickness)	Description	SEDIMENT	Grain size	Form/rolling test (thickness)	Description
1	**Rocky moraine**		Mineral soil particles <20 mm missing (above 0.5 m below ground surface)	**Rocks**	> 20 mm		Visual estimation
2	**Gravelly moraine**	Cannot be formed	Plenyt of gravel, few smaller fractions, excl. sand. Often rocky.	**Gravel**	20-2 mm		Visual estimation
3	**Sandy moraine**	Hardly formable	Sand dominates. Some blocks or rocks.	**Course sand**	2-0.6 mm		Grain size estimation
4	**SANDY-silty moraine**	Can be formed	When adding water*, plenty of sand remains. "Crunches"**.	**Sand**	0.6-0.2 mm	Hardly formable	Grain size estimation
5	**Sandy-SILTY moraine**	6-4 mm	When adding water, moderate amounts of sand remains. Crunches vaguely**.	**Fine sand**	02.-0.06 mm	Can be formed	Grain size estimation
6	**Course silty moraine**	4-3 mm	When adding water, a very small amount of sand remains. Sticky and smeary. Small amounts of rough powder.	**Course silt**	0.06-0.02 mm	6-4 mm	Very powdery, rough powder.
7	**Silty moraine**	3 mm	Very powdery, sticky, becomes running ground when water is added (very rare soil type).	**Silt**	0.002-0.0002 mm	4-3 mm	Very powdery, rough powder.
8	**Clayey moraine**	2 mm	When rolling, the presence of larger grains can be felt. Usually few rocks.	**Clay**	<0.0002 mm	<3 mm	Light clay is very powdery. Stiff clay is not powdery, instead sticky.

* Plenty of water is added while holding a sample in your cupped hand. Carefully let the water drain and the courser fractions are left in the hand.
** A naturally damp (moderately moist) soil sample "crunches" if pressed and rubbed between thumb and forefinger. Moraine containing fine particles instead produces a "cracking" sound. Hold the sample to your ear!

Soil Depth	Refers to average soil depth of the sample plot/section (do not register if it is bare bedrock with a soil depth of less then 10 cm).
1 >70 cm, deep soil	No visible bare bedrock.
2 20-70 cm, rather shallow soil	Some bare bedrock. Habitats on level or slightly sloping ground with a abundant hard plans are also included in this category.
3 <20 cm, shallow soil depth	Abundant bare bedrock.
4 Varied soil depth	Partly visible areas of broken bedrock, e.g. rift-valley landscapes.
Boulder amount	The amount of surface boulders in the area. A combination of size and frequency of boulders. Surface boulders are stones that are partly visible, or at least their contours are clearly visible on the surface. A surface boulder can not be covered with mineral soil, but may be blanketed by humus (however, it can not be covered with peat).
0 No surface boulders	
1 Few boulders/ all sizes	Only a few boulders (all sizes).
2 Scattered boulders/all sizes	Scattered boulders, small and mid-sized.
3 Frequent boulders, >0.5 m >100	Boulder diameters larger than 0.5 m. More than 35-40 per 100 m^2.
4 Large boulders, >1 m > 15	Boulder diameter larger than 1 meter. More than 5 boulders per 100 m^2.

Variables on peat

In peat soil, where the bottom layer is dominated by swamp mosses (mainly peat moss, *Sphagnum,* but also some species of *Polytrichum*, some brown mosses such as *Calliergonella*, *Scorpidium* and *Campylium*), several kinds of vegetation classes creating the mire mosaic are found. This occurs mainly in mires with a thick peat cover, and is classified only in peat soil, i.e. where the peat layer is more than 30 cm deep. Peat soil with mesic vegetation (other type of ground vegetation, e.g. mosses *Pleurozium schreberi* and *Hylocomium splendens*, with *Vaccinium* sprigs) can be found in areas influenced by draining (ditches) or in areas that are in the late stages of being overgrown with many trees, and are in these cases classified as ‘other peat soil’. NOTE: Patches of mire with deep water (bog-pools) are, however, not included in the above mentioned classifications. Bog-pools and mesic ground vegetation can however be found within the peat soil mosaic in a specific sample plots/section, and the sum of peat soil variables may then (and only then) be lower than 100%.

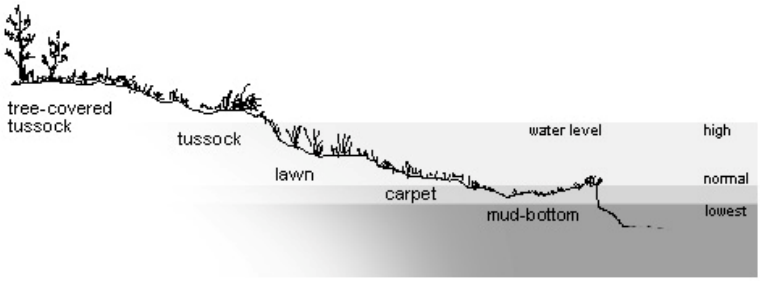


Figure 4.9: Different vegetation elements in wetland, based on hydrological conditions. Modified after the Swedish National Encyclopaedia.

Lawn% Cover of lawn.
000-100%

Lawn is a part of the mire where the peat surface often is wet but seldom under water, and where the vegetation usually forms a relatively firm, supporting base, due to plentiful amounts of root stocks and roots just under the ground surface (Figure 4.9). In the bottom layer e.g. *Sphagnum fuscum* can be found. Typical plants are *Eriophorum vaginatum* and *Trichophorum cespitosum*, and in fens also *Molina caerulea* and *Carex lasiocarpa.* Lawns are common in drier parts of the fen hollows and in sloping fenland which are most common on higher ground. This also includes dwarf-shrub dominated mire vegetation on, for example, bog hummocks and lawn hummock-strings (Figure 4.9). Drier mire areas with moss-dominated, firm vegetation with good 'carrying capacity'. Sometimes with patches of e.g. heather and *Empetrum* or small pines.

Dwarf Shrubs on Lawn Cover of dwarf shrubs (genus *Ericaceae*) on lawn.
000-100%

Cover of dwarf shrubs on peat lawn is estimated in order to determine the amount of moisture. This makes it possible to separate drier, dwarf-shrub dominated lawns from lower, wetter lawns. NOTE: It is not necessary compare this assessment with the cover of dwarf shrubs in Land cover (chapter 4.5) even if the values in principle should coincide in areas totally dominated by lawn. Make the estimates separately without going back to confirm that the numbers are the same.

Lawn type Type of lawn.

1 Floor	
2 Hummock-string	At most 5 meters wide, at least 10 meters long
3 Hummock	At most 5 meters wide, at most 10 meters long

Floor refers to everything that is not elevated or depressed in the mire mosaic, for example flarks and hollows (i.e. low lying areas surrounded by hummock-strings and hummocks in the mire) which most often consists of mud-bottom or carpet, but also includes larger connected areas of e.g. lawn and carpet

vegetation. NOTE: If there are hollows or ‘pits’ of carpet in a lawn floor, enter both categories as floor.

Hummock-strings are long, narrow (often high) elevations perpendicular to the slope of the mire. They are often just a few decimeters wide. The hummock-strings alternate between wetter (and often wider) flarks, which consist of mud-bottom or carpet. If the slope is significant, the hummock-strings are often parallel, but are sometimes more irregular. Hummock-strings often consist of more or less dwarf-shrub covered lawn (maybe of shrub tussock type) but there can also be carpet hummock-strings between mud-bottom flarks.

Tussocks/Hummocks resemble strings but are often more rounded or irregularly formed areas of, e.g. lawn. The lower parts (‘the floor’) in such a mosaic can be called hollows or flarks. Larger hummocks can also be called ‘islands’.

Carpet% Cover of carpet

000-100%

Carpet refers to wet parts of a mire with continuous, often moss-dominated vegetation of low density (Figure 4.9). The field layer is often sparse, with *Carex* or *Eriophorum* species. In the bottom layer there is also *Sphagnum pulchrum* and *S. papillosum.* Most typical is the quagmire that floats on water or loose mud. Most carpets contain roots and other parts of underground vegetation that keeps them afloat. This also gives a certain viscosity, so you only sink down a little bit while walking on them. A carpet can also be present on hummock-strings, planes, flarks or hollows**.** Carpets are sometimes found in most larger or deeper mire hollows, but also in many fens, especially in wet hollows and next to open water.

Carpet type Type of carpet

1 Floor

2 Hummock-string at most 5 meters wide, at least 10 meters long

3 Tussock/Hummock At most 5 meters wide, at most 10 meters long

Mud-bottom% Cover of mud-bottom.

000-100%

Mud-bottom refers to shallow water-filled or sometimes dry areas with a large part bare, loose peat and no, or very sparse bottom layer, but often with a thin layer of algae (Figure 4.9). Mud-bottom is normally found in flarks or hollows, and may also be covered by shallow water (less than 10 cm deep), for example in so called flark-pools. NOTE: Deeper water counts as bog-pools, and is not included in mud-bottom. Neither is mud-bottom vegetation with dense field layer, which is classified as reed swamp (see below).

Reed Swamp Cover of reed swamp.
000-100%

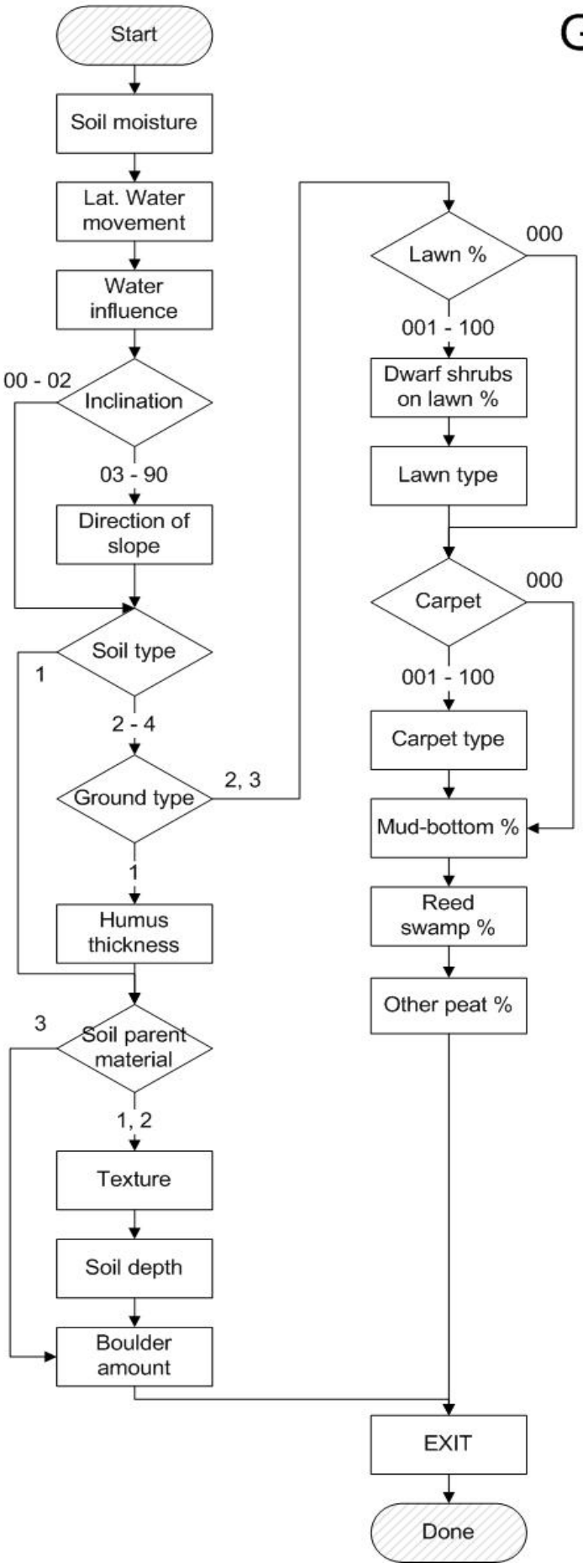
Reed swamp is water-logged vegetation where the bottom layer often is sparse and has ‘mud-bottom characteristics’. There exists, however, a field layer of swamp vegetation with e.g. tall sedge species, reeds or saw grass. Reed swamps are common in overgrown pools of water with peat and marshy meadows (i.e. mires affected by flooding close to water courses).

Other peatland Cover of other peat soil.
000-100%

Other peatland is vegetation on peat soil, where the bottom layer does not resemble that in other peat areas. It is drier and is not dominated by mire vegetations with e.g. *Sphangum* mosses. Field and bottom layers are normally similar to mesic or moist firm ground, i.e. dominated by such moss species as *Pleurozium schreberi* and *Hylocomium splendens*, with *Vaccinium* dwarf shrubs. ‘Other Peat’ is most common in areas influenced by draining, often with a relatively dense tree layer.

NOTE: The sum of lawn, carpet, mud- bottom and swamp is often, but not always 100% (although never higher than 100%). There may also be areas with water, solid ground or other peat soil. Reed swamp is often dominant in an area, but can also be found in combination with other types of peatland.

Ground description



Soil moisture
1 Dry soil
2 Mesic soil
3 Mesic-moist soil
4 Moist soil
5 Wet soil

Lateral water movement
0 Lat water, missing-rarely
1 Lat water, shorter periods
2 Lat water, longer periods

Water influence
0 No water influence
1 Broad irrigation
2 Spring influence
3 Occasionally flooded

Soil type
1 Brown forest soil/cultivated soil
2 Podsol with bleached horizon
3 Swamp soil, no bleached horizon
4 Other soil

Ground Type
1 Solid ground, 0-30 cm humus
2 Peat, biological, 30-50 cm humus
3 Peat, geological >50,5 cm humus

Soil Parent Material
1 Sediment - sorted incl. Mud
2 Till
3 Bare bedrock < 10 cm mineral soil

Texture
1 Rocky moraine/Rocks
2 Gravelly moraine/Gravel
3 Sandy moraine/Coarse sand
4 SANDY - Silty moraine/ sand
5 Sandy- SILTY moraine/fine sand
6 Coarse silty moraine/coarse silt
7 Silty moraine/Silt
8 Clayey moraine/ Clay

Boulder amount
0 No surface boulders
1 Few boulders/ all sizes
2 Scattered boulders/all sizes
3 Frequent boulders, >0.5 m >100
4 Large boulders, >1 m > 15

4.10. DETAILED TREE DATA

Aim

The aim is to follow changes in the tree layer in pasture land, semi-open mires, mountain areas and mountain birch forest. In addition, detailed tree data is collected from certain types of discontinued farm land and from all sample plots in semi-natural pastures and meadows. In other forest types, detailed tree data is collected by the Swedish National Forest Inventory (RIS), and is therefore not included in NILS.

Criteria for registration

- Register all sample plots with trees more than 5 dm high, which do not qualify as ground type forest according to FAO's definition (chapter 4.5). In addition, register all sample plots with trees over 5 dm high in mountain birch forest (see definitions below), and on abandoned farm land that has not actively been planted, but with spontaneous establishment of trees with less than 10% canopy cover and maximum 5 m height.
- Register all live trees, even if they grow horizontally or have broken tops (but only if they are over 1.3 m high).
- Register dead trees only if they are standing (leaning less than 45 degrees) and are over 40 mm in diameter at breast height.
- Register trees that grow at the edge of the sample plot, if the growing point (or the point where the root shoot or stump shoot originated) is located within the sample plot.
- Goat willow and other willows are considered to be trees if they (or at least one stem per clump) have a diameter of at least 20 mm at breast height, but are considered as shrubs if they are thinner than 20 mm.

Procedures

- Measure with caliper or count trees in the concentric sample plots depending on tree size. For sample plot sizes and diameter thickness see Table 4.7.
- The thickest trunk in a clump determines if the tree should be measured with caliper or counted in a sample plot with 10 or 3.5 meter radius (the same applies when determining if sallow trees and willows are to be counted as trees or shrubs). Register diameters for the three thickest trunks in the clump and the total number of trunks at breast height. Register clumps with the thickest trunk under 40 mm as one unit (do not count number of trunks). The thickest trunk in the clump determines which ‘small dimension’ they belong to, see Table 4.7.
- Mark the trees discretely with paint, facing the center of the plot, after they have been measured with the caliper or counted in order to avoid missing trees or counting trees more than once. After completed inventory, double-check that all trees are marked and therefore counted.
- Mistakenly registered caliper trees can be removed by entering ‘00 Removed Caliper Tree’ in the variable Tree type.

Definitions

Individual Tree

An individual tree consists of all trunks and branch parts that emerge from the same spot above the humus layer or mineral soil, but maybe below the litter**.** (Note that litter

becomes humus over time and can accumulate in a stump shoot that branches deep down. In these cases, use the level of the surrounding humus layer as a reference).

Clumps

Clumps are individual trees that divide below 1.3 m into two or more stems growing upward, where each one is, or may become, a trunk (Figure 4.10). Clumps are registered with individual codes. Clumps are not differentiated from trees if they are shorter than 1.3 m. E.g. cut-down trees with several stump shoots are counted as one tree when they are less than 1.3 m high, but changes to a clump when two or more trunks grow taller.

Diameter

Diameter is measured at 1.3 m height. NOTE: The height is measured as the length of the trunk. For Mountain birch, the fact that the trunks often are crooked or leaning should also be taken into consideration. Ground level refers in this case to the level where the seed once germinated, or corresponding level for root and stump shoots.

Mountain Birch Forest

Mountain birch forest is forest close to alpine areas (above the coniferous tree line) dominated by Mountain birch (*Betula pubescens* ssp. *czerepanovii*). No coniferous trees or tree stumps may be present, except scattered, shrub-like pines or spruces (chapter 4.11). NOTE: If there are coniferous trees (or stumps) present and the forest corresponds to FAO's definition of forest (chapter 4.5), the area is considered to be alpine coniferous forest and no detailed tree data registration is performed. This definition is therefore somewhat stricter than the definition of habitat type ‘Mountain Birch Forest’ in Natura 2000 (chapter 4.11). The distinction between Mountain birch forest and land that otherwise is considered forest, corresponds to the upper limit for the Swedish national Forest Inventory (RIS) definition of mountain coniferous forest. If only birches grow in proximity to bare mountain, the site class limit 1 m^3 forest per hectare and year is decisive. NOTE: In NILS, this limit is approximated by classifying all birch forest close to alpine regions as mountain birch forest if the basal area weighted mean height is less than 12 meters.

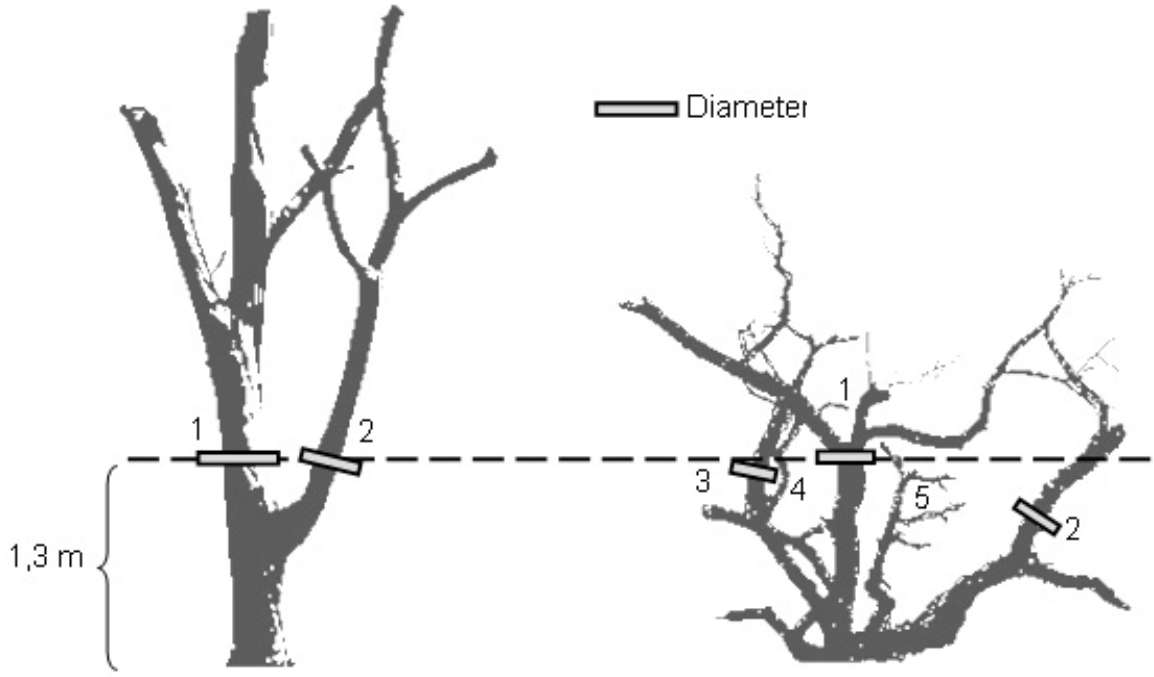


Figure 4.10. Register trees with stems reaching upwards which separate below 1.3 m are considered clumps. The diameter is measured for the three thickest stems, and the number of trunks above 1.3 m are counted for each clump (in the example 2 and 5 stems respectively). NOTE: When measuring crooked or leaning trunks, the height is measured as the length of the trunk.

Table 4.7 Configuration of class borders for different modules within Detailed Tree Data

Individual stems	**Clumps**	**Radius**
Small Dimensions (at least 5 dm high, less than 40 mm diameter, only live trees		
Number of trees 5-12 dm	*	3.5 m
Number of trees 1-19 mm DBH	Number of clumps 1-19 mm DBH	3.5 m
Number of trees 20-39 mm DBH	Number of clumps 20-30 mm DBH	3.5 m
Caliper Trees (40-100 mm diameter, thickest trunk)		
Register live trees	Register the 3 thickest trunks in the clump + number of trunks	3.5 m
Register dead trees (standing at max. 45^{o} angle)	**	3.5 m
Caliper Trees (thicker than 100 mm, thickest trunk)		
Register live trees	Caliper the 3 thickest trunks in the clump + number of trunks	10 m
Register dead trees (standing at max. 45^{o} angle)	**	10 m

* Register clumps lower than 1.3 m as trees, see left column

** Do not register dead trunks in clumps.

Measuring Tree Diameter

The tree diameter is normally measured with a caliper. For very thick trees where the caliper is not big enough, the diameter is measured with a measurement tape (diameter = circumference/3.14). Always measure with the caliper ruler pointing to (or from) the sample plot center (Figure 4.11). The tree is measured at breast height, i.e. 1.3 m above ground (or the level where the seed germinated). Normally ground level corresponds with the humus surface or the bare mineral soil's upper boundary. For leaning trees, measure the distance from the ground along the trunk.

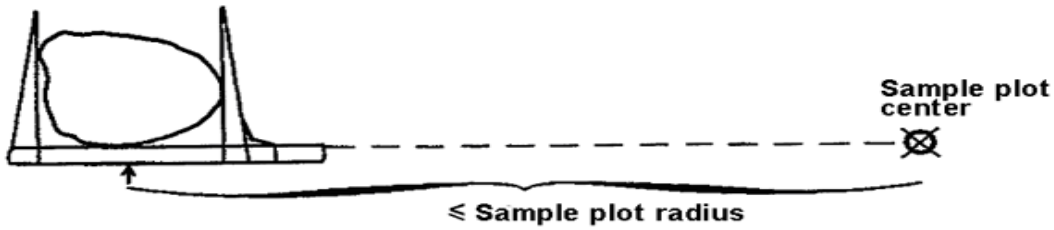


Figure 4.11: Measure with the caliper at breast height (i.e. 1.3 m) above the sprouting point of the tree, with the ruler of the caliper pointing toward the sample plot center. Caliper measuring is only performed on trees with the center within the sample plots radius.

Menu Detail Tree - variables

Detailed Tree Data? 0 No, no detailed tree data 1 Yes, register detailed tree data	Note if detailed tree data will be registered.
Reason 0 Not relevant 1 Relevant, >5 dm trees missing	Reason why detailed tree data is not registered. Forest, but not within the alpine forest area.
Caliper Tree	Opens menu **caliper Tree**
Small Dimension? 0 No, small dim. missing 1 Yes, small dim. present	Note if small dimension trees are present, i.e. over 5 dm high and up to 39 mm diameter DBH.
Small Dimension	Open menu **Small Dimension**

Menu Caliper Tree - variables

Tree Number

The menu automatic designates consecutive numbers for all tree trunks measured with the caliper. When a tree is saved in the EXIT menu, the number for the next tree in that series will automatically appear. To leave the Caliper tree menu after the last tree has been saved, enter ‘2 Back out of empty menu’ in the EXIT menu.

Tree Species

11-97 Tree Species	Species and codes according to tree species list (appendix 14)
00 Removed caliper tree	
06 Clump live	
05 Clump dead	
04 Dead, unknown	
03 Dead, unknown deciduous	
02 Dead, unknown coniferous	
01 Dead, species known	

Tree Species Dead	Register if tree is = 01 above.
11-97 Tree Species	Species and codes according to appendix 14

Diameter

0040 - 9999 mm

Clump Tree Species	Register if tree is = 05 or 06 above.
11-97 Tree Species	Species and codes according to appendix 14.

Clump Thickest	Thickest trunk diameter in the clump.
0001-9999 mm	

Clump 2nd Thickest	Second thickest trunk diameter in the clump.
0001-9999	

Clump 3rd Thickest	Third thickest trunk diameter in the clump (0000 if the clump only has two trunks).
0001-9999 mm	
0000 missing (only 2 trunks)	

Clump Number	Total number of stems over 1.3 m in the clump.
00-99	

Menu Small Dimension - variables

Small Diemsion Number

The menu automatic designates consecutive numbers for all tree species where small dimensions are included. When a tree is saved in the EXIT menu, the number for the next tree in that series will automatically appear. To leave the Small Dimension menu after the last tree has been saved, enter ‘2 Back out of empty menu’ in the EXIT menu.

For the following variables, BF indicates blank format

Small tree species

11-97 Tree Species — Species and codes according to tree species list (appendix 14).

Number 5-12 dm

000-999 BF

Number 1-19 mm

000-999 BF

Number 20-39 mm

000-999 BF

Clump No. 1-19 mm

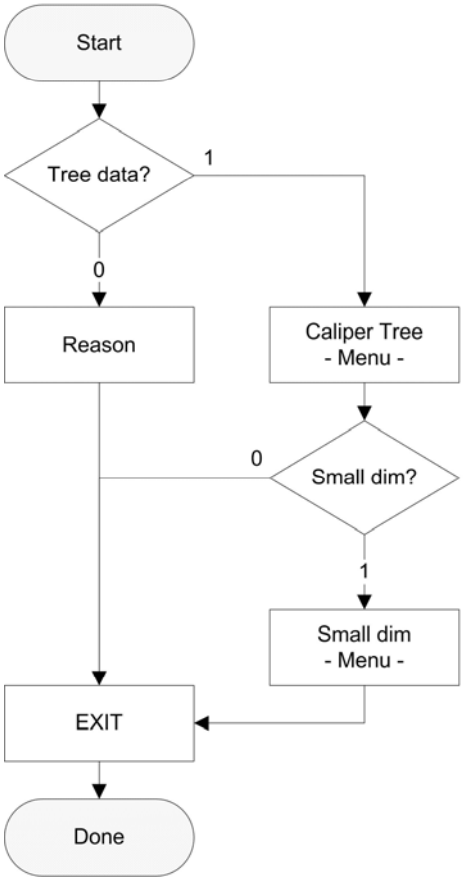
000-999 BF

Clump No. 20-39 mm

000-999 BF — The thickest trunk in the clump determines how to classify the clump.

If there are many trees of the small dimensions on the sample plot, a representative smaller area can be measured and appropriately multiplied when registering number of trunks (Table 4.5).

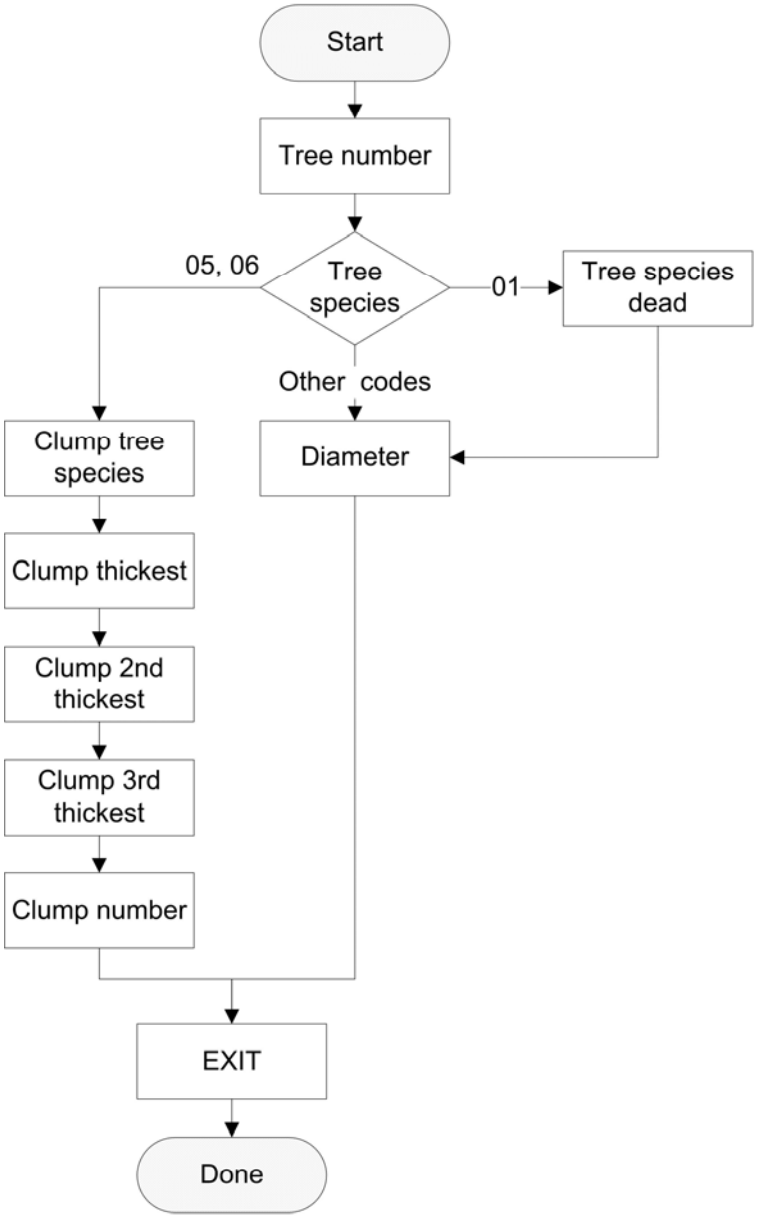
Detail Tree



Tree Data?
0 No, no detailed tree data
1 Yes, register detailed tree data

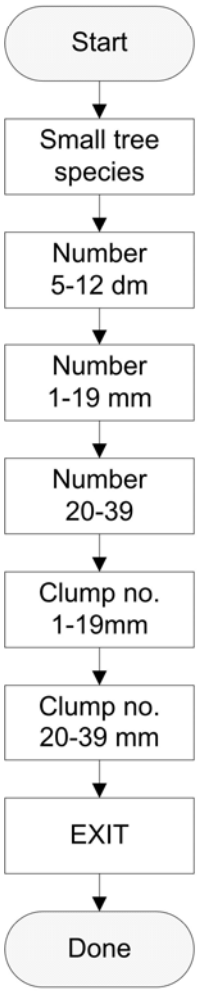
Reason
0 Not relevant
1 Relevant, >5 dm trees missing

Caliper Tree



Tree species
11 Pinus sylvestris
12 Pinus mugo
15 Pinus cembra
81 Pinus contorta
14 Other Pinus
13 Larix decidua
21 Picea abies
22 Other Picea
23 Abies sp.
24 Taxus baccata
29 Other coniferous
30 Betula sp.
41 Populus tremula
42 Populus sp.
51 Quercus robur
61 Fagus sylvatica
62 Aesculus hippocastanum
71 Fraxinus excelsior
72 Ulmus sp.
73 Tilia cordata
74 Acer platanoides
93 Acer pseudoplatanoides
75 Carpinus betulus
76 Prunus avium
77 Prunus padus
78 Prunus domestica
83 Malus domestica
84 Pyrus communis
91 Alnus glutinosa
92 Alnus incana
94 Salix caprea
82 Salix (Willows)
95 Sorbus aucuparia
97 Sorbus intermedia
96 Other deciduous trees
00 Removed caliper tree
06 Clump living
05 Clump dead
04 Dead, unknown
03 Dead, unknown deciduous
02 Dead, unknown coniferous
01 Dead, species known

Small Dimension



Tree species
11 Pinus sylvestris
12 Pinus mugo
15 Pinus cembra
81 Pinus contorta
14 Other Pinus
13 Larix decidua
21 Picea abies
22 Other Picea
23 Abies sp.
24 Taxus baccata
29 Other coniferous
30 Betula sp.
41 Populus tremula
42 Populus sp.
51 Quercus robur
61 Fagus sylvatica
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71 Fraxinus excelsior
72 Ulmus sp.
73 Tilia cordata
74 Acer platanoides
93 Acer pseudoplatanoides
75 Carpinus betulus
76 Prunus avium
77 Prunus padus
78 Prunus domestica
83 Malus domestica
84 Pyrus communis
91 Alnus glutinosa
92 Alnus incana
94 Salix caprea
82 Salix (Willows)
95 Sorbus aucuparia
97 Sorbus intermedia
96 Other deciduous trees

4.11. HABITAT TYPES IN MOUNTAINS AND MOUNTAIN FOREST

Aim

The aim is to obtain information about acreage and distribution of Natura 2000 habitat types in the mountains (alpine and subalpine areas) as a complement to general monitoring of favorable conservation status. Another reason is to achieve consensus with RIS's (Swedish National Forest Inventory) inventory of mountain coniferous forest and mountain birch forest. The NILS program performs the detailed measuring of mountain birch forest that is necessary in order to complete the information about Swedish forests for, among other things, climate reporting.

The cover of a selection of plant species that indicate limestone within the 10 m sample plot (section) is registered. The aim is to get basic knowledge in order to separate siliceous grassland from limestone grassland.

Criteria for registration

- Only register this module in alpine areas (stratum 10) and in Norrland's inland (strata 8 and 9, Figure 1.2). In strata 8 and 9 the alpine types in question are very rare.
- Alpine habitat is registered in each sample plot/section (the ones visited in the field as well as the ones inventoried from a distance).
- NOTE: Type of alpine habitat is determined for the 20 m sample plot/section and only areas of at least 0.1 hectare are considered. The classification is normally done after 'Land cover' and 'Small Vegetation Plots'. At this point, general knowledge of the vegetation composition in the area is achieved.

Procedures

- Decide Mountain Type.
- Estimate degree of cover in dm^2 of species in the menu Mountain Species in the 10 m plot (species list, appendix 14). In this case, strict cover is registered in dm^2 to achieve a higher degree of detail in the data. Leave blank if the species is not present. NOTE: dm^2 - accuracy is only indicated if the cover is less than 1 m^2.
- Decide Natura 2000 habitat type by using the chart below, where the habitat types can be separated in a hierarchic order.
- Check to make sure the correct habitat type has been selected by reading the definition of the chosen habitat type.

Menu Habitat Type - variables

Mountain Type	Type of area
0 No, not relevant (other type)	
1 Area above FOREST limit	NOTE: Do not forget detailed tree data.
2 Mountain birch forest, NILS definition	NOTE: Do not forget detailed tree data.
3 Alpine coniferous forest, RIS definition	
4 Climate impediment below the mountain birch	Climate impediments with no trees below the mountain birch forest boundary. NOTE: Do not

forest	forget detailed tree data.

Definitions

Area above the Forest Limit
NOTE: This classification refers to areas above the forest boundary (not only above tree line). Include areas above the NILS line for mountain birch forest, i.e. bare mountain region. Trees higher than 2 meter may not have a canopy cover of more than 10% (diffuse cover). All areas above the mountain birch forest are included, i.e. also swamps. (NOTE: The tree line is normally considered the altitude where the trees grow to a height of less than 2 m, with no regard to the degree of cover).

Mountain Birch Forest (NILS definition)
All birch forest above the boundary for RIS (Swedish National Forest Inventory) alpine coniferous forest (see below). Include all birch forest devoid of coniferous trees (or coniferous stumps), if the site class is below 1 m^3 forest per hectare and year (corresponds to about 12 m mean height). The trees must be at least 2 meters high and the canopy cover must exceed 10%. Occasional coniferous trees must be very few (at least 25 m between individual trees) and should preferably be shrub-like. NOTE: Wetlands, blocks and bare bedrock areas within the mountain birch forest that do not comply with the criteria for height and cover, are not included. Classification is consistent with birch forest within the RIS land use class Alpine Areas.

Mountain Coniferous Forest (Swedish National Forest Inventory, RIS, definition)
Transition zone between forest (Swedish definition) and alpine areas. Site class is lower than 1 m^3 forest per hectare and year. The coniferous trees are not able to form stands, but can be grouped together. Birches are normally crooked. NOTE: Alpine coniferous forest must contain coniferous trees, or at least stumps from coniferous trees. If the alpine forest is clearly birch forest without noticeable amounts of coniferous trees (or stumps) it is classified as mountain birch forest, if the site class is below 1 m^3 per hectare and year. The boundary between forest and alpine forest is conventionally set at 10 m mean height if the coniferous trees are able to form stands. If the coniferous trees only occur in small groups**,** normally with low growing birches in between, the area is considered alpine coniferous forest even if the mean height of the coniferous trees exceeds 10 m. Individual trees can often reach a height of 15 meters in the alpine coniferous forest. NOTE: Wetlands, blocks and bare bedrock areas within the mountain birch forest that do not comply with the criteria for height and cover, are not included.

Climate Impediment with No Trees Below the Mountain Birch Forest Limit
NOTE: This classification refers to areas below the boundary for mountain birch forest. Level, and often moist tundra-like areas in Norrland, where the ground water is not prominent enough for the area to be classified as mire. Canopy cover of trees that have reached 2 meters in height can not exceed 10%.

Alpine Species	Opens meny **Alpine species**.
Natura 2000	Type of Natura 2000-habitat. See classification schedule and definitions below.
00 Other type	This class is used when none of the classes 01-12 is applicable.
01 Alpine and Boreal heath 4060	

02 Sub-Arctic *Salix* scrub 4080
03 Nordic subalpine/subarctic mountain birch forest 9040
04 Siliceous alpine and subalpine grassland 6150
05 Alpine and subalpine calcareous grassland 6170
06 Hydrophilous tall herb fringe communities 6430
07 Calcareous rocky slope 8210
08 Siliceous rocky slope 8220
09 Palsa mire 7320
10 Siliceous scree 8110
11 Calcareous and calcshist scree 8120
12 Permanent glacier 8340

Heath sub-type See definitions below.
1 Siliceous heath
2 *Dryas octopetala* heath

Menu Mountain Species – variables

Species list, see Appendix 14 .
Cover is registered as dm^2 and m^2.

Classification schedule, Natura 2000 habitats

Use the schedule only on altitudes above the forest boundary (Swedish definition) and on 'natural land'. Do not register Natura 2000-habitat on land that has been heavily influenced by land use, such as agricultural land, build-up areas, and areas with ongoing recreational use (for example ski slopes) Enter code 00 in these cases. This does not apply to Mountain hay meadows (6520), which are included in Hydrophilous tall herb fringe communities.

For definitions of the different habitat types, see below.

1	Snow- or ice covered area, permanent ice core	Permanent glacier
–	Different	2
2	Peat land, ≥30 cm humus	3
–	Solid ground, <30 cm humus	4
3	Mire with palsas, at least one 1 m high palsa within 50 m distance	Palsa mire

–	Other peat land	Other type
4	Rocky slope, ≤10% cover of trees, shrubs and field layer; soil depth (i.e. humus and mineral soil) <2 cm on at least 70% of the area	5
–	Scree, ≥70% cover of rock, stone or gravel; slope of ≥30 degrees in the upper part	6
–	Different	7
5	Calcareous bedrock	Calcareous rocky slope
–	Other type	Siliceous rocky slope
6	Calcareous bedrock	Calcareous and calcshist scree
–	Other type	Siliceous scree
7	Tree cover ≥10% and tree height >2 m	8
–	Different	9
8	Proportion of birch (*Betula* spp.) of total tree cover ≥70%	Nordic subalpine/subarctic mountain birch forest
–	Proportion of birch of total tree cover <70%	Other type
9	Average height of *Salix* spp. (excl. *Salix reticulata*, *S. herbacea*, *S. polaris*) ≥0.3 m	10
–	Average height of *Salix* spp. <0.3 m or missing	11
10	Cover of *Salix* spp. (excl. *Salix reticulata*, *S. herbacea*, *S. polaris*) ≥20%	Sub-Arctic *Salix* scrub
–	Cover of *Salix* spp. <20%	11
11	Cover of field layer (excl. *Salix reticulata*, *S. herbacea*, *S. polaris*) <10%	Other type
–	Cover of field layer ≥10%	12
12	Cover of dwarf shrubs (genus *Ericaceae*) higher than the cover of other field layer plants	Alpine and Boreal heath
–	Cover of other field layer plants higher than the cover of dwarf shrubs (genus *Ericaceae*)	13
13	Below the high water level along water courses, influenced by flooding	Other type. This includes Alpine rivers with herbaceous vegetation along their banks (3220), and Northern boreal alluvial meadows (6450)
–	Above the flooded zone	14
14	Cover of herbs (graminids, broad-leaved herbs and ferns) ≥25%	15
–	Cover of herbs <25%	16
15	Characteristic species for Hydrophilous tall herb	Hydrophilous tall herb fringe

	fringe communities dominate in the field layer	communities This includes Mountain hay meadows (6520)
–	Different	16
16	Species-rich vegetation. Presence of at least three species indicating calcareous grassland	Alpine and subalpine calcareous grassland
–	Species-poor vegetation. Presence of less than three species indicating calcareous grassland.	Siliceous alpine and subalpine grassland

Snow-beds dominated by *Salix reticulata*, *S. herbacea*, *S. polaris*, mosses, and other vegetation types that do not fit into any of the types mentioned below, are classified as Other type.

Permanent glacier (8340)
Permanently snow- or ice-covered areas. NOTE: Extreme snow-beds that only melt in during short periods of the year are not included in this class. Currently the glaciers in the arctic region of Sweden are melting. The areas that until now have been snow- and ice-covered for a long time shall be counted as glacier, even if they can be expected to melt in the near future.

Palsa mire (7320)
Palsa mires are mires with shallow mounds of peat and ice. A palsa has a permanent ice core that makes it higher than the surrounding mire. The higher palsa crests are mostly laid bare by the wind erosion in the winter. Slight snow cover and low temperatures in combination with strong winds are factors that make the frost penetrate deep down forming a constant ground frost, which is a requirement for palsas to form. A palsa can grow to be 6-7 meters high, but are usually 1-2 meters high. The life cycle for a palsa from the time it forms until it collapses and decomposes may be as long as 500 years. Palsas are typical for permafrost areas and are mostly found in the low terrain east of the mountain range in the northern-most part of the country. The vegetation on the palsa is very distinctive. The high palsas surrounded by fens and water-filled areas creates a mosaic miniature landscape where plants with very varied habitat demands grow close together. A characteristic species for the palsa is the moss *Polytrichum strictum,* but *Dicranum* spp. are also common. *Empetrum hermaphroditum* and *Rubus chamaemorus* are common in the field layer. The water-filled hollows and pals ponds are dominated by *Eriophorum angustifolium* and *Sphagnum* spp. *Betula nana*, *Andromeda polifolia*, *Vaccinium uliginosum*, *V. vitis-idaea* and *V. myrtillus* often grow on the slopes of the palsa.

The mounds must be at least 1 meter high in order for a mire to be classified as a palsa, and plots situated in mires and with a shortest distance to a palsa of 50 meters is included in this type of habitat. However, in cases where there is a sharp border between different mire categories between the sample plot and the palsa, consider the border for the palsa mire at this border. A requirement for the 50 meters rule is similar mire conditions between the palsa and the sample plot.

Rocky slope (calcareous=8210 or siliceous=8220)
The categories include cliff areas (exposed bedrock) that are at least 0.1 hectare in size (in projection to the horizontal plane). Maximum 10% (strict) cover of tree, shrub or field layer may be present, but the cover of mosses and lichen can vary. Included in ‘cliff areas’ are all areas with a soil depth of less than 2 cm, and minor interspersed areas

with deeper soil layers. Heterogeneous areas where bare cliffs are mixed with deeper soil are included, if the proportion of exposed rock (including soil with depth of less than 2 cm) exceeds 70%. Cliff areas with calcareous bedrock (including other alcaline rock) are included in 8210, while all the rest are included in 8220.

Scree (siliceous=8110 or calcareous=8120)
Screes are larger continuous areas of at least 0.1 hectare (in projection to the horizontal plane) with at least 70% (strict) cover of boulders, stones, gravel or annual plant species. Minor areas of bare rock can also be included. The inclination has to be at least 30 degrees in the upper part of the slope. Screes include parts located on the highest elevations (often rich in fine, sandy or gravelly substrate), as well as parts in lower areas (often with boulders). The demarcation is made when the fallen boulders no longer cover 70% of the plot. The objects can be talus cones as well as wide screes. Eroded sections along water courses are also included, as well as screes in man-made environments such as quarries, mines etc.
Older no longer active screes gradually transform by overgrowth of vegetation and should be categorized in other type of habitat. Screes with dominantly alcaline rock species (including lime) are included in 8120, while other screes are included in 8110.

Nordic subalpine/subarctic mountain birch forest (9040)
Forest dominated by mountain birch (*Betula pubescens* ssp. *czerepanovii).* Tree cover must be at least 10% (diffuse cover) of trees that have reached at least 2 meters in height. However, all parts of the trees are counted in estimating total cover. At least 70% of the tree cover must be birch (excluding *Betula nana*). In Nordic mountain birch forest, all birch forest above the forest boundary according to the Swedish definition of forest.

- Height refers to trunk length, which often differs from the vertical height since mountain birch trunks often are crooked.
- The belt with sparse trees that often occurs further up on the mountains sides is not included in the mountain birch forest (because the trees are too sparse or low-growing to fit the definition).
- Forests that have been temporarily defoliated by e.g. the autumnal moth (*Epirrita autumnata*) are included in the mountain birch forest class, even if the tree cover at the time for the inventory is lower because of the defoliation. Do not, however, include forest totally killed by moths or for any other reason.

Observe that large areas of forest classified by the Swedish National Forest Inventory as ‘Alpine Coniferous Forest’ fall in this category, since “Alpine Coniferous Forest’ (Swedish National Forest Inventory, RIS, definition) also includes deciduous alpine forest with only marginal amounts of coniferous trees.

Sub-arctic Salix scrub (4080)
Land with *Salix* species (except the low-growing *Salix reticulata*, *S. herbacea* and *S. polaris*). Total cover of *Salix* species must be at least 20% (strict cover) of *Salix* that has reached a height of at least 1.3 meters. However, all parts of the shrubs count when estimating total cover. NOTE: Height, in this case, is measured vertically from the ground, not along the trunks of the *Salix* shrubs (in contrast to the mountain birch mentioned above).
Characteristic species: *Salix lapponum*, *S. lanata*, *S. glauca*, *S. myrsinites* and *S. arbuscula*.

Alpine and boreal heath (4060)
Ericaceous dwarf shrubs (family *Ericaceae*, including *Empetrum* spp.) and *Dryas octopetala* (mountain avens) dominate over graminids and other vegetation in the field

layer. The cover of the field layer (excluding *Salix reticulata*, *S. herbacea* and *S. polaris*) has to be at least 10%. Areas must be naturally free of trees, i.e. the climatic conditions prevent trees from growing. A few low trees (less than 10% tree cover or trees lower than 2 meters) plus junipers (*Juniperus communis*) can be present. The vegetation varies from extreme wind heaths area to the sheltered slope. Included here are dry, mesic and wet dwarf shrub-dominated heath.
Characteristic species: *Empetrum hermaphroditum*, *Salix herbacea*, *Cassiope tetragona*, *Arctostaphylus alpinus*, *Dryas octopetala*, *Vaccinium myrtillus*, *Vaccinium uliginosum*, *Loiseleuria procumbens*, *Cladina* lichens, *Alectoria nigricans* and *Alectoria ocroleuca*. NOTE: Grass-rich heaths are included in grassland habitats. Mires in the mountain area are not included here.

Siliceous heath
Widely distributed in the alpine region. Without or with insignificant amounts of calcareous species. On siliceous mountains, the wind-exposed heaths are covered by, among others, *Empetrum hermaphroditum* (crowberry heath) and low-growing *Betula nana*, with small occurences of e.g. *Loiseleuria procumbens*, *Arctostaphylos alpinus, Diapensia lapponica*, and 'wind-lichens' (*Cetraria nivalis, Cetraria cucullata*, *Thamnolia vermicularis*, *Alectoria ochroleuca*), sometimes also *Cladina* lichens. *Vaccinium myrtillus* never occurs on wind-exposed heaths. *Diapensia lapponica*- and *Loiseleuria procumbens*-dominated heaths with "wind-lichens' occur on extremely wind-exposed heaths. *Empetrum* n*igrum*- and *Betula nana*-dominated heaths with "wind-lichen' and mosses can be found on less extreme wind heaths. The sheltered slopes have a predictable but not extremely durable snow cover, and here *Betula nana* can grow taller. Dominating here is often *Vaccinium myrtillus*, which is missing completely on the wind-exposed heath, since the blueberry plant needs protective snow cover during the spring months. Other species are *Empetrum* spp., *Vaccinium vitis-idaea*, *Betula nana*, *Deschampsia flexuosa*, *Trientalis europaea*, *Solidago virgaurea*, *Hieracium* coll. *Alpina*, *Alchemilla alpina*, *Pleurozium schreberi*, *Hylocomium splendens*, *Dicranum* spp. and *Cladina stellaris*. *Vaccinium myrtillus*-dominated heath is very sharply demarcated on both its upper and its lower part along the mountain side, upward because of the exposure during the winter, downward because the snow-cover stays too long during the summer. At the bottom of the sheltered side where the snow-melting is late (as late as in July) there is no *Vaccinium myrtillus*, and it is replaced mainly by different grass species.

Dryas octopetala-heath
A vegetation type rich in species, on calcareous ground with many rare and calcicole species. *Dryas octopetala* is common, but is only occasionally completely dominant.
Characteristic species: *Dryas octopetala*, *Saxifraga oppositifolia*, *Silene acaulis*, *Salix reticulata*, *Carex atrata*, *Carex rupestris*, *Kobresia myosuroides*. In the Northern mountain range *Rhododendron lapponicum*, *Arnica angustifolia*, *Campanula uniflora*, *Carex nardina* (in wind heaths) and *Oxytropis lapponica*. In the Northernmost parts, *Dryas octopetala* is partly replaced by *Cassiope tetragona* on the sheltered slopes. Other species favoured by calcareous ground are *Astragalus* spp., *Thalictrum alpinum*, *Leucorchis albida*, *Chamorchis alpina*, *Bartsia alpina*, *Salix myrsinites*, *Tofieldia pusilla* and *Bistorta vivipara*. Here many species from the siliceous heath can also be found, such as *Empetrum* spp., *Vaccinium uliginosum*, *Arctostaphylos alpinus* and *Betula nana*, whereas *Vaccinium myrtillus* and *Calluna vulgaris* do not occur.

Hydrophilous tall herb fringe communities (6430)
Areas with a maximum of 10% tree cover (diffuse) and at least 25% cover (strict) of

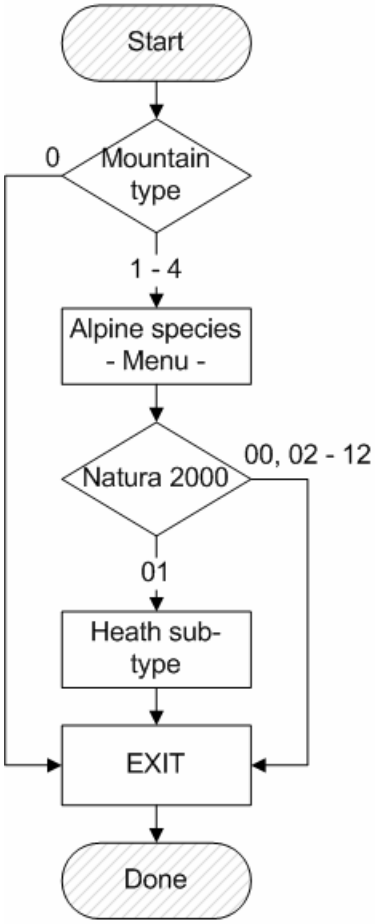
graminoids, broad-leaved herbs and ferns. Soil moisture is mesic or moist. The height of the field layer (fully developed) must be at least 3 dm. Characteristic species dominate in the field layer, i.e. make up at least half of the cover.
Characteristic species: *Aconitum lycoctonum*, *Geranium sylvaticum*, *Trollius europaeus*, *Cicerbita alpina*, *Calamagrostis purpurea*, *Deschampsia cespitosa*, *Cirsium helenoides*, *Angelica sylvestris*, *Angelica archangelica*, *Petasites frigidus*, *Filipendula ulmaria*, *Valeriana* spp., *Thalictrum flavum*, *Geum rivale*, *Anthriscus sylvestris*, *Silene dioica*, *Ranunculus* spp. and *Crepis paludosa*.

Siliceous alpine and subalpine grassland (6150)
Areas on siliceous ground where graminoids, broad-leaved herbs and ferns dominate the cover in the field layer over dwarf shrubs. The cover of the field layer (excluding *Salix reticulata*, *S. herbacea* and *S. polaris*), must be at least 10%. The area must be naturally free of trees, i.e. the climate conditions shall prevent trees from growing. Occasional low-growing trees (less than 10% cover or lower than 2 meters) can be present. NOTE: Do not include mires in this category. The delimitation against calcareous grassland can be difficult to determine – the determining factor is to what extent species characteristic for calcareous grassland occur.
Characteristic species: *Juncus trifidus*, *Carex bigelowii*, *Festuca ovina*, *Loiseleuria procumbens*, *Cladina* spp., *Alectoria nigricans*, *Alectoria ocroleuca*, *Cetraria nivalis, Cetraria cucullata* and *Rhizocarpon* spp.

Alpine and subalpine calcareous grassland (6170)
Areas on alcaline ground where graminoids, broad-leaved herbs and ferns dominate the cover in the field layer over dwarf shrubs. The cover of the field layer (excluding *Salix reticulata*, *S. herbacea* and *S. polaris*), must be at least 10%. The area must be naturally free of trees, i.e. the climate conditions shall prevent trees from growing. Occasional low-growing trees (less than 10% cover or lower than 2 meters) can be present. NOTE: Do not include mires in this category.
Characteristic species: *Poa alpina*, *Bistorta vivipara*, *Saussurea alpina*, *Dryas octopetala*, *Gentiana nivalis*, *Astragalus alpinus*, *Carex rupestris*, *Bartsia alpina*, *Silene acaulis*, *Thalictrum alpinum*, *Petasites frigidus*, *Saxifraga aizoides* and *Selaginella selaginoides*.

NOTE: When distinguishing between silicate grassland and calcareous grassland; please note that at least three species characteristic for calcareous grassland must be present in the 10 m sample plot (section) on calcareous grassland.

Habitat Type



Mountain Type
0 No, not relevant (other type)
1 Area above FOREST line
2 Mountain birch forest, NILS def.
3 Mountain coniferous forest, RIS def.
4 Climate impediment below the mountain birch forest

Natura 2000
00 Other type
01 Alpine and Boreal heath 4060
02 Sub-Arctic *Salix* scrub 4080
03 Nordic subalpine/subarctic mountain birch forest 9040
04 Siliceous alpine and subalpine grassland 6150
05 Alpine and subalpine calcareous grassland 6170
06 Hydrophilous tall herb fringe communities 6430
07 Calcareous rocky slope 8210
08 Siliceous rocky slope 8220
09 Palsa mire 7320
10 Siliceous scree 8110
11 Calcareous and calcshist scree 8120
12 Permanent glacier 8340

Heath sub-type
1 Siliceous heath
2 *Dryas octopetala* heath

4.12. FIELD AND BOTTOM LAYER IN SMALL VEGETATION PLOTS

Aim

Many changes that influence nature have a rapid impact on the composition of the ground vegetation, e.g. fertilizing, draining, grazing, managed hay-making and ground disturbances. Even detailed changes in the composition of the vegetation can be observed in small vegetation plots. The aim is to detect early indications in qualitative changes that otherwise are hard to discover until a long time has passed. Presence of individual species in the field and bottom layers is also recorded and used both to characterize the environment and to study detailed changes.

In semi-natural pastures and meadows an increased number of species of vascular plants (important indicators of high natural value in cultivated land) are registered. In order to get better data of infrequent species, six additional small vegetation plots are added in these areas.

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Criteria for Registration

- The module is performed in all circular sample plots regardless type of landscape. Exceptions are made for sample plots covered with water or sample plots that can not be visited for other reasons (field with growing crop, steep cliff, private property etc.).
- Register presence and cover in three small vegetation plots.
- Small vegetation plots are never divided; they are moved so that the entire small vegetation plot is located within the sample plot section in which the original center of the small vegetation plot was located. Small vegetation plots are never moved for any other reasons than division.
- Vascular plants are registered according to the extended species list for semi-natural pastures and meadows in all sample plots within semi-natural pastures or meadows. They are, however, not registered in the 12 permanent sample plots, even if they happen to be located in semi-natural pastures or meadows.

Procedures

- Three vegetation plot sticks with 28,2 cm long strings are placed 3 meters from the center point of the sample plot (in directions of 0, 120 and 240 degrees, Figure 4.14). It is important that the locations are very carefully measured. The location of the small vegetation plots should be the same in repeated inventory.
- If the sticks are difficult to place in the ground (e.g. on rocks or beside tree trunks), a circle frame can be used. The circle frame can also be used together with the stick to verify and calibrate the estimated cover. The circle frame may only be used when it does not disturb the vegetation too much. It must be centered around the stick very carefully.
- If the small vegetation plot is located on the border between two sample plot sections, it is moved as short a distance as possible so that the entire small vegetation plot is within the section where the original center point (the stick) was located (Figure 4.14).
- Indicate what section the small vegetation plot is located in.
- Estimate cover of bottom layer and field layer. All cover estimates refer to the condition of the plot at the time of inventory. Register all species that have a live part of the shoot (leaf, inflorescence etc.) within the small vegetation plot as seen from above. Please note all cover estimates refer to the vertical projection. The

layers can be estimated in any order. In some cases it can it be advantageous to estimate the field layer first, since it may be disturbed by e.g. inventory of the bottom layer. NOTE: The bottom layer always covers 100% of the ground area. Add all categories together. If the sum does not add up to 100%, double-check and adjust the estimations.

- Make an estimate of the total cover of the field layer first. This number later acts as 'control' of detailed estimates.
- Within the field layer, several species-groups can overlap, but the field layer can also be very sparse. The sum of the field layer categories can therefore end up anywhere from 0% to well over 100%.
- Register presence of vascular plants, bryophytes and lichens according to appendix 14. Be careful not to move shoots or leaves in or out of the plot during inventory.
- Also register vascular plants in semi-natural pastures and meadows according to the special P&M-menu.
- In semi-natural pastures and meadows, two additional small vegetation plots are placed in each direction, 5 and 7 meters from the center. Only record presence of vascular plants in the P&M menu for these vegetation plots (Figure 4.15 and appendix 14).

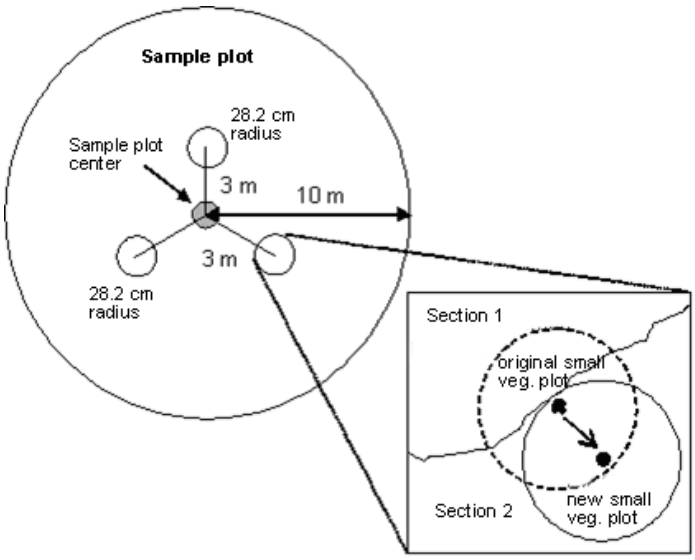
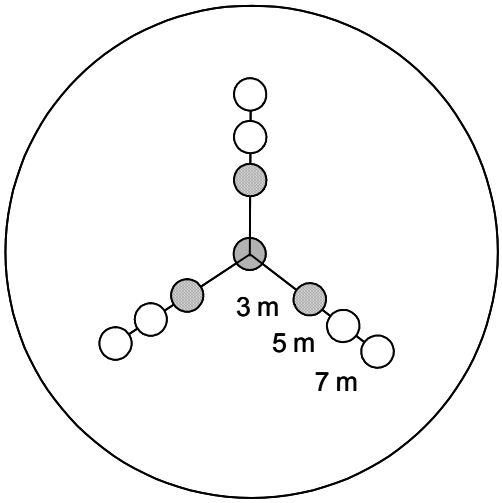


Figure 4.14: Illustration of the locations of the small vegetation plots within a sample plot (10 m radius), and an example of how to move a small vegetation plot if it is located on a division line.



Numbering of small vegetation plots in semi-natural pastures and meadows

Direction/Distance	3 m	5 m	7 m
North (0)	1	4	7
South-East (120)	2	5	8
South-West (240)	3	6	9

Figure 4.15: Layout of the small vegetation plots for registration of vascular plants in semi-natural pastures and meadows. In the three inner small vegetation plots (shaded) all methods are used, and species according to the P&M vascular plats list are registered in all nine plots.

Table 4.8: Table of reference for conversions between cover in% and dm^2 for a small vegetation plot with a radius of 0.28 m. Round off the percentages: 01 = 0.5-1.4% etc.

0.28 m plot (0.25 m2)		
Percent	dm^2 mean	dm^2 interval
00		0.00-0.12
01	0.25	0.13-0.37
02	0.50	0.38-0.62
03	0.75	0.63-0.87
04	1.0	0.88-1.12
05	1.25	1.13-1.37
06	1.50	1.38-1.62
07	1.75	1.63-1.87
08	2.00	1.88-2.12
09	2.25	2.13-2.37
95	23.8	
99	24.7(25)	

Menu Small vegetation plot - variables

For the following cover estimations, BF indicates blank format.

Vegetation Plot Number	Number of small vegetation plot to be inventoried.
1 Small Veg. Plot north	North (0 degrees), 3 meters from center.
4 Small Veg. Plot north	North (0 degrees), 5 meters from center. NOTE: only P&M
7 Small Veg. Plot north	North (0 degrees), 3 meters from center. NOTE only P&M
2 Small Veg. Plot s/e	South east (120 degrees), 3 meters from center.
5 Small Veg. Plot s/e	South east (120 degrees), 5 meters from center. NOTE: only P&M
8 Small Veg. Plot s/e	South east (120 degrees), 7 meters from center. NOTE: only P&M
3 Small Veg. Plot s/w	South west (240 degrees), 3 meters from center.
6 Small Veg. Plot s/w	South west (240 degrees), 5 meters from center. NOTE: only P&M
9 Small Veg. Plot s/w	South west (240 degrees), 7 meters from center. NOTE: only P&M

Section Number	Number of the section where the small vegetation plot is located. Register 0 for an undivided sample plot. NOTE: Do not divide a small vegetation plot, move it (shortest possible distance) to the section where the center is located. See Figure 4.14. The alternatives depend on the division information registered earlier, in menu Land cover (Chapter 4.5).
0 Undivided plot	
1 Section 1	
2 Section 2	
3 Section 3	
4 Section 4	
5 Section 5	

Inventory?	
0 No, omitted	The small vegetation plot is omitted if the center is located within one of the area types mentioned under ‘Reason’, below.
1 Yes	Inventory of the small sample plot.

Reason	
01 Permanent water	Area always under water.
02 Temporary under water	Temporarily under water deeper than 10 cm.
03 Inaccessible wetland	Part of wetland that can not be visited for safety reasons, e.g. quagmire.
04 Field with agricultural growth	Growing or newly seeded field, newly worked field or energy forest. NOTE: Hay-making fields not included.
05 Field with pasture ground	Pasture land with seeded growth, regularly plowed and used for hay-making (not grazed).
06 Inaccessible, steep	Steep or in any other way too dangerous to be

ground	visited, more than 35 degree slope.
07 Inaccessible, risk for landslide	The area has obvious risk for landslide, erosion, etc.
08 Home, industrial site or other building site	Fenced in or otherwise private land close to built-up area or other construction sites, cannot be entered.
09 No trespassing	Area with no trespassing.
10 Other reason – file report	A written report must be filled out (blue form, appendix 2).

Deciduous Shrubs%
00-99%
Strict cover of deciduous shrubs lower than 130 cm above ground.

Deciduous Trees%
00-99%
Strict cover of deciduous trees lower than 130 cm above ground.

Coniferous Trees - Juniper
00-99%
Strict cover of coniferous trees and juniper shrubs lower than 130 cm above ground.

Field Total
00-99%
Total cover of the field layer, which includes ferns, herbs, dwarf shrubs, graminids and *Salix reticulata, Salix herbacea* or *Salix polaris*. Include live leaves and parts of shoots, newly yellowed/dead parts. NOTE: Graminid litter is not included.

Field Layer% — Opens menu **Field Layer**

Broad-leaved Herbs — Opens menu **Broad-leaved Herbs**

Ferns — Opens menu **Ferns**

Dwarf Shrubs — Opens menu **Dwarf Shrubs**

Graminoids — Opens menu **Graminids**

Gram litter%
00-99%
Last years (and older) dead leaves and shoots of graminoids.
Often as a diffuse layer partly mixed with the rest of the field layer.

Bottom layer% — Opens menu **Bottom layer**

Bryophytes — Opens menu **Bryophytes**

Lichens	Opens menu **Lichen**

P&M Plants	Opens menu **P&M plants**. NOTE: Only in small vegetation plots in semi-natural and pastures and meadows. In plots 4-9, only this menu is registered.

Menu Field Layer - variables

Blank format: '00' indicates that the species group is present in small amounts (maximum 0.4%)

0-100% BF	Herbs	Herbs contain all vascular plants except ferns, dwarf shrubs, graminids, and low *Salix*-species. Last year's litter not included.
0-100% BF	Ferns	All species within *Pteropsida*, ferns.
0-100% BF	Horse-Tails	All species within *Equisetum*, horse tails.
0-100% BF	Club-mosses	All species within *Lycopsida* **,** club-mosses.
0-100% BF	dwarf shrubs	All live shoots of plants within the heather genus; *Ericaceae*.
0-100% BF	*reti/ herb/ polaris*	All live shoots of *Salix reticulata*, *S. herbacea or S. polaris.*
0-100% BF	Narrow-leaved grasses	Grass with thread-like or brush-like leaves (i.e. rolled or tightly folded) narrower than 2 mm.
0-100% BF	Broad-leaved grasses	Other grasses with flat, furrow-like or lightly folded leaves that often (but not always) are wider than 2 mm.
0-100% BF	*Carex* sp.	Sedge within the *Carex* group.
0-100% BF	Other graminoids	Sedges (except *Carex* sp), rush (*Juncus* sp) and bulrush (*Typha latifolia*).

Control: The total of all cover in the field layer menu must be at least as high as **Field Total**.

Menu Broad-leaved Herbs - variables
Species list, see appendix 14 and Ericsson (2005).

Menu Ferns - variables
Species list, see appendix 14 and Ericsson (2005).

Menu Dwarf Shrubs - variables
Species list, see appendix 14 and Ericsson (2005).

Menu Graminids - variables
Species list, see appendix 14 and Ericsson (2005)

Menu Bottom layer - variables

Blank Format: ‘00’ indicates that the structure is present in small amounts (at the most 0.4%).
For definitions of bryophyte- and lichen groups, see Weibull (2004) and Hylander & Esseen (2005).

0-100% BF	Peat mosses	All species of peat moss (*Sphagnum*).
0-100% BF	*P. commune*	*Polytrichum commune*
0-100% BF	Other bryophytes	All other mosses and liverworts present in the bottom layer.
0-100% BF	*Cladina*	All species in the *Cladonia* family, group *Cladina*. The most common species are *Cladonia stellaris*, *Cladonia rangeferina* (including *C. stygia), Cladonia ciliata* and *Cladonia mitis*. NOTE: *Cladonia uncialis* is not included.
0-100% BF	Other fruticose lichens	All other fruticose lichens, for example, *Cetraria islandica, Stereocaulon condensatum* and all *Cladonia* species except reindeer lichens, see Hylander & Esseen (2005). NOTE:
0-100% BF .	Ground-living foliose lichens	All foliose lichen living on the ground, mainly *Peltigera* sp., *Nephroma* sp., *Solorina* sp., see Hylander & Esseen (2005). NOTE: Fallen down epiphytial lichens not included. Do not count litter of epiphytic lichens on the ground.
0-100% BF	Foliose lichen on rock	All foliose lichens living directly on rock (stones to bare bedrock). This includes mostly *Umbillicaria* sp., *Melanelia* sp., *Caloplaca* sp., *Xanthoria* sp., *Phaeophyscia* sp., *Physcia* sp., and some *Platismatia* and *Hypogymnia* species, see Hylander & Esseen (2005).
0-100% BF	Stone/ boulder/ bedrock >20 mm	Bare stones, boulders or bare bedrock (over 20 mm) not covered by vegetation, or only with crustose lichens present. Only areas lacking humus layer are included in this category.
0-100% BF	Mineral soil/ gravel <20 mm	Bare mineral soil (particle size under 20 mm) with no vegetation, or with ruderal crustose lichen or an extremely thin layer of ruderal brypophytes (mainly in alpine areas), and with no humus layer. Normally, brown forest soil and cultivated soil are included in this category.
0-100% BF	Humus/peat	Bare humus/peat, i.e. substrate that is dominated by partly decomposed organic material where plant parts etc. have lost much of their original characteristics.
0-100% BF	Man-made/ paved land	Ground with a cover that prevents growth, mainly asphalt but also other types of pavement, gravel/macadam or cement.
0-100%	Water	Water, permanent or temporary with a depth more

BF		than 10 cm.
0-100% BF	Other, left to 100%	Cover of all other materials in the bottom layer that together with the above add up to 100%. This includes e.g. leaves and needles (litter), dense grass tufts, branches/twigs/roots and artificial materials (deposition etc.).

Control: The sum of all cover in the bottom layer menu must equal 100%.

Menu Bryophytes - variables

Species list, see appendix 14 and Weibull (2004).

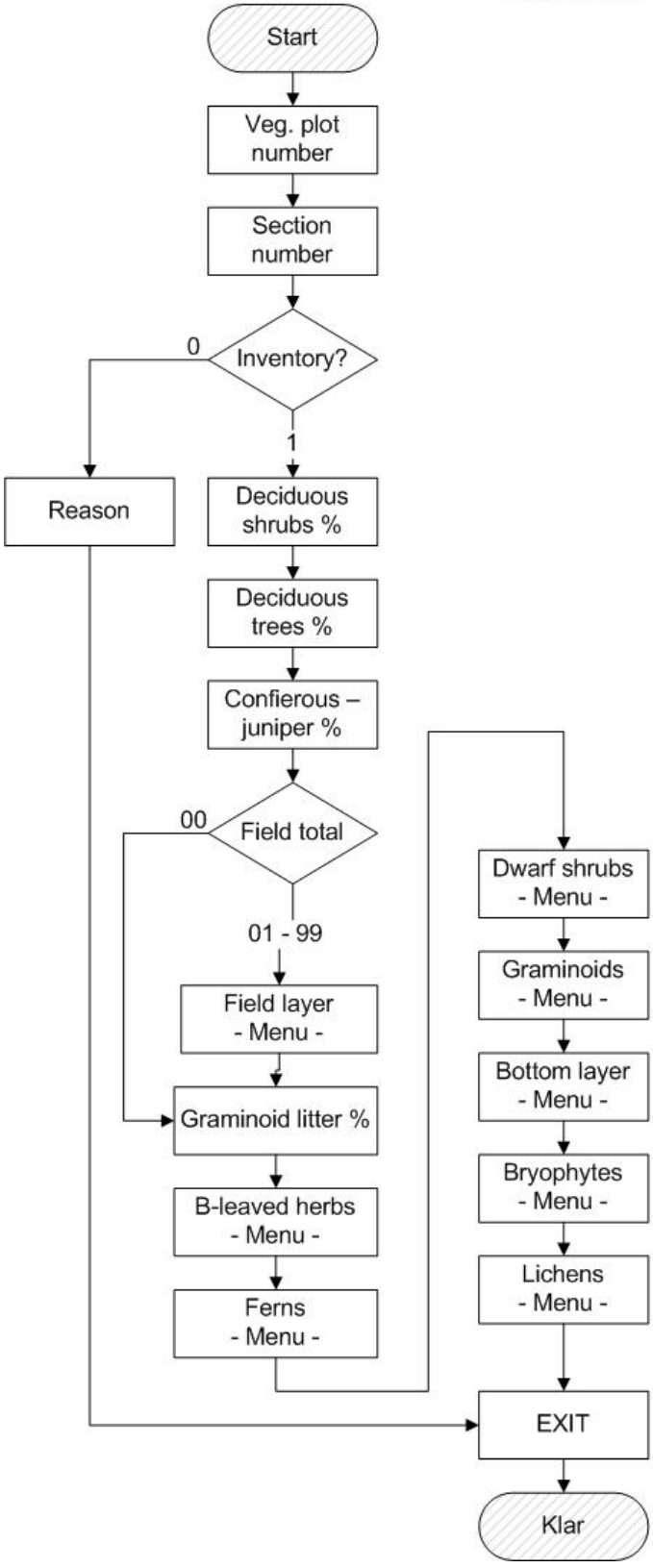
Menu Lichens - variables

Species list, see appendix 14 and Hylander & Esseen (2005)

Menu P&M Plants - variables

Species list, see appendix 14.

Small Vegetation Plot, NILS



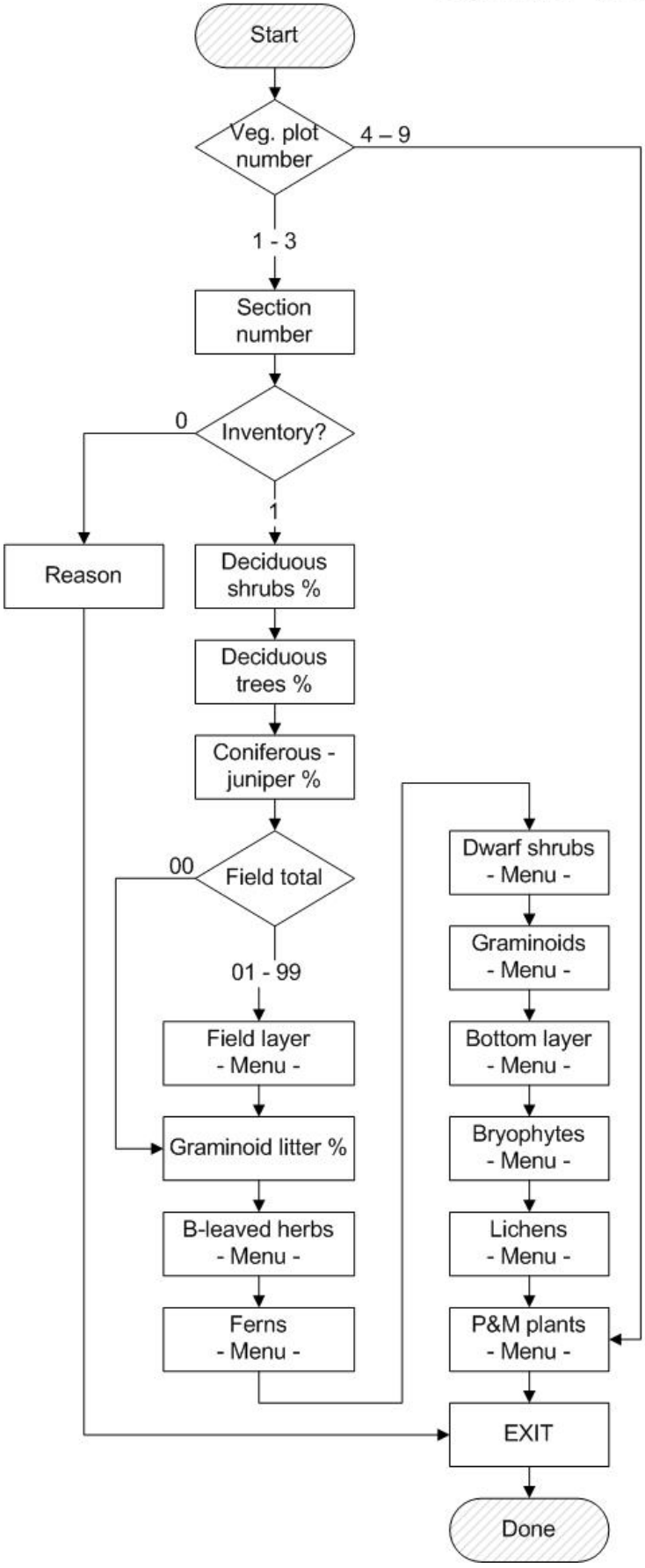
Veg. plot number
1 Small veg plot N (0)
2 Small veg plot S-E (120)
3 Small veg plot S-W (240)

Section number
0 Undivided plot
1 Section 1
2 Section 2
3 Section 3
4 Section 4
5 Section 5

Inventory?
0 No, omitted
1 Yes

Reason
01 Permanent water
02 Temporary under water
03 Inaccessible wetland
04 Field with agricultural growth
05 Field with pasture ground
06 Inaccessible, steep ground
07 Inaccessible, risk for landslide
08 Home, industrial site or other building site
09 No trespassing
10 Other reason – file report

Small Vegetation Plot, P&M



Veg. plot number
1, 4, 7 Small veg plot N (0)
2, 5, 8 Small veg plot S-E (120)
3, 6, 9 Small veg plot S-W (240)
Distances 3, 5 and 7 m

Section number
0 Undivided plot
1 Section 1
2 Section 2
3 Section 3
4 Section 4
5 Section 5

Inventory?
0 No, omitted
1 Yes

Reason
01 Permanent water
02 Temporary under water
03 Inaccessible wetland
04 Field with agricultural growth
05 Field with pasture ground
06 Inaccessible, steep ground
07 Inaccessible, risk for landslide
08 Home, industrial site or other building site
09 No trespassing
10 Other reason – file report

5. LINE INVENTORY

5.1. INTRODUCTION

These variables include linear elements (Table 5.1) that are inventoried by means of line intersect sampling (Figure 5.1) along 200 m inventory lines. For each linear element, a number of variables are registered, such as type, size, condition and vegetation, if any. Management activities and disturbances are also registered. Each type of linear element has its own menu in the field computer. A general description of the linear element is made; normally a 5 m wide zone on each side of the reference point measured lengthwise is considered during line inventory.

The main aim of the inventory is to determine the quality and quantity of the different linear elements. Linear elements can represent both environments/substrate or dispersal corridors (vegetation strips, forest edges, etc.) as well as indicators of a special function or influence in the landscape (roads, ditches, fences). By registering the number of intersection points, the amount of linear elements in the landscape can be estimated. In total, line inventory is carried out along a stretch of 2400 meters in each landscape square.

Methods

The distance (position along the line) where the inventory line intersects the objects reference point (Figure 5.1) is registered. In some cases, the line can cross the element in several places and the element is then registered each time. Forest edges and shores constitute transitions between two different types of environments (ecotones) but are basically inventoried in the same way as other linear elements. The only practical difference is that the intersect position is registered at specific ecological borders (edge tree line and high water line respectively). Registration of variables for linear elements is made within a 10 m wide zone stretching 5 m to each side of the reference point measured lengthwise along the linear element (Figure 5.1). NOTE: Forest edges are described in a 20 m wide zone.

Criteria for registration

- Register all linear elements that are included in Table 5.1 and whose reference point is intersected by the inventory line.
- Line inventory is not performed in built-up areas.
- Line inventory stops when the line crosses a private property boundary. If there is a road or other linear element (except private property border fence) outside the private property boundary, it is registered even if, according to the map, it is situated within the built-up polygon.
- Parks and green areas that have public access are inventoried if they are larger than 500 m^2 (0.05 hectare, border between natural and prepared land).
- In built-up areas too small to be considered a separate polygon, everything that is outside of private property is inventoried.
- If unsure of which areas to inventory, contact the office personnel.

Table 5.1: Overview of all linear elements.

CHAP.	ELEMENT	CRITERIA*	REFERENCE POINT = distance+identity
6.1	**Transport route** NOTE: Do not inventory freeways	**Width:** Small path in the mountains: 10-20cm. Others at least 20cm, no maximum width.	Center-point at line crossing
6.2	**Vegetation strip**	Width 10-20 m	Center-point at line crossing
6.3	**Forest edge**	**Open Land:** Width at least 20 m, tree height (trees maximum 5 m high). **'Normal Forest':** Width at least 20 m, tree height at least 5 m, tree cover at least 30%.	Point of germination of edge trees (diameter at breast height at least 10cm)
6.4	**Fence**	Height at least 30cm, length at least 4 m. Crash barriers or fences around private properties are not included.	Center-point at line crossing
6.5	**Ditch/water course**	Width of water-affected stream channel at least 2 dm, or total depth of ditch at least 30cm. Width including shore zone at most 6 m.	Mid-point of water course
6.6	**Shore**	Width (including shore zone) more than 6 m.	High water line
6.7	**Forest Grouse**	Birds at most 50 m from inventory line.	Distance at line crossing, right angle from the line to the birds.

* See specific descriptions for each element for more detailed criteria.

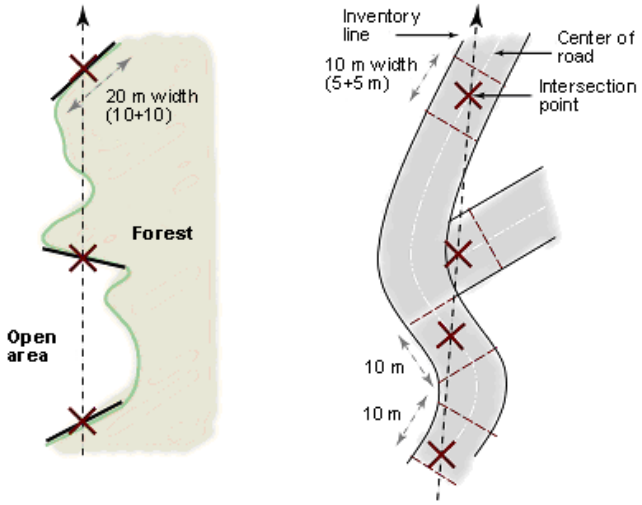


Figure 5.1: Illustration of how to register the reference point for two linear elements (forest edge and road) along inventory lines and how to define the inventoried zone.

Procedures for Line Inventory

During inventory, walk clock-wise along the 200 meter lines. Normally a mirror-compass and a 50 m tape measure (line with distance markings) are used. One person navigates with the compass and drags the line behind him/her. The position of the line marks the reference point and defines the mid-point for inventory of linear elements and forest grouse. Inventory of the 200 m lines is normally done in four segments of 50 m each.

Procedures for inventory of a 50 m segment:

- While navigating with the compass, mainly focus on navigation and not too much on the linear elements. NOTE: The only exception is forest grouse.
- When there is only a few meters left until the navigator has reached the 50 m point, the person left behind tugs on the line gently (or calls out) to give a signal to the navigator that it is time to stretch the line.
- The navigator stretches the line (held in the other end by the other team member), and places a wooden stick into the ground at exactly 50 m distance. The line is placed on the ground to be used as a reference during the inventory of the segment.
- The navigator retraces his/her steps along the line to help with the registering of linear elements. While walking back, look carefully for linear elements.
- When inventory is completed, both team members have arrived at the 50 m stick, where inventory of a new 50 m segment (or navigation to a new sample plot) commences.

When performing line inventory in steep terrain, the distance must sometimes be corrected when measuring with a line. See Table 2.1 for further instructions.

Inventory lines must sometimes be interrupted since some terrain is inaccessible or should

not be inventoried. In these cases special instructions apply (registering inventory boundary, chapter 5.2). NOTE: A GPS and field map are used to locate the point where line inventory is resumed. It could mean walking along a field to the point where the X or the Y coordinate agrees with the inventory line in question. When the point for resumed inventory on an interrupted line is to be located, it is often necessary to use the GPS all the way. NOTE: Register every line start and end point, as well as every break and resume point in the GPS. These can be obtained the 'fast way', i.e. it is not necessary to take average positions.

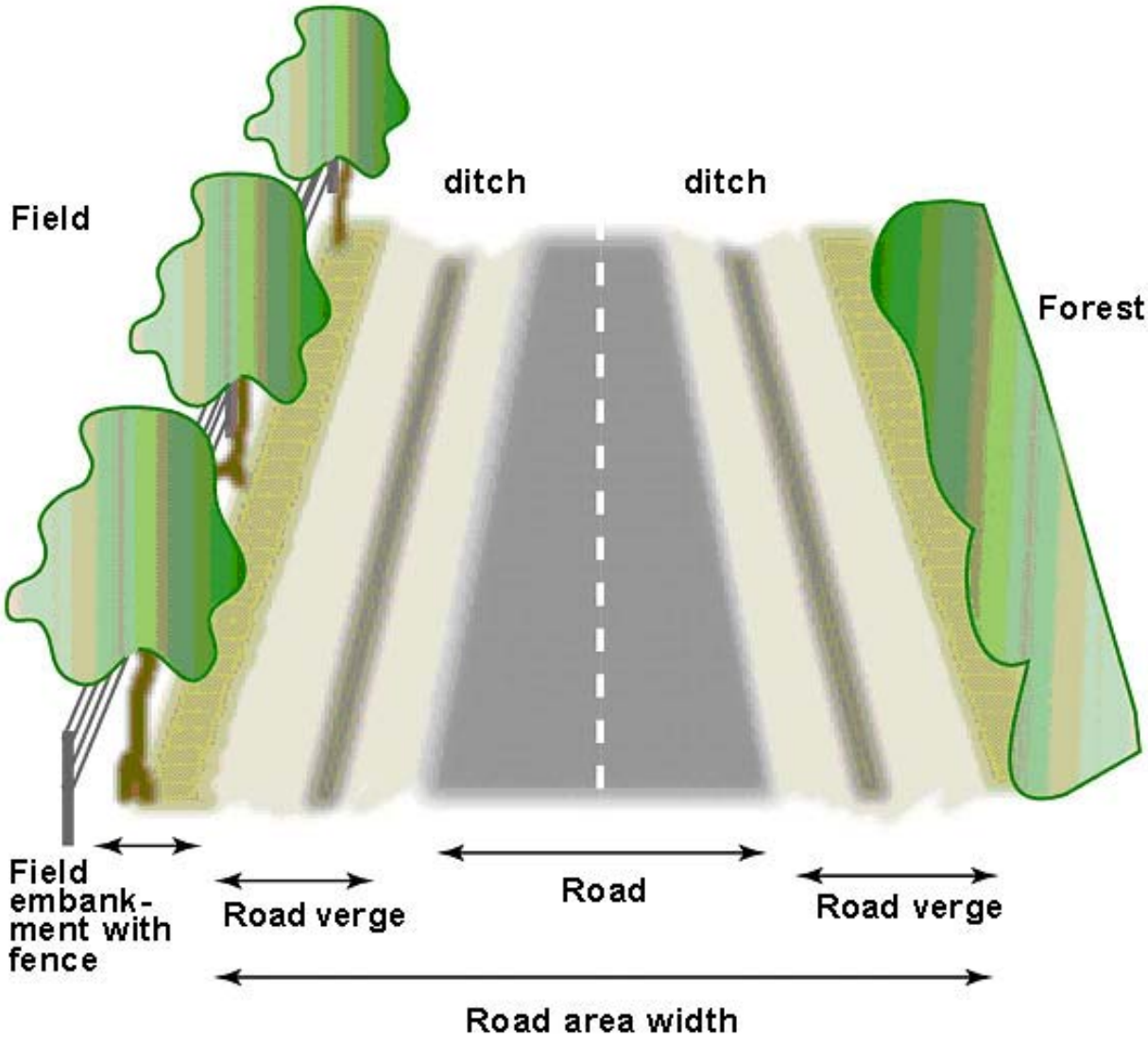


Figure 5.2: Different linear elements and their locations in relation to each other.

5.2. LINE IDENTITIES

A group of variables that describe the 200 m line to be inventoried.

Menu Line - variables

Line number
01-12

The number (identity) of the inventory line (200 m line), according to Figure 4.4 and Table 5.2

In the field computer, the theoretical start and end point coordinates of the 200 m line are shown.

Table 5.2: The theoretical coordinates of the lines in relation to the km-square lower left corner.

Line	Theroretical start point		Theroretical end point		Normal walking direction
	North coord. X	East coord. Y	North coord. X	East coord. Y	
1	150 m	125 m	350 m	125 m	North
2	400 m	125 m	600 m	125 m	North
3	650 m	125 m	850 m	125 m	North
4	875 m	150 m	875 m	350 m	East
5	875 m	400 m	875 m	600 m	East
6	875 m	650 m	875 m	850 m	East
7	850 m	875 m	650 m	875 m	South
8	600 m	875 m	400 m	875 m	South
9	350 m	875 m	150 m	875 m	South
10	125 m	850 m	125 m	650 m	West
11	125 m	600 m	125 m	400 m	West
12	125 m	350 m	125 m	150 m	West

Starting distance

1 000 m start normal/clockwise — Clockwise direction of inventory.

2 200 m start counter-clockwise — Counter-clockwise direction of inventory.

It is important to always start at the line starting point (0 m) while performing line inventory, and walk clockwise. This means navigating north for line 1 to 3, east for line 4 to 6, south for line 7 to 9, and west for line 10 to 12. If there are specific reasons, navigation in the opposite direction is allowed. In these cases, start at the end point (200 m) and walk counter-clockwise. NOTE: Always enter distances along the line from 0 and up in the direction you are moving, even if it is in an opposite direction.

Direction — Stating the navigation direction. The variable is

1 Navigating north 2 Navigating east 3 Navigating south 4 Navigating west	needed in order to be able to follow the same direction while re-visiting the line in future inventory. The direction cannot change while navigating along the 200 m line.

Invent type Start	Type of inventory at the start of the line.
1 Field inventory	Normal line inventory with tape measure (line).
2 Map inventory	Line starts in an area that can not be visited in the field.

NOTE: Register linear elements even if they are totally surrounded by map inventory line sections, if the reference point of the linear element can be reached.

Reason	Reason for map inventory.
01 Arable field - yearly crop	
02 Hay-making field	
03 Water	
04 Inaccessible, wetland	
05 Inaccessible, steep slope	More than 25 degree slope if there are stones/boulders. More than 35 degree slope if covered with vegetation.
06 Inaccessible, risk of landslide	
07 Private property, industrial area	
08 Biotope island, cannot be reached	E.g. non-arable land within an arable field, small island.
09 No trespassing	
10 Fence, not passable	
11 Dangerous area – file report	A written report must be filled out (blue form, appendix 2).
12 International border	
13 Other – file report	A written report must be filled out (blue form, appendix 2).

Start GPS number 000-999	Waypoint number in the GPS for the start of the line, registered only if Invent type = Field inventory. Enter “999’ if the GPS is malfunctioning.

Start GPS X 000-999	Distance according to the GPS in the north-south direction, to the southern-most line of the 1 km

square, i.e. the closest 1000 m line. Enter the three last digits on the display. Enter “999’ if the GPS is malfunctioning.

Start GPS Y
000-999

Distance according to the GPS in the east-west direction, to the western-most line of the 1 km square, i.e. the closest 1000 m line. Enter the three last digits on the display. Enter “999’ if the GPS is malfunctioning.

Linear Element Opens menu **Linear Element**.

Inventory Boundary Opens menu **Inventory Boundary**.

Inventory boundaries are registered in order to state how each 200 m line is inventoried, if it is a normal line inventory, or if certain line sections are not field inventoried (map inventoried line sections). NOTE: An inventory boundary is always registered when inventory must be interrupted for map inventory, or when field inventory is continued after a map-inventoried section. NOTE: Inventory boundaries are also registered between different types of map inventoried sections, e.g. at border between water and built-up area. Inventory boundaries often coincide with certain types of linear elements, and should be entered when registering e.g. shores if inventory cannot be continued with the line.

NOTE: Several linear elements can be inventoried in the field even if they are positioned within a map inventoried section, e.g. a ditch or utility road between two fields. If it is possible to reach the reference point of the element, it is to be registered. Line inventory is performed normally, and inventory boundaries are registered when starting and ending inventory. On rare occasions it is allowed to skip inventory boundaries, e.g. if a single linear element or a small group of linear elements are surrounded on both sides by the same type of map inventoried sections. Normally, inventory boundaries are not necessary if the total distance between them is less than 10 m.

Inventory Type End Type of inventory at the end of the line.
1 Field inventory
2 Map inventory

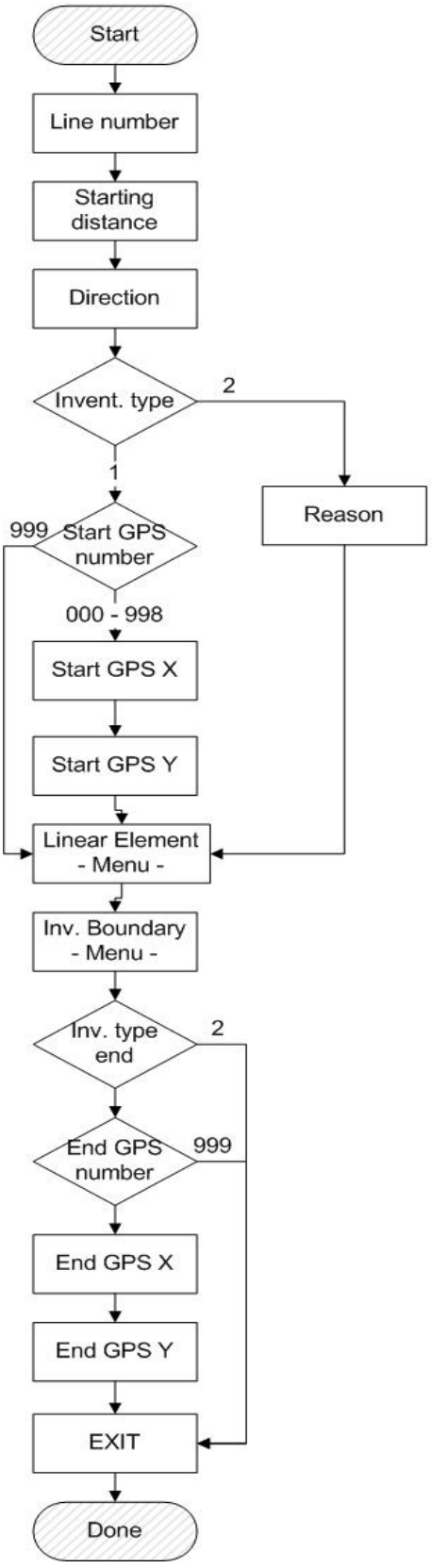
End GPS Number
000-999

Waypoint number in the GPS for the end of the line, registered only if Invent type = Field inventory. Enter “999’ if the GPS is malfunctioning.

End GPS X Distance according to the GPS in the north-south

000-999 direction, to the southern-most line of the 1 km square, i.e. the closest 1000 m line. Enter the three last digits on the display. Enter “999’ if the GPS is malfunctioning.

End GPS Y
000-999 Distance according to the GPS in the east-west direction, to the western-most line of the 1 km square, i.e. the closest 1000 m line. Enter the three last digits on the display. Enter “999’ if the GPS is malfunctioning.



Line

Line number
01 N 150 - 350 m, E 125 m
02 N 400 - 600 m, E 125 m
03 N 650 - 850 m, E 125 m
04 N 875 m, E 150 - 350 m
05 N 875 m, E 400 - 600 m
06 N 875 m, E 650 - 850 m
07 N 850 - 650 m, E 875 m
08 N 600 - 400 m, E 875 m
09 N 350 - 150 m, E 875 m
10 N 125 m, E 850 - 650 m
11 N 125 m, E 600 - 400 m
12 N 125 m, E 350 - 150 m

Starting distance
1 000 m start normal/clockwise
2 200 m start counter-clockwise

Direction
1 Navigating north
2 Navigating east
3 Navigating south
4 Navigating west

Reason
01 Field - yearly crop
02 Hay-making field
03 Water
04 Inaccessible, wetland
05 Inaccessible, steep slope
06 Inaccessible, risk of landslide
07 Private property, industrial area
08 Biotope island, cannot be reached
09 No trespassing
10 Fence, not passable
11 Dangerous area – file report
12 International boundary
13 Other – file report

Menu Linear Element - variables

Main menu for line inventory and choices of linear elements. NOTE: Several different linear elements can be registered at the same distance, but only one element of each type. If there for example are two fences at the same distance, separate them by 1 m.

Distance 000-200 m	Distance from the start of line inventory to the reference point for the element in question.

Distance to registered element is always registered from 0 and up to a maximum of 200 m in the navigation direction. NOTE: This also includes navigation in the opposite direction (counter-clockwise), i.e. when starting at the normal end-position (200 m); the distances still start with 0.

TIP: When exiting the menu for a linear element, the distance and type is added to a list in the right-hand side window under ‘reg. menus and dist. of line (no.)’. In this window, a complete list of all distances of earlier registered objects along the 200 m line is visible. Choose one of these distances and enter the menu for the linear element in question to double-check or change the data.

NOTE: Remember to change distance when registering of a new linear element, if it is not the same distance as the previous element.

Transport route	Opens menu **Transport route** (chapter 6.1).
Vegetation strip	Opens menu **Vegetation strip** (chapter 6.2).
Forest edge	Opens menu **Forest edge** (chapter 6.3).
Fence	Opens menu **Fence** (chapter 6.4).
Ditch/water course	Opens menu **Ditch/water course** (chapter 6.5).
Shore	Opens menu **Shore** (chapter 6.6).
Forest grouse	Opens menu **Forest grouse** (chapter 6.7).

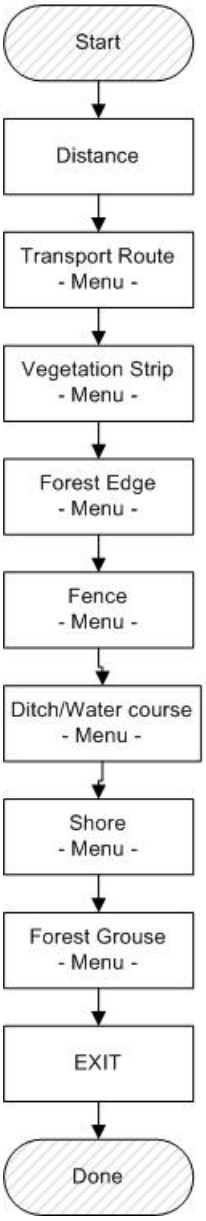
How to correct a mistake?
In order to correct mistakes, the last variable for a linear element and inventory border is a control question. The control question must always be answered. The normal answer is “1 Yes, distance and element correct’.

What if the wrong type of linear element is selected?
Exit the menu in question without saving or registering any variables (enter ‘Back out of empty menu’ in the EXIT menu), then exit the menu. If some variables are already registered, they must first be deleted (enter “Clear this menu’ in the EXIT menu). Then proceed as above.

What if the registered distance is incorrect?
NOTE: It is not possible to go back and change the distance for a linear element if it has been saved, since the distance also acts as the identity of the element. If the registered distance is incorrect, select alternative 2 in the control question (“Wrong distance – change’) and enter the correct distance for the element.

How to remove an object?
Sometimes an object has been incorrectly registered and must be removed. This can happen if it is discovered that the linear element does not meet the criteria, or if the line is positioned in the wrong place. In cases like this enter alternative 3 in the control question (“Incorrect registration - delete!’). The registered element remains in the database, but is marked for deletion. It is possible to erase the element completely by entering ‘Erase menu from database’ in the EXIT menu. By doing this, previously saved elements may also be deleted.

Linear Element



Menu Inventory Boundary - variables

Boundary Distance 000-200 m	Distance from where the line inventory started to the inventory boundary in question.

The distance for the inventory boundary is obtained from the line, the field map or in some cases, from the GPS. NOTE: Check that the registered distance is correct by using the field map. Mark all inventory boundaries on the map.

TIPS: When re-entering the menu after the inventory boundaries has been saved, the right-hand side window will show a complete list of earlier registered inventory boundaries along the 200 m line in question under ‘registered boundary distances’. In order to update the list, the menu must be exited and re-entered.

Boundary Type

1 From field inv to map inv

2 From map inv to field inv

3 From map inv to other map inv

Map Inventory Type

01 Arable field - annual crop	
02 Hay-making field	
03 Water	At the high water line.
04 Inaccessible, wetland	
05 Inaccessible, steep terrain	
06 Inaccessible, risk of landslide	
07 Private property, industrial area	Where property starts or ends.
08 Biotope island, cannot be reached	
09 No trespassing	
10 Fence, not passable	
11 Dangerous area – file report	A written report must be filled out (blue form, appendix 2).
12 International boundary	
13 Other reason – file	A written report must be filled out (blue form,

report appendix 2).

Boundary GPS Number
000-999
Waypoint number in the GPS for the boundary. Enter “999’ if the GPS is malfunctioning.

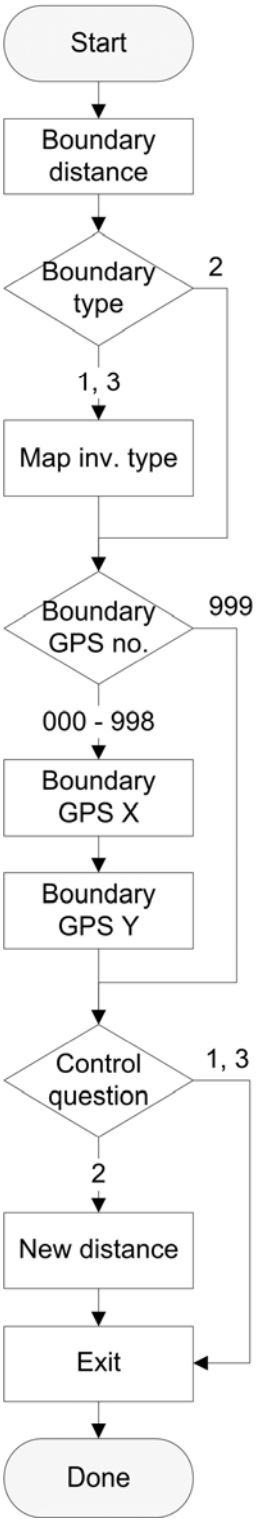
Boundary GPS X
000-999
Distance according to the GPS in north-south direction, to the southern-most line of the 1 km square, i.e. the closest 1000 m line. Enter the three last digits on the display. Enter “999’ if the GPS is malfunctioning.

Boundary GPS Y
000-999
Distance according to the GPS in east-west direction, to the western-most line of the 1 km square, i.e. the closest 1000 m line. Enter the three last digits on the display. Enter “999’ if the GPS is malfunctioning.

Always register the GPS position for boundaries between field inventories and map inventoried sections. Do not register the GPS position for boundaries between two map inventoried sections that have not been visited in field. NOTE: Mark all inventory boundaries on the field map.

Control question
1 Yes, distance and boundary correct
2 Wrong distance - change
3 Incorrect registration - delete!
If an inventory boundary has been incorrectly registered, proceed in the same way as for incorrectly registered linear elements.

New Distance
000-200 m



Invent. Boundary

Boundary Type
1 From field inv to map inv
2 From map inv to field inv
3 From map inv to other map inv

Map Inv. Type
01 Agricultural field - annual crop
02 Hay-making field
03 Water
04 Inaccessible, wetland
05 Inaccessible, steep slope
06 Inaccessible, risk of landslide 07
Private property, industrial area
08 Biotope island, cannot be reached
09 No trespassing
10 Fence, not passable
11 Dangerous area – file report
12 International boundary
13 Other reason – file report

6. LINEAR ELEMENTS AND FOREST GROUSE

6.1. TRANSPORT ROUTE

Aim

Transport routes are first and foremost signs of external influence. The direct effect on the environment can be measured as the amount of disturbed or paved ground. Paths, vehicle tracks and utility roads can also be indicators of e.g. disturbance of animals, ongoing recreation, motorcycles, snow-mobiles or forestry vehicles. In addition, old utility roads, animal paths and foot-bridges are cultural indications of previous land use.

Criteria for registering

- All transport routes intersected by the inventory line that meet the size requirements are registered, i.e. elements that are over 20cm wide, except ‘small alpine paths’ (mostly reindeer paths) which are 10 to 20cm wide.
- All man-made transport routes (except highways) are included regardless of size, except if they are completely abandoned and unusable.
- Never register highways.
- A transport route that ends within the 10 m zone or is a branch of another (often bigger) path or track area is registered, as long as it is located within the 10 m zone, from the branching point or at the end point (Figure 6.1). Branches of a path or short transport routes are not registered if they are not intersected by the inventory line.
- Distinct paths are normally registered as separate transport routes. If, on the other hand, a more diffuse ‘stretch’ of vague and partly intermingled paths (along e.g. a hiking trail) it may be registered as one element. Width and substrate cover then refers to the total width of the element.

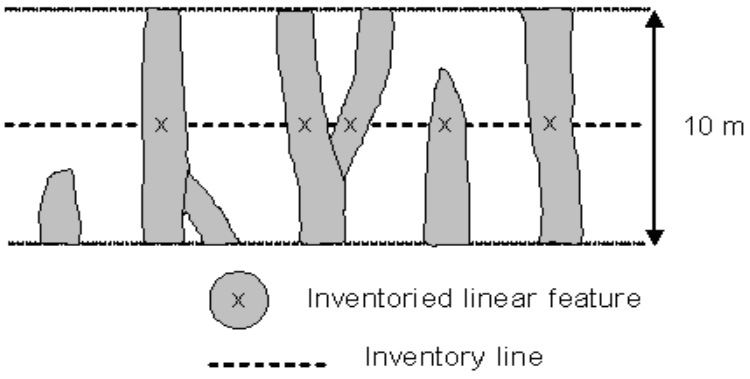


Figure 6.1: Examples of transport routes along an inventory line. The elements marked with an X are to be registered.

Procedures

- Determine type of transport route and type of disturbance for paths and tracks.
- Register width, paving (if any) and cover of vegetation. The variables represent an average for a zone of 5 m on each side of the intersection point, measured lengthwise (Figure 5.1).
- Estimated the age of foot-bridges.
- NOTE: Watch the traffic on all roads! Use Vertex distance meter to measure the width of roads.

Definitions

Transport route
Transport routes include all linear elements that are used to transport vehicles, animals and people.

Non-constructed routes
Paths, tracks and utility roads are clearly defined tracks in the vegetation, which have formed ‘spontaneously’ by repeated trampling or driving. NOTE: If vegetation exits on non-paved routes, it must be distinctly sparser or have a visibly different composition than the surrounding vegetation. Low growing vegetation, trampled or folded over vegetation is not enough; neither is an indentation that has been completely overgrown. NOTE: Do not register strip roads or tire tracks in clear-cuts if they do not have a considerable effect on the ground vegetation, are deep or contain a large amount of exposed soil. Always register transport routes of more or less permanent nature.

Constructed routes
Constructed roads, railroads and foot-bridges are man-made by digging and/or adding materials (gravel, macadam, cement, wood, etc.) as opposed to utility roads, paths and tracks that have been formed “spontaneously’, by repeated trampling or driving. Measure the width of a paved route as wide as visible disturbance is noted. This includes the narrow gravel strips at the side of the pavement on e.g. an asphalt road. NOTE: In some cases a road bank can be built up for a short distance where a road crosses for instance a damp hollow. If the line intersects this part, the road is registered as a constructed road, even if the rest of the road rates as a utility road.

Menu Transport Route - variables

Route Type	Type of transport route.
1 Path/track >2 dm	Path or track with or without sparse/low vegetation, different in composition from the surrounding vegetation, due to trampling or driving.
2 Small path in the mountains 1-2 dm	‘Reindeer path’ in the mountains (stratum 10), larger reindeer paths are classified as ‘Path/track’. NOTE: Vegetation must be visibly disturbed by trampling.
3 Utility road	Permanent unpaved road made by four-wheeled vehicles often in connection to a field. It follows the terrain, has no roadbed or side ditches, sometimes partially covered with rocks or bricks in, e.g. hollows.

	Included if not obviously abandoned or unusable.
4 Constructed road	Man-made road on a roadbed of added material. All roads with permanent pavement (asphalt/oil gravel etc.) are included.
5 Constructed walkway/bike path	Narrow, man-made roads for walking or bike-riding. Often paved.
6 Railroad (railroad embankment)	Railroad embankment, in use or abandoned. Include as long as the rails are still there. A road or a path on a railroad embankment is registered as a road or a path.
7 Footbridge, planks	Longitudinal planks of sawed lumber that have been placed as a walkway over wetland, for example in mires.
8 Footbridge, round timber	Longitudinal poles or timber (not sawed) that have been placed as a walkway over wetland.

Path Type	Type of path/track. Determined by dominating influence.
1 Human influence, walking	Path that has been formed by human trampling.
2 Domestic animals, except reindeer	Path that has been formed by trampling of domesticated animals, except reindeer.
3 Reindeer influence	Path (over 20cm wide) that has been formed by trampling of reindeer.
4 Wild animal influence	Path that has been formed by wild animals (e.g. deer, moose, ants).
5 Main influence unknown	Dominant type of trampling unclear.
6 Vehicle tracks	Tracks formed by vehicle traffic, e.g. motorcycles, forest machinery or tractors. Utility roads not included.
7 Vehicles tracks and path	Path or vehicle tracks influenced by both trampling and driving.
8 Path with bark, sawdust, cinders	Path paved with bark, sawdust, cinders etc. (e.g. jogging track).

Vehicle Type	Dominant type of vehicle that have formed the tracks.
1 Bicycle/motorcycle	Two wheelers (bikes or motorbikes).
2 Four wheeled vehicles	Four wheeled vehicles (cars, tractors, forest machinery, four wheelers etc.).

3 Single-track vehicles	Single-track vehicles (snow-mobiles).
4 Dual-track vehicles	Dual-track vehicles (weasels, forestry equipment).
Track Depth 00-99cm	Average depth of track on the 10 m stretch.
Path Width 02-99 dm	Width of path or track – influenced area (substrate/bottom layer/field layer) or paved ground.
Road Width 001-999dm	Width of roadway – influenced area (substrate/bottom layer/field layer) or paved ground.
Area Width 001-999 dm	Total width of road area, i.e. total width of cleared area in connection with a man-made road, including roadway, ditches, slopes, etc. (Figure 6.2).
Pavement 0 None 1 Gravel 2 Asphalt/oil gravel 3 Cement/Cement blocks 4 Paving stones/other stones 5 Bark/sawdust/cinder	Added surface layer on the road (on top of the road bed) that prevents vegetation.
6 Other pavement – file report	A written report must be filled out (blue form, appendix 2).
Median Strip 00-99 dm	Average width of a strip of vegetation in the middle of a non-paved road. The median strip differs from the surrounding vegetation and is often sparse and low-growing. Enter “00’ if median strip is missing.
Disturbance % 000-100%	Estimated amount of mineral soil or humus that is bared due to disturbance, or newly disturbed area populated by disturbance tolerant plants (e.g. *Plantago major*, *Poa annua*). Soil bared for other reasons than disturbance (e.g. strong shade) is not included. Estimations within the path/road width area.
Stones % 000-100%	Stones/boulders/bare bedrock >20 mm. Bare rock surface with no vegetation or humus.

Soil/gravel % 000-100%	Mineral soil/gravel <20 mm. Bare mineral soil or brown forest soil that may be covered with ruderal crustose lichens.
Humus % 000-100%	Bare humus or peat.
Age	Estimated for foot-bridges.
1 New (<5 years)	Less than 5 years old.
2 Modern type	Older than 5 years but usable (recreation, forestry etc.).
3 Older type	Abandoned, once used (foot-bridges over old peat workings etc.).

Control question

1 Yes, distance and element correct

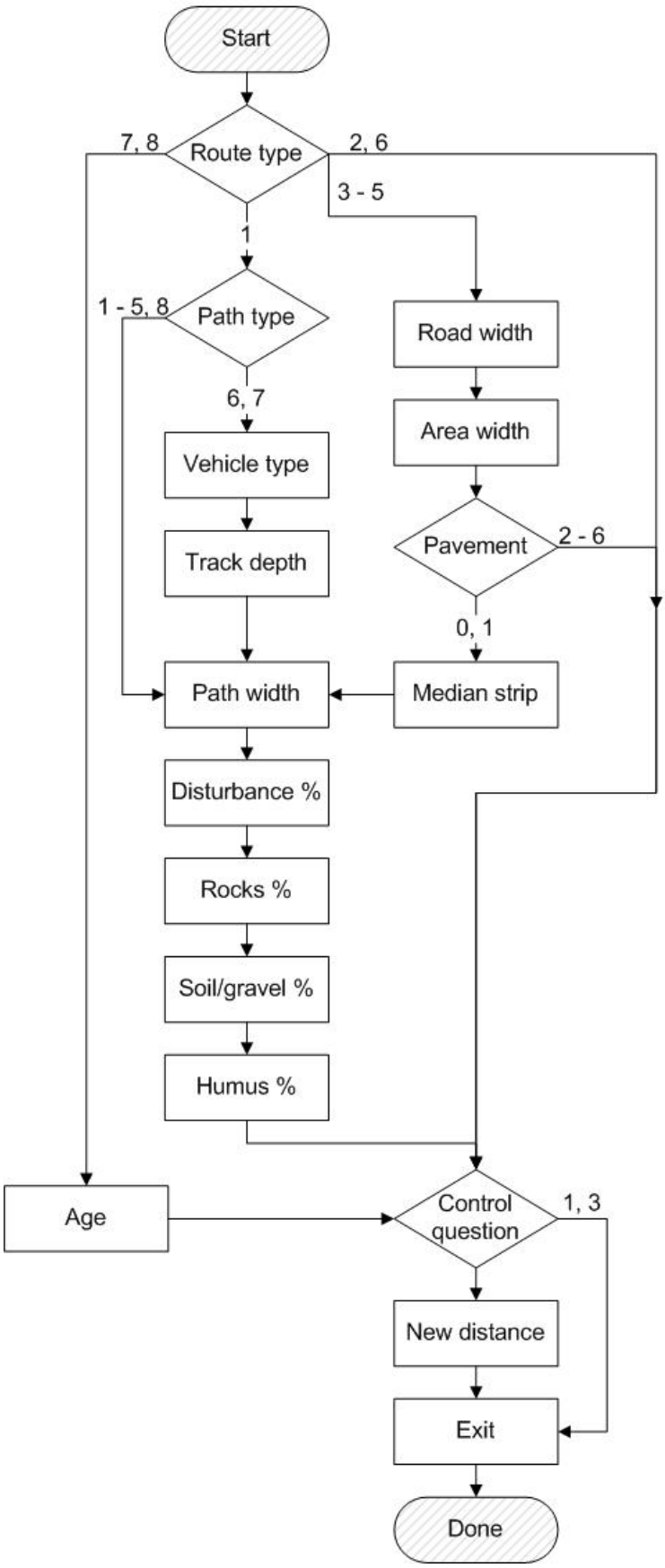
2 Wrong distance - change

3 Incorrect registration - delete!

New Distance

000-200 m

Transport Route



Route Type
1 Path/track >2 dm
2 Small alpine path 1-2 dm
3 Utility road
4 Paved road
5 Paved walkway/bike path
6 Railroad (railroad embankment)
7 Footbridge, planks
8 Footbridge, round timber

Path Type
1 Human influence, walking
2 Domestic animals, except reindeer
3 Reindeer influence
4 Wild animal influence
5 Main influence unknown
6 Vehicle tracks
7 Vehicles tracks and path
8 Path with bark, sawdust, cinders

Vehicle Type
1 Bicycle/motorcycle
2 Four wheeled vehicles
3 Single-track vehicles
4 Dual-track vehicles

Pavement
0 None
1 Gravel
2 Asphalt/oil gravel
3 Cement/Cement blocks
4 Paving stones/other stones
5 Bark/sawdust/cinder
6 Other pavement – file report

6.2. VEGETATION STRIP

Aim

The amount and quality of vegetation strips in the landscape are important for organisms that can not survive in intensely cultivated environments. They function as dispersal corridors, and may be important for food foraging and winter survival. They also protect and buffer against leaching of nutrients or biocides into water courses. Since many vegetation strips are maintained or kept open in other ways, they act as ‘surrogate environments’ for plants and animals which otherwise populate fields and pastures.

Criteria for Registration

- Vegetation strips are defined by size and not by function. Minimum width is 1 m, and maximum width is 10 m. Strips wider than 10 m are considered areal elements. They must also be more than 10 m long (in total) and be at least 5 times as long as they are wide. Thus, a 9 m wide strip must be at least 45 m long.
- However, border strips in arable land are considered vegetation strips up to a width of 20 m.
- A vegetation strip must differ sharply and distinctly from the surroundings on both sides. The edge can be represented by a sharp land use border between cultivated and natural ground (border between e.g. a field, building, private property or paved road) or a border between terrestrial and semi-aquatic/aquatic land (water courses and shores, the high water line acts as the point of reference).
- A clearly defined edge is especially important if registering ‘other strip’. The vegetation in the field layer and bottom layer must always be very sharply different from the surroundings, not only the tree layer and shrub layer. It is therefore not enough that trees and shrubs have been cleared if the effects are not clearly visible in the ground vegetation.
- As for other linear elements, a vegetation strip is registered each time the inventory line intersects with the mid-point of the strip (Figure 5.1).
- Vegetation strips cannot overlap.

Procedures

- Determine type of vegetation strip and demarcate it from the surrounding area.
- Determine if the vegetation strips along ditches, i.e. ditch-banks or road slopes, should be registered as one (‘overlapping’) or two (‘connected’) elements.
- Register width, vegetation, disturbance, etc. The variables represent averages for a zone 5 m on each side of the intersection point, measured lengthwise (Figure 5.1).

Definitions

A ***vegetation strip*** is a linear element covered with vegetation, defined by a sharp boundary in the ground conditions between man-made land, cultivated land (arable field, etc.) or shores. Slopes or banks with large amounts of bare substrate are also included, even if the vegetation is very sparse, as long as they may house vegetation and the disturbed ground was created by clearing or constructing ditches or road verges. The

composition of the vegetation must differ on both sides from the surrounding area.

Boundary strips (field margins) on arable land are located on regularly plowed ground, often on areas facing shores or water courses. The land owner has left a strip where perennial vegetation can be established (spontaneously or by sowing perennial grasses) in order to reduce leaching of nutrients into the water. Such protective zones can be at most 20 m wide, but is often narrower.

Register ***road verges*** for the “road area’, i.e. the area that is maintained around paved roads. This also includes areas along ditches within the road area (as opposed to ditch-banks, see below) where the ditch overlaps the road verge. Included here are cuttings in loose materials (moraine, sand/gravel), while rock cuttings higher than 1 m are described only below the cut area. However, smaller boulders and bare bedrock are included in the road verge (Figure 6.2).

Ditch banks are registered along ditches that are not located within a road area (compare road verges above). The banks on either side in the water channel of a ditch are normally described as a single element where the ditch element (i.e. the stream channel and the variables Total Ditch Depth and Total Ditch Width, chapter 6.5) are considered overlapping with the vegetation strip (Figure 6.2). The element must still be at least 1 meter wide (except the possible stream channel).

Field verges are vegetation strips in proximity to a field, but not directly connected to a ditch (within the ‘total width’ of a ditch) or within a road area (Figure 6.2).

Overlapping ditch/water course
A ditch (linear element ditch/water course) can overlap with a vegetation strip (ditch-bank or road verge) if the verges/banks are not significantly different from each other on either side of the ditch. If overlapping, the verges/banks are registered as a single element (chapter 6.5).

Menu Veg Strip - variables

Road verge? 0 No, not in road area 1 Yes, incl. in road area (road verge)	Man-made strip located within the road area of a paved road. The verge’s inner part is located on the shoulder, and the outer part is located on the slope (definition of road area under Road area width (Area Width, chapter 6.1), and Figure 6.2). Maintained or cleared, often with gravel.
Ditch Bank? 0 No, not in ditch 1 Yes, in ditch (ditch bank)	Vegetation strip that is included in the ditch furrow (included in the total width and total depth of the ditch, Figure 6.2).
Other strip 1 Field verge	Man-made strip bordering field but not a part of a ditch or a road area. However, it can border a road

	verge or a ditch bank.
2 Other strip	Other, clearly defined strip that differs significantly from the surrounding area. It can border a shore, paved ground or ground with visibly different land use.
3 Boundary strip, facing water	Deliberately set-aside vegetation-covered area on the edge of a field (1 to 20 m wide) with an edge facing water. Usually in proximity to a field or ditch embankment.
4 Other boundary strip on arable land	Deliberately set-aside vegetation-covered area on the edge of a field (1 to 20 m wide) with an edge facing other land use (not water). Usually in proximity to a field or ditch embankment.
Zone Width 000-200 dm	Average width of the boundary strip, measured perpendicular to the length of the 10 m section.
Zone Field Layer 00-99%	Cover of the field layer in the boundary strip.
Width of Strip 010-100 dm	Average width of the vegetation strip, measures perpendicular to the length of the 10 m section.

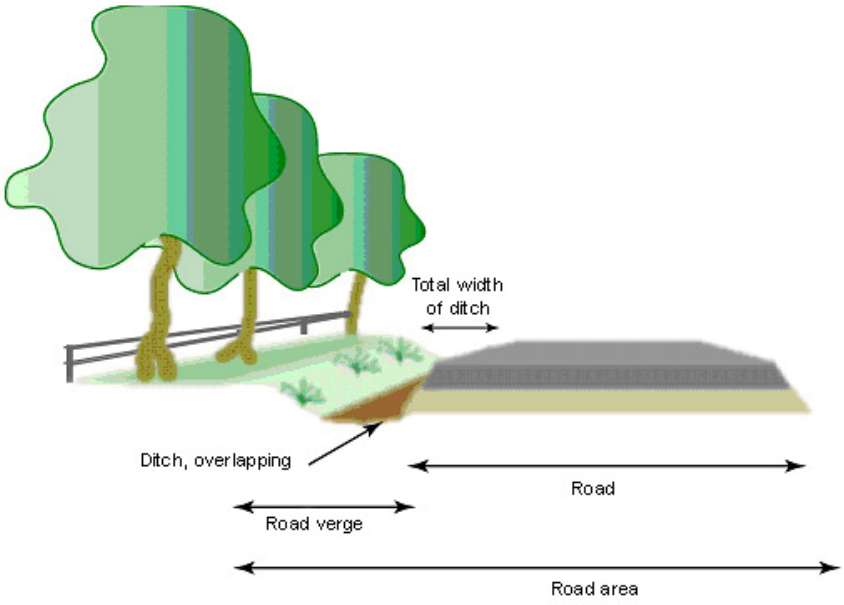


Figure 6.2: Examples of different vegetation strips and how they can connect with other linear elements. Ditch-banks and road verges can connect to or overlap with ditches.

In the following cover estimations, BF indicates Blank Format.

Herbs %
00-99% BF

Cover of herbs, last year's litter not included.

Dwarf Shrubs %
00-99% BF

Cover of all shoots of plants within the *Ericaceae* family.

Graminoids %
00-99% BF

Cover of graminids (grasses, sedges, rushes, bulrush), last year's litter not included

Bryophytes %
00-99% BF

Cover of mosses and liverworts on the ground or on stone, also under leaves.

Lichens %
00-99% BF

Cover of fruticose and foliose lichens on ground and stone, also under leaves.

Shrubs %
00-99% BF

Cover of shrubs.

Trees %
00-99% BF

Cover of trees.

Activities
0 No, no activities
1 Yes, cultivated/ cleared/ disturbed

Grazing or Cutting
0 Not grazed or cut
1 Low, grazed vegetation <5cm
2 Medium grazed vegetation 5-15cm
3 High, grazed vegetation >15cm

If the vegetation is grazed, the average height of vegetation in the field layer is stated (Figure 4.7). Mowed or cut grass is only registered if done recently (i.e. current season). Estimate type of management for the entire strip, even if it is not evident at the intersection point. Also enter appropriate form of Clearing if shrubs or small trees have been cleared in connection with cutting.

4 Mowing/ road-side cutting

Managed for the purpose of influencing the ground vegetation. This management may also result in the cutting of shrubs and small trees, especially beside larger roads.

5 Lawn mowing

Clearing	Cutting or clearing of the vegetation strip. This includes all removal of trees or shrubs regardless of method (also including road-side cutting that affect woody plants). If both small and large trees are removed, the dominant category (referring to cover) is recorded. Small trees are defined by having a stump diameter of less than 10cm. Heavy clearing requires removal of more than 50% of all trees/shrubs, while light clearing calls for removal of 5 - 50%.
0 No clearing	
1 Heavy clearing of large trees	
2 Light clearing of large trees	
3 Heavy clearing of small trees	
4 Light clearing of small trees	
5 Heavy clearing of shrubs	
6 Light clearing of shrubs	

Clearing Time	Time of clearing.
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Disturbance	Type of disturbance of the vegetation strip.
0 No disturbance	
1 Disturbance by vehicles	E.g. cars, snow-mobiles or tractors.
2 Disturbance by humans	Human trampling.
3 Disturbance by animals	Trampling by domestic or wild animals, including reindeer.
4 Water erosion (indications)	Erosion caused by running water.
5 Slide erosion (landslide)	Ground disturbed by slide, steep banks etc. slide because of indirect water effects.
6 Careful clearing	Clearing (mainly in ditches) where the vegetation has been scraped away to keep water flowing freely and maintain draining.
7 Heavy clearing	Heavy clearing where the top soil layer has been scraped away, often affecting the entire ditch embankment.
8 Straightening	Straightening of a water course.
9 Dredging/digging	Digging that removes the substrate and vegetation

	on the bottom of a body of water (mainly along shores) to increase water surface and depth.
Disturbance time 00 Current year or season 01 Last year or season 02 Year or season 2 05 Year or season 3-5	Time of ground disturbance.
Disturbance % 000-100%	Cover of ground disturbance.
Deposition 0 No deposition/accumulation	Type of deposit or accumulation.
1 Rock	Recent deposits of rocks, e.g. from blasting or building.
2 Digging deposition	Soil etc., deposited after digging.
3 Building material, incl. Bricks	Leftovers from building sites or demolition of buildings, e.g. plaster, cement or wood.
4 Cutting/clearing deposition	Large piles of branches, brush etc., leftover from cutting or clearing.
5 Other deposition, misc.	Mix of the above and/or other kinds of waste (discarded animal feed, leftover materials from industrial activity, slag, ashes, etc.).
6 Natural accumulation, fine matter	Natural accumulation of fine matter such as sand fractions or smaller (grain size, less than 2 mm). Thickness of accumulated layer least 5cm, cover more than 5% of the area.
7 Natural accumulation, course matter	See above. Coarse material refers to gravel and larger fractions (over 2 mm grain size).
Deposition Time 00 Current year or season 01 Last year or season 02 Year or season 2 05 Year or season 3-5	Time of deposition.
Deposition %	Cover of deposits or accumulation on the vegetation strip.

000-100%

Control question

1 Yes, distance and element correct

2 Wrong distance - change

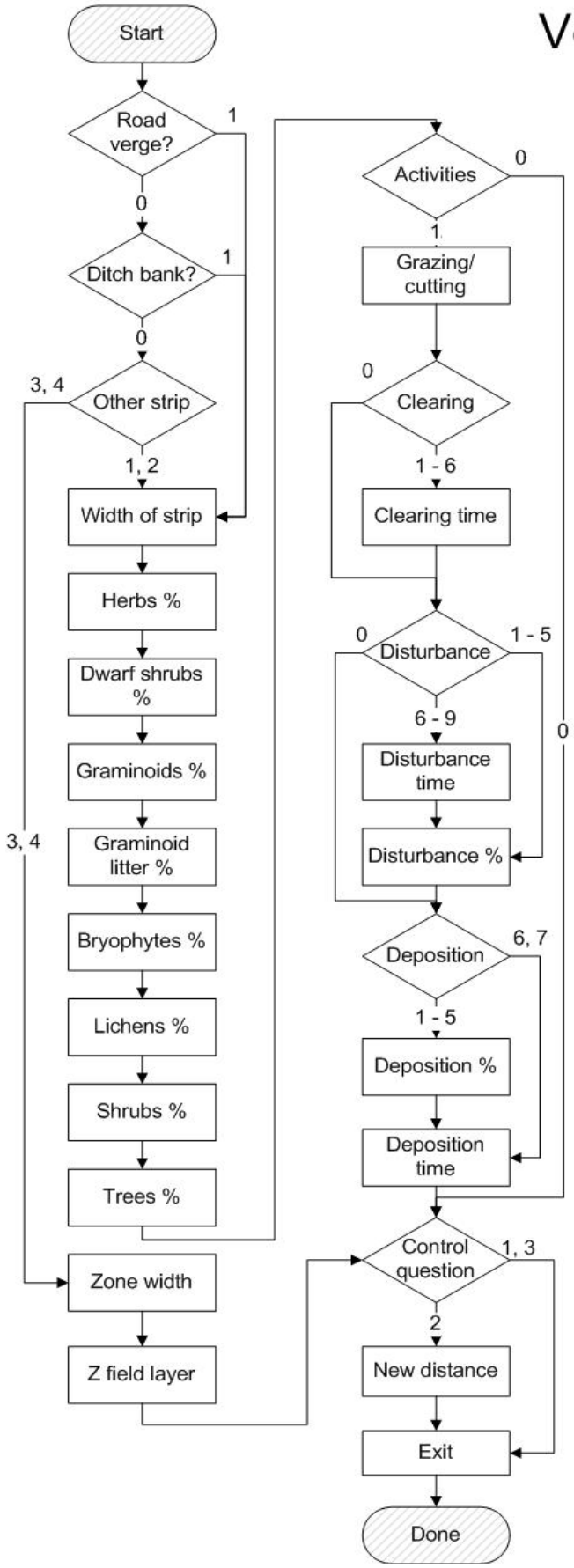
3 Incorrect registration - delete!

New Distance

000-200 m

.

Vegetation Strip



Other strip
1 Field verge
2 Other strip
3 Boundary stip, facing water
4 Other boundary strip on arable land

Activities
0 No, no activities
1 Yes, cultivated/ cleared/ disturbed

Grazing or cutting
0 Not grazed/cut
1 Low, grazed veg. <5 cm
2 Medium grazed veg. 5-15 cm
3 High, grazed veg. >15 cm
4 Mowing/ road-side cutting
5 Lawn mowing

Clearing
0 No clearing
1 Heavy clearing of large trees
2 Light clearing of large trees
3 Heavy clearing of small trees
4 Light clearing of small trees
5 Heavy clearing of shrubs
6 Light clearing of shrubs

Cleaning Time
00 Current year or season
01 Last year or season
02 Year or season 2
05 Year or season 3-5

Disturbance
0 No disturbance
1 Disturbance by vehicles
2 Disturbance by humans
3 Disturbance by animals
4 Water erosion (indications)
5 Slide erosion (landslide)
6 Careful clearing
7 Heavy clearing
8 Straightening
9 Dredging/digging

Disturbance time
00 Current year or season
01 Last year or season
02 Year or season 2
05 Year or season 3-5

Control question
1 Yes, distance and feature correct
2 Wrong distance – change
3 Incorrect registration - delete!

6.3. FOREST EDGE

Aim

Transition zones (eco-tones) between different biotopes are important environments in the landscape which can sustain a rich biological diversity, due to the mixture of landscape elements, habitats and species. Several factors also work together, among them the composition and structure of the vegetation, direction, moisture level, age, land use and management. Forest edges are important environments for many species that have been suppressed in today's landscape, such as flowering plants, berry trees, insects and other animal groups. Effects on environmental change can often be seen earlier in forest edges than in adjacent non-edge environments. Forest fragmentation leads to an increase in the amount of forest edge in the landscape, which can have negative as well as positive influence on the biological diversity.

The inventory of forest edges aims at estimating the amount of edge environments in the landscape and to describe characteristics that are important for the biological diversity in edge habitats. The method can be used for most types of forest edges and forest edges, including forested shores and forest edges bordering open wetland. However, long, gradual transition zones (over 40 m wide) are not included, for example from open to sparsely forested wetlands or in diffuse tree limits in the mountains. Neither are transitions from open areas to very sparse forest (with less than 30% canopy cover).

Criteria for registration

The definition of a forest edge is based on the difference in vegetation structure between open habitat and forest. The aerial photos are a great help when distinguishing forest edges. NOTE: It is always the actual situation in the field that determines if a forest edge is registered or not.

Requirements for the forest edge:

- The inventory line must cross the reference line of the forest edge (edge tree boundary, definitions below).
- The total width of the edge, including possible shrub belt, must not exceed 40 meters.

Requirements for the open habitat:

- Must be at least 20 m wide, counted from the outer canopy border of the forest mantel (shelter belt) (definitions below). E.g. do not register a forest edge near a road with a road area narrower than 20 m.
- Must be at least 0.1 hectare (i.e. 1000 m^2).
- The height of the dominant tree/shrub layer (referring to cover) may not exceed 5 m. Occasional higher trees can be present. However, trees higher than 5 meters may not exceed 10% canopy cover. When estimating cover of trees, diffuse cover is used. Shrubs are estimated by strict cover. For trees lower than 5 m there are no limits for cover.

Requirements for the ‘normal forest’:

- Must be at least 20 meters wide, counted from the inner canopy border of the forest

mantel (i.e. where the normal forest starts, definitions below). Do not register forest edge for rows of trees.

- Must be at least 0.1 hectare in size (referring to “normal forest’, definitions below).
- Trees and shrubs with a diameter of at least 10cm at breast height must be present.
- The mean height of trees and shrubs must be at least 5 meters.
- The canopy cover of trees and shrubs must be at least 30%.

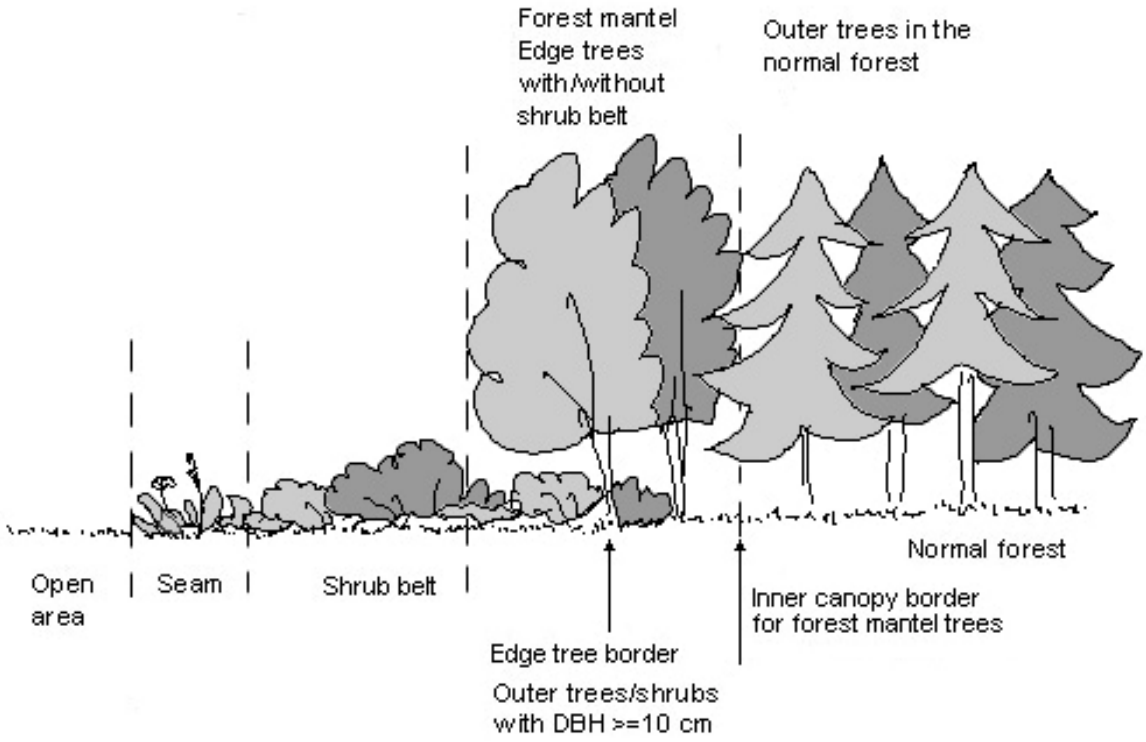


Figure 6.3: Cross section of a well developed forest edge with both shrub belt and forest mantel. Modified after Stierlin et al (1994).

Procedures

- Determine if all criteria for the forest edge are met. NOTE: Make sure that all criteria for ‘open habitat’ and ‘normal forest’ have been met.
- Decide where the inventory line crosses the edge tree border. Use a wooden stick to mark the reference point.
- Register the distance along the inventory line at the reference point in the field computer.
- Register the variables.

Definitions

Herb belt (‘seam’)
A zone dominated by grass, herbs or dwarf-shrubs. Normally the herb belt is located directly outside the shrub belt. Scattered trees and shrubs may occur.

Shrub belt (=outer edge belt)
Distinct zone dominated by shrubs (or shrub-like trees lower than 5 m) within or outside the mantel (Figure 6.3). The shrub belt must be distinctly developed within at least 75% of the 20 m stretch. Cover of shrubs and trees must be at least 30%. The shrub belt is normally lower than 5 meters, but a few stray taller trees or shrubs may occur.

Forest mantel (=inner edge belt, 'shelterbelt')
Zone with trees (often deciduous) that exhibit clear signs of being affected by the proximity to the open habitat. Edge trees often lean outward, often have crooked, one-sided crowns and branches that are larger closer to the edge. Edge trees have a diameter at breast height of at least 10cm, and cover at least 30%.

Edge tree border (= the reference line of the forest edge)
The average location of the outer trees or shrubs with diameter at breast height of at least 10cm, that form the forest edge. Defined as the mid-point between at least two trunks (i.e. the point of germination), at least one on each side of the inventory line.

Reference point for forest edge
The distance where the inventory line crosses the edge tree border.

Outer canopy border for the forest mantel
Refers to the outer border for a more or less connected canopy cover, i.e. the outer part of the tree crowns vertically projected towards the ground. Also referred to as the canopy drip-line.

Inner canopy border for the forest mantel
The canopy cover boundary of the outer trees toward the forest. This border marks the beginning of the 'normal forest'.

Normal forest (core area)
Part of the forest where the trees show no distinct influences from the forest edge, i.e. no fringe effects. The total canopy cover of trees and shrubs must be at least 30%.

Tree edge (trunk fringe)
The forest edge consists of trees and may or may not have a forest mantel. There is no shrub belt, but scattered shrubs may occur. Tree edges are found in new clearings, in grazed areas or in the edges of stands with heavily shading trees.

Shrub fringe
A distinct strip of shrubs or small trees. A well developed shrub belt must cover over 75% of the 20 m stretch of the forest edge in question. A shrub fringe is often dense, spread out and low-growing. The shrub belt is usually lower than 3 meters, but can in some cases be over 5 meters high. Species needing light, such as blackthorn and roses are common.

Mosaic fringe
Different combinations of shrub and tree species that grow in clumps of varied sizes and height. Mosaic fringes can appear in hay-fields or in overgrown pastures with light grazing, where shrubs and trees find their way into the pasture, but will be partly held back by

grazing. Solitary trees may occur.

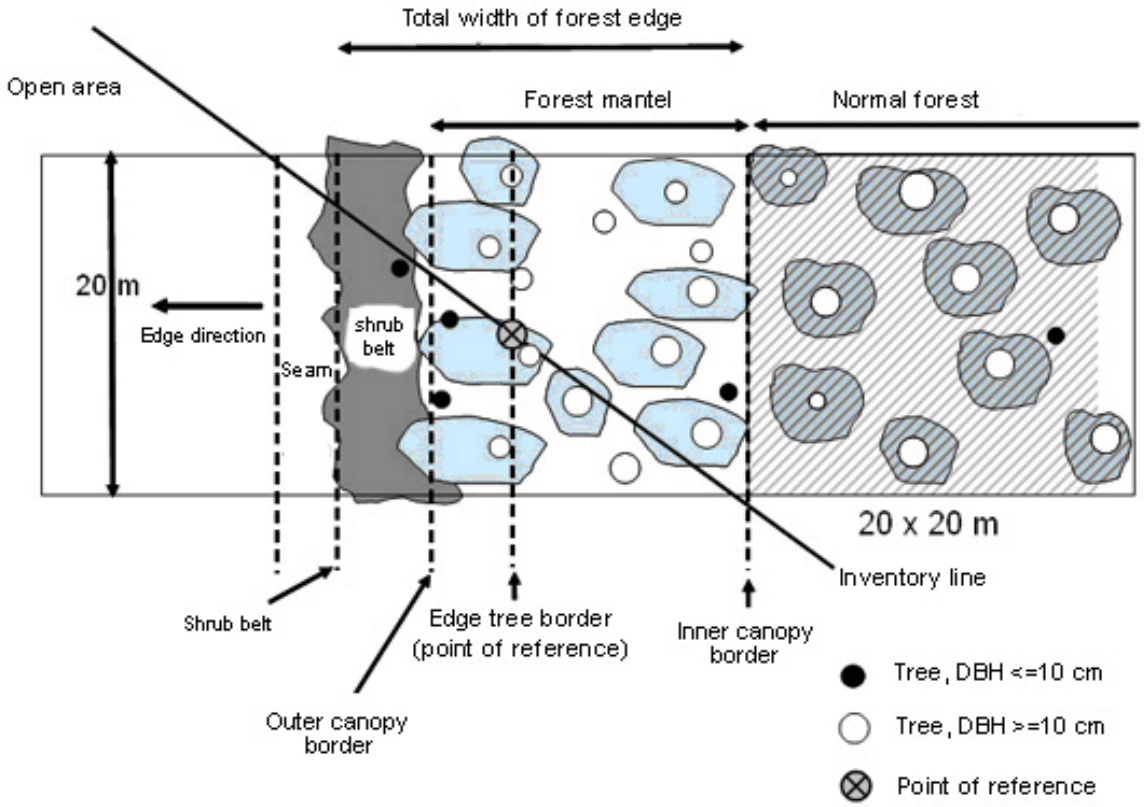


Figure 6.4: Vertical projection of a forest edge with different zones. DBH=diameter at breast height.

The edge is inventoried perpendicular to the length in a 20 m wide zone (Figure 6.4).

Menu Forest Edge - variables

Open Area Type of open area that the forest edge is facing.

01 Clear-cut, trees <0.5 m
02 Clear-cut, saplings 0.5-1.3m
03 Clear-cut, trees >1.3m tall
04 Agricultural field/hay-field
05 Meadow/pasture, managed
06 Abandoned agricultural land
07 Built-up area
08 Substrate ground
09 Wetland
10 Water >20 m wide (between high water lines)
11 Road, road area >20 m wide
12 Cleared path/power line corridor

>20 m wide
13 Forest glade
14 Forest-fire area
15 Bare mountain
16 Other open ground

Edge Age

Time since the edge creation (years since cutting). Only registered for edges in forests habitat. The variable is estimated from the age of the trees and the composition of the vegetation.

00 Age <1 year
02 Age 1-2 years
05 Age 2-5 years
10 Age 5-10 years
25 Age 10-25 years
50 Age 25-50 years
99 Age >50 years

Limitation

When a major linear element (except shore by a lake or ocean) prevents the forest edge to spread. A different type of land use (e.g. grazing or farming) is not considered a limitation. If several elements are present, the most limiting is entered. NOTE: The linear elements should be registered as separate elements if the inventory line crosses their point of reference.

0 No, no linear element
1 Paved road, asphalt, cement, stones
2 Paved road, gravel
3 Utility road
4 Ditch
5 Wall
6 Other fence
7 Water course
8 Other linear element — NOTE: Shores not included.

Forest type

Type of forest in the ‘normal forest’, i.e. inside the forest edge zone. NOTE: The amount of tree species is based on amount of canopy cover (not basal area or number of trunks). Refers to the ‘normal forest’.

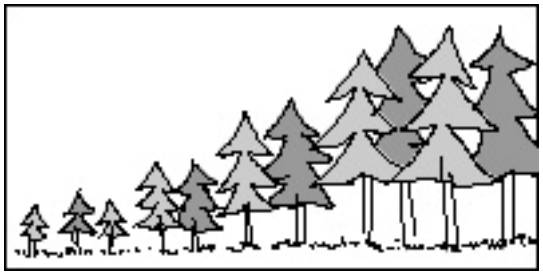
01 Spruce forest — Minimum 70% Norway spruce (*Picea abies*)
02 Pine forest — Minimum 70% Scots pine (*Pinus sylvestris*)
03 *Contorta* forest — Minimum 70% Lodgepole pine (*Pinus contorta*)
04 Mixed coniferous forest — Minimum 70% oniferous trees, maximum 70% of any single species.
05 Mixed forest — 30 to 70% coniferous trees and 30 to 70% deciduous trees.
06 Birch forest — Minimum 70% birch (*Betula sp.*).
07 Other trivial deciduous forest — Minimum 70% trivial deciduous trees, i.e. birch,

	aspen, alder, rowan.
08 Oak forest	Minimum 70% oak (*Quercus* spp.).
09 Beech forest	Minimum 70% beech (*Fagus sylvatica*).
10 Forest with other Temperate deciduous trees	Minimum 70% deciduous trees and over 50% of temperate deciduous trees (ash, elm, lime, linden, maple, hornbeam and wild cherry).
11 Mixed deciduous forest	Minimum 70% deciduous trees and max 50% hardwood (ash, elm, lime, linden, maple, hornbeam and wild cherry).
Canopy Cover Forest % 30-99%	Total cover of trees in the normal forest, i.e. behind the forest mantel. Estimated in a 20 x 20 meter square (Figure 6.4).
Mean Height Forest 050-500 dm	Mean height of the normal forest (chapter 4.5., Land cover). A few stray taller trees may be present in the forest mantel and should not be included. The height must be at least 5 meters. If basal area weighted mean height is over 70 dm, the height is measured as basal area weighted mean height, if not – as arithmetic mean height.
Trees/shrubs Open Habitat % 00-99%	Total cover of trees and shrubs in the open area. Trees and shrubs in the edge belt are not included. Estimate in a 20 m x 20 m area, located outside the actual fringe, i.e. outside shrub belt or forest mantel.
Mean Height Open Habitat 00-50dm	Mean height (arithmetic) of trees/shrubs in the dominant layer (referring to cover) in the open area (20 m x 20 m). If the height is very varied, disregard individual plants lower than 0.5 m. The height may not exceed 5 m. Individual, higher trees that do not belong to the dominating layer are not included.
Width Open Habitat 020-999 m	Shortest distance over open biotope measured from the outer canopy border for forest mantel to the opposite forest edge. Measure at a right angle to the forest edge, i.e. the same direction as the edge direction (see below). Long distances are measured on the field map. Enter “999’ if the distance is more than 500 meters.
Edge direction 000-360 degrees	The facing direction of the edge, i.e. perpendicular to the reference line of the forest edge (Figure 6.4). Average direction of a 20 m stretch.

Edge profile

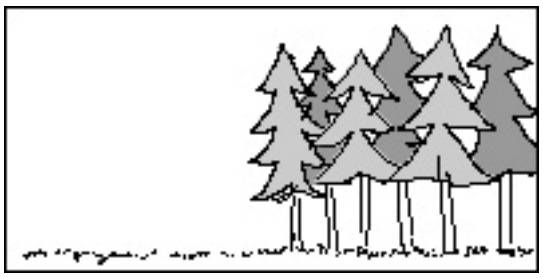
1 Tree edge, gradual

Consists only of trees. More or less continuing transition from small to large trees. Found mostly in mires with growing trees, bog forest and in forest edges in the alpine area. There is no shrub belt or forest mantel.



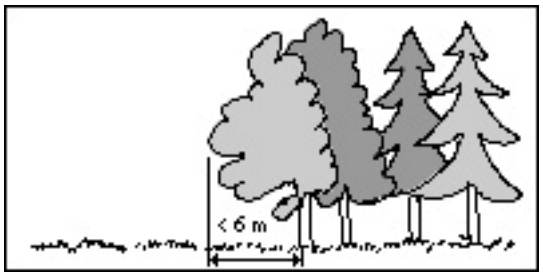
2 Tree edge, no forest mantel

Coniferous or deciduous trees. No shrub belt. Common in a recently clear-felled area.



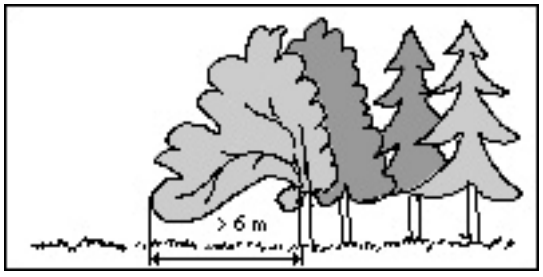
3 Tree edge, abrupt forest mantel

With forest mantel normally consisting of deciduous trees. No shrub belt. The crowns of the edge trees reach less than 6 m from the edge tree border.



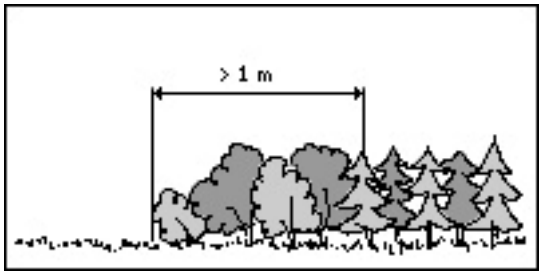
4 Tree edge, extended forest mantel

Same as 3, but the tree crowns extend over into the open ground. No shrub belt. The crowns of the edge trees extend more than 6 m from the edge tree border.



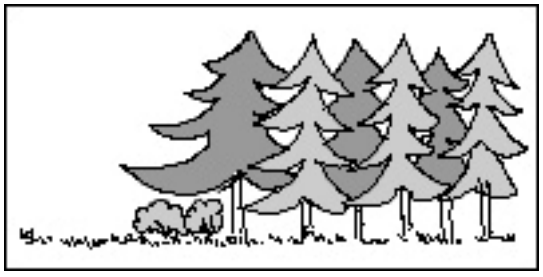
5 Shrub fringe, no forest mantel

With border of shrubs or small trees but no forest mantel. Low growing forest, young forest or low producing forest. A variation of type 2.



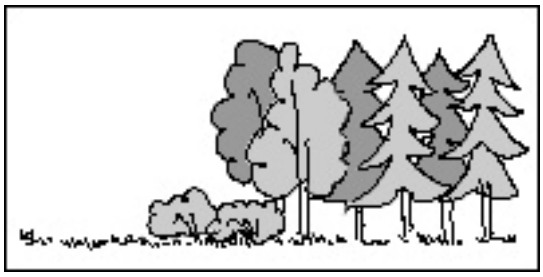
6 Shrub fringe, shrubs under forest mantel

With border of shrubs or small trees clearly under the tree crowns of the forest mantel.



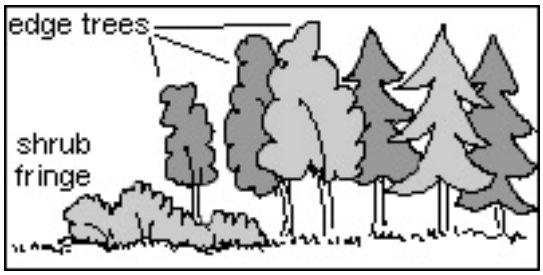
7 Shrub fringe, shrubs in front of forest mantel

With border of shrubs or small trees clearly in front of the tree crowns of the forest mantel. With outer and inner edge belt. Mid-edge belt with large shrubs and small trees is missing.



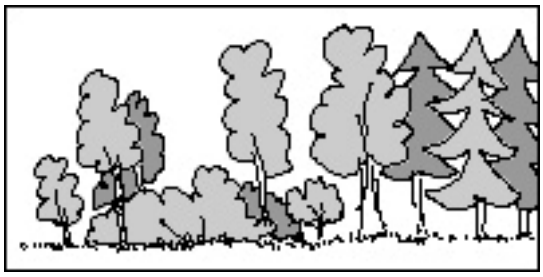
8 Shrub fringe, formed as steps

With border of shrubs or small trees clearly in front of the tree crowns of the forest mantel. A typical case is a well developed fringe with an outer edge belt of shrubs, a mid-edge belt of small trees and shrub-like trees and an inner edge belt with larger trees.



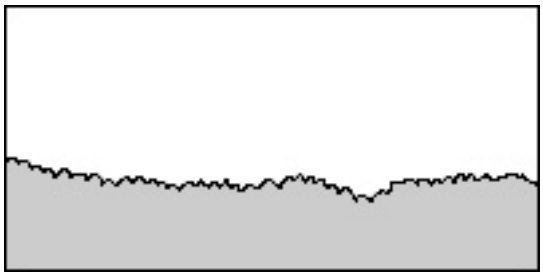
9 Mosaic fringe

A mosaic of different combinations of shrubs and trees, solitary or in groups. Often with glades and spits.



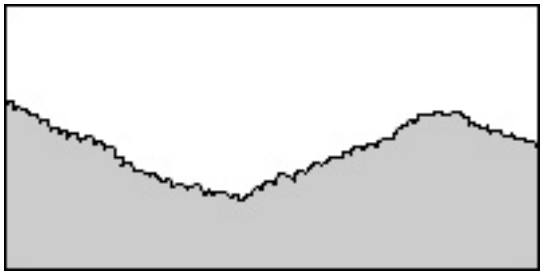
Edge shape

1 Straight - slightly curved edge



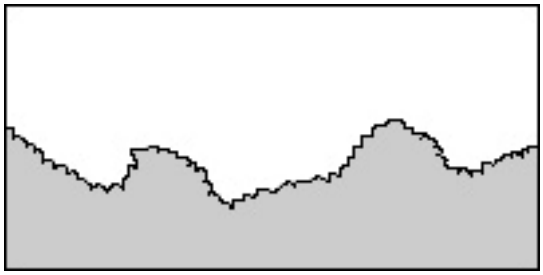
2 Undulating edge

Slightly curved without protruding groups of trees/shrubs, alternatively with an obvious ‘forest corner’.



3 Indented edge

With one or two protruding groups of trees/shrubs, alternatively with two obvious ‘forest corners’.

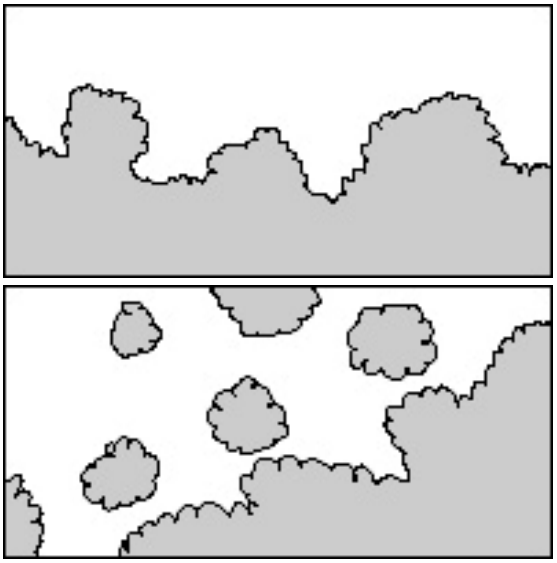


4 Deeply indented edge

With more than two protruding groups of trees/shrubs.

5 Patchy edge

Forest edge with several protruding, isolated trees or groups of trees and shrubs.



Images of edge profile and edge shape modified after Stierlin et al (1994).

The shape of the forest edge is determined along a 50 m stretch, 25 m on each side of the inventory line. Use the aerial photo/field map as support while determining the shape.

Control question

1 Yes, distance and element correct

2 Wrong distance - change

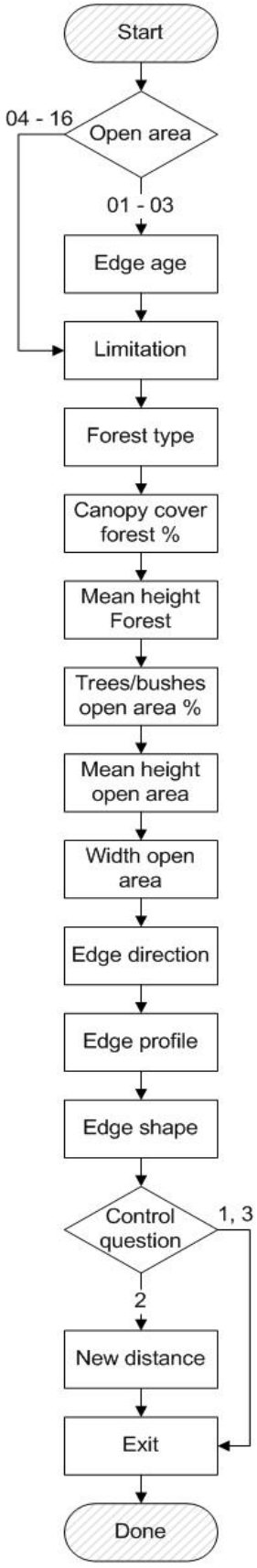
3 Incorrect registration - delete!

New Distance

000-200 m

References

Stierlin, H.R.; Brändli, U.B.; Herold, A.; Zinggeler, J. 1994. Schweizerisches Landesforstinventar: Anleitung für die Feldaufnahmen der Erhebung 1993–1995. Birmensdorf: Eidgenöss. Forsch.anst. Wald Schnee Landsch.



Forest Edge

Open Area
01 Clear-felled area, trees <0.5 m
02 Clear-felled area, forest plants 0.5-1.3 m
03 Clear-felled area, trees >1.3 m
04 Field/hay-field
05 Meadow/pasture, managed
06 Overgrown agricultural land
07 Populated area
08 Substrate ground
09 Wetland
10 Water >20 m wide (between high water lines)
11 Road, road area >20 m wide
12 Cleared path/cable corridor >20 m wide
13 Forest glade
14 Forest-fire area
15 Bare mountain
16 Other open ground

Edge Age
00 Age <1 year
02 Age 1-2 years
05 Age 2-5 years
10 Age 5-10 years
25 Age 10-25 years
50 Age 25-50 years
99 Age >50 years

Limitation
0 No, no linear element
1 Paved road, asphalt, cement, stones
2 Paved road, gravel
3 Utility road
4 Ditch
5 Wall
6 Other fence
7 Water course
8 Other linear element

Type of forest
01 Spruce forest
02 Pine forest
03 *Contorta* forest
04 Mixed coniferous forest
05 Mixed forest
06 Birch forest
07 Other deciduous soft wood
08 Oak forest
09 Beech forest
10 Other deciduous hardwood
11 Mixed deciduous forest

Fringe Profile
1 Tree edge, gradual
2 Tree edge, no forest mantel
3 Tree edge, abrupt forest mantel
4 Tree edge, extended forest mantel
5 Shrub fringe, no forest mantel
6 Shrub fringe, shrubs under forest mantel
7 Shrub fringe, shrubs in front of forest mantel
8 Shrub fringe, formed as steps
9 Mosaic fringe

Edge Shape
1 Straight – slightly curved edge
2 Undulating edge
3 Indented edge
4 Deeply indented edge
5 Patchy edge

6.4. FENCE

Aim

Fences are indicators of land use (e.g. fences around enclosed pastures or private properties), or barriers for dispersal of animals (wildlife fences). Older fences indicate previous land use and are important cultural remains. Certain fences may also provide substrate habitats for different organisms (e.g. lichens and wood-living insects), i.e. stones or dead wood. Stone walls can provide nesting sites and protection for larger animals, e.g. reptiles and certain birds.

Criteria for registration

- All fences intersected by the inventory line are registered, even if they are partly ruined or broken and no longer function as a fence. For practical reasons, only fences higher than 30cm and longer than 4 m are registered.
- Fences along old animal paths are registered in the same way as other fences.
- A fence is registered every time the inventory line intersects its point of reference, even if it is the same fence winding along the line, and regardless of how many times this happens (Figure 5.1).
- Crash barriers along roads are not considered fences.
- Fences with a main purpose of demarcating private property are not registered. However, fences around housing areas (noise barriers etc.), cemeteries, schools and day-care facilities, water purification plants, military areas, etc. are registered.

Procedures

- Determine type, size, condition and function. The variables represent averages for a zone of 5 meters on each side of the intersection point measured lengthwise along the fence (Figure 5.1).
- For stone walls or wooden fences, register level of sun exposure and clearing, if any.
- For stone walls, register vegetation cover and deposits, if any.

Definitions

Electric fence
Electric fences either have straight metal threads or thin metal treads woven into nylon bands. The fence posts may be of different materials (wood, plastic) but the thread is always attached to isolators, which are often made of plastic.

Barbed wire fence
Barbed wire fences are often attached to wooden fence posts to hold the wire taut. Occasional barbed wire on wooden fences or grid/wire-fences, or an electric wire or wooden crossbar on a barbed wire fence, is considered a secondary part of the fence and is not registered.

Wooden fence
Older types of wooden fences are made from whole or split poles. Often not nailed, but

slanted (or perhaps braided or tied). Modern wooden fences are mostly made from sawed and nailed boards.

Stone wall

Stone walls look different depending on type. Limestone walls are often made of angular stones, while older stonewalls in moraine landscape (for example in Småland) often consist of rounded stones. Stone walls include both plain, stacked walls, and more complex stone fences. However, a modern wall with cut stones and mortar is registered as ‘other wall’.

Menu Fence - variables

Height 00-99 dm	Height from the ground, excluding fence posts.
Type	
1 Wire/net fence	Wire or net fence, often to keep grazing animals in (so called sheep fence), or wildlife fence.
2 Barbed wire fence	Barbed wire fence (possible with one or more electric wires).
3 Electric fence	Fence with electric wire (possibly with crossbar made of wood).
4 Metal fence	Welded metal fence, but not wire/net fence.
5 Wooden rail fence	Nailed wooden fence (mostly sawed boards).
6 Plank	Solid wall, most often constructed from wood or metal.
7 Wooden fence - old type	Traditional wooden fence made from whole or split poles. Often not nailed, but slanted or sometimes braided.
8 Stone wall - old type	Simple type of stone wall or a complex row of stones of traditional type. Registered only if the stones are clearly stacked and the height is over 30cm.
9 Other wall	Other type of wall, e.g. brick wall, often with mortar.
Square size 01-99cm	Smallest width of mesh in a wire/net fence.
Width 00-99 dm	Average width of the fence in dm, measured perpendicular to the length. Stated for stone walls and other walls.
Stone shape	
1 Rounded	Naturally shaped, from e.g. moraine or coarse ridge material.
2 Cut	Cut or quarried stone, or crystalline or stratified type

	of rock, such as lime stone or shale.
3 Angular (blast stone)	Irregular, angular shape (blasted) of all dimensions.

In the following cover estimations, BF indicates blank format.

Field total 00-99%BF	Total cover of field layer (ferns, herbs, dwarf shrubs and graminids) growing directly on the wall.
Bryophytes 00-99%BF	Total cover of mosses and liverworts growing directly on the wall
Lichens 00-99%BF	Total cover of fruticose and foliose lichens growing directly on the wall.
Shrubs 00-99%BF	Total cover of shrubs and shrubs over the wall.
Trees 00-99%BF	Total cover of trees over the wall.
Sun exposure	The actual shading of the fence. Stated for wooden fences and stone walls. Estimate average exposure on a sunny day between 11 am and 3 pm (daylight savings time).
1 Complete sun exposure	Sun exposure of over 50% of the fence.
2 Partial sun exposure	Sun exposure of 5 - 50% of the fence.
3 Complete shade	Sun exposure of less than 5% of the fence.
Activities 0 No, no activities 1 Yes, cutting/clearing/ depositions/accumulation	
Clearing 0 No cutting/clearing 1 Heavy clearing of large trees 2 Light clearing of large trees 3 Heavy clearing of small	NOTE: register cutting or clearing for a 2 m wide zone on each side of the fence. If both small and large trees are removed, the dominant category (referring to cover) is stated. Small trees are defined by having a stump diameter of less than 10cm. Heavy clearing requires removal of more than 50% of all trees/shrubs, while light clearing calls for removal of 5 - 50%.

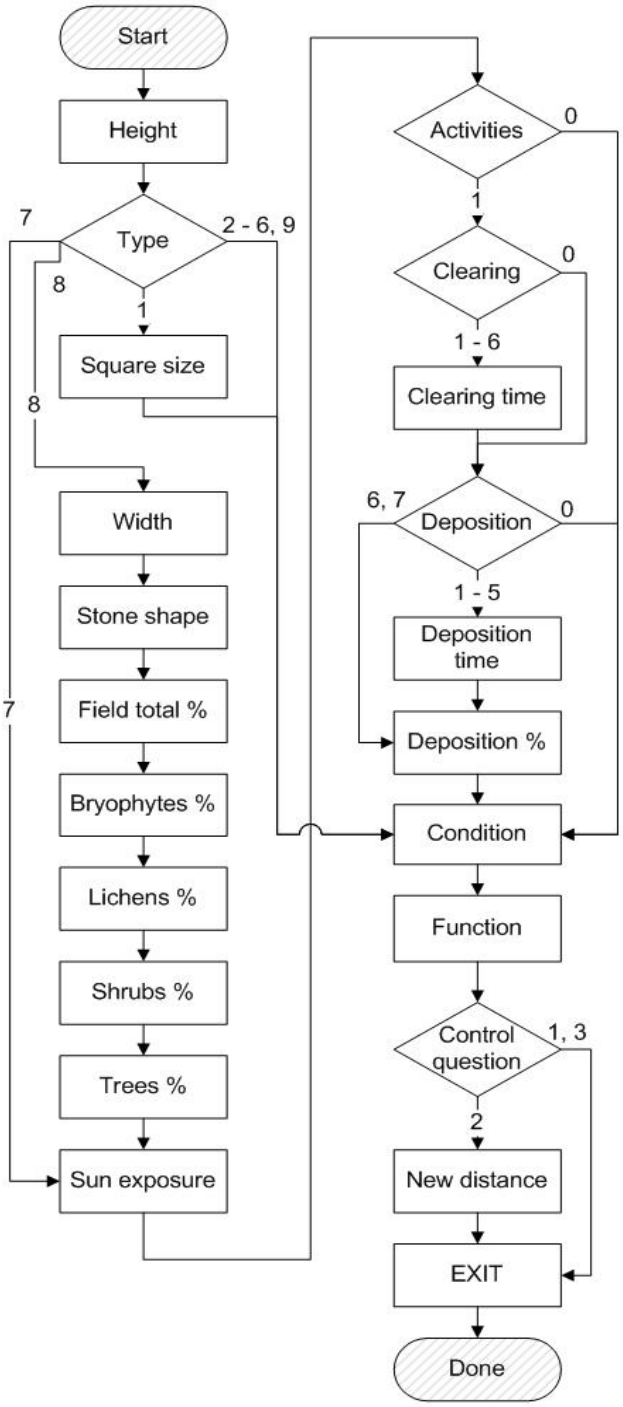
trees
4 Light clearing of small trees
5 Heavy clearing of shrubs
6 Light clearing of shrubs

Clearing time	Time of cutting or clearing.
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Deposition	Type of deposits or accumulation.
0 No deposition/accumulation	
1 Rock	Recent deposits of rocks, e.g. from blasting or building.
2 Digging deposits	Soil etc., deposited after digging.
3 Building material, incl. Bricks	Leftovers from building sites or demolition of buildings, e.g. plaster, cement or wood.
4 Cutting/clearing deposits	Large piles of branches, brush etc., leftover from cutting or clearing.
5 Other deposition, misc.	Mix of the above and/or other kinds of waste (discarded animal feed, leftover materials from industrial activity, slag, ashes, etc.).
6 Natural accum, fine matter	Natural accumulation of fine matter such as sand fractions or smaller (grain size, less than 2 mm). Thickness of accumulated layer least 5cm, cover more than 5% of the area.
7 Natural accum, course matter	See above. Coarse material refers to gravel and larger fractions (over 2 mm grain size).

Deposition time	Time of deposit.
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Deposition %	Cover of deposits or accumulation on the element.
000-100%	
Condition	The condition of the fencing.
1 In use, functioning	Functioning fence that is maintained regularly, that functions, or can easily regain function, as a fence, e.g. around an enclosed pasture or along a road.
2 Not in use, dilapidated/ overgrown	Dilapidated fence, not maintained for a long period of time (loose or fallen wires, holes, fallen rocks etc.), but may be restored, albeit with great effort.
3 Completely or partially unusable.	A fence so dilapidated that it is beyond repair, in pieces or completely ruined.
Function	
1 Fence for domesticated animals	Enclosure to hold in grazing cows, sheep, horses, etc.
2 Fence for deer, etc.	Enclosure for deer and other wild animals.
3 Reindeer fence	Reindeer enclosure for rounding up reindeer etc.
4 Wildlife fence beside road	Fence that is erected to keep animals away from the road. Parts of enclosures not included.
5 Fence in built-up area	Hedges, fences, walls etc. that enclose built-up areas, industrial parks and other building sites.
6 Noise barrier	Planks constructed for noise protection in built-up areas, mostly along roads.
7 Other, unknown function	
Control question	
1 Yes, distance and element correct	
2 Wrong distance - change	
3 Incorrect registration - delete!	
New Distance	
000-200 m	



Fence

Type
1 Wire/net fence
2 Barbed wire fence
3 Electric fence
4 Metal fence
5 Wooden rail fence
6 Plank
7 Wooden fence - old type
8 Stone wall - old type
9 Other wall

Stone shape
1 Rounded
2 Cut
3 Angular (blast stone)

Sun exposure
1 Complete sun exposure
2 Partial sun exposure
3 Complete shade

Activities
0 No, no activities
1 Yes, cutting/clearing/dep/acc

Clearing
0 No cutting/clearing
1 Heavy clearing of largetrees
2 Light clearing of large trees
3 Heavy clearing of small trees
4 Light clearing of small trees
5 Heavy clearing of shrubs
6 Light clearing of shrubs

Clearing time
00 Current year or season
01 Last year or season
02 Year or season 2
05 Year or season 3-5

Deposition
0 No deposition/accumulation
1 Rock
2 Digging deposits
3 Building material, incl. Bricks
4 Cutting/clearing deposits
5 Other deposition, misc.
6 Natural accum, fine matter
7 Natural accum, course matter

Deposition time
00 Current year or season
01 Last year or season
02 Year or season 2
05 Year or season 3-5

Condition
1 In use, functioning
2 Not in use, dilapidated/ overgrown
3 Completely or partially unusable

Function
1 Fence for domesticated animals
2 Fence for deer, etc.
3 Reindeer fence
4 Wildlife fence beside road
5 Fence in built-up area
6 Noise barrier
7 Other, unknown function

6.5. DITCH/WATER COURSE

Aim

Shallow water environments in ditches and water courses contain great biological diversity and add variety to the landscape. Running water creates variations in substrate, oxygen content etc. Ditches provide habitats, but are also signs of de-watering that may influence nearby wetlands (mires, marshy forest etc.) in a negative way. The quality and influence of ditches/water courses can vary widely.

Criteria for registering

- All elements intersected by the inventory line are registered, if the stream channel is at least 2 dm wide (Figure 6.5). However, variables for detailed description of water courses are only estimated for elements at least 5 dm wide.
- Ditches are included even if the stream channel is narrower or missing, if the total depth (including surrounding banks) exceeds 30cm measured from the level of the lowest bank (Figure 6.5). This means that the width of the ditch furrow in a registered ditch sometimes can be zero (i.e. there is no stream channel).
- A ditch/water course may not be wider than 6 meters (including shore zones). If the water course is wider, the shores are described as separate linear elements, Shores.
- A ditch/water course is registered every time the inventory line intersects its point of reference, even if it is the same ditch/water course winding along the line, and regardless of how many times this happens (Figure 5.1).
- For water courses (and shores), two separate zones are described. One is the water covered zone, where aquatic plants and water variables are registered. The other is the temporarily dry shore zone (Figure 6.5), which is described with the same variables as vegetation strips. NOTE: For ditches/water courses the shore zone is described as an average of both sides of the water course. If the entire element is temporarily dry, the shore variables are estimated for the entire ditch/water course.
- The width of the temporarily dry shore zone is always measured, but in order to register other descriptive variables, the average width of the shore zone must be at least 1 m. NOTE: In ditches/water courses (with a width of at most 6 m) the width of the shore zone (on either side) can never exceed 3 m.

Procedures

- Determine type of ditch/water course
- For a ditch, state type of connection to surrounding vegetations strip (ditch within or in close proximity to road verge or ditch-bank), if any.
- For ditches, measure total depth and total width, including surrounding ditch-banks or possible (part of) road verges (Figure 6.5). NOTE: The depth of a ditch is always measured from the lowest bank.
- Describe the water environment (water variables, shore type, aquatic plants etc.). Estimate aquatic plants in a ditch or water course for the entire water covered surface (i.e. the width of the water surface).
- Demarcate and register variables and activities if the shore zone is at least 1 meter wide, or is the ditch/water course is temporarily dry.

Definitions

Ditches are constructed to drain water and are therefore usually straight, with steep, straight edges. They are often bordered by ditch banks which are a part of the total depth, but often not directly affected by water. The total depth and the total width of the stream channel and banks are signs of the draining function.

Water courses occur naturally. They mostly run in their original, naturally formed course, but can also be straightened or cleared.

Demarcation of the shore zone

Shores and ditches/water courses contain two parts; a flooding zone where the water level regularly changes between flooded and dry, and an area permanently covered with water.

The ***shore zone*** is the temporarily dry flooding zone between the actual water level at the time of inventory and the high water mark. The flooding zone actually refers to the zone all the way down to the mid-low water level, which is difficult to see and is therefore not used for practical reasons. NOTE: A water element is always demarcated by the high water mark, due to the fact that it is the most stable and functionally most important boundary. The alternative would result in the width of the water course being strongly affected by the current water level, which would be much harder to interpret. If the water course is temporarily dry, the dry stream channel is described in the same way as shore zones in general.

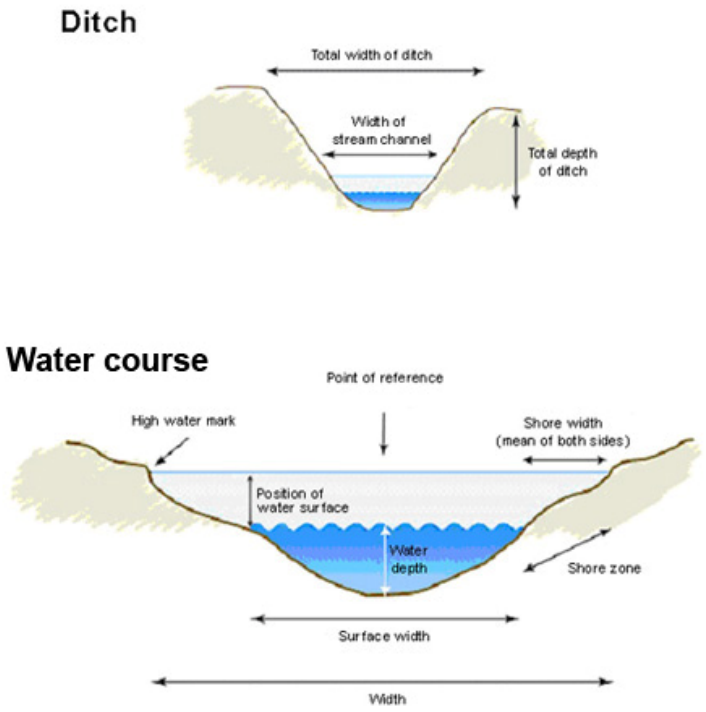


Figure 6.5: Description of reference lines and described zones in ditches and water courses.

The ***high water mark*** refers to the mid-high water mark during a normal year, which corresponds to the upper limit for the part of the shore that is obviously affected by regular flooding (Figure 6.5). The high water mark can be defined as:

- The upper boundary for high *Carex* and rush-vegetation (along protected shores) as well as *Glyceria maxima***,** *Equisetum fluviatile***,** bulrush (*Typha latifolia*) etc.
- The upper boundary for exposed, eroded ground substrate (from waves and ice-chafing, e.g. along exposed shores). Block shores also included. There may also be drift-banks of seaweed etc. The exposed substrate is often covered with new sediment or mud. Exceptions are sand dunes affected by wind, where bare sand can be found well above the high water mark due to wind erosion.
- The lower boundary for most dwarf shrubs, lichens, shrubs and trees, most obvious in such species as blueberry, spruce, reindeer lichens etc. Exceptions are e.g. bog-myrtle (*Myrica gale*), alder (*Alnus* sp.) and *Salix* species that may grow in the shore zone along protected shores.

Connection

In order to avoid double registration of field and bottom layer variables on ditch-banks, their connection to surrounding vegetation strips is stated (Figure 6.6). In an overlapping ditch, the banks coincide with the vegetation strip.

A. The ditch-banks are between 1 and 10 m wide and differ substantially from the surroundings. The banks can be described together if the vegetation is similar and the stream channel is not significantly different.

   The reason for allowing joint description of the banks is to save time during inventory when the banks are very similar. The stream channel is described first and in order to avoid double registration it is ignored while describing the banks. Thus, the width of the vegetation strip refers to the *sum of the width of the banks, except the stream channel*. The smallest width when registering a linear element is 1m, even if two ditch-banks are combined.

B. If the ditch-banks or road slopes are markedly different in vegetation, maintenance etc., they are registered as separate vegetation strips, and the ditch is then counted as connected to the vegetation strips.

   It is reasonable to always register the banks as separate elements in wider ditches, where it is difficult to get an overview of both banks at the same time. A rule of thumb is to always register the banks separately when the stream channel is wider than 1 m. If unsure, register the banks as two separate elements.

C. If vegetation strips are missing, or if they are too narrow to be registered as linear elements (narrower than 1 meter), the ditch is considered as being separate.

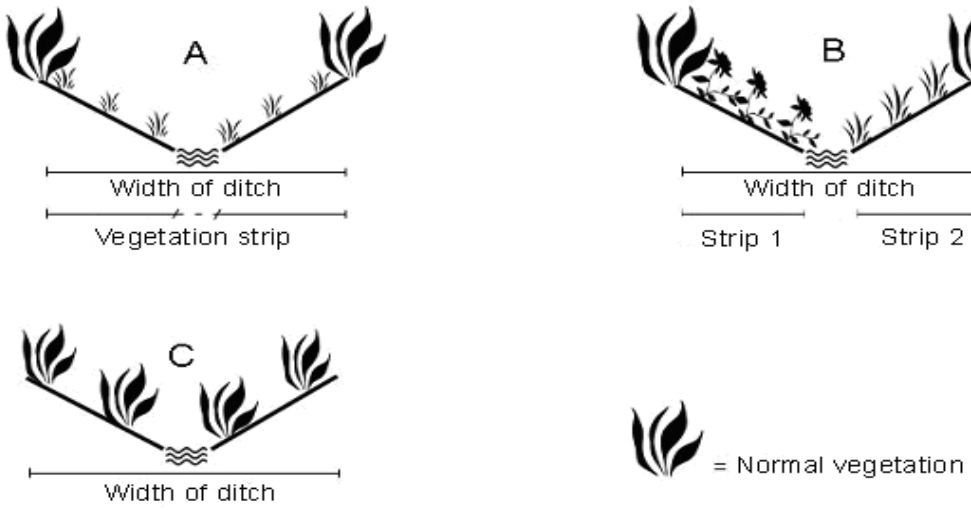


Figure 6.6: Schematic illustration of connection of ditch-banks to vegetation strips.
A) Overlapping, B) Connected, C) Separate.

Menu Ditch/water course - variables

Type

1 Ditch	Excavated ditch constructed to convey water, with or without stream channel.
2 Straightened w-way/ canal <= 6 m	Water course with clear signs of straightening by digging. Straight, steep banks even in shallow areas, possibly with dikes.
3 Natural water course <= 6 m	Often winding and varied flow with shallow banks. Water flow and substrate may vary.

In mire?	Shoreline bordering wetland with peat at least 30cm deep and at least 1 m wide, often with peat as bottom substrate.
0 No, not in mire	The shore does not border wetland with peat.
1 Shore in mire – lawn or carpet	The shore borders mire dominated by lawn or carpet (chapter 4.9), possibly with elements of or other types of wetland.
2 Shore in reed swamp	The shore borders wetland (often called marshy meadow) with over 70% graminoids and/or graminid litter.

Reed shore?

0 No, not dominated by reed/sedge	Reeds or sedges missing or scarce, with little or no litter. The boundary between shore and water and the bottom layer of the shore zone or ground surface is visible.
1 Yes, reed/sedge dominated	Substrate type not discernable since the shore and inner water surface is dominated by tall graminoids, e.g. reed, reed-sedge, bulrush or *Glyceria maxima*, often with significant amounts of graminoid litter. The boundary between the shore zone and water surface is obscured.

Type of bottom

1 Muddy bottom/muddy shore	The water-covered bottom is dominated by a layer of mud (fine sediment with high organic content) which has formed on the site. The mud must be at least several cm thick, and underlying structures (branches, rocks) are totally concealed. Most often found at different types of sheltered shores on solid ground, with a narrow or non-existent shore zone (not eroded) with moderate or weak water fluctuation.
2 Sandy shore/fine sediment	The water-covered bottom (possibly even the shore zone) is covered with sand, silt and other fine sediments, mainly non-organic. Found at sheltered shores of different types, also shores with occasional stone blocks or shores in close proximity to sand dunes.

3 Stone/gravel shore	The water-covered bottom (possibly even the shore zone) is covered to a large part with stones and gravel. Often found at changing water levels, medium to strong water flow or obvious wave influece. Occasional stones or small amounts of sediment or other fine substrates may be present.
4 Boulder shore	Shore zone dominated by boulders, maybe also some isolated cliffs and a certain amount of stones (total area of stone/bounder/cliff over 50%), but not too much mud or sand/fine sediments.
5 Cliff shore	Shore dominated by water-exposed cliffs (over 70%) that often project into the water, sometimes in combination with stony/gravelly bottom or isolated boulders, but not too much mud or sand/fine sediments.
6 Other firm ground shore (till etc.)	Other shore on different kinds of solid ground without significant amount of fine substrate, gravel, or boulders/cliffs. This is a common type in relatively shelterd environments (no pronounced water erosion) or with little sedimentation of mud or other fine sediments. This class is stated when the bottom type is hard to see or distinguish.
7 Man-made shore	Man-made shore with quays (cement/stone), longitudinal piers or pavement without natural shore zone, or where the shore zone is hidden.
Connection 0 Separate 1 Connected 2 Overlapping	State connection type for ditches that are situated by or in a vegetation strip, i.e. bank or hillside (Figure 6.6).
Depth of Ditch 01-50 dm	Total depth of the entire ditch, measured from the lowest ditch-bank at right angle to the bottom (Figure 6.5).
Width of Ditch 01-99 dm	Horizontal width of the entire ditch, including banks. If the banks are of different height, measure to the point on the higher bank that corresponds to the height of the lower bank.
Width of Stream Channel 00-60 dm	The horizontal width of the stream channel perpendicular to its length, i.e. the zone with water-affected ground or vegetation, often sparsely covered with vegetation, with bared substrate, and/or species that favor damp environments. NOTE: Corresponds to the width of the water course between the high water marks.

Width of Water Surface
00-60 dm

Width of the water surface, the water covered zone (which together with the shore zone constitutes the stream channel).

Position of Water Surface
00-99 dm

The vertical distance (height) between the high water mark and the water surface. If completely dried out, measure to the deepest point at the bottom of the stream channel.

Water Level

0 Temporarily dry	The entire water course is temporarily dry but the ground and vegetation is still clearly affected by water. This refers to all cases where the 10 m stretch is dried out.
1 Low water-level	The water-level is clearly lower than normal with a distinct, sometimes relatively wide shore zone.
2 Normal water-level	The water-level is normal. In bodies of water with a very stable water-level this often coincides with the high water mark, but in other cases a dry shore zone is present.
3 High water-level	The water-level is higher than normal and the actual water mark is close to the high water mark.
4 Extremely high water	Unusually high water where the water covers terrestrial vegetation. The water reaches outside the boundary of the water course, i.e. above the high water mark.

Water Depth
00-20 dm
21: >20 dm

Estimated deepest water at the time of inventory. If the depth exceeds 20 dm, enter ‘21’.

Flow
0 Still water
1 Calm <0.2 m/s
2 Weak flowing - laminar
3 Flowing - turbulent
4 Torrential >0.7 m/s

The average speed of the water in the 10 m stretch. If needed, measure the speed with a small object (pine cone, short stick). If the water flows calmly and with even speed, measure a shorter distance. Turbulent water includes whirlpools while torrential water is foaming.

Aquatic Plants	Opens menu **Aquatic Plants**

Menu Aquatic Plants - variables

Cover of aquatic plants within the area defined by the width of the water surface. Species list and definitions in appendix 14.

Include only plants that are rooted in the water in ‘other helophytes’. However, do

not try to separate individual plants of the same species that grow in the shore zone from the ones standing in water. In these cases, estimate the vertical cover (as usual) over the water surface. If unsure if a species is considered terrestrial or water-living, include it in the water-living plants.

Menu Ditch/water course, cont.

Shore width
00-30 dm

The area affected by flooding; the temporarily dry shore zone between the actual water level and the high water level. Measure the width as an average for the 10 m stretch. NOTE: Average for both sides of the stream channel, i.e. max 30 dm. NOTE: Make sure that the width of the stream channel is the sum of the double shore width and the width of the water surface. Cover variables are given for shore with a width of at least 10 dm.

For the following cover estimations, BF indicates blank format.

Broad-leaved herbs %
00-99%BF

Cover of herbs in the shore zone. Last year's litter not included.

Graminoids %
00-99%BF

Cover of graminoids (grass, sedge, rush and bulrush) in the shore zone. Graminid litter not included.

Gram litter %
00-99%BF

Cover of graminoid litter (last year's litter of grass, sedge, rush and bulrush) in the shore zone.

Shrubs %
00-99%BF

Total cover of shrubs and shrubs over the ditch/water course (i.e. stream channel).

Trees %
00-99%BF

Total cover of trees over the ditch/water course (i.e. stream channel).

Clear-cutting?
0 No, no cutting within 40 m
1 Yes, cutting within 40 m

Clear-cut forest area (average height of new growth lower than 1.3 m) within 40 meters from the high water mark.

Distance Cutting
00-40 m

Distance from the high water mark to the clear-cut forest area (up to 40 m).

Activities

0 No, no activities

1 Yes, managed/ cut/ cleared/ disturbed/ depositions

Grazing or Cutting

0 Not grazed or cut

1 Low grazed vegetation <5cm

2 Medium grazed vegetation 5-15cm

3 Tall grazed vegetation >15cm

4 Mowing/road-side cutting

5 Lawn Mowing

If the vegetation is grazed, the average height of vegetation in the field layer is stated (Figure 4.7). Mowed or cut grass is only registered if done recently (i.e. current season). Estimate type of management for the entire ditch/water course, even if it is not evident at the intersection point. Also enter appropriate form of Clearing if shrubs or small trees have been cleared in connection with cutting.

Clearing

0 No clearing

1 Heavy clearing of large trees

2 Light clearing of large trees

3 Heavy clearing of small trees

4 Light clearing of small trees

5 Heavy clearing of shrubs

6 Light clearing of shrubs

Cutting or clearing of the vegetation strip. This includes all removal of trees or shrubs regardless of method (also including road-side cutting that affect woody plants). If both small and large trees are removed, the dominant category (referring to cover) is stated. Small trees are defined by having a stump diameter of less than 10cm. Heavy clearing requires removal of more than 50% of all trees/shrubs, while light clearing calls for removal of 5 - 50%.

Clearing Time

00 Current year or season

01 Last year or season

02 Year or season 2

05 Year or season 3-5

Time of clearing.

Disturbance

0 No disturbance

1 Disturbance by vehicles

Type of disturbance of the vegetation strip.

E.g. cars, snow-mobiles or tractors.

2 Disturbance by humans	Human trampling.
3 Disturbance by animals	Trampling by domestic or wild animals, including reindeer.
4 Water erosion (indications)	Erosion caused by running water.
5 Slide erosion (landslide)	Ground disturbed by slide, steep banks etc. slide because of indirect water effects.
6 Careful clearing	Clearing (mainly in ditches) where the vegetation has been scraped away to keep water flowing freely and maintain draining.
7 Heavy clearing	Heavy clearing where the top soil layer has been scraped away, often affecting the entire ditch embankment.
8 Straightening	Straightening of a water course.
9 Dredging/digging	Digging that removes the substrate and vegetation on the bottom of a body of water (mainly along shores) to increase water surface and depth.

Disturbance time	Time of ground disturbance.
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Disturbance %	Cover of ground disturbance.
000-100%	

Deposition	Type of deposit or accumulation.
0 No deposition/accumulation	
1 Rock	Recent deposits of rocks, e.g. from blasting or building.
2 Digging deposits	Soil etc., deposited after digging.
3 Building material, incl. Bricks	Leftovers from building sites or demolition of buildings, e.g. plaster, cement or wood.
4 Cutting/clearing deposits	Large piles of branches, brush etc., leftover from cutting or clearing.
5 Other deposition, misc.	Mix of the above and/or other kinds of waste (discarded animal feed, leftover materials from industrial activity, slag, ashes, etc.).

6 Natural accum, fine matter	Natural accumulation of fine matter such as sand fractions or smaller (grain size, less than 2 mm). Thickness of accumulated layer least 5cm, cover more than 5% of the area.
7 Natural accum, course matter	See above. Coarse material refers to gravel and larger fractions (over 2 mm grain size).

Deposition time — Time of deposits

00 Current year or season

01 Last year or season

02 Year or season 2

05 Year or season 3-5

Deposition % — Cover of deposit or accumulation.

000-100%

Control question

1 Yes, distance and element correct

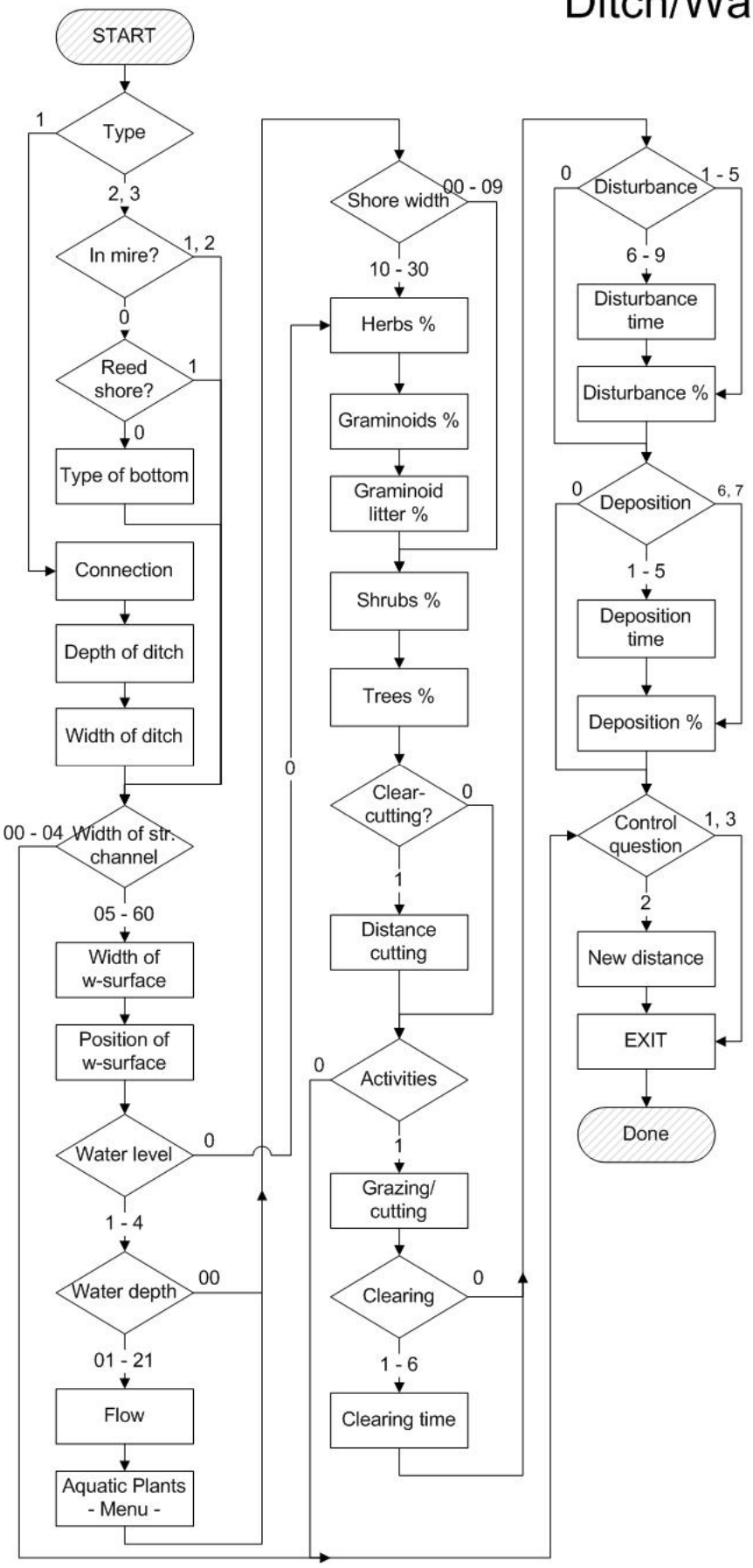
2 Wrong distance - change

3 Incorrect registration - delete!

New Distance

000-200 m

Ditch/Water course



Type
1 Ditch
2 Straightened w-course/ canal <= 6 m
3 Natural water course <= 6 m

Type of bottom
1 Mud bottom/mud shore
2 Sandy shore/fine sediment
3 Rock/gravel shore
4 Block shore
5 Cliff shore
6 Other firm ground shore (till etc.)
7 Man-made shore

Connection
0 Separate
1 Connected
2 Overlapping

Water level
0 Temporarily dry
1 Low water level
2 Normal water level
3 High water level
4 Extremely high water

Flow
0 Still water
1 Calm <0.2 m/s
2 Weak flowing – laminar
3 Flowing – turbulent
4 Torrential >0.7 m/s

Clear-cutting?
0 No, no cutting within 40 m
1 Yes, cutting within 40 m

Activities
0 No activities
1 Yes, managed/cut/cleared/dist./dep.

Grazing or cutting
0 Not grazed or cut
1 Low grazed veg. <5 cm
2 Medium grazed veg 5-15 cm
3 Tall grazed veg >15 cm
4 Mowing/road-side cutting
5 Lawn mowing

Clearing
0 No clearing
1 Heavy clearing of large trees
2 Light clearing of large trees
3 Heavy clearing of small trees
4 Light clearing of small trees
5 Heavy clearing of shrubs
6 Light clearing of shrubs

Disturbance
0 No disturbance
1 Disturbance by vehicles
2 Disturbance by humans
3 Disturbance by animals
4 Water erosion (indications)
5 Slide erosion (landslide)
6 Careful clearing
7 Heavy clearing
8 Straightening
9 Dredging/digging

Deposition
0 No deposition/accumulation
1 Rock
2 Digging deposits
3 Building material, incl. Bricks
4 Cutting/clearing deposits
5 Other deposition, misc.
6 Natural accum, fine matter
7 Natural accum, course matter

6.6. SHORE

Aim

The shore is represented by a flood zone where the changing water level in conjunction with environments of shallow water creates good conditions for specially adapted species and great species diversity. The natural value of the shore is influenced by nutritional content of the water and the ground, waves, wind, and saline influence, as well as shading by trees and shrubs in the shore zone. Grazing (and previous hay-making) creates riparian meadows which are important habitats for many species of birds.

Criteria for registration

- A shore is registered every time the inventory line intersects its point of reference (the high water mark), even if it is the same shore winding along the line, and regardless of how many times this happens (Figure 5.1).
- Register all shores where the distance to the other opposite shore is farther than 6 m, for example wide water courses and straits, or where the body of water exceeds 0.05 hectares.
- The shore zone, i.e. the temporarily dry zone between the high water mark and the actual water level at the time of inventory, is described in detail if it is at least 1 meter wide.
- The water environment (water variables and possible water vegetation) is described for all shores. Register aquatic plants in a 3 x 10 m area along the actual water level (Figure 6.7).

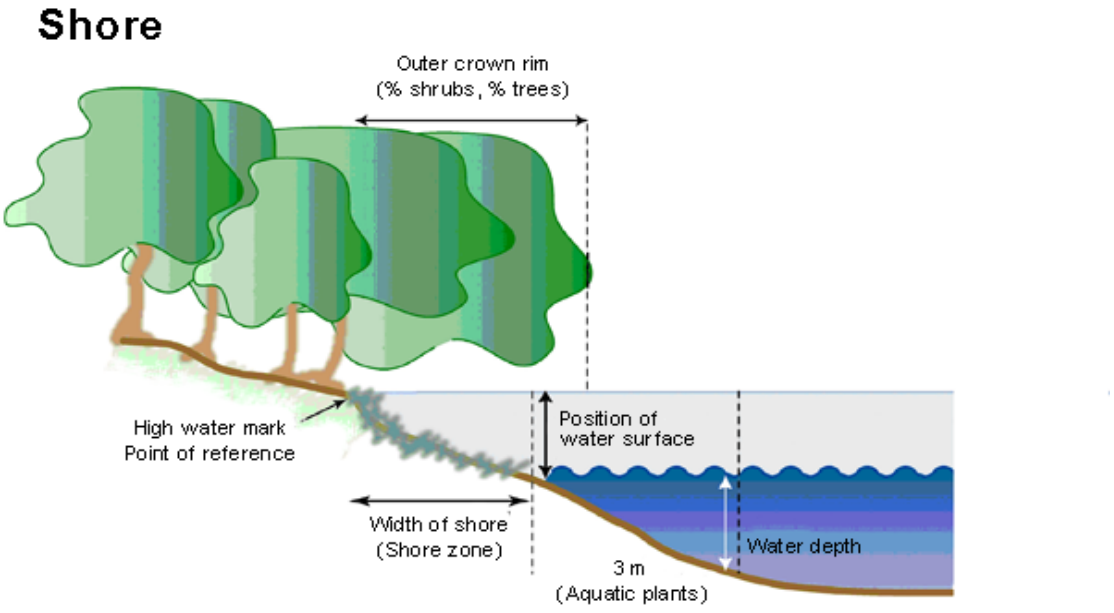


Figure 6.7. Reference line, zones and dimensions at shore-lines.

Procedures

- Determine type of shore, water depth, flow speed, etc.
- State the amount of aquatic plants and type of shore. Aquatic plants are registered 3 m from the actual level.
- Demarcate the shore zone and register variables and activities for the shore zone, if it is at least 1 m wide. NOTE: Don't forget to register a forest edge at the shore, if relevant.
- If the field inventory along the line must be interrupted, register an inventory boundary at the same distance along the line as the shore and switch to map inventory. If field inventory can continue, there is no need to register an inventory boundary.

Definitions

The shore zone is the temporarily dry flood zone between actual water level at the time of inventory and the average high water mark for a normal year (definitions, see Ditch/water course, chapter 6.5). By definition, the flood zone reaches all the way to the average low water mark, but this mark is difficult to discern and is therefore not used for practical reasons. The aquatic vegetation is registered up to 3 m out from the actual water level. The vegetation is divided into groups on the basis of phenotype, and some species/groups of species are registered individually. NOTE: The cover of trees and shrubs is determined from the high water mark to given Outer crown rim (including the shore zone and shaded water surface).

Menu shore -variables

Type	Type of shore zone.
1 Large water course/canal >6 m	
2 Fresh water shore, lake/pond	
3 Brackish water shore	The Baltic Sea, south and east coasts.
4 Ocean shore	The west coast (down to the Öresund bridge)
In mire?	Shore bordering wetland with peat at least 30 cm deep and at least 1 m wide, often with peat as bottom substrate.
0 No, not in mire	The shore does not border wetland with peat.
1 Shore in mire – lawn or carpet	The shore borders mire dominated by lawn or carpet (chapter 4.9), possibly with elements of or other types of wetland.
2 Shore in reed swamp	The shore borders wetland (often called marshy meadow) with over 70% graminoids and/or graminoid litter.
Reed Shore?	
0 No, not dominated by	Reeds or sedges missing or scarce, with little or no

reed/sedge	litter. The boundary between shore and water and the bottom layer of the shore zone or ground surface is visible.
1 Yes, reed/sedge dominated	Substrate type not discernable since the shore and inner water surface is dominated by graminoids, e.g. reed, reed-sedge, bulrush or *Glyceria maxima*, often with significant amounts of graminoid litter. The boundary between the shore zone and water surface is obscured.

Type of Bottom

1 Muddy bottom/muddy shore	The water-covered bottom is dominated by a layer of mud (fine sediment with high organic content) which has formed on the site. The mud must be at least several cm thick, and underlying structures (branches, stones) are totally concealed. Most often found at different types of sheltered shores on solid ground, with a narrow or non-existent shore zone (not eroded) with moderate or weak water fluctuation.
2 Sandy shore/fine sediment	The water-covered bottom (possibly even the shore zone) is covered with sand, silt and other fine sediments, mainly non-organic. Found at sheltered shores of different types, also shores with occasional stone blocks or shores in close proximity to sand dunes.
3 Stone/gravel shore	The water-covered bottom (possibly even the shore zone) is covered to a large part with stones and gravel. Often found at changing water levels, medium to strong water flow or obvious wave influence. Occasional stone blocks or small amounts of sediment or other fine substrates may be present.
4 Block shore	Shore zone dominated by stone blocks, maybe also some isolated cliffs and a certain amount of rocks (total area of rock/block/cliff over 50%), but not too much mud or sand/fine sediments.
5 Cliff shore	Shore dominated by water exposed cliffs (over 70%) that often project into the water, sometimes in combination with stony/graveled bottom or isolated blocks, but not too much mud or sand/fine sediments.
6 Other firm ground shore (till etc.)	Other shore on different kinds of solid ground without significant amount of fine substrate, gravel, or boulders/cliffs. This is a common type in relatively sheltered environments (no pronounced water erosion) or with little sedimentation of mud or other fine sediments. This class is stated when the bottom type is hard to see or distinguish.

7 Man-made shore	Man-made shore with quays (cement/stone), longitudinal piers or pavement without natural shore zone, or where the shore zone is hidden.
Position of Water Surface 00-99 dm	The vertical distance (height) between the high water mark and the water surface. If completely dried out, measure to the deepest point at the bottom of the stream channel.
Water level	
0 Temporarily dry	The entire water course is temporarily dry but the ground and vegetation is still clearly affected by water. This refers to all cases where the 10 m stretch is dried out.
1 Low water-level	The water-level is clearly lower than normal with a distinct, sometimes relatively wide shore zone.
2 Normal water-level	The water-level is normal. In bodies of water with a very stable water-level this often coincides with the high water mark, but in other cases a dry shore zone is present.
3 High water-level	The water-level is higher than normal and the actual water mark is close to the high water mark.
4 Extremely high water	Unusually high water where the water covers terrestrial vegetation. The water reaches outside the boundary of the water course, i.e. above the high water mark.
Water depth 00-20 dm 21: >20 dm	Estimated water depth at the time of inventory. Measured 3 m from the current water level. If the depth exceeds 20 dm, enter ‘21’.
Flow 0 Still water 1 Calm <0.2 m/s 2 Weak flowing - laminar 3 Flowing - turbulent 4 Torrential >0.7 m/s	The average speed of the water in the 10 m stretch. If needed, measure the speed with a small object (pine cone, short stick). If the water flows calmly and with even speed, measure a shorter distance. Turbulent water includes whirlpools while torrential water is foaming.
Aquatic Plants	Opens menu **Aquatic Plants**

Menu Aquatic Plants - variables

Cover of aquatic plants within 3 m of the current waterline. Species list and definitions in appendix 14.

Include only plants that are rooted in the water in ‘other heliophytes’. However, do not try to separate individual plants of the same species that grow in the shore zone from the ones standing in water. In these cases, estimate the vertical cover (as usual) over the water surface. If unsure if a species is considered terrestrial or water-living, include it in the water-living plants.

Menu Shore, cont.

Shore width
00-30 dm

The area affected by flooding; the temporarily dry shore zone between the actual water level and the high water level. Measure the width as an average for the 10 m stretch. NOTE: Average for both sides of the stream channel, i.e. max 30 dm. NOTE: Make sure that the width of the stream channel is the sum of the double shore width and the width of the water surface. Cover variables are given for shore with a width of at least 10 dm.

For the following cover estimations, BF indicates blank format.

Broad-leaved herbs %
00-99% BF

Cover of herbs in the shore zone. Last year’s litter not included.

Graminoids %
00-99% BF

Cover of graminoids (grass, sedge, rush and bulrush) in the shore zone. Graminoid litter not included.

Gram litter %
00-99% BF

Cover of graminoid litter (last year’s litter of grass, sedge, rush and bulrush) in the shore zone.

Outer Crown Rim
00-99 dm

Distance from the high water mark to the outer boundary of the crowns of trees and shrubs (the farthest-reaching branches within the 10 m stretch). NOTE: Include branches reaching over the water (Figure 6.7).

Shrubs %
00-99% BF

Total cover of shrubs over the ditch/water course (i.e. stream channel).

Trees %
00-99% BF

Clear-cutting?
0 No, no cutting within 40 m
1 Yes, cutting within 40 m

Clear-cut forest area (average height of new growth lower than 1.3 m) within 40 m from the high water mark.

Distance cutting
00-40 m

Distance from the high water mark to the clear-cut forest area (up to 40 m).

Activities
0 No activities
1 Yes, managed/ cut/ cleared/ disturbed/ depositions

Grazing or Cutting
0 Not grazed or cut
1 Low grazed vegetation <5 cm
2 Medium grazed vegetation 5-15 cm
3 Tall grazed vegetation >15 cm
4 Mowing/road-side cutting
5 Lawn mowing

If the vegetation is grazed, the average height of vegetation in the field layer is stated (Figure 4.7). Mowed or cut grass is only registered if done recently (i.e. current season). Estimate type of management for the entire ditch/water course, even if it is not evident at the intersection point. Also enter appropriate form of clearing if shrubs or small trees have been cleared in connection with cutting.

Clearing
0 No clearing
1 Heavy clearing of large trees
2 Light clearing of large trees
3 Heavy clearing of small trees
4 Light clearing of small trees
5 Heavy clearing of shrubs

Cutting or clearing of the vegetation strip. This includes all removal of trees or shrubs regardless of method (also including road-side cutting that affect woody plants). If both small and large trees are removed, the dominant category (referring to cover) is stated. Small trees are defined by having a stump diameter of less than 10 cm. Heavy clearing requires removal of more than 50% of all trees/shrubs, while light clearing calls for removal of 5 - 50%.

6 Light clearing of shrubs

Clearing Time	Time of clearing.
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Disturbance	Type of disturbance of the vegetation strip.
0 No disturbance	
1 Disturbance by vehicles	E.g. cars, snow-mobiles or tractors.
2 Disturbance by humans	Human trampling.
3 Disturbance by animals	Trampling by domestic or wild animals, including reindeer.
4 Water erosion (indications)	Erosion caused by running water.
5 Slide erosion (landslide)	Ground disturbed by slide, steep banks etc. slide because of indirect water effects.
6 Careful clearing	Clearing (mainly in ditches) where the vegetation has been scraped away to keep water flowing freely and maintain draining.
7 Heavy clearing	Heavy clearing where the top soil layer has been scraped away, often affecting the entire ditch embankment.
8 Straightening	Straightening of a water course.
9 Dredging/digging	Digging that removes the substrate and vegetation on the bottom of a body of water (mainly along shores) to increase water surface and depth.

Disturbance time	Time of ground disturbance.
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Disturbance %	Cover of ground disturbance.
000-100%	

Deposits	Type of deposit or accumulation.
0 No deposits/ accumulation	
1 Rock	Recent deposits of rocks, e.g. from blasting or building.
2 Digging deposits	Soil etc., deposited after digging.
3 Building material, incl. bricks	Leftovers from building sites or demolition of buildings, e.g. plaster, cement or wood.
4 Cutting/clearing deposits	Large piles of branches, brush etc., leftover from cutting or clearing.
5 Other deposits, misc.	Mix of the above and/or other kinds of waste (discarded animal feed, leftover materials from industrial activity, slag, ashes, etc.).
6 Natural accum, fine matter	Natural accumulation of fine matter such as sand fractions or smaller (grain size, less than 2 mm). Thickness of accumulated layer least 5 cm, cover more than 5% of the area.
7 Natural accum, course matter	See above. Coarse material refers to gravel and larger fractions (over 2 mm grain size).

Deposits time	Time of deposits
00 Current year or season	
01 Last year or season	
02 Year or season 2	
05 Year or season 3-5	

Deposits %	Cover of deposit or accumulation.
000-100%	

Control question

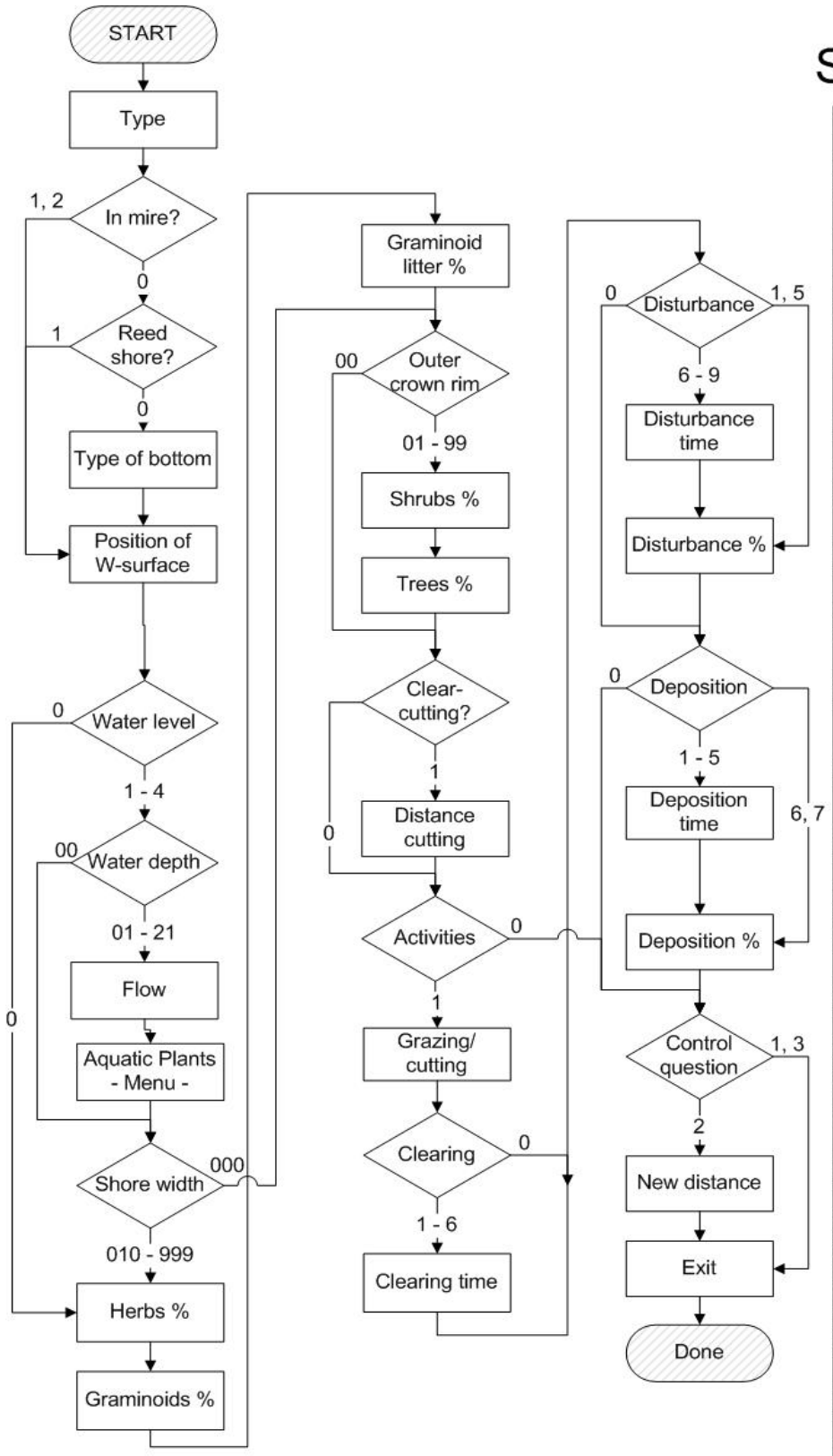
1 Yes, distance and element correct

2 Wrong distance - change

3 Incorrect registration - delete!

New Distance

000-200 m



Shore

Type
1 Large water course/canal >6 m
2 Fresh water shore, lake/pond
3 Brackish water shore
4 Ocean shore

Type of bottom
1 Mud bottom/mud shore
2 Sandy shore/fine sediment
3 Rock/gravel shore
4 Block shore
5 Cliff shore
6 Other form ground shore (till)
7 Man-made shore

Water level
0 Temporarily dry
1 Low water level
2 Normal water level
3 High water level
4 Extremely high water

Flow
0 Still water
1 Calm <0.2 m/s
2 Weak flowing – laminar
3 Flowing – turbulent
4 Torrential >0.7 m/s

Clear-cutting?
0 No, no cutting within 40 m
1 Yes, cutting within 40 m

Activities
0 No activities
1 Yes, managed/cut/cleared/dist./dep.

Grazing or cutting
0 Not grazed or cut
1 Low grazed veg. <5 cm
2 Medium grazed veg 5-15 cm
3 Tall grazed veg >15 cm
4 Mowing/Road-side cutting
5 Lawn mowing

Clearing
0 No clearing
1 Heavy clearing of large trees
2 Light clearing of large trees
3 Heavy clearing of small trees
4 Light clearing of small trees
5 Heavy clearing of shrubs
6 Light clearing of shrubs

Disturbance
0 No disturbance
1 Disturbance by vehicles
2 Disturbance by humans
3 Disturbance by animals
4 Water erosion (indications)
5 Slide erosion (landslide)
6 Careful clearing
7 Heavy clearing
8 Straightening
9 Dredging/digging

Deposition
0 No deposition/accumulation
1 Rock
2 Digging deposits
3 Building material, incl. bricks
4 Cutting/clearing deposits
5 Other deposition, misc.
6 Natural accum, fine matter
7 Natural accum, course matter

6.7. FOREST GROUSE

Aim

By observing the presence of forest grouse while performing line inventory, abundance and importance of landscape for different forest grouse can be estimated. Since the plot is re-inventoried, the birds' response to changes in the landscape can be studied. The species included are Capercaillie (*Tetrao urugallus*), black grouse (*Tetrao tetrix*), hazel hen (*Bonasa bonasia*), willow ptarmigan (*Lagopus lagopus*) and ptarmigan (*Lagopus mutus*).

Criteria for registration

- This inventory module is performed during line inventory in all types of terrain in the entire country. Ptarmigans are registered in forests as well as in the alpine region.
- Discovery of an individual or a group of birds is based on the take-off point, or if the individual/group moves along the ground, away from the inventory line (or is lying down but is discovered). NOTE: Neither birds that fly over the inventory line nor birds discovered solely by sound (except flapping of wings) are registered.
- Observations within 50 m from the inventory line are registered (see Figure 6.8). However, observation of all forest grouse within 50 m from the line is not required. Only spotted birds are registered.
- Only observations during line inventory are registered. NOTE: Do not register birds observed in the 50 m space between two inventory lines. If, on the other hand, a bird takes off more than 25 m in front of a sample plot center – maybe during inventory of a sample plot – the bird is registered on the following inventory line.

Procedures

- The person navigating with the compass also keeps an eye open for relevant forest grouse. Note or memorize the observations in order to enter them in the field computer during line inventory. The navigator must pay particular attention to where the birds were spotted in order to be able to make the registration later.
- Measure the distance (1 m resolution) between the inventory line and the bird/birds at a right angle (for distances up to 30 m a transponder or tape measure is used, for distances between 30-50 m the distance is estimated as closely as possible and measuring is not necessary).
- Note the distance along the inventory line. NOTE: The distance refers to the point where the right angle distance from the line to the birds is measured, and not at the point where the observation was made. Note that different distances must be entered for registration of more than one bird (if for example a hen and a rooster took off together). State the direction, left or right, from the inventory line (referring to the walking direction).
- Register species, gender and number of birds for each observation. If the species can not be determined, but one is certain that it was one of the relevant species (capercaillie, black grouse, hazel hen, willow ptarmigan or ptarmigan), the species is registered as 'Unknown'.
- Try to avoid walking in the vicinity of not yet inventoried lines (e.g. while walking from the car to the first sample plot) in order to avoid scaring off forest grouse along the inventory lines.

- Be aware of some other species with similar flapping sounds as the forest grouse in question, e.g. stock doves.

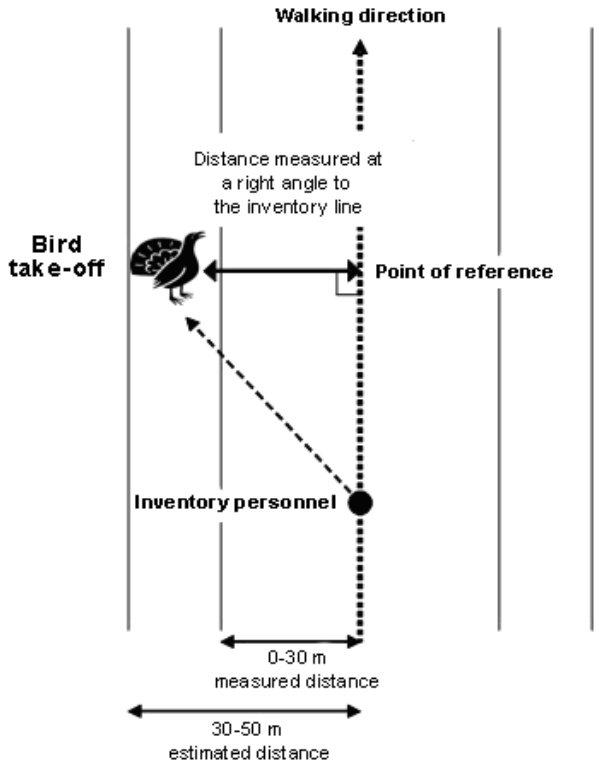


Figure 6.8: Schematic image of how to register forest grouse during line inventory.

Menu forest grouse - variables

Species

0 Unknown	Unknown capercaillie, black grouse, hazel hen or ptarmigan.
1 Capercaillie	
2 Black grouse	
4 Hazel hen	
5 Willow ptarmigan	
6 Ptarmigan	

Gender

0 Unknown	Also stated if a group consists of birds of different genders.
1 Female	
2 Male	

Brood
0 No
1 Yes

Stated if gender is female or unknown.

Number
01-15

Total number of birds in a brood (including the hen) or other group.

Distance
00-50 m

Distance measured at a right angle from line (Figure 6.8). Distance stated with a 1 m resolution.

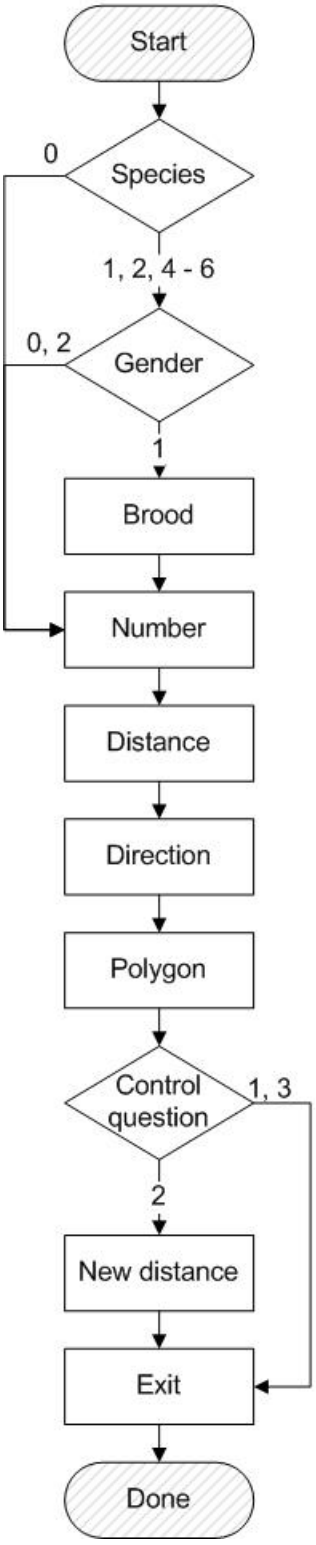
Direction
1 Left
2 Right

State on what side of the inventory line (in the walking direction) the bird/birds were observed (compare chapter 5.2).

Control question
1 Yes, distance and element correct
2 Wrong distance - change
3 Incorrect registration - delete!

New Distance
000-200 m

Forest Grouse



Species
0 Unknown
1 Capercaillie
2 Black grouse
4 Hazel hen
5 Willow ptarmigan
6 Ptarmigan

Gender
0 Unknown
1 Female
2 Male

APPENDICES

APPENDIX 1. ROUTINES FOR STARTING INVENTORY OF A NEW LANDSCAPE SQUARE

A tip is to share responsibilities within the inventory team in order to remember all necessary equipment when going out into the field. In this way, each team member checks only their own back-pack at the start of each day.

Checklist when starting inventory on a new landscape square:

- Maps
- Field equipment
- Set date in the digital camera
- Load new GPS-coordinates
- Forms for sample plot and division of sample plot
- Charge electronic equipment
- Pack extra batteries

Continue the list with your own tips and check-points!

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX 2. ROUTINES WHEN INVENTORY OF A LANDSCAPE SQUARE IS COMPLETED

When the inventory of a square is completed, the data is sent to the office. From 2007, all data and all papers concerning a square are to be sent in directly after the square is completed. This makes organizing control inventory much easier, as well as increases the odds that all maps and forms are returned.

For each landscape square, a large envelope with a checklist is sent in to the office. Make sure to complete the list with relevant information.

Checklist for a completed landscape square:

- Download photos, data and GPS-coordinates to the laptop and save them in the folder with the same number as the square (Figure B8).
- Burn a CD with the folder for the square (photos, GPS-coordinates and datafiles). Mark the CD with landscape square number, team number and date, and put it in a CD-mailer in the large envelope.
- Put all maps, aerial photos, sample plot forms, division forms, the green form and blue forms – if any – in the large envelope.
- Send an e-mail to the office that the square is completed. Include information of your plans for the near future (i.e. next landscape square, or holiday).
- Mail the large envelope.
- Load an empty database into the field computer (if needed).

NOTE: Do not remove photos, GPS-coordinates or data files from the laptop during the field season. If the hard drive runs out of space, contact the office.

Instruction for NILS error report (blue form)

When a problem or irregularity in the inventory is encountered, a blue form should be filled out. This includes e.g. the following situations:

- If something has been registered incorrectly, and cannot be corrected in the field computer.
- If the sample plot cannot be visited in the field, for “other reason’ (chapter 4.5).
- If a sample plot in a semi-natural pasture or meadow is divided and one section is located outside the pasture/meadow.
- Suggestions for changes in the content of the manual/computer program where the instructions or variables do not correspond well to the field situation.

The blue form is sent in to the office together with other papers and data when the inventory of the landscape square is completed.
NOTE: Please keep in mind that the blue form is read by office personnel, probably during the winter while going over the field data. Therefore it is very important to describe the problem very clearly so that a person not involved in the field inventory might understand

not only the problem, but also how to correct the data, if needed.
NOTE: Suggestions for improvement or discrepancy-reports for the ecopolicy are not reported on blue forms, but on specific discrepancy forms. These are found in the team's administrative folder. Further instructions below.

Instruction for NILS Square-Info (green form)

In 2007, a new form – green form – is added. On this form, the inventory team describes the landscape square in order to facilitate re-inventory. A green form must be filled out for every landscape square and is sent in to the office along with all other forms and data when inventory of the square is competed. The green form includes information that makes planning of the inventory easier for future NILS-teams visiting the square.

On the green form is stated e.g. the amount of time needed for inventory, recommended transport routes, where to find gate keys, recommended lodging, need for rubber boots, unfriendly cattle, etc. Please fill out the green form as thoroughly as possible!

Instruction for discrepancy-report (white form)

If something happens that deviates from the ecopolicy of SLU, a discrepancy-report must be filed. This might include e.g. a container with spray-paint lost in the forest, spilt carosene etc.

Also file a discrepancy-report if you have a suggestion concerning our environmental management. For further information, please read the ecopolicy in the administrative folder.

APPENDIX 3. ROUTINES AT THE END OF THE FIELD SEASON

All NILS field teams spend one day at the end of the field season “demobilizing’ at the office in Umeå. A couple of things to keep in mind:

- Make sure to have gone through the equipment before arriving in Umeå. There might be several teams unloading equipment on the same day and there might not be enough room for all teams to check their equipment simultaneously. It could also be nicer to go through the equipment on a sunny day, instead of possibly in the rain on the parking lot outside the Umeå office.
- The field equipment should be packed in the designated boxes and the list of equipment should show if equipment is damaged or missing. Please remember that the field personnel are responsible for all equipment during the field season. The equipment list is handed to the office personnel in charge.
- The computer equipment must be checked off and be in good condition in the designated bag. Leave the bag with the office personnel in charge, and not in the field equipment storage room. No rat’s nest of wires, please!
- Questions concerning specification of travel expenses or working hours are answered by the designated office personnel. Please remember that you are not the only one with questions, so please have all papers ready. Also remember that office working hours are between 8 a.m. and 4 p.m. in the summer, unless an appointment is made.
- The car should be washed, both inside and out, before leaving Umeå. In order to speed things up, a rough clearing of the inside of the car can be done before arriving in Umeå. You can also stop by a car wash immediately when arriving, in case many teams are unloading equipment at the time. Remember that the roof box and roof racks must be removed before entering the car wash.
- If you need a lift to the airport or train station, the office personnel can help. Just let us know ahead of time so that we can plan joint trips.

APPENDIX 4. COVER ESTIMATIONS

The aim of cover estimations is to appreciate the quantities of species, vegetation layers, substrate and other ground structures in a uniform way. One advantage with cover estimations is that they can be applied to many types of plants and structures of different scales. The same principle can be used to estimate cover of for example, narrow-leafed grass, needle litter, ferns and raspberry bushes. The exception is ‘diffuse cover’ for tree species, which is described below.

Principles for estimating cover

The estimated cover is the vertical projection above the ground of the species, group or structure. NOTE: This means the percent of the area that is covered if viewed from above. The plants do not need to be rooted in the square in order to be included. For an individual species, group or structure the total cover can not exceed 100%. Different groups sometimes overlap, and in these cases the total sum may in some cases exceed 100%. In order to facilitate entering data into the field computer, cover is in many cases indicated with two positions (00-99%) – 99% counts in these cases as 100%. NOTE: All estimates of cover within NILS refer to the cover at the time of inventory.

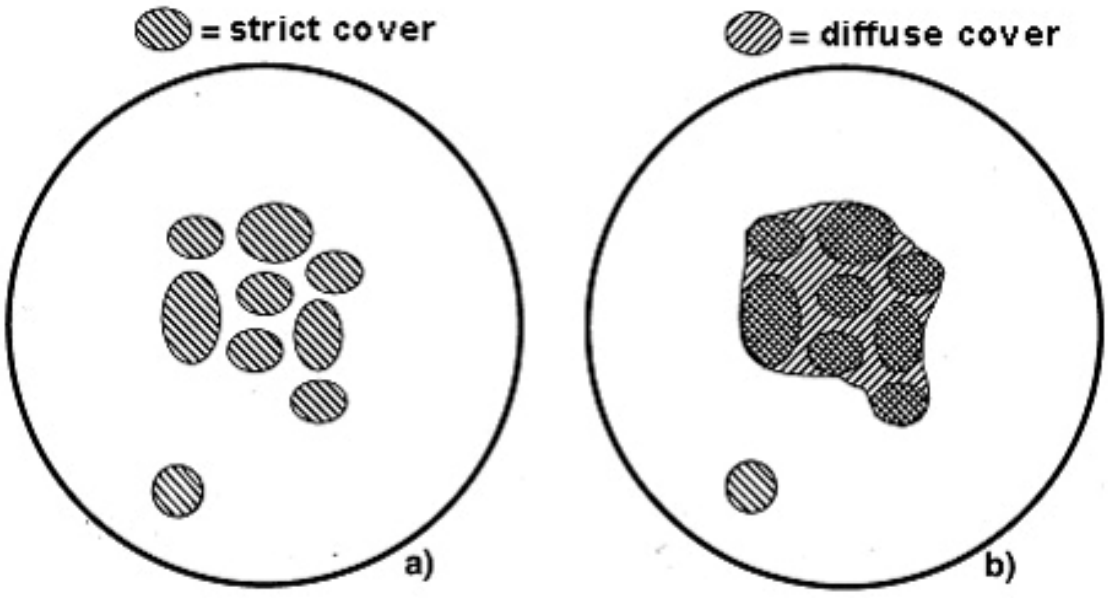


Figure A1: a) Strict cover; b) Diffuse cover

Vegetation cover within NILS is estimated as either ‘strict’ or ‘diffuse’ cover (Figure A1). The latter is used when estimating tree cover and certain activities.

Strict cover: When estimating cover using this principle, consider the vegetation according to a strict vertical projection. NOTE: Sections within for example a shrub that is not covered by leaves, branches or trunk - in strict vertical projection - are not included.

Diffuse cover: According to this principle, all sections within e.g. the outer perimeter of a tree crown are considered to be covered to 100%. The degree of diffuse cover is therefore higher than the degree of strict cover. Strict cover is impossible to estimate in aerial photo interpretation of e.g. tree canopy cover, instead diffuse cover is used. In field inventory both principles can be used. Many international definitions of e.g. forest are based on diffuse cover.

Accuracy

The cover is estimated to the nearest percent, in other words, in 1% resolution. The high resolution makes subsequent calculations easier than if the cover consistently was indicated with even 5 or 10 percent classes. For example, cover is often used for '*a posteriori'* classification of habitat types normally are based on limits of even tens (often larger than 10, 30 or 70%). Estimated values of even tens are therefore difficult to place within one class or another. The problem is magnified if these even values also are over-represented. It is therefore very important that the inventory personnel at all times indicate cover in a 1% resolution. It is important to remember that this does not mean that the margin for error in the estimations is 0.5%. The point is to not round off estimations to even tens unnecessarily and thereby complicate subsequent analyses.

Procedures

It is often difficult to immediately estimate an exact value, but by gradually closing in on a number, a surprisingly high accuracy can be reached. Intermediate cover is the hardest to estimate. In these cases it is important to follow a structured process. Start by estimating to the nearest 10%, if it feels easiest. For example; is the cover higher or lower than 10%? A lot or just a little higher/lower? Is the cover closer to 20% than 30%? How much closer?

Especially in the beginning, a tool or structured 'line of thought' is needed, in order to close in on a fairly accurate estimation. Gradually switch to a more direct estimate based on experience. The guidelines described here are meant to be used as examples during a learning and calibrating phase. With experience it will be easy to quickly make an estimate without going through all the steps. The advantage is to learns to handle many different situations, species and plot sizes at an early stage.

- **'Joining':** As the simplest cases, estimate cover of large, homogenous areas that are easy to separate from the surroundings. For species in scattered but somewhat distinct 'patches' (dense shrubbery, bare bedrock, patches of reindeer lichen etc.), join all patches in the entire plot mentally. Estimate the size of the area section that is needed in order to represent cover of the species. This method can probably best be used by gradually dividing the area in halves (1/2, 1/4, 1/8, 1/16) which corresponds to 50, 25, 12.5 and 6.25%. The estimate can then be adjusted up or down from the size of the section that fits. This method works best for species that are not too sparse (a practical minimum is around 1/16 of the plot area).
- **'Estimation of reference areas' (converting between acreage and cover):** For species with low total cover in the interval between 2 and 6-8%, which is often hard to estimate, it is best to use reference areas. Mentally position 1% squares until they correspond to the cover of the species/group. In the small vegetation plot1% corresponds to a square of 5 cm, and in the 10 m sample plot, a circle with a 1 m radius (= 2 m diameter). Other sizes can be used, or simply estimate the species cover (in m^2 or dm^2), and convert it to the corresponding cover percentage. Every covered dm^2 in the small vegetation plot corresponds to 4% of cover, and every m^2 in the large sample plot corresponds to 0.3%. The method is rather insensitive to if the species are clustered or evenly scattered. If the species/group is sparse and scattered it might be easier to get an overview by dividing the sample plot/section into four equal parts, and estimate one square at a time. Add the results together for the cover of the entire sample plot (or section of a divided sample plot).
- **Adjustment of average plots:** For sparse and/or scattered plants with small, narrow or lobate leaves, none of the above methods are suitable. Instead, estimate

cover in several steps, with minor calculations in between. Choose a small, average plot of optional size that feels comfortable to use for a reference estimate. The smaller and narrower the leaves, the smaller the plot. Estimate the cover within this reference area, and if it is representative of the entire sample plot, the same percentage of cover will apply. If not, determine the cover of the entire sample plot where the reference plot is representative. For example; if the species is present within one third of the area and there has a cover of 12%, the cover for the entire plot is 4%.

Application - examples

- **Dense patches or clumps:** ‘Joining’ often works well. If the species is dense and plentiful it is easy to estimate a representative section of the plot.
- **Large, broad leaves:** ‘estimation of reference areas’ usually works better than ‘joining’ if the species is sparser than the example above. The leaves ought to be large enough for each one to correspond to a percentage (part of% or several%).
- **Small, scattered or narrow leaves:** Make estimations in several steps, first in a small ‘average area’ where the species is found, then determine the size of the plot section that the species covers.
- **Lobate leaves:** Estimate in several steps, first by ‘joining’ or ‘reference areas’ for the entire leaf, then re-count according to the cover of the leaves.

Blank Format

A blank format refers to a data field that is left totally blank if the species is missing. This format occurs in all menus where cover estimations are entered. It is important to remember that ‘00’ in this case means that the species is present; however in such small amounts that it does not add up to more than 0.4%. When cover is 0.5% to 1.4%, enter ‘1’, and so on.

It is not expected that the field personnel should spend considerable amounts of time searching for minimal amounts of cover for groups, species or structures in the field and bottom layer in the 10 meter plot in order to be able to enter ‘00’ for these variables. If, however, small amount are discernable while conducting an overview of the plot, they should be registered.

APPENDIX 5: DEFINITIONS OF SOIL TYPE

Soil type
The upper part of the ground that for a certain, often long, period of time has been affected mainly by geology, climate, hydrology and organisms. These influences have often resulted in visible and distinctive soil horizons. The soil includes the humus layer but not the litter layer/S-horizon (Figure 4.7).

Humus
Humus is organic substance under degradation. When the litter**,** due to activities of the ground organisms, after a while loses it's original structure, it has changed into humus.

Humus layer
The humus layer includes the H-, O-, and A-horizons, as well as ground litter and small, living ground organisms and fine roots. If there is an AB-horizon in soils containing the humus types mull and mull-like moder, the upper half of this horizon is included in the humus-layer.

H-horizon
The degradation is hampered/has been hampered by insufficient oxygen supply, caused by high water content in the ground surface layer for a substantial amount of time during the vegetation period. Typical species/groups contributing with litter to the humus layer are peat moss, *Polytrichum* sp., sedges, rushes, reeds and horse-tail species. The mineral soil content is often minimal. In general terms, the H-horizon is actually a peat layer. Note however that the humus form is called peat-like mor if the depth of the humus layer is more than 30.5 cm.

O-horizon
The degradation is usually only temporarily hampered by high water content during the vegetation period. An O-horizon is therefore formed on naturally well-drained sites. In general terms, an O-horizon is a mor layer.

A-horizon
A mineral soil horizon mixed with humus, which is formed close to the ground surface. The humus form mull is an example of A-horizon. It consists of mineral soil mixed with humus, where the mineral soil content is greater than 10 volume%. The organic matter is well decomposed. This horizon is formed with or without the influence of ground animals.

Humus forms - peat types

Peat
The organic horizon is an H-horizon with a depth of more than 30.5 m.

Peat-like mor
The organic horizon is an H-horizon thicker than 30.5 cm. The H-horizon is often divided into a decomposition layer and a humus layer that, when wet, is ‘buttery’. Do not confuse moder and peat-like mor. Contrary to moder, peat-like mor is developed in damp habitats or in deep hollows where the decomposition of the organic material is hampered, or has been hampered by oxygen deficiency. The ground litter often consists of *Polytrichum* species and/or peat moss.

Peat (a soil parent material)
Peat is a soil parent material of organic origin, rich in humus and formed by incomplete decomposition of plant- and animal parts. The peat is formed in shallow water or in damp ground where dead biomaterial is prevented from total decomposition due to lack of oxygen. Peat is usually saturated with water during most of the year. The peat is divided into the marsh peat and moss peat depending of its origin. Moss peat is light-brown and poor in nutrition. Included in this group is *Sphagnum*-peat and different kinds of forest moss peat, with mostly tree residue from pine. Marsh peat is rich in nutrition with a high content of nitrogen and sometimes also “lime’. Included in this group are reed peat, sedge peat and wood peat, mainly with tree residue from spruce and deciduous trees.

Humus forms - mor types

Mor types
Earlier raw humus, a form of humus accumulated on top of the mineral soil since the digging organisms are few and the mixing low. Normally, the pH-level is low. See also ‘O-horizons’ above.

Moder
Transition form between mor and mull. The humus layer consists of an upper decomposition layer and a bottom humus layer. In moder, the decomposition of the organic substance to humus in the upper layer is more advanced than in mor, and certain aggregation may occur. If the thickness of the upper layer exceeds 25% of the total thickness of the humus layer, it is considered mor**.**

Humus forms - mull types

Mull-like moder
The humus form is a transition type between moder and mull. Distinctive for mull-like moder is that the organic material is concentrated to the upper part of the humus layer, unlike mull.

Mull
The humus layer is heavily mixed with mineral soil as a result of activity from digging ground animals, mostly worms. In fields and garden soil, the mixing is mainly caused by man or machine. The dominating part of the humus layer is an A-horizon with a well developed aggregate structure, requiring a soil type with high clay content.

APPENDIX 6: FIELD METHODS FOR DETERMINING THE TEXTURE OF A SOIL SAMPLE

Several different methods have been worked out in order to determine soil texture. Some of them are described below and should be known when working in the field. These methods are basically uncomplicated and are mainly designed to test the soil's forming and rolling capacity. In order to be able to use these methods with acceptable accuracy, regular practice and calibration using samples with known grain size is necessary. Within NILS the rolling- and wash-tests are often used.

Remember that the texture feels somewhat different in depending on degree of moisture - dampen the sample if it is dry.

Determining the texture of dry soil

Scratch test

A glass-rod with a rounded tip is used to scratch a furrow on a flat surface of the soil sample and observe the result. This method is seldom used, but can be used as a complement to other methods on especially dry sediment types before the sample is dampened.

Stroke test

Two variations can be used:

- Place a dry sample on a flat surface and stroke it with your finger back and forth. The accumulated amount of 'meal' will be an indication of the cohesiveness and solidity. This variation is seldom used.
- A damp sample is pressed between the fingers. When it is dry, an estimation of the character of the powder is made. This variation is often better in the field where the soil seldom is completely dry.

Determining the texture of damp soil

Form test

A lightly dampened sample is tested with reference to the cohesiveness of the mineral grains by pressing it into a sugar-cube form between the thumb and index-finger (Figure A2). If the sample retains its form when balanced on your index-finger, it is considered formable.

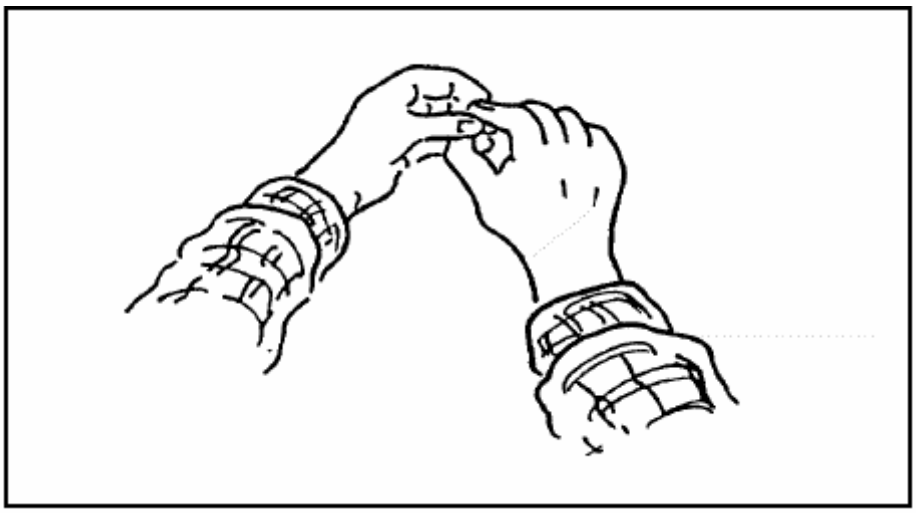


Figure A2: Form-test.

Wash test

Place a small soil sample in your cupped hand and add plenty of water (Figure A3). Mix well and pour off the muddy water. Medium-sand and coarser particles remain. Compare the amount of these coarse particles to the amount of original sample. The color (muddiness) of the poured off water gives an estimate of the amount of fine material (in this case fine sand and finer).

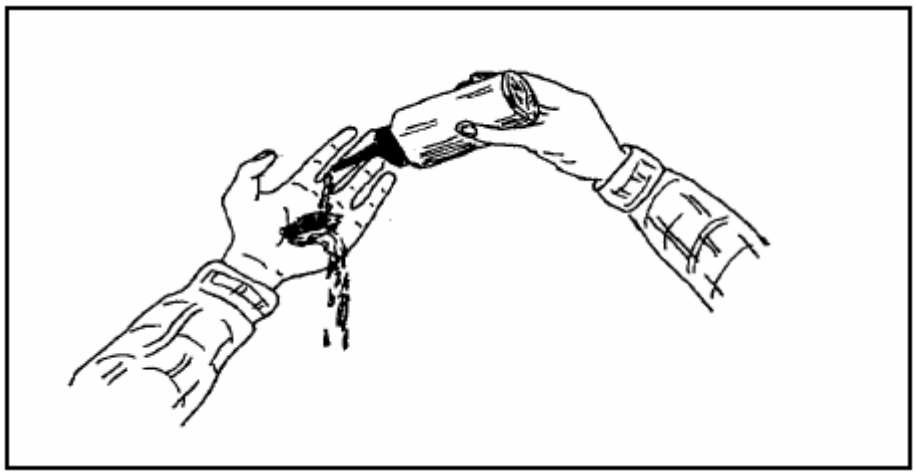


Figure A3: Wash-test

Rolling test

This is the most common field method to estimate the texture of a soil sample. Pick out a homogenous, but not sticky clump of soil. Be very careful to get a sample with the correct water content. If the sample is too dry it will crumple when rolled out into a too thick thread, if it is too damp, the thread will be too thin. If too much water is added so it starts to stick, knead it in your hand until it stops sticking and then the right water content is achieved.

First decide if the kind of soil is sorted (sediment) or unsorted (moraine). Unsorted soils contain grains of all sizes, while the sorted soils mostly contain a few different grain sizes, one of them often dominant. With a small soil sample, decide if it is sorted or not by add plenty of water. The finer fractions will ‘get muddy’ and stain the water. By removing this muddy water, the coarser fractions are left, e.g. gravel, sand and fine sand (compare wash-test above). Roll out a small lump of the soil sample on a flat

surface - preferably a masonite board, never in your hand (Figure A4). NOTE: Roll out moraine samples with light pressure and sediment samples with heavy pressure.

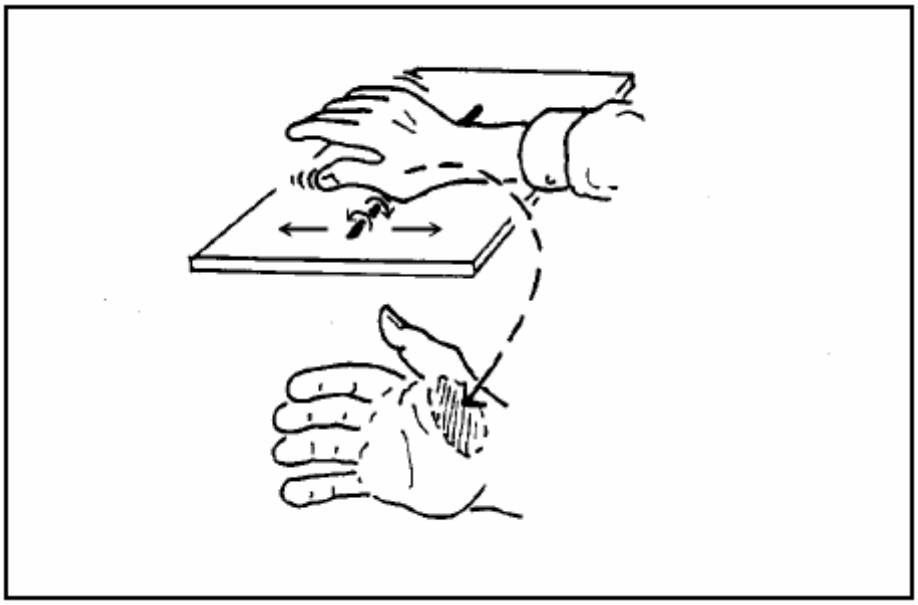


Figure A4: Rolling-test

The thickness of the roll when it starts to crumble is an indication of the cohesiveness of the mineral particles, and therefore an approximate measurement of the mud content. In sandy-silty moraines, the roll breaks earlier (thicker diameter) than with moraines with more fine soil rich moraines, since breaks occur close to grains of sand (remove grains of sand or gravel before rolling). Sand, fine sand and coarser moraines, free of mud, can not be rolled out at all.

With the above described field methods it is easy to ‘slide’ on the scale while determining the texture, up as well as down. It is of utmost importance to continue calibration of textures by using known textures and continuously use the above methods.

Never try to estimate soil type with a dry soil sample (except scratch- and stroke tests).

Description of texture classes

1. Rocky moraine/Rocks
Moraine: Rock hollows, block slopes and other rocky moraine, and stony moraine. No areas with mineral soil grain sizes smaller than 20 mm**.** Can not be formed or rolled.
Sediment: Fields of rubble (old shore lines) and other rock or stone sediments. Diameter larger than 20 mm. Visual estimation only. No areas with mineral soil grain sizes smaller than 20 mm. Can not be formed or rolled.

2. Gravelly moraine/Gravel
Moraine: Gravelly moraine. Form test: Can not be formed. Rolling test: Can not be rolled. Rich in grains of gravel, few small particles except sand. Often plenty of rocks.
Sediment: Gravel. Grain size between 20 and 2 mm (coarse gravel 20-6 mm, fine gravel 6-2 mm) Stroking test: Not coherent. Form test: Can not be formed. Rolling test: Can not be rolled. Color in dry state: Reddish. Visual inspection only.

3. Sandy moraine/Course sand
Moraine: Sandy moraine. Dominated by sand particles. Usually moderate amounts of rocks and stone**.** Form test: Hardly formable. Rolling test: Can not be rolled.
Sediment: Course sand. Grain size between 2-0.6 mm. Scratch test: Can not be formed. Stroking test: Not coherent. Form test: Can not be formed. Rolling test: Can not be rolled. Color in dry state: Reddish. Visual inspection or grain group scale.

4. SANDY–silty moraine/Sand
Moraine: SANDY-silty moraine. Form test: Can be formed. Wash test: If a small sample is mixed with water, large amounts of sand remain. Rolling test: Can, with very light pressure, be rolled to a 4-6 mm roll. The soil sample ‘crunches’ if it is pressed between thumb and index finger when dry (using similar procedure with moraine containing more fine soil will result in a ‘cracking’ sound). Put the hand with the sample close to your ear. Variable amounts of rocks.
Sediment: Sand. Grain size between 0.6-0.2 mm. Scratch test: Can hardly be formed. Stroking test: Not coherent. Form test: Can hardly be formed. Rolling test: Can not be rolled. Color in dry state: Reddish. Visual inspection or grain group scale.

5. Sandy-SILTY moraine/Fine sand
Moraine: Sandy-SILTY moraine. Form test: Can be formed. Wash test: A fair amount of sand remains in the hand. Rolling test: With light pressure 6- 4 mm. Somewhat ‘crunching’. Variable amounts of rocks.
Sediment: Fine sand. Grain size between 0.2-0.06 mm. Scratch test: Very deep furrow. Negligible cohesiveness. Stroking test: Very loose, falls apart. Form test: Can be formed. Rolling test: Can not be rolled. Color in dry state: Light gray or slightly reddish. Visual inspection or grain group scale. Fraction 0.2-0.05 mm is internationally known as fine sand.

6. Coarse silty moraine/Coarse silt
Moraine: Coarse silty moraine. Wash test: Insignificant amount of sand remains. Rolling test: With light pressure 4-3 mm. “Cracking’ sound. Feels sticky and smeary. Small amounts of rough powder. Small or moderate amounts of rocks.
Sediment: Coarse silt. Grain size between 0.06-0.02 mm. Scratch test: Very deep furrow. Negligible cohesiveness. Stroking test: Very powdery, rough powder. Rolling test: 6-4 mm. Color in dry state: Light gray. Fine silt grains can not be seen with the naked eye, but they feel rough. Internationally known as coarse silt (0.05-0.02 mm).

7. Silty moraine/Silt

Moraine: Silty moraine. Rolling test: With light pressure around 3 mm. Very powdery when dry (main characteristic). Sticky and achieves running ground form when wet. NOTE: The difference between course silty and silty moraine can be difficult to establish with the rolling test, and the degree of "powder' is seen as a more conclusive way of differentiating between the two. Note that both coarse silt and silt are present in both texture classes, but in different proportions.

Sediment: Silt. Grain size between 0.02 and 0.002 mm. Scratch test: Very deep furrow. Rather good cohesiveness. Stroking test: Very powdery, mealy powder. Rolling test: 4-3 mm. Color in dry state: Light grayish white. Internationally separated into moderate silt (0.02-0.005 mm) and fine silt (0.005-0.002 mm).

8. Clayey moraine/clay

Moraine: Clayey moraine, moraine clay. Rolling test: With high pressure less than 2 mm (light moraine clay 2.5 mm, moderate moraine clay 1.5 mm, stiff moraine clay 1 mm). In the rolling test, presence of coarse, rough grains can be felt. Usually small amounts of rocks. Other: Mud, clayey mud and muddy clay are also included in class 8. Rolling test results in a roll of less than 3 mm. Dense, rubbery consistency.

Sediment: Clay. Grain size less than 0.002 mm. Rolling test: Less than 3 mm. (light clay around 2 mm, moderate clay 1.5 mm, moderate clay 1 mm, stiff clay less than 1 mm). Heavy stickiness. Scratch test: From a deep, wide matte furrow (clayey soil) to a narrow and shiny furrow (stiff clay). Stroking test: From very powdery (clayey soil) to not powdery (stiff clay). Color in dry state: Varies between regions and process of formation (light reddish brown, light gray, gray, grayish brown, dark grayish brown).

APPENDIX 7: VOLUME DENSITY

The volume density of the area is estimated from basal area and the basal area weighted mean height (Figure A5). Use as aid for estimates of 'Fully stratified forest' (chapter 4.5) and 'Activities/disturbance' (chapter 4.8)

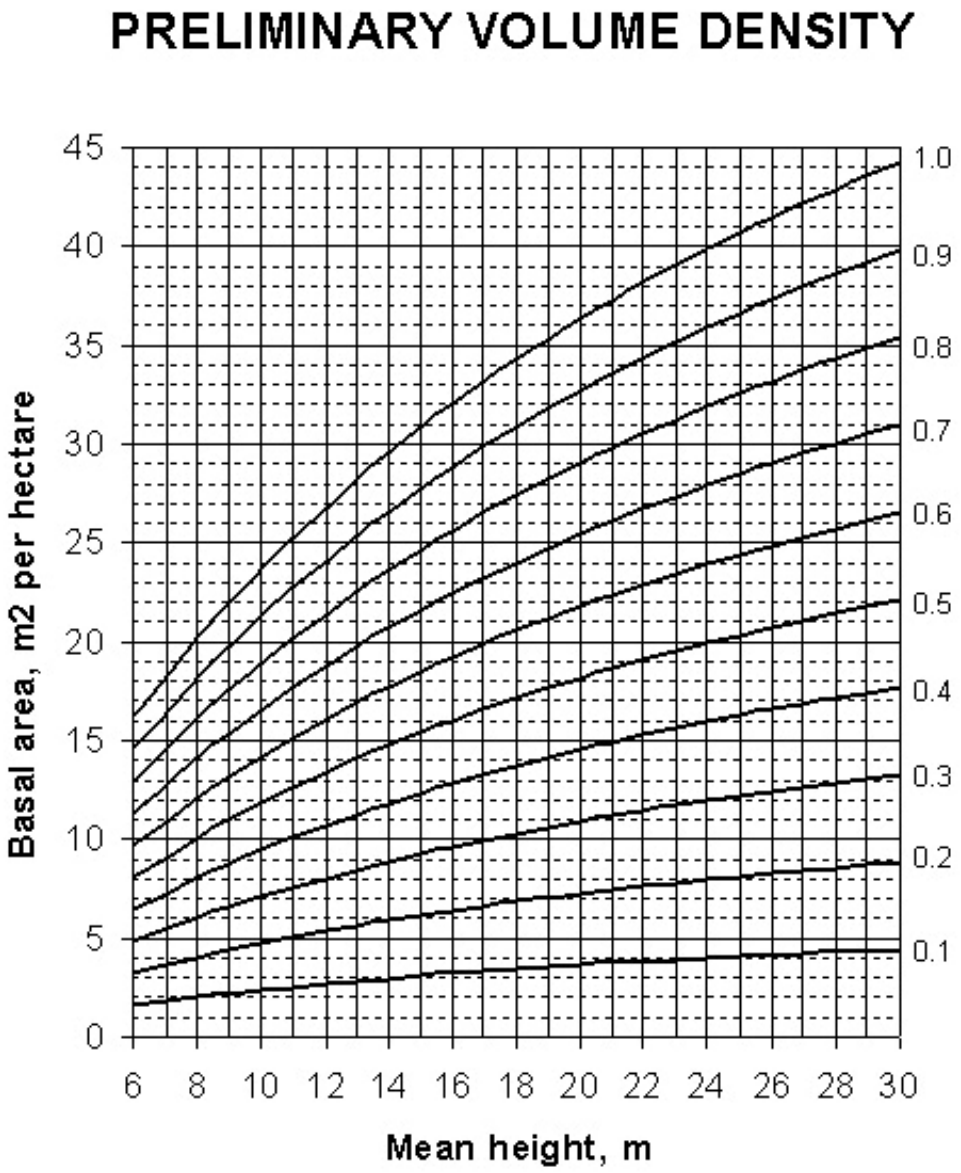


Figure A5: Diagram for estimating volume density.

APPENDIX 8: MEASURING HEIGHT

Measuring height with Vertex III

Starting and shutting down the transponder

Start: Place the Vertex amplifier against the transponder amplifier, keep the left arrow button pressed down until you hear two short signals. The transponder will signal now and then while it is on.
Shut down: Keep the button pressed down in the same way until you hear seven short signals.

Calibrate

Use a tape-measure to measure exactly 10.00 m between transponder and the front of the Vertex.
Press the ON button and proceed forward to CALIBRATE with he left arrow button. Keep the ON button pressed down until the display locks into the calibrated distance. The instrument now calibrates and shuts down automatically.

Distance measuring

Start the transponder and place it where the distance is to be measured from. Press the left arrow button (DME) and note the numbers on the display. Keep holding the button down if the Vertex has problems connecting with the transponder immediately.

Measuring height with transponder

Start the transponder and place it on the object to be measured, normally 1.3 m above ground (T.HEIGHT).
Press ON. Aim toward the transponder and keep the ON-button pressed down until the cross disappears. Aim at the height to be measured. Keep the ON-button pressed down until the cross disappears. NOTE: Repeat this for the next height. The measured heights can be seen on the Vertex display.

Measuring height without transponder

Press ON. HEIGHT is shown. Press ON and M. DIST. is shown. Change the distance with the arrow buttons or use the distance on the display. Aim at the point where the height is to be measured (T.HEIGHT). Keep the ON-button pressed down until the cross disappears.
Aim at the height to be measured. Keep the ON-button pressed down until the cross disappears. NOTE: Repeat this for the next height. Read the heights on the Vertex display.

Height measuring from the horizon

Press ON. HEIGHT is shown. Press ON and M. DIST. is shown. Change the distance with the arrow buttons or use the distance on the display. Press the ON-button and the angle window is shown. Keep the arrow button pressed down and press ON when the angle shows 0. Aim at the height to be measured. Keep the ON-button pressed down until the cross disappears. NOTE: Repeat this for the next height. Read the heights on the Vertex display.

Measuring height with Suunto or Silva height measuring gauge

Measuring heights with Suunto or Silva is done in 2 steps: First the distance to the tree is measured, then the height of the tree is measured.

Measuring distance
Both measuring gauges are based on height measurements carried out from a pre-fixed distance. The distance used depends on the selected scale (15 or 20 m from the tree), the height of the tree and the view of the tree. The distance is measured with a tape measure.

Measuring height
Standing at the correct distance from the tree, measure by aiming the gauge first toward the base of the tree (=ground surface) and read from the scale that corresponds to the actual distance from the tree, then aim toward the tree-top and make a new reading. Keep both eyes open while using the height measuring gauge. The height of the tree is then obtained by (i) or (ii) below:

i) If the tree base is below eye level the tree height is obtained by adding the two numbers (Figure A6 a).

ii) If measuring in an upward slope, the base of the tree may be above eye level. The tree height is then equal to the measured number at the top minus the number at the base (Figure A6 b).

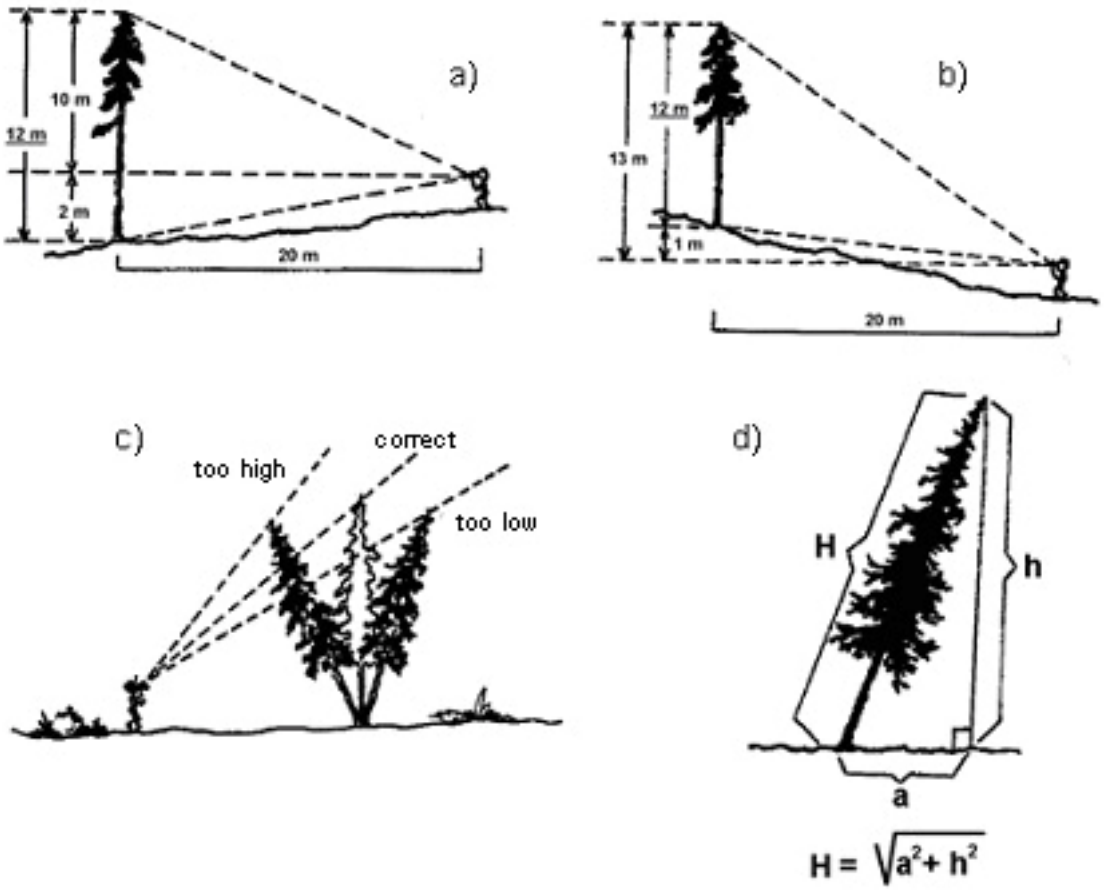


Figure A6: Measuring height with Suunto or Silva height measuring gauges.

If possible, try to find a place to measure from where the tree base is below eye level (Figure A6 a). If the tree base is above eye level it becomes difficult to measure the horizontal distance to the tree. NOTE: Read the correct scale, read the scale correctly

and do not tilt the instrument side-ways.

The definition of tree height is the distance along the trunk from the sprouting point to the top. In many cases (i.e. for a vertical tree with a clearly visible top and root) the height can easily be measured according to the above described principles. In some situations (e.g. case ‘c’ and ‘d’ in Figure A6), it can be difficult to obtain the height from the described procedures. In these, rather rare, situations do your best to correct the numbers to correspond to the tree height. The most frequently occurring example is that while measuring height of deciduous trees with wide crowns, one tends to aim at the front edge of the crown rather than toward the tree top. The result is then an over-estimation of the height (compare Figure A6 c).

APPENDIX 9: DIGITAL CAMERA – PHOTO DOCUMENTATION

All sample plots should be documented with the digital camera. The purpose is to:

- document the location of the sample plot in order to facilitate re-inventory
- with the aid of field photography, document the permanent sample plots' structure for calibration of the aerial photo interpretation
- create a photo archive to study changes in vegetation and landscape patterns and create a reference library to show how estimates are made on different types of landscape
- create reference material for use in presentations of NILS-results

All photographing should be made as a first step after the sample plot center and small vegetation plots have been established. If there is a possibility that the north small vegetation plot will be moved, because it is located on a division border, make the photos after dividing the section. Take one photo in each direction (north, south, east and west) from a point located 4 m behind the sample plot center, in the indicated direction (Figure A7). Make sure the entire center pole is visible in the picture. Avoid showing back-packs and other equipment in the pictures.

Figure A7: Photo example of the sample plot with center marking.

Also photograph the northern small vegetation plot on every sample plot. Take the picture of the sample plot from a central point, at least 1 meter above the ground surface. NOTE: Place the stick in the middle of the picture with the chain stretched out and visible. If possible, use a circle frame while photographing.

Setting the date

It is very important that the date is set in the camera before any sample plot photos are taken. The date remains in the camera as long as it is not without power for a time. If the date is not set, there is no way of determining which sample plot the photos refer to. Figure A8 shows an example of the correct way of saving photo folders.

Figure A8. Example of correctly saved folders.

Standard for flash setting

It is important that the camera is held still while the picture is taken, especially if the light is poor (= slow shutter speed). Normally, the automatic flash setting is used. If the picture is taken inside a forest with branches in front of the camera, the flash may have to be shut off. If the picture is taken against the light, a forced flash can give better details. Try to shade the lens (without blocking the picture) from strong sun- light to minimize reflections. NOTE: Check the quality of the picture in the monitor after it is taken. Re-take pictures of poor quality. However, a crappy picture is better than no picture at all.

Sample plot (over-view pictures)

Take one picture in each direction (north, east, south and west) from a point about 4 m behind the sample plot center, toward the indicated direction. Make sure that the entire center pole fits in the picture (if it is not blocked by dense vegetation etc). If possible, the pictures should be taken with support (tripod etc.) from at least 1.5 m above ground. Take the pictures a soon as the sample plot has been established. Make sure that no equipment or people are showing in the picture.

Small vegetation plot (detailed picture)

The northern small vegetation plot is documented with a photo. Take the picture from a central point at least 1.5 m above the ground surface. Place the plot stick and scale of measurement so they are clearly visible in the picture. Stand in a way that does not shade the plot. Try to get the sunlight to show in the sample plot. NOTE: Try to use the camera's automatic flash. If you shut off the flash, because of close branches etc., turn it on again as soon as the picture is taken.

Control and documentation

When the photos are taken, check the quality in the monitor. Re-take pictures of poor quality.

Weather conditions (strong sunlight, rain etc.) can make it difficult to get good pictures from all sample plots. In these cases, remember that a bad picture is better than no

picture at all.

When decent photos are obtained, register them in the computer in the **PHOTO** menu. Registering of pictures in the computer is described in chapter 4.3. The numbers registered are the 4 last digits shown in the camera display of each individual photo. Press the button ‘DISP’ if the number is turned off before you have a chance to read it.

If it is impossible to take a picture, enter 9999 in the **PHOTO** menu. If the conditions change during the inventory, try to visit the area again under better conditions, and re-take the photos, time permitting.

Saving pictures

Transfer the pictures from the camera to the computer when inventory of the landscape square is completed, or if you leave off for any other reason (e.g. holiday). If there are many ‘junk pictures’ or personal pictures in the camera, it may have to be emptied more often. If unsure how many pictures the camera can hold, read the camera instructions!

Connect the camera and the computer with a USB-cable. Transfer the pictures from the camera to the photo folder in the corresponding landscape square folder in the laptop.

NOTE: When disconnecting the camera from the computer, it is important to not just pull the plug. Click the USB icon down in the right corner of the taskbar. Shut down the computer connection to the camera in the dialog box and camera can be safely disconnected.

NOTE: If you would like to review the pictures after they have been transferred to the computer, do not save them again. If you do, they file gets a new identity. Do not turn, enlarge or reduce them. If you do, all the hidden image data may change, and possibly make future handling of them impossible.

Sending in pictures

When the inventory of a landscape square is completed, copy all data on a CD. Follow the instructions in Appendix 2. NOTE: Leave all files in the laptop during the field season without removing anything from the computer.

APPENDIX 10: EQUIPMENT

Technical equipment
Laptop
Field computer, Allegro CE with accessories
Mobile phone, GPRS with accessories
Satellite phone
Small transistor radio
GPS receiver, Garmin GPS 72
Digital camera, Casio GV 20
Pocket calculator
Height and distance gauge, Vertex III
Transponder + adapter
Height meter, Suunto
Binoculars, Lotus 8x35
Magnifying glass, 10 x
Multiple power strip
Bag for electronic equipment

Literature and office materials
Field instruction
Reference booklet
Nordic Flora *(Mossberg & Stenberg 2005)*
NILS species, vascular plants (Ericsson 2005)
Lichens *(Moberg & Holmåsen, 2000)*
Lichen compendium, NILS *(Hylander & Esseen, 2005)*
Mosses *(Hallingbäck & Holmåsen, 2000)*
Moss compendium, NILS *(Weibull, 2004)*
Tree and bush flora
CD-R
NILS landscape square maps
Forms
Note paper
Office tools, scissors, ruler, pens, etc.
Forms, sample plot location
Forms, division of sample plot
Archive bag

Car equipment
First aid kit + first aid articles
Small first aid kit
Car folder (phone numbers, gasoline credit cards etc.)
C
Car map

Field equipment
Backpack 130l (alpine backpack)
Backpack with rain-gear
Field vest
Height measuring pole, 3 m
Water depth gauge
Soil probe
Mini soil probe (alpine probe)
Soil sample spade
Stapler with extra staples
Axe
Caliper
Carpenter belt, cutters' tape measure holder
Knives (2+1)
Geology hammer
Safety glasses
Sighting compass
Compass Silvia expedition
Mirror compass
Relascope**,** three columns
Relascope**,** small black model
Tape measure, 50 m
Tape measure (20 m + 25 m)
Folding yardstick
Diameter tape measure
Monopod; Center pole (for distance gauge)
Tripod (for distance gauge)
Line for line inventory, 50 m
Saw, small
Tape measure, 1.5 m, with diameter scale
Rising-plate meter
Alpine kit (tent, sleeping mat etc.)
Seat cushion
Rubber boat incl. life-jackets (if needed)
Tool-kit
Leatherman multi-tool
Flashlight
Masonite board for soil samples tests
Water bottle
Packing boxes for equipment

Miscellaneous consumables

Blue paint for tree marking; not permanent
Red paint for sample plot marking; permanent
Wooden sticks
Matches
Aluminum markers with plastic tops
Work gloves; 2 classic, 2 rubber, 2 suede
CRC 5-56 universal lubricant
Batteries 1.5 volt AA
Battery charger
Packing tape, duct tape, office tape
Paper bags for collection of specimens
A4 envelopes
Bug spray
Zinc balm

APPENDIX 11: FIELD COMPUTER AND THE DATA COLLECTION PROGRAM

General

NILS VB was in 2005 a new program for data collection. It is written in eMbedded Visual Basic and can only be run on a field computer (Allegro) that uses the Window CE operating system**.** The following is a short description of the most important functions and a flowchart of the menus.

Checking the battery capacity: Click start, settings, control panel, power. NOTE: In order to save the batteries, use "Automatically turn off while on battery power" and "Turn off after 1 minute".

Changing batteries: When changing batteries, have the new batteries on hand so you can change without delay. The Allegro can only handle a few minutes without a battery.

Change background lighting: Click start, settings, control panel, display.

Change volume and sound: Click start, setting, control panel, volume.

Touch screen: Use "reasonable" pressure on the screen. During normal working procedures, leave the touch screen off to avoid unintentional jumping between program menus. This is especially important during line inventory when the screen can be exposed to branches etc. If it gets difficult to use the screen, calibrate by clicking start, settings, control panel, stylus. Follow the instructions.

KEY	FUNCTION
On/Off	Use during pauses in the inventory. NOTE: If on/off is held down for more than 8 seconds, the system will RESET. This means that all programs close down. Normally saved data is retained, but data can be lost in menus that have not been saved (i.e. closed).
Enter	Confirming given code at EXIT.
BkSp	Backspace. Erases symbols during feed.
Blue+TS	Turns on/off the touch screen.
Blue+Start	Opens the WindowsCE Start menu.
TAB	Left TAB jumps one step up in the menu and right TAB jumps one step down in the menu.
Arrow DOWN/UP	Is used in presence and cover menus while moving between species. In the other species and alternative list menus, the arrows have a scrolling function.
F1	Shows function buttons.
F3	Shows division of sample plot. ESC switches back to the menu.
F5	Switches focus to the right window. ESC switches back to the menu.
Yellow+F4 (half moon)	Lessens contrast.
Yellow+F5 (full moon)	Increases contrast.

Structure of the NILS program

The NILS program includes around 50 menus in a hierarchical system with sub-menus. A data table is connected to many of the menus (program menus).

NOTE: It is only when code=3 is indicated and the ENTER button is pressed at EXIT that the data is saved in a data table.

The text shown on the screen depends on the content of the menu in question, but is also decided by so called flow-directing variables. When a menu is first opened, all variables up until the first flow-directing variable can be selected for registration of values, while the variables below “gray”. The appropriate variables will then be activated depending on which flow-directing alternative is chosen.

Identity variables

In order to keep track of which “object” (landscape square, sample plot, section, line-/point feature, distance, etc.) to register, identity variables are used, i.e. variables that create an identity post. These are then saved in different data tables and create a unique identification of the object, i.e. there can never be two objects with the exact same identity. NOTE: Make sure to check that the identity is entered correctly for the object in question.

Variables with normal format or blank format

For normal variables, a valid entry must be registered – the data field can not be left blank. Variables with blank format need not be entered; the data field can be left blank and skipped. Blank format is used in all menus where cover or presence of several species is registered. If a species is not present, leave the field blank (do not enter 0!).

Handling errors

The program demands that the variables in question have a correctly entered value before the menu can be exited.

See chapter 5.2 for error correction in linear features and inventory boundaries. If a mistake occurs that can not be changed in the program, file an error report (blue form, Appendix 2). Carefully check that the information entered in the program is correct, especially for identities (square, sample plot, section, line, distance etc.).

If the program freezes on any of the variables, it can be activated by touching the screen.

Start and close the NILS program

The program is started by double-clicking the NILS icon and pressing the ENTER-button when the welcome screen is shown. To end the program, you must exit a Square and then press ESC.

If the NILS program freezes

RESET (press on/off button down for at least 8 seconds) can be used as a last resort if the program freezes completely. Always contact NILS personnel every time there is a problem. See special instructions.

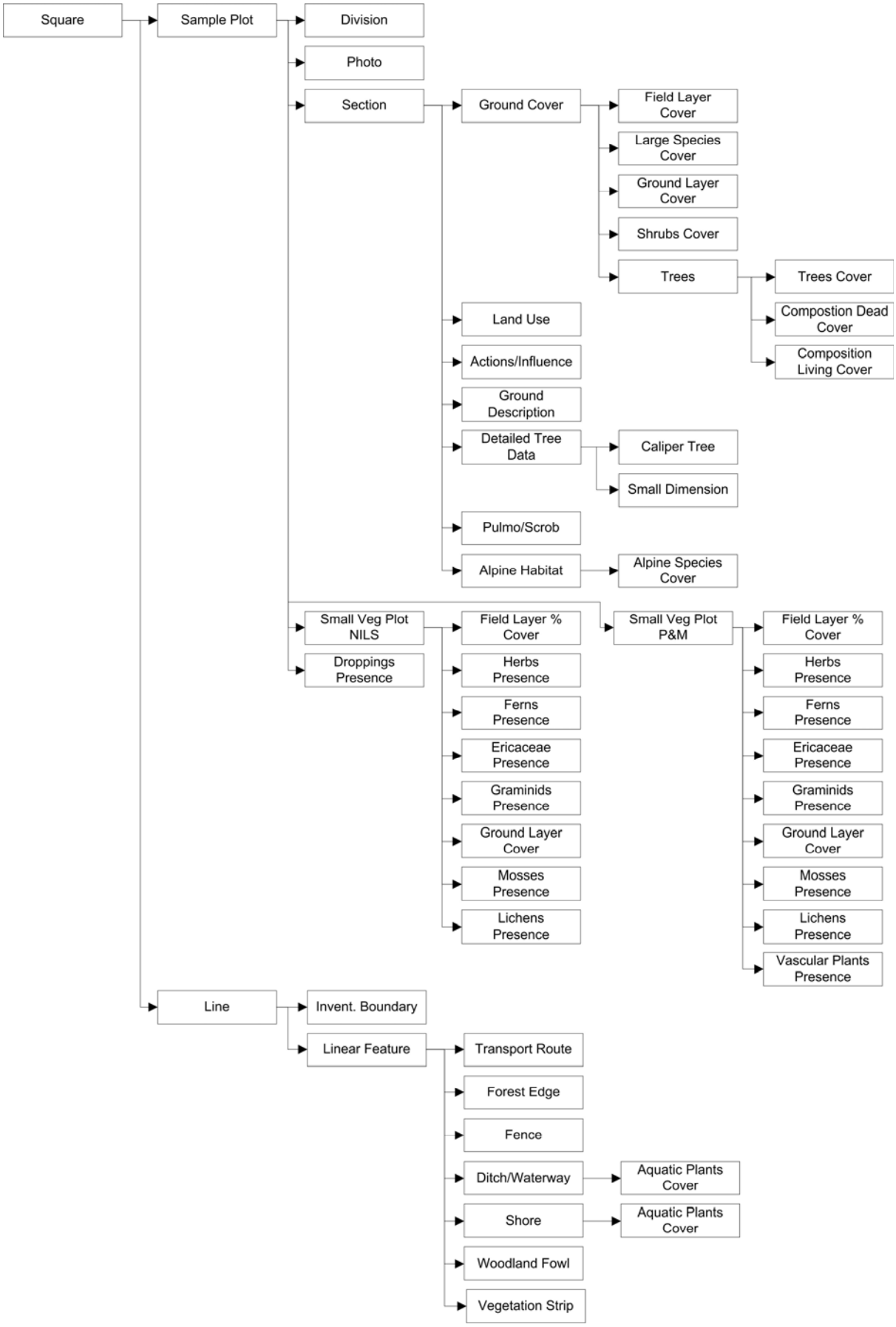


Figure A9.Flow of menus in the NILS data collection program.

APPENDIX 12: GARMIN GPS 72

Instructions of how to use the Gamin GPS 72 is found in the Garmin Handbook. The information below mainly consists of important details and working procedures. For a beginner it may be a good idea to play around with the GPS, preferably with the instruction book handy. It will then be easier to find the menus and functions referred to here. If you do this indoors, use the "simulator-mode" in order to avoid the warning beeps of a non-existent satellite contact.

Menu SYSTEM, tips and settings

All settings below are made in the main menu under Systems.

Signal and WAAS, tab: General.
If you want to remove the annoying beep that comes with each key stroke, set "Beeper" to be active only for messages, or turn it off all together.

WAAS (USA) and EGNOS (Europe) is a correction system that results in more accurate positioning. The system is fully operational in Europe as of 2004 and should therefore be used in order to achieve the highest accuracy. Set WAAS to “enabled”.

Time setting, tab: Time
Select either 12 or 24 hours.

Select "Other" under time-zone set UTC Offset to + 02:00 during daylight savings time. During the winter months the setting is UTC Offset + 01:00.

Units, tab: Units
Make sure the distances are measured in meters and the bearings in degrees.

Showing coordinates, tab: Location
To get the GPS to show coordinates in the Swedish grid (RT 90) check that the settings are as follows: Location format = RT 90, Map datum = RT 90 and North reference = True.

Arrival warning, tab: Alarms
The alarm that sounds when you get near the point you are navigating to, can be pre-set. An appropriate distance for the alarm is 20 meters. An alternative is to turn the sound off all together.

Tab: interface
Serial Data Format should be set to Garmin.

Other tips or settings

In order to save the batteries, the tracking function can be turned off. This is a good idea if there is no special reason not to. From the main menu, open "Tracks" and click the menu; Setup Track Log becomes available. If you still want to use the tracking function, it may be a good idea to erase the old tracks now and then.

It is possible to show the navigation pages to suit your needs. Go to the page you want to modify, click Menu and select Setup Page Menu and then Change Data Fields. Bearing and Distance to the next point must always be shown, the other information can be changed to suit your needs.

Transferring Coordinates

Note that the file format is dBase (*.dbf) when downloading files to the GPS, but when saving the files on the computer, they should be in text format (*.txt). Download the coordinates to the hard drive and to a CD with the help of the GPS utility program after each landscape square.

Downloading coordinates from computer to GPS

- Start the program GPS Utility and make sure all the settings are correct. Under "Options<General" check that the first "loadable grids" are "Sweden", absolutely not "SWEDISH GRID" or anything else, change all three to "SWEDEN" just to be sure.
- Under "File<Open" select file format "dBase", locate and open the file in question.
- Make sure WGS 84 is selected for the coordinate page in the upper right scroll bar and that "Sweden" is selected in the scroll bar to the left. Check to make sure the coordinates are correct.
- Start the GPS, erase non-essential waypoints, if any, and then connect the chord.
- Click Ctrl + u, select "GPS < Upload All" in the program menu, or click on the button with the blue arrow far to the left on the coordinate page menu to upload. When the upload is complete the GPS will beep, if the alarm system is not turned off. Check in the GPS "Points<Waypoints" that all the waypoints are loaded properly and check to make sure they are OK.

Downloading coordinates from GPS to computer

- Start the program GPS utility and make sure all the settings are correct. Under "Options<General" check that the first "loadable grids" are "SWEDEN". Check that the GPS is on.
- Click Ctrl + d or select "GPS <Download All" in the program menu. Remove all check marks except "Waypoints" and start the download.
- Make sure that everything looks good on the data page, save in file format .txt in the correct folder and name the file correctly. If the data page contains mysterious breakpoints, e.g. from earlier areas, or if you also downloaded trackpoints, they are easily removed. Mark the points you do <u>not</u> want to save and select in the menu "Record<Cut Marked", select in the dialog window "highlighted" and click OK. Select file format .txt and then click the "Save As" button and save in the correct folder and name the file correctly. If you are uncertain that the file was saved correctly, re-it open and check what was saved.
- After the download is complete and the waypoint file is saved both on the computer and on the CD, all waypoints can de deleted in the GPS and new ones can be uploaded.
- NOTE: Bring spare batteries in the field.

APPENDIX 13: COMPASS BEARING AND MAPS

Coordinates (from the Swedish Land Survey's web-page)

The map projection of Sweden can be illustrated as a cylinder touching the ellipsoid along a meridian, the central meridian. The points are depicted (projected) on the cylinder. The cylinder is unfolded to create a flat map. Only the central meridian is shown as a straight line, the other meridians are arched toward it.

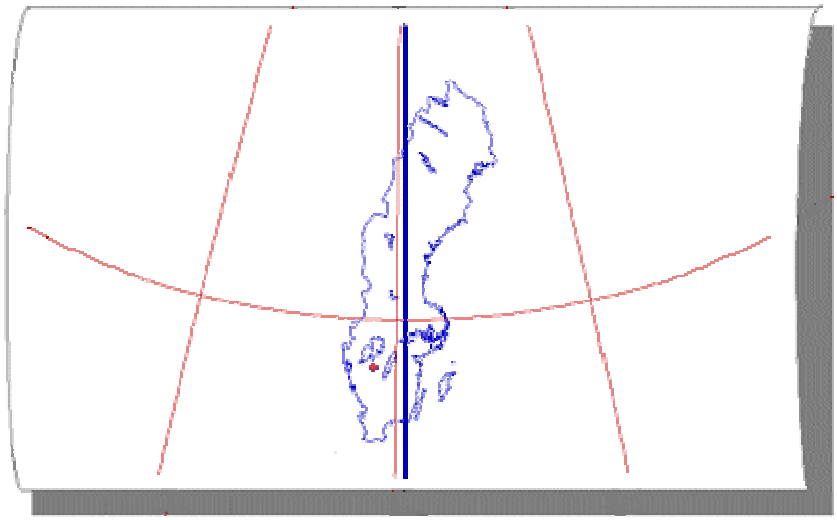


Figure A10: Central meridian for Sweden with converging meridians.

If the central meridian is set to 2.5 gon west (400 gon or "grades" = 1 revolution = 360°) from Stockholm's old observatory, which equals 15°48'29.8" east Greenwich, we will arrive at the projection system for general Swedish maps. The true origin of the coordinates is where the central meridian intersects with the equator, more than 6 100 kilometers south of Sweden.

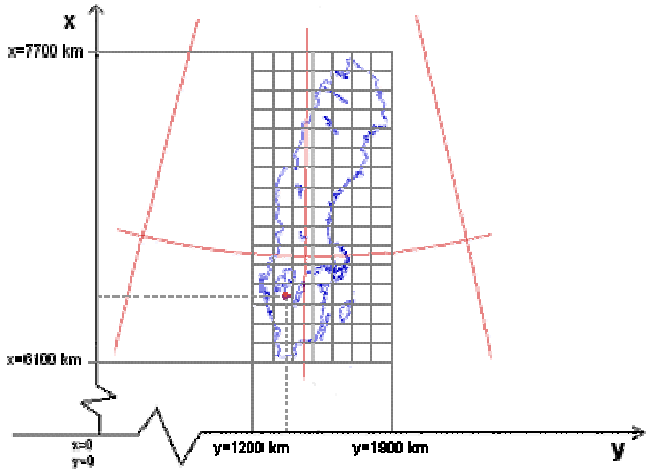


Figure A11: Flat coordinate system with the central meridian image as the x-axis.

We get a flat coordinate system with the central meridian's image as an x-axis, and the equator as a y-axis. (In Sweden and some other countries, the north axis is usually named x, and the east axis is named y.) In order to avoid negative y points, the standard is to add 1 500 kilometers. In other words, points on the central meridian have

a y coordinate of 1 500 kilometers (1 500 000 meters). The entire country of Sweden then gets x- and y-coordinates in meters with 7 digits, e.g. the cathedral of Skara with the approximate coordinates x = 6 476 100 m, y = 1 361 700 in the Swedish Grid (RT 90) 1990 gon V 0:- 15). A right-angled grid can now be created in RT90, which covers the entire country. This grid is also the foundation of Swedish maps.

Example

The black grid in the example map (figure A12) is shown in RT90, and the numbers in the frame of the map are given in kilometers (printed in black) in the page corners. In between, only the two last digits for each line in the grid are indicated. One square on this map is 2 x 2 km, in e.g. the Terrain Map (The Green Map) the squares are 1 km. In the bottom corner (SW) in the example picture (figure A12) the north coordinate is (x) = 6 700 km (6 700 000 m) and the east coordinate is (y) = 1525 km (1 525 000 m). The grid for degrees is printed in brown with red digits (degrees and minutes). The marked point 1 has the positional latitude 60°50' and longitude 16°20'. The marked point 2 has the RT90 position x = 6 746 000 meters, y = 1 530 000 meters. For points between the lines in the grid, draw lines at right angles to the map edge, and estimate or measure the closest kilometer numbers. For example, the marked point 3 has the position x = 6 703 000 m, y = 1 531 000 meters in RT90.

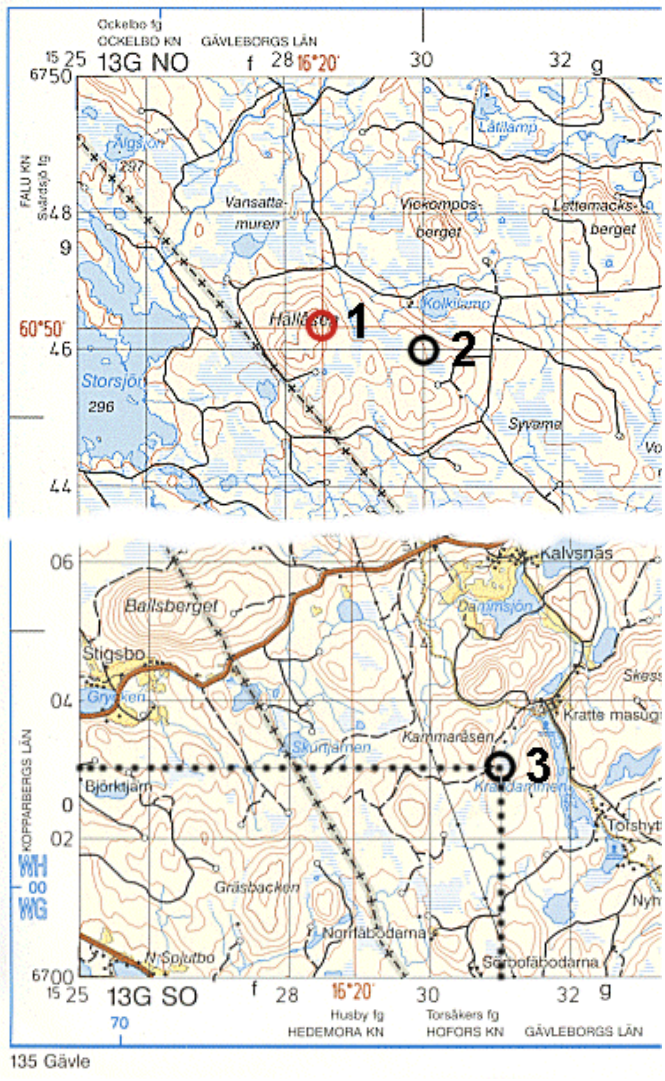


Figure A12: Map example from Road Map/Blue Map illustrating how coordinates are indicated.

Navigating with a compass

1. Before starting, place the compass on the map with its longest side pointing from where you are to the point you want to reach (figure A13), in other words with the direction arrow in the desired direction on the map.
2. Turn the compass housing until N on the graduated circle points toward north on the map. Check that the lines on the compass housing are parallel with the meridians on the map (north-south lines).
3. Keep the compass horizontal in your hand in front of you. Turn your body until the red tip of the compass needle points toward N in the compass housing. The arrow in the very front of the compass rule plate now shows the correct navigation direction. Look up, take aim at an object in the terrain and walk toward it.

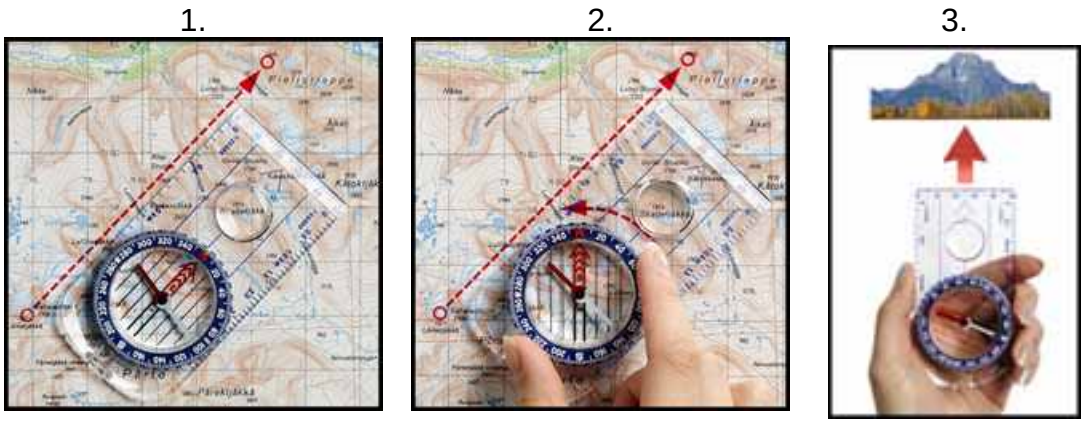


Figure A13: Navigating with compass.

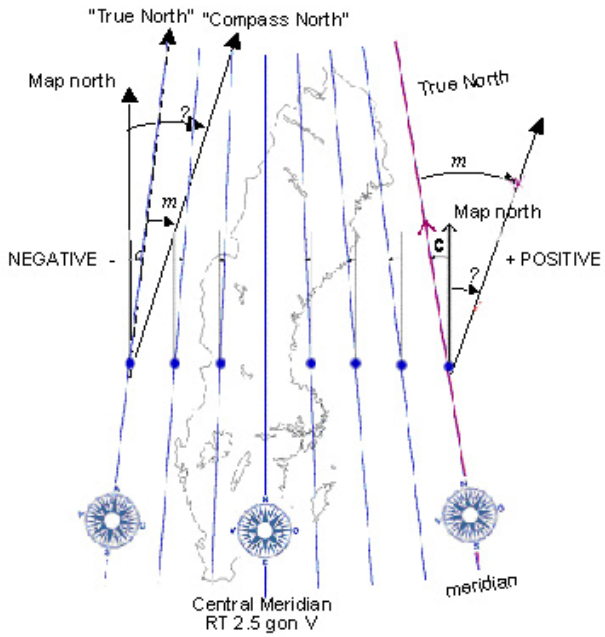


Figure A14: Meridian convergence in Sweden showing the angles that may need adjusting when correcting the compass deviation. Modified figure from the Swedish Land Survey's web-page, with angles and directions inserted.

Compass deviation

Meridian convergence in Sweden with the angles that may need adjusting. Adjustments are based on the angle between "compass north" and "map north". The direction and angle of "compass north" in the figure above (A14) is a rough indication to illustrate the principle, but in most parts of the country, the deviation is easterly. C = meridian convergence and d = deviation in the explanation below.

East of the central meridian, c is positive. West of the central meridian, c is negative. For easterly deviation d is positive, and for westerly deviation d is negative. In order to walk in a "Map north" direction, the right course is c - d. The convergence and deviation often negate one another, and the result is only one or two degrees off, but to the west of the central meridian, the convergence is negative (see above) and the resulting compass deviation can be up to 4 or 5 degrees. A simple method to compensate for c and d is to place the compass in "map north" and turn the compass housing toward a meridian and after that adjust for deviations. Information about the deviance in the area is found on NILS field maps.

APPENDIX 14: SPECIES LISTS

Trees

Cover (00-99%). Enter “00” if the cover is less than 0.5 % (i.e. 1.5 m^2 in an un-divided sample plot). Sallow and willows under 20 mm are considered shrubs.

11 *Pinus silvestris*
12 *Pinus mugo*
15 *Pinus cembra*
81 *Pinus contorta*
14 other *Pinus* spp.
13 *Larix decidua*
21 *Picea abies*
22 Exotic *Picea* spp.
23 *Abies* spp.
24 *Taxus baccata*
29 Other exotic coniferous trees
30 *Betula spp.*
41 *Populus tremula*
42 Other *Populus* spp.
51 *Quercus* spp.
61 *Fagus sylvatica*
62 *Aesculus hippocastanum*
71 *Fraxinus excelsior*
72 *Ulmus* spp.
73 *Tilia* spp.
74 *Acer platanoides*
93 Other *Acer* spp.
75 *Carpinus betulus*
76 *Prunus avium*
77 *Prunus padus*
78 *Prunus domestica*
83 *Malus spp.*
84 *Pyrus malus*
91 *Alnus glutinosa*
92 *Alnus incana*
94 *Salix caprea*, diam >20 mm
82 *Salix pentandra*/*fragilis*/*alba*/*triandra*
95 *Sorbus aucuparia*
97 *Sorbus intermedia*
96 Other broad-leaved trees

Shrubs

Cover (00-99%). Enter “00” if the cover is less than 0.5 % (i.e. 1.5 m^2 in an un-divided sample plot).

0	Dead decidiuous shrubs	35	*Crataegus spp.*
1	*Juniperus communis*, living	36	*Prunus spinosa*
2	*Juniperus communis*, dead	52	*Cytisus scoparius*
10	*Salix* (partly)	40	*Evonymus europaeus*
11	*Salix myrsinites*	50	*Rhamnus catharticus*
12	*Salix glauca/lanata/lapponum*	51	*Frangula alnus*
13	*Myrica gale*	60	*Daphne mezereum*
14	*Betula nana*	61	*Hippophae rhamnoides*
15	*Corylus avellana*	70	*Cornus sanguinea*
16	*Berberis vulgaris*	71	*Cornus alba ssp. stolonifera*
20	*Ribes* (partly)	72	*Hedera helix*
21	*Ribes uva-crispa*	80	*Ligustrum vulgare*
22	*Ribes alpinum*	81	*Syringa vulgaris*
25	*Spiraea spp.*	85	*Sambucus racemosa*
26	*Rubus idaeus*	86	*Sambucus nigra*
27	*Rubus caesius*	87	*Viburnum opulus*
28	*Rubus* (partly)	88	*Symphoricarpos rivularis*
30	*Rosa* (partly)	90	*Lonicera periclymenum/caprifolium*
31	*Rosa rugosa*	91	*Lonicera xylosteum*
32	*Potentilla fruticosa*	92	*Lonicera caerulea*
33	*Amelanchier spp.*	99	Other shrubs
34	*Cotoneaster spp.*		

”Dead shrubs” refer to completely dead individual shrubs.
“Salix (partly)” refers to all species of the genus *Salix*, except sallow (*Salix caprea*) and willows over 20 mm diameter at breast height (considered trees), *Salix myrsinites*, *S. glauca* and *S. lanata* (separate group), and *Salix reticulata*, *S. herbacea* and *S. polaris* (included in the field layer).
All other lignified, bush-like apecies which are not included in the species list for trees and can not grow to tree height are included in “other shrubs”. Sallow and willows smaller than 20 mm (diameter at breast height) are included in the shrub layer. Thicker specimens are included in the tree layer.
Rowan (*Sorbus acuparia*) is always considered a tree.
Dwarf shrubs of the genus *Ericaceae* are always included in the field layer.

Large species
Cover 00-99% (inventoried in the 10 m sample plot).

Pteridium aquilinum
Urtica dioica
Aconitum lycoctonum
Trollius europaeus
Filipendula ulmaria
Lupinus spp.
Impatiens glandulifera
Epilobium angustifolium
Angelica sylvestris
Angelica archangelica
Heracleum mantegazzianum
Solidago canadensis/*gigantea*
Cicerbita alpina
Juncus effusus/*conglomeratus*
Glyceria maxima
Phalaris arundinacea
Phragmites australis
Schoenoplectus lacustris/*tabernaemontani*
Cladium mariscus
Typha spp.
Carex aquatilis
Carex cespitosa/*juncea*/*elata*
Carex acuta

Alpine species
Cover 001.100 dm^2, 001-314 m^2 (inventoried in the 10 m sample plot). Dm^2-accuracy if the cover is less than 1 m^2.

Selaginella selaginoides
Gentiana nivalis
Silene acaulis
Poa alpina
Thalictrum alpinum
Dryas octopetala
Petasites frigidum
Saussurea alpina
Astragalus alpinus
Saxifraga aizoides
Cassiope tetragona
Carex rupestris
Bistorta vivipara
Bartsia alpina

Aquatic plants
Cover 00-99% (in ditch/waterway and shore, 10 m wide zone).

Equisetum fluviatile
Juncus effusus/conglomeratus
Glyceria maxima
Phragmites australis
Typha spp.
Schoenoplectus lacustris/*tabernaemontani*
Cladium mariscus
Carex aquatilis
Carex cespitosa/*juncea*/*elata*
Carex acuta
Other helophytes
Nymphaea spp., *Nuphar* spp.
Other aquatic plants with floating leaves
Lemna spp., *Spirodela* spp.
Cladophora spp.,

Aquatic plants are rooted under water, but grow upright and a substantial amount of the leaves are above water. Several species can also grow on temporarily dry ground. *Sparganium emersum* and *Glyceria fluitans*, which sometimes have floating leaves, are also included. NOTE: Terrestrial plants hanging over the water and not normally tolerant too flooding (e.g. *Filipendula ulmaria* and *Ranunculus repens*) are not included.

Plants with floating leaves and free-floating plants:
These are rooted on the bottom, but the leaves are floating on the water surface, e.g. *Nymphaea* sp. and *Potamogeton natans*. Included in “other aquatic plants with floating leaves” are e.g. *Sagittaria natans* and *Potamogeton* sp.
Lemna sp. belong to a separate group, while other free-floating species (e.g. *Hydrocharis morsus-ranae*) is included in “Other aquatic plants with floating leaves”.

Cladophora sp.:
Fine-thread algae, looks like fibrous slime and grow in dense clumps or rugs on the bottom. Sometimes it also floats on the surface.

Plants in the field layer – Species inventoried in the small vegetations plots.

Ferns
Presence in 0.25m^2 small vegetation plots.

10 *Huperzia selago*
11 *Lycopodium annotinum*
12 *Lycopodium clavatum*
13 *Diphasiastrum alpinum*
14 *Selaginella selaginoides*
20 *Equisetum arvense*
21 *Equisetum fluviatile*
22 *Equisetum sylvaticum*
30 *Pteridium aquilinum*
31 *Phegopteris connectilis*
32 *Athyrium distentifolium*
33 *Gymnocarpium dryopteris*
34 *Polypodium vulgare*

Ericaceae (dwarf shrubs)
Presence in 0.25m^2 small vegetation plots.

80 *Vaccinium vitis-idaea*
81 *Vaccinium myrtillus*
82 *Vaccinium uliginosum*
83 *Empetrum* spp.
84 *Loiseleuria procumbens*
85 *Phyllodoce caerulea*
86 *Cassiope tetragona*
87 *Erica tetralix*
88 *Calluna vulgaris*
89 *Rhododendron tomentosum (=Ledum palustre)*
90 *Andromeda polifolia*
91 *Oxycoccus* spp.
92 *Arctostaphylos alpinus*
93 *Arctostaphylos uva-ursi*

Graminids
Presence in 0.25m^2 small vegetation plots.

53 *Deschampsia flexuosa*
54 *Deschampsia cespitosa*
40 *Luzula pilosa*
41 *Juncus filiformis*
42 *Juncus effusus/conglomeratus*
43 *Juncus trifidus*
50 *Dactylis glomerata*
51 *Melica nutans*
60 *Glyceria maxima*
61 *Calamagrostis canescens/purpurea*
62 *Calamagrostis arundinacea*
63 *Phragmites australis*
64 *Molinia coerulea*
65 *Nardus stricta*
70 *Typha* spp.
71 *Trichophorum cespitosum*
72 *Eriophorum angustifolium*
73 *Eriophorum vaginatum*
74 *Carex globularis*
75 *Carex pauciflora*

Vascular plants

Presence in 0.25m^2 small vegetation plots (Ericsson, 2005).

100 *Salix reticulata*
101 *Salix herbacea*/*polaris*
201 *Urtica dioica*
210 *Polygonum aviculare*
212 *Bistorta vivipara*
214 Other *Rumex* spp.
216 *Rumex acetosa*
218 *Rumex acetosella*
220 *Stellaria media*
221 *Silene acaulis*
230 *Aconitum lycoctonum*
231 *Anemone nemorosa*
232 *Hepatica nobilis*
233 *Trollius europaeus*
234 *Caltha palustris*
235 *Ranunculus repens*
236 *Ranunculus acris*
237 *Thalictrum alpinum*
240 *Drosera* spp.
241 *Sedum acre*/*album*/*annuum*, etc.
242 *Rhodiola rosea*
250 *Parnassia palustris*
260 *Filipendula vulgaris*
261 *Filipendula ulmaria*
262 *Rubus chamaemorus*
263 *Rubus arcticus*
264 *Rubus saxatilis*
265 *Dryas octopetala*
266 *Geum* spp.
268 *Potentilla palustris (=Comarum palustre)*
269 *Potentilla argentea*
270 *Potentilla erecta*
271 *Fragaria vesca*
272 *Alchemilla alpina*
273 Other *Alchemilla* spp.
280 *Lupinus* spp.
281 *Astragalus alpinus*
282 *Lathyrus linifolius*
283 *Trifolium repens*
284 *Trifolium pratense*
285 *Trifolium medium*
290 *Oxalis acetosella*
300 *Geranium sylvaticum*
310 *Hypericum* spp.
320 *Viola palustris*
321 *Viola biflora*
330 *Epilobium angustifolium*
340 *Cornus suecica*
350 *Anthriscus sylvestris*
351 *Pimpinella saxifraga*
352 *Aegopodium podagraria*
353 *Angelica sylvestris*
354 *Angelica archangelica*
360 *Orthilia secunda*
371 *Primula veris*/*elatior*
372 *Trientalis europea*
380 *Menyanthes trifoliata*
390 *Galium verum*
391 *Galium album*
392 *Galium boreale*
400 *Ajuga pyramidalis*
410 *Veronica officinalis*
411 *Melampyrum pratense/ sylvaticum*
412 *Euphrasia* spp.
413 *Bartsia alpina*
414 *Pedicularis palustris*
415 *Pedicularis lapponica*
416 *Rhinanthus* spp.
420 *Plantago major*
421 *Plantago media*
430 *Linnaea borealis*
440 *Valeriana* spp.
500 *Solidago virgaurea*
501 *Gnaphalium sylvaticum*
502 *Gnaphalium norvegicum*
503 *Antennaria dioica*
504 *Achillea millefolium*
505 *Tussilago farfara*
506 *Petasites frigidum*
507 *Saussurea alpina*
508 *Cirsium helenoides*
509 *Cirsium arvense*
510 *Cicerbita alpina*
511 *Taraxacum* spp.
512 Other *Hieracium* spp.
513 *Hieracium coll. Alpina*
514 *Pilosella* spp.
601 *Tofieldia pusilla*
602 *Narthecium ossifragum*
603 *Convallaria majalis*
604 *Maianthemum bifolium*
605 *Paris quadrifolia*

Mosses

Presence in 0.25m^2 small vegetation plots (Weibull, 2004).
S = solid ground, W = Wetland.

10	*Pleurozium schreberi*	W, S
11	*Hylocomium splendens*	W, S
12	*Ptilium crista-castrensis*	S
13	*Rhytidiadelphus squarrosus*	S
14	*Rhytidiadelphus triquetrus*	S
15	*Abietinella abietina*	S
16	*Campylium stellatum coll.*	W
17	*Calliergonella cuspidata*	W, S
18	*Climacium dendroides*	S
19	*Helodium blandowii*	W
20	*Plagiothecium undulatum*	S
21	*Scorpidium scorpioides*	W
22	*Tomentypnum nitens*	W
30	*Dicranum majus*	S
31	*Polytrichum commune*	W, S
32	*Polytrichum juniperinum*	S
33	*Polytrichum piliferum*	S
34	*Polytrichum strictum*	W
35	*Cinclidium stygium*	W
36	*Leucobryum glaucum*	S
37	*Paludella squarrosa*	W
38	*Plagiomnium undulatum*	S
40	*Plagiochila asplenioides*	S
50	*Sphagnum capillifolium*	S
51	*Sphagnum fimbriatum*	W
52	*Sphagnum fuscum*	W
53	*Sphagnum lindbergii*	W
54	*Sphagnum magellanicum*	W
55	*Sphagnum papillosum*	W
56	*Sphagnum riparium*	W
57	*Sphagnum squarrosum*	W, S
58	*Sphagnum tenellum*	W
59	*Sphagnum teres*	W

Lichens

Presence in 0.25m^2 small vegetation plots (Hylander & Esseen, 2005).

Fruticose lichens

10 *Cladonia* group *Cladina*
11 *Cetraria islandica, C. ericetorum, Cetrariella* spp.
12 *Flavocetraria nivalis*
13 *Flavocetraria cucullata*
14 *Stereocaulon* spp.
15 *Sphaerophorus* spp.
16 *Thamnolia vermicularis*
17 *Alectoria ochroleuca*
18 *Alectoria nigricans*

Foliose lichens

20 *Nephroma arcticum*
21 *Peltigera aphthosa, P. leucophlebia*
22 *Peltigera*, delvis
23 *Solorina crocea*
24 *Umbilicaria* spp.
25 *Lasallia pustulata*

Crustose lichens

30 *Rhizocarpon*, delvis

Vascular plants in semi-natural pastures and meadows
Presence in 0.25m^2 small vegetation plots in semi-natural pastures and meadows.

NOTE: Species marked with a * are present both in this menu and in the regular menus for the small vegetation plots in NILS (Vascular plats, Ferns and Graminids). Please check that presence of these species is registered in both menus!

*Aconitum lycoctonum**
*Ajuga pyramidalis**
Alchemilla spp.*
*Antennaria dioica**
Armeria maritima
Arnica montana
*Bartsia alpina**
*Bistorta vivipara**
Botrychium spp.
Briza media
Campanula rotundifolia
Cardamine pratensis
Carex hostiana
Carex panicea
Carlina vulgaris
Centaurium spp.
*Cirsium helenoides**
Crepis praemorsa
Dactylorhiza incarnata
Dactylorhiza maculata
Danthonia decumbens
Dianthus deltoides
Epipactis palustris
Euphrasia spp.*
Festuca ovina
*Filipendula vulgaris**
*Galium verum**
Gentiana pneumonanthe
Gentianella campestris
Gymnadenia conopsea
Helianthemum spp.
Helictotrichon pratensis
Hypochoeris maculata
Leontodon hispidum
Leucanthemum vulgare
Linum catharticum
Lotus corniculatus
Luzula campestris
Luzula multiflora m.fl.
Lychnis flos-cuculi
*Melampyrum pratens/sylv**
*Nardus stricta**
Ophioglossum vulgatum
Orchis mascula
*Parnassia palustris**
*Pedicularis palustris**
Pedicularis sylvatica
Phleum alpinum
Pilosella sp.*
*Pimpinella saxifraga**
Pinguicula palustris
Plantago lanceolata
Plantago media
Platanthera spp.
Poa alpina
Polygala spp.
Primula farinosa
*Primula veris/elatior**
Pulsatilla vulgaris
Rhinanthus spp.*
*Saussurea alpina**
Scorzonera humilis
*Selaginella selaginoides**
Serratula tinctoria
Succisa pratensis
Thymus serpyllum
Trifolium fragiferum
Triglochin maritimum
Triglochin palustris
*Trollius europaeus**
*Veronica officinalis**
Veronica spicata

APPENDIX 15. GLOSSARY

This glossary is NILS-specific and alternative explanations of words not concerning NILS are omitted. Definitions are as far as possible based on Skogsordlistan, Wikipedia, Wiktionary and the Swedish National Encyclopaedia. Other definitions are based on professional opinions.

a priori class
Pre-determined, objective class.

area unit
A demarcated geographical area, or *polygon*, described separately in the aerial photo interpretation.

arithmetic mean
Quotient of the algebraic sum of a series of observations and the number of observations (compare *basal area weighted mean*)

basal area
The area of a cross-section of a tree-trunk, or several tree-trunks. Basal area is measured at breast height for a number of trees and consists of the sum of all cross-sections. Stated in sq m/hectare. Measured with a *relascope*.

basal area weighted mean
Mean value based on the basal area (i.e. trees included in the *relascope* measurement). Results in a higher mean that e.g. *arithmetic mean*.

biotope
Habitat. Area with uniform ecological structure.

blank format
The data field is left blank (=empty) in the field computer if the species is missing. Entered value "00" indicates presence of up to 0.4%.

borderline tree
Tree on the verge of being counted when measuring the *basal area* with a *relascope*. These trees often need to be measured with a calliper in order to determine if they are to be counted or not.

breeding bird survey
Inventory performed by volunteers since 1975, and based on point inventory. Since 1996, 716 fixed routes are inventoried 3 times per year with random sampling. The fixed routes are scattered evenly over the entire country.

circular sample plot
Sample plot with a fixed center and radius. Circular sample plots can have the same center point but different radii. In NILS, 3 sample plots with different radii (3.5m, 10m, 20m) are positioned on the same plot center (fig. 1.1., chapter 1.3)

cleared area
Area along a road that has been cleaned (often by mowing or cutting on the road embankment) for increased visibility.

compass navigation
To walk in a certain direction using a compass.

concentric
With the same central point.

control inventory
Re-inventory of selected sample plots for quality control of the collected data. Appr. 5% of the sample plots are controlled every year.

cover estimation
Visual estimation of the vertical projection of a certain plant or group of plants. See also *diffuse cover*, *strict cover*.

cycle
(Time between) the re-inventory interval. In NILS, the cycle is 5 years, i.e. one individual *landscape square* is inventoried every 5 years.

detailed tree data
A more detailed description of trees not growing in forests. See chapter 4.10.

deviation
The difference in bearing between the compass needle (pointing towards the *magnetic north pole*) and the *geographic north pole*.

diffuse cover (estimation)
Cover estimation where the entire area within the periphery of the plant is considered fully covered. Often used for large organisms, e.g. trees. Compare *strict cover (estimation)*.

division train
Specific sequence of points that describe the periphery of a *section* of the 10 m sample plot. The points are described as *polar coordinates*.

ecotone
Transition area between *biotopes*.

environmental indicator
Species that is affected by certain environmental actions/influences. The purpose is to create awareness and provide a basis for planning and decision-making.

field layer
Herbs, grass, dwarf shrubs (Ericaceae) etc. See *vegetation layers*.

fixed point
A point which is clearly visible from the sample *plot center* and from which the location of the *plot center* can be found. Ideally, three fixed point are should be located 10-20 m from the *plot center* and marked

with permanent spray paint. See chapter 4.1.

flagship inventory
Inventory of a number of NILS *landscape squares* outside the regular random sample. These *landscape squares* have been established for educational purposes or by commission.

flow-directing variable
A variable which determines the following variables in the flow of the field computer program based on the information entered.

geographic stata
See *stratum.*

geographical north pole
The point on the northern hemisphere where the earth's axis of rotation intersects with the surface, 90 degrees north. Compare *magnetic north pole*.

GPS
Global Positioning System. Satellite-based positioning system.

ground layer
The lowest of four *vegetation layers*, includes bare *substrate*, mosses, lichens etc.

habitat
See *biotope*.

hectare
1 ha = 10 000 sq m = 100 x 100 m

high coast line
The highest water level that has been reached during or after the last ice age.

identity post
Unique identity (key identity) that makes it possible to identify a variable or post in the database. E.g. Square, Sample plot, Section, Line.

inventory
Examining and registering of pre-determined variables on location, according to specific instruction.

kilometer square
The central 1x1 km square in a NILS *landscape square*, and in which the field inventory and detailed aerial photo interpretation is performed.

landscape square
NILS random sample consists of 631 permanent landscape squares, 5x5 km. These are inventoried both with aerial photo interpretation and field inventory, i.e. *two-phase estimation*. The landscape squares are inventoried in a 5-year *cycle*.

line inventory
Inventory along a line, using a tape measure and a compass. All relevant *linear features* are registered. See chapter 5.

linear feature
Object of inventory, inventoried along a line. In NILS, six different types of linear features are registered. See chapter 5.

magnetic north pole
The pole in the earth's magnetic field close to the *geographic north pole*, and where the compass needle points.

mapped unit
An area (polygon) mapped during aerial photo interpretation. Smallest area 0.05 ha.

meridian convergence
The convergence that occurs since the earth is a sphere and all meridians gather in the geographic north pole.

nature conservation boundary (SNF)
Description of the frontier for the continuous forest close to mountains, above which all forest is considered to be protected. The boundary is established by interpretation of satellite images and input by a large number of local districts of the Swedish Society for Nature Conservation (SNF) close to the mountain region.

normal inventory
Inventory that is not *control inventory* or *flagship inventory*.

plot center
The center point of a *circular sample plot*. The plot center is described by theoretical coordinates in the *kilometer square's sample plot block*, *GPS* coordinates from the field inventory, and *fixed points*.

point feature
A small, non-linear feature that differentiates itself clearly from its surroundings, e.g. solitary trees, piles of rocks, buildings (hay barns, buildings in water), biotope islets, small pools of water etc.

polar coordinate
Horizontal distance and bearing (degrees) to a point in relation to a reference point in a coordinate system. In NILS, the reference point is the sample *plot center* and the reference bearing is north.

polygon
Geometric shape with multiple corners. In NILS, the aerial photo interpreters demarcate the landscape into polygons on the basis of vegetation or land use. They then describe each polygon separately. See also *area unit*.

production area
An area demarcated by both the natural conditions that influence the prerequisites for agriculture (e.g. bed-rock, soil parent material, topography or climate) and administrative boundaries (e.g. counties or parish boundaries). Sweden is divided into 8 larger production areas.

relascope
Instrument for measuring *basal area* in a stand of trees.

RT 90
The reference system all Swedish maps are based on. Also known as *Swedish grid*. Used for positioning oneself on maps produced by the Swedish Land Survey.

sample plot block
Several sample plots placed in a pre-determined pattern. In NILS, there is a sample plot block for each *circular sample plot* (fig. 1.1), as well as for each *kilometer square* (fig. 4.4).

sample plot inventory
Inventory of a *circular sample plot*.

sample plot location (form)
A form for describing *fixed points* for the *circular sample plot*. Used when locating the sample plot during re-inventory.

section (sample plot section)
A homogenous area of a *circular sample plot*, demarcated according to the rules of division (chapter 4.2) and described by a *division train*.

semi-natural pastures and meadows
Fenced in or in other ways demarcated areas, currently or previously used for grazing animals or small-scale hay-making. Demarcated by the Swedish Board of Agriculture's inventory of semi-natural pastures and meadows. Shortened in NILS to P&M.

shrub layer
All shrubs and bushes regardless of size. See *vegetation layers*.

sighting compass
Compass with aid for accurate measurement of bearing. When the compass is pointed towards something, a clearly visible scale appears.

signal species
Animal or plant species found in *habitats* with high natural value. A signal species should be easily recognized in the field.

small dimension
Tree higher than 0.5 m and with a diameter at breast height smaller than 39 mm. Registered in *detailed tree data*.

small vegetaion plot
Sample plot for registration of vegetation, with a radius of 28.2 cm (= 0.25 sq m).

square spacing
Spacing according to the corners of a network of evenly sized quadrates. Spacing is described as distance and positioning of forest plants or screefing.

stratum
Geographical area, demarcated both by natural and administrative criteria. Sweden is divided into strata in order to be able to separate normal variation from variation due to geographical conditions. See chapter 1.5.

strict cover (estimation)
Cover estimation where each individual leaf is considered separately. Results in a lower cover estimation than *diffuse cover*. Used on smaller organisms, e.g. shrubs and plants in the *field layer*.

substrate
The material on which a plant grows. Often soil, rock or peat.

Swedish grid
See *RT 90*.

train
A specific sequence of coordinates or points, see *division train*.

tree layer
1. All trees, regardless of height, see *vegetation layers*. 2. All trees of somewhat equal height.

two-phase estimation
Estimation of the same variables made in two different ways. The estimations are then compared in order to correct systematic errors. In NILS, estimations are made in both aerial photos and in the field.

vegetation layer
The vegetation is grouped vertically by sociological composition into four layers: *ground layer* (substrate, mosses, lichens etc.), *field layer* (herbs, grasses, dwarf shrubs etc.), *shrub layer* (all shrubs and bushes regardless of size) and *tree layer* (all trees regardless of size).

vertical projection
Two-dimensional projection of three-dimensional shapes perpendicular to the ground. Overlap is disregarded.

visual estimation
Estimation without using instruments.

APPENDIX 16. ADDRESSES

NILS
National Inventory of the Landscape in Sweden

Swedish University of Agriculture (SLU)
Department of Forest Resource Management
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http://nils.slu.se/