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# Oskarshamn site investigation

# Investigation of the amount of dead wood

Johan Andersson, FORAN Sverige AB

May 2005

**Svensk Kärnbränslehantering AB**
Swedish Nuclear Fuel
and Waste Management Co
Box 5864
SE-102 40 Stockholm Sweden
Tel 08-459 84 00
+46 8 459 84 00
Fax 08-661 57 19
+46 8 661 57 19

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*Keywords:* Vegetation inventory, Dead wood.

# Abstract

This study is part of the site investigation for a deep repository of spent nuclear fuel in the community of Oskarshamn. During 2002–2003, 4 vegetation sample sites was chosen and divided into compartments, based on their vegetation and tree layer characteristics. During 2003 an investigation of the amount of dead wood was conducted within these vegetation sample sites. The volume dead wood was registered with data of the tree species, decomposition class and position, divided on each compartment. The results showed an average of 1.89 $m^3$ per hectare, which are considerably lower than both the average for the region as well as for the whole country. This is probably due to the fact that large areas investigated contains of thin, nutrient poor pine forest, which are a low-producer of dead wood. The low turnover rate also makes the main part found very little decomposed.

# Sammanfattning

Inom projektet för undersökningarna av lämplig lokal för slutförvar av kärnbränsle i Oskarshamns kommun har en inventering av död ved genomförts. Under 2002–2003 delades 4 vegetationsprovytor (VPY), 87–170 ha stora, in i avdelningar som skildrade dess nuvarande vegetation och dess tillväxtsförutsättningar. Volymen av den döda veden registrerades, men även data om trädslag, nerbrytningsgrad och läge, fördelad på varje enskild avdelning. Resultatet visade på ett snitt på 1,89 $m^3$/ha, vilket är klart under snittet för både regionen, och för landet i stort. Detta beror med stor sannolikhet på att samtliga VPY:er är kraftigt dominerade av gles tallskog, en skogstyp vilken producerar låg mängd död ved. Den låga omsättningen i området gör också att huvuddelen av veden återfinns i nerbrytningsklass 1, mycket lite nerbruten.

# Contents

# 1 Introduction

A site investigation is an important step in the process of siting a deep repository for spent nuclear fuel. In spring 2001 SKB was interested in conducting thorough investigations in two municipalities; Oskarshamn and Östhammar. Each site investigation is divided into discipline-specific programmes for a number of disciplines. The discipline-specific programme for surface ecosystems aims at an all-round identification and characterization of the surface ecosystems for a comprehensive assessment of the biosphere conditions in the area. The site investigations of surface ecosystems are also supposed to furnish the information on area conditions that enable the site investigations to be carried out in consideration of nature conservation and environmental protection.

One part of the surface ecosystem programme is a general inventory of the area's production of dead wood. An estimate of the distribution within the area's biotopes is made. Existing information on the total quantity (biomass) of dead wood will later be compiled and calculated for different entities using the vegetation maps. Based on the biomass determination, the annual production of biomass will be calculated enabling estimation of material flows of carbon, water and nutrients. The original description of the amount of dead wood will also be used as a base line from which long-time monitoring can be performed. The amount of dead wood was inventoried during the autumn of 2003 in both the community of Forsmark and Oskarshamn.

The activity was performed according to Activity plan, SKB AP PS 400-02-007, (SKB internal controlling document), with addition dated 2003-06-03. This report describes the methods used and the results obtained from the inventories in Oskarshamn and an analysis of these results.

# 2 Material and methods

## 2.1 The Simpevarp area

The Simpevarp area (Oskarshamn community) is situated 30 km north of Oskarshamn. The investigation area is situated north and west of the nuclear power plant, see Figure 2-1. The area is located in the hemiboreal zone /Ahti et al. 1968/. Conifers dominate the forests but deciduous trees are present, especially in the vicinity of water.

The soils are mostly course moraines. Even if there are rich nutrient soils in the area, the dominating type is dry, nutrient poor rocky soils.

The land is mostly covered by forest. However, open acres and grazed pastures are present, especially in the Laxemar area, see Figure 2-2.

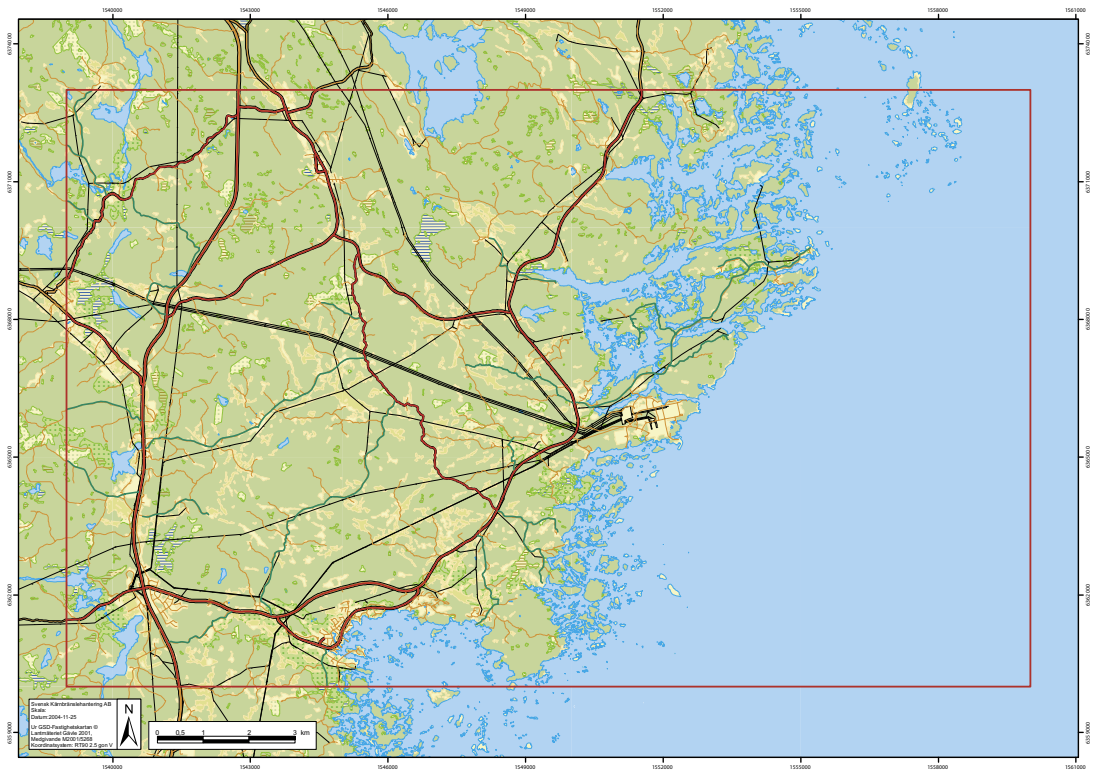

***Figure 2-1.*** *The Simpevarp area*

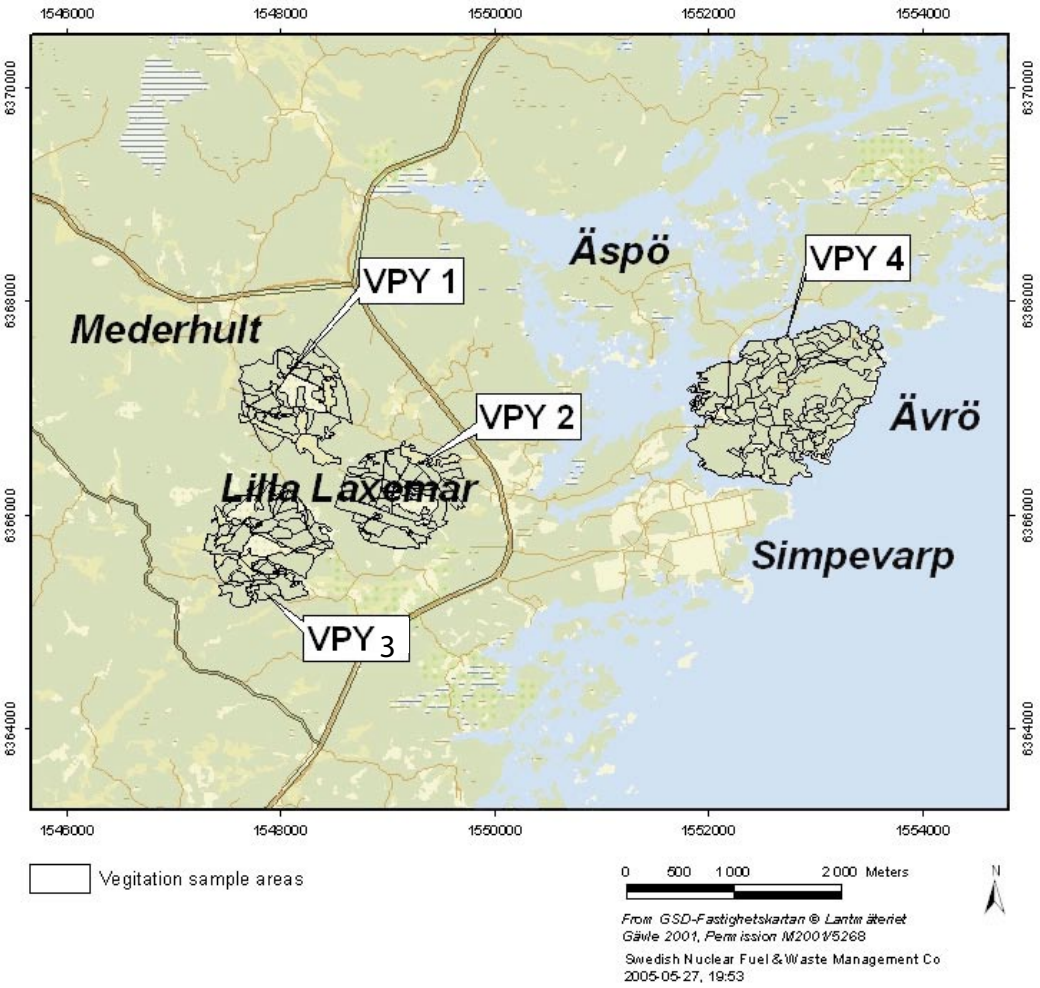


***Figure 2-2.*** *The investigated areas at Simpevarp. The borders of the compartments are viewed. TheVPY-numbers represent the vegetation sample areas investigated.*

## 2.2 Investigation methods

### 2.2.1 Identification of sample areas

The sampling sites were located in the same area investigated during the vegetation inventories /Andersson, 2004/. The sampling areas are in some cases connected to the places where the initial boreholes for geological investigations were planned to be located. A circle with a radius of 500 m was drawn around each potential drilling site. The location of all investigated areas at Simpevarp can be seen in Figure 2-2.

For each area ortophoto maps were studied. On the map (on screen), heterogeneous parts were divided by borders, so that areas with similar tree characters were delimited in compartments. Thereafter each area was visited. At this visit the borders drawn based on the maps were checked. The field layer characteristics were also studied. If sharp differences in the field layer were discerned, new borders were added. After this visit the borders between the compartments were built on both tree and field layer characteristics. The compartments are thereby describable units in the vegetation sample site. These compartments are the basic division for the dead wood inventory.

### 2.2.2 Parameters sampled

It this study there were a few restriction if the dead wood was to be registered or not.

1. The origin of the dead wood. Dead wood left behind from logging activities as cutting and thinning or from any other forms of human intervention was not included.
2. Logs with a diameter beneath 10 cm were not registered.
3. The volume is measured above the tree base including the bark and top. This is the most common way of measure tree volume in the field and is also used in the reference material.

The parameters sampled were; if the log was standing or lying down, what tree class it belonged to, the degree of decomposition and the volume.

To determine if the log was standing or lying down, the angel of the log was estimated. If it was beneath 45 degrees towards the ground it was decided to be lying. Otherwise it was regarded as standing.

The degree of decomposition was measured in a 5-grade scale, earlier used by The Swedish Environmental Protection Agency /Anon, 1999/ based on the percentage of volume still present, see Table 2-1.

**Table 2-1. The decomposition classes.**

| Class | Description | Comment |
|---|---|---|
| 1 | Less then 10% of original volume are missing or contains of soft wood. | Stem very little influenced by decomposing organism. |
| 2 | 10–25% of original volume are missing or contains of soft wood. | The rest contains of hard wood. |
| 3 | 25–50% of original volume are missing or contains of soft wood. | The rest contains of hard wood. |
| 4 | 50–75% of original volume are missing or contains of soft wood. | |
| 5 | 75–100% of original volume are missing or contains of very soft wood. | Core can still be present. |

The tree class used in this study, are based upon the likely decomposing rate of the wood, see Table 2-2.

**Table 2-2. The tree classes.**

| Tree class | Tree species |
|---|---|
| Pine | Scotch pine (Pinus silvestris) |
| Spruce | Norway spruce (Picea abies) |
| Birch and Aspen | Birch (Betula sp.) and Aspen (Populus tremula) |
| Oak and Beech | Oak (Querqus sp.) and Common beech (Fagus sylvatica) |
| Other brood leafs | Ash (Fraxinus excelsior), Linden (Tilia sp.), Norway maple (Acer platanoides) and Elm (Ulmus sp.) |
| Other trivial hard wood | Alder (Alnus sp.), Willow (Salix sp.) and Mountain ash (Sorbus aucuparia) |
| Undetermined | Unable to determine the species of the log |

The tree layer classes used for each compartment are based on the vegetation maps constructed by SwedPower /Boresjö Bronge and Wester, 2003/, see Table 2-3.

**Table 2-3. The tree layer classes used to group the compartments.**

| Classcode | Forest | Skogstyp (Swe) |
|---|---|---|
| 1 | No tree layer (<30% crown coverage) inside forest area | Trädskikt saknas innanför skogsmark |
| 2 | No tree layer (<30% crown coverage) outside forest area | Trädskikt saknas utanför skogsmark |
| 11 | Old spruce | Gammal gran |
| 12 | Young spruce | Ung gran |
| 13 | Old pine | Gammal tall |
| 14 | Young pine | Ung tall |
| 17 | Unspecified young conifer | Ospecificerad ung barrskog |
| 21 | Birch | Björk |
| 22 | Young birch (thicket on clear-cut) | Ung björk (på hygge) |
| 24 | Birch or oak mixed with spruce | Björk el ek blandat med gran |
| 25 | Oak | Ek |
| 27 | Coastal birch/oak | Kustnära/björk/ek |
| 30 | Mixed forest | Blandskog |
| 100 | Water | Vatten |

The volume was calculated differently dependent on if the log was standing or lying down.

Standing logs: The diameter of the tree was taken at breast height (1.3 m above ground) and the height was of the tree was taken with a height measurer. These numbers were used in a table, see Appendix 1, for estimating the volume.

Logs on the ground: The diameter of the log was taken at the half its length, to be able to calculate the volume according to a cylinder form ($radius^2 * \pi * length$). The diameter and the length was used in a table, see Appendix 2, for estimation of the volume.

## 2.3 Nonconformities

No nonconformities with respect to the activity plan occured

# 3 Results

The dead wood inventory of 2003 in Oskarshamn was carried out by Johan Andersson, FORAN Sverige AB. It started 2003-07-15 and ended 2003-10-10. Johan Andersson, FORAN Sverige AB, also carried out the division of compartments in the area of Simpevarp during the summer of 2002 and 2003. The data have been stored in the database SICADA.

Data from the inventory are presented below, named after the number of the vegetation sample site (VPY1–4) and a SICADA Id code (ASM002300–002303).

In the following figures, the dead wood data have been given a vegetation class according to the method of the vegetation maps constructed by SwedPower /Boresjö Bronge and Wester, 2003/. The compartment has been related to the tree layer code. The left side of each table shows the volume for each vegetation class based on the total area of that class. The right side shows the mean, median and quartiles of the volume for the compartments of each vegetation class.

## 3.1 VPY 1 – ASM002300

The vegetation class 13, old pine, dominate in VPY 1, both in total volume and in volume per hectare. 57% of the standing volume and 47% of the lying volume consists of pine.

**Table 3-1. Volume of dead wood for different vegetation classes in VPY 1.**

| VPY 1 | | | | | Compartment | | | |
|---|---|---|---|---|---|---|---|---|
| Class | Standing volume $m^3sk$ | Lying volume $m^3sk$ | Area ha | Volume/ha $m^3sk$ | Mean/ha $m^3sk$ | Median/ha $m^3sk$ | Q1/ha $m^3sk$ | Q3/ha $m^3sk$ |
| 1 | 0.39 | 2.41 | 9.68 | 0.29 | 0.54 | 0.54 | 0.33 | 0.75 |
| 2 | 0.00 | 0.00 | 27.99 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 6.94 | 14.98 | 10.80 | 2.03 | 2.39 | 1.59 | 1.40 | 3.23 |
| 13 | 15.57 | 28.66 | 36.17 | 1.22 | 2.70 | 2.78 | 1.89 | 3.60 |
| 22 | 0.40 | 0.77 | 0.48 | 2.44 | 2.44 | 2.44 | 2.44 | 2.44 |
| 25 | 0.28 | 1.66 | 0.60 | 2.93 | 2.93 | 2.93 | 2.93 | 2.93 |
| 30 | 0.11 | 0.31 | 0.71 | 1.75 | 1.75 | 1.75 | 1.75 | 1.75 |
| **Total** | **23.69** | **48.79** | **86.43** | | | | | |

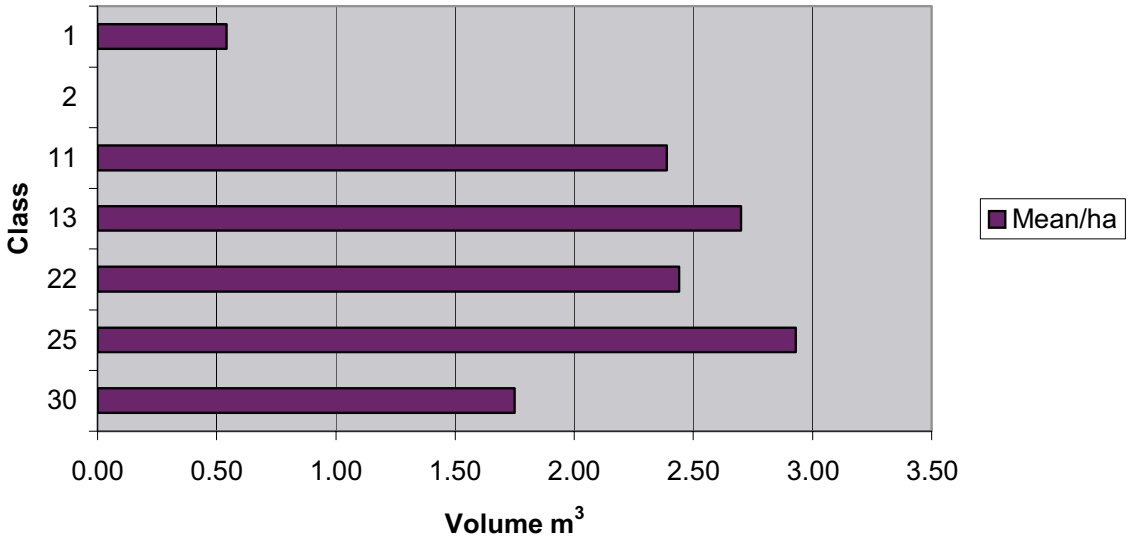


***Figure 3-1.*** *Volume of dead wood for different vegetation classess in VPY 1.*

## 3.2 VPY 2 – ASM002301

The vegetation class 11, old spruce, dominate in VPY 2, both in total volume and in volume per hectare. 79% of the standing volume and 49% of the lying volume consists of spruce.

**Table 3-2. Volume of dead wood for different vegetation classes in VPY 2.**

| VPY 2 | | | | | Compartment | | | |
|---|---|---|---|---|---|---|---|---|
| | Standing volume | Lying volume | Area | Volume/ha | Mean/ha | Median/ha | Q1/ha | Q3/ha |
| Class | $m^3sk$ | $m^3sk$ | ha | $m^3sk$ | $m^3sk$ | $m^3sk$ | $m^3sk$ | $m^3sk$ |
| 1 | 5.31 | 21.81 | 11.49 | 2.36 | 1.89 | 1.32 | 1.29 | 2.53 |
| 2 | 0.00 | 5.39 | 22.23 | 0.24 | 0.08 | 0.00 | 0.00 | 0.00 |
| 11 | 22.47 | 30.63 | 14.19 | 3.74 | 3.42 | 3.39 | 2.71 | 4.10 |
| 13 | 2.21 | 26.87 | 14.80 | 1.96 | 1.61 | 1.57 | 1.15 | 2.05 |
| 14 | 0.26 | 3.88 | 4.20 | 0.99 | 0.98 | 0.98 | 0.95 | 1.00 |
| 17 | 1.21 | 9.12 | 6.48 | 1.59 | 1.18 | 1.18 | 0.79 | 1.56 |
| 21 | 0.07 | 0.48 | 0.32 | 1.72 | 1.72 | 1.72 | 1.72 | 1.72 |
| 22 | 0.19 | 1.63 | 2.04 | 0.89 | 0.92 | 0.92 | 0.89 | 0.95 |
| 25 | 0.00 | 0.01 | 0.21 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| 30 | 0.71 | 1.85 | 0.99 | 2.59 | 2.61 | 2.61 | 2.54 | 2.68 |
| 100 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | **32.43** | **101.67** | **77.17** | | | | | |

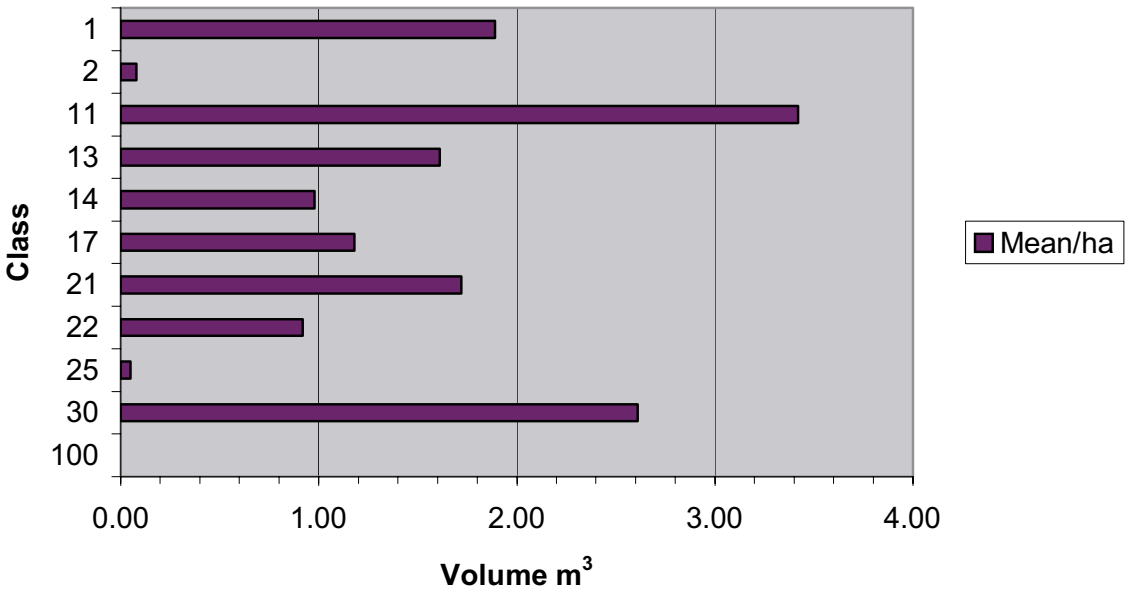


***Figure 3-2.*** *Volume of dead wood for different vegetation classes in VPY 2.*

## 3.3 VPY 3 – ASM002302

The vegetation class 11, old spruce, dominate in total volume but class 24, mixed deciduous and coniferous forest, has the highest volume per hectare (only one compartment though). 67% of the standing volume and 64% of the lying volume consists of spruce.

**Table 3-3. Volume of dead wood for different vegetation classes in VPY 3.**

| VPY 3 | | | | | Compartment | | | |
|---|---|---|---|---|---|---|---|---|
| Class | Standing volume $m^3sk$ | Lying volume $m^3sk$ | Area ha | Volume/ha $m^3sk$ | Mean/ha $m^3sk$ | Median/ha $m^3sk$ | Q1/ha $m^3sk$ | Q3/ha $m^3sk$ |
| 1 | 9.79 | 26.94 | 23.13 | 1.62 | 1.41 | 1.30 | 0.76 | 1.95 |
| 2 | 0.00 | 0.00 | 11.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 20.59 | 74.37 | 27.68 | 3.43 | 3.58 | 2.38 | 1.55 | 3.53 |
| 13 | 22.13 | 25.28 | 11.99 | 3.95 | 2.68 | 1.93 | 1.25 | 4.30 |
| 21 | 0.33 | 5.78 | 3.29 | 1.86 | 1.78 | 1.78 | 1.72 | 1.84 |
| 22 | 0.54 | 2.35 | 2.29 | 1.26 | 1.17 | 1.31 | 0.93 | 1.49 |
| 24 | 14.40 | 18.34 | 3.78 | 8.66 | 8.66 | 8.66 | 8.66 | 8.66 |
| 25 | 7.27 | 3.92 | 2.03 | 5.51 | 5.51 | 5.51 | 5.51 | 5.51 |
| 30 | 3.84 | 7.68 | 3.37 | 3.42 | 3.40 | 3.40 | 3.31 | 3.49 |
| **Total** | **78.89** | **164.66** | **89.15** | | | | | |

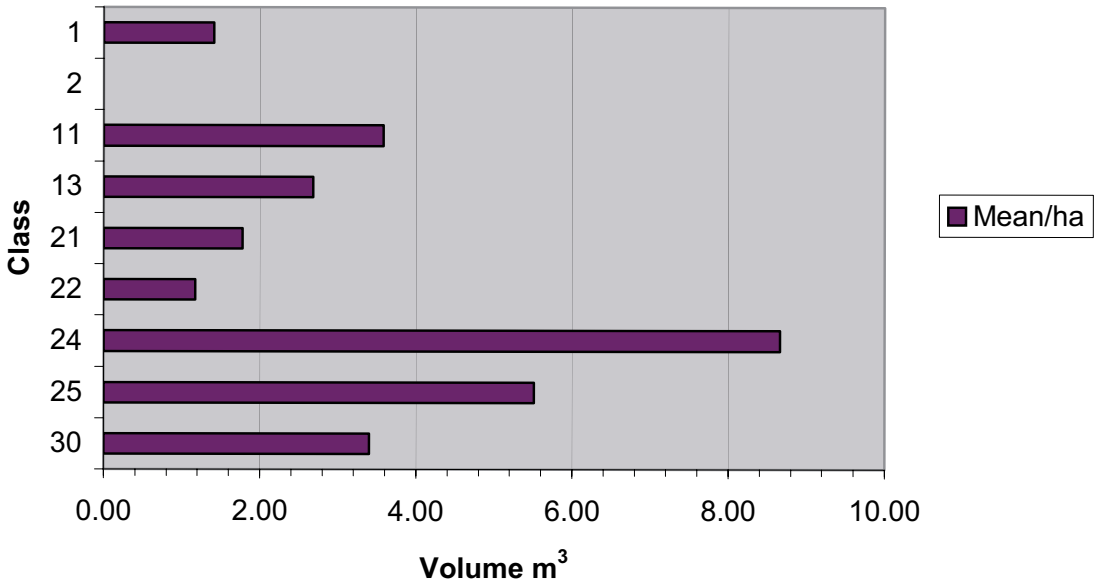


***Figure 3-3.*** *Volume of dead wood for different vegetation classes in VPY 3.*

## 3.4 VPY 4 – ASM002303

The vegetation class 13, old pine, dominate in total volume but class 25, oak, has the highest volume per hectare (only one compartment though). 40% of the standing volume and 56% of the lying volume consists of pine.

**Table 3-4. Volume of dead wood for different vegetation classes in VPY 4.**

| VPY 4 | | | | | Compartment | | | |
|---|---|---|---|---|---|---|---|---|
| Class | Standing volume $m^3sk$ | Lying volume $m^3sk$ | Area ha | Volume/ha $m^3sk$ | Mean/ha $m^3sk$ | Median/ha $m^3sk$ | Q1/ha $m^3sk$ | Q3/ha $m^3sk$ |
| 1 | 2.57 | 7.84 | 12.21 | 0.85 | 1.67 | 0.79 | 0.69 | 1.87 |
| 2 | 0.12 | 0.24 | 4.14 | 0.09 | 0.07 | 0.06 | 0.00 | 0.14 |
| 11 | 0.20 | 0.44 | 0.68 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 |
| 12 | 0.35 | 2.99 | 4.84 | 0.69 | 0.64 | 0.70 | 0.37 | 0.97 |
| 13 | 45.60 | 126.78 | 135.88 | 1.27 | 1.58 | 1.72 | 0.90 | 2.13 |
| 14 | 1.37 | 7.43 | 7.60 | 1.16 | 1.25 | 1.25 | 1.15 | 1.34 |
| 21 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 9.58 | 11.27 | 13.19 | 1.58 | 2.28 | 1.89 | 1.24 | 2.85 |
| 25 | 1.11 | 1.43 | 0.54 | 4.70 | 4.70 | 4.70 | 4.70 | 4.70 |
| 27 | 2.80 | 6.28 | 3.68 | 2.47 | 1.62 | 1.62 | 1.01 | 2.22 |
| 30 | 2.13 | 4.38 | 3.49 | 1.87 | 3.60 | 1.17 | 0.80 | 5.19 |
| **Total** | **65.83** | **169.08** | **186.75** | | | | | |

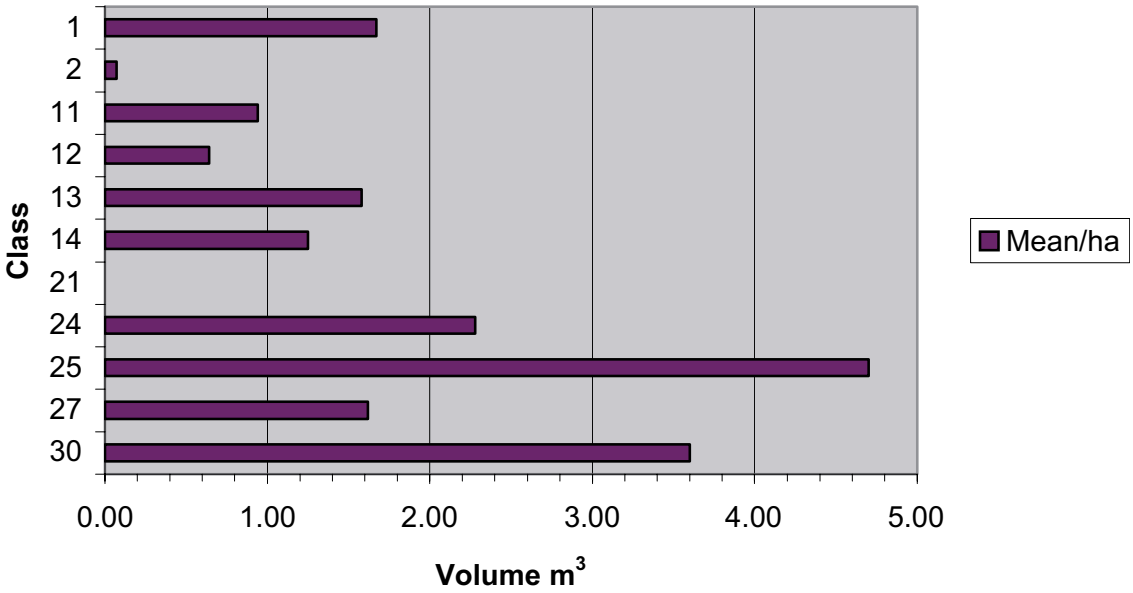


***Figure 3-4.*** *Volume of dead wood for different vegetation classes in VPY 4.*

## 3.5 All VPY in total

**Table 3-5. Combined data for all 4 investigated vegetation areas.**

| VPY 1–4 | | | | | Compartment | | | |
|---|---|---|---|---|---|---|---|---|
| Class | Standing volume m³sk | Lying volume m³ | Area ha | Volume/ha m³sk | Mean/ha m³sk | Median/ha m³sk | Q1/ha m³sk | Q3/ha m³sk |
| 1 | 18.06 | 59.00 | 56.52 | 1.36 | 1.55 | 1.08 | 0.69 | 2.04 |
| 2 | 0.12 | 5.63 | 65.95 | 0.09 | 0.04 | 0.00 | 0.00 | 0.00 |
| 11 | 50.20 | 120.42 | 53.35 | 3.20 | 3.12 | 2.38 | 1.44 | 3.62 |
| 12 | 0.35 | 2.99 | 4.84 | 0.69 | 0.64 | 0.70 | 0.37 | 0.97 |
| 13 | 85.51 | 207.59 | 185.19 | 1.58 | 1.92 | 1.83 | 1.02 | 2.38 |
| 14 | 1.63 | 11.31 | 11.79 | 1.10 | 1.11 | 1.04 | 1.00 | 1.15 |
| 17 | 1.21 | 9.12 | 6.48 | 1.59 | 1.18 | 1.18 | 0.79 | 1.56 |
| 21 | 0.40 | 6.26 | 4.11 | 1.62 | 1.32 | 1.69 | 1.25 | 1.76 |
| 22 | 0.60 | 2.83 | 2.84 | 1.21 | 1.07 | 0.98 | 0.86 | 1.31 |
| 24 | 33.56 | 40.88 | 30.16 | 2.47 | 2.85 | 1.89 | 1.49 | 3.96 |
| 25 | 8.66 | 7.02 | 3.44 | 4.56 | 3.30 | 3.82 | 2.22 | 4.91 |
| 27 | 2.80 | 6.28 | 3.68 | 2.47 | 1.62 | 1.62 | 1.01 | 2.22 |
| 30 | 6.79 | 14.22 | 8.08 | 2.60 | 3.07 | 2.61 | 1.61 | 3.31 |
| 100 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | **209.89** | **493.55** | **436.65** | | | | | |

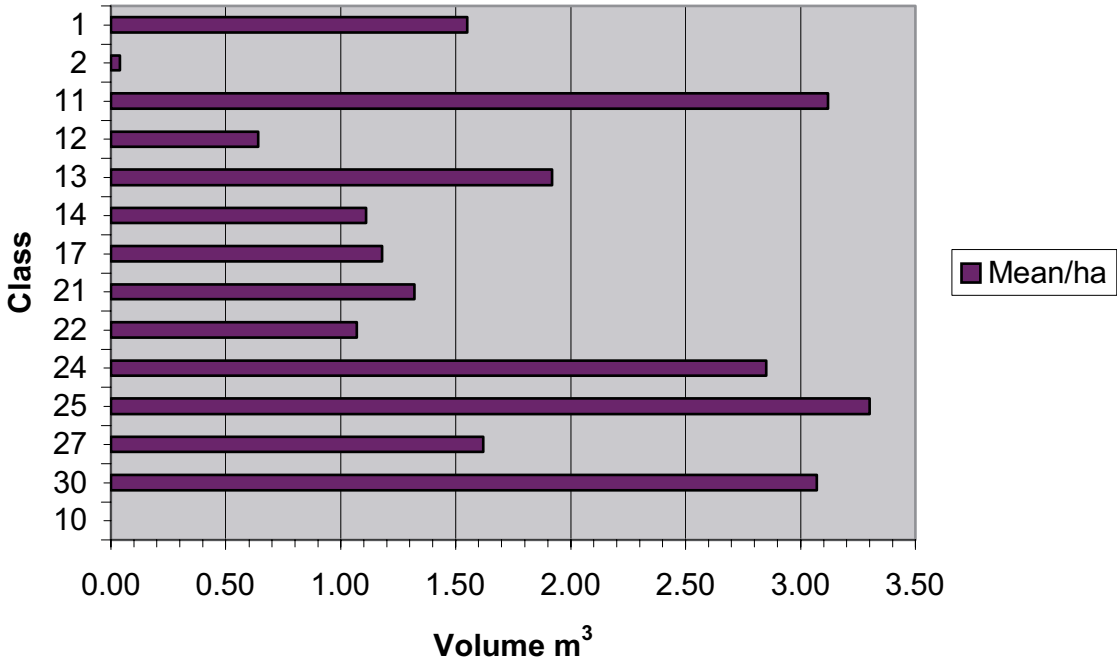


***Figure 3-5.*** *Volume of dead wood for different vegetation classes in all VPY-areas.*

## 3.6 Vegetation monitoring area

**Table 3-6. Calculated volume of dead wood within the total area where SKB are conducting vegetation monitoring around the area of Oskarshamn, based on the combined data from the 4 investigated areas.**

| Investigation area | | Based on compartment mean/ha VPY 1–4 | | Based on volume/ha VPY 1–4 | |
|---|---|---|---|---|---|
| Class | Area ha | Standing volume $m^3sk$ | Lying volume $m^3$ | Standing volume $m^3sk$ | Lying volume $m^3$ |
| 1 | 704.3 | 225.0 | 735.2 | 255.2 | 836.5 |
| 2 | 2,839.6 | 5.2 | 242.4 | 0.1 | 1.1 |
| 11 | 580.2 | 545.9 | 1,309.9 | 532.6 | 1,277.6 |
| 12 | 611.0 | 44.2 | 377.5 | 37.5 | 350.1 |
| 13 | 9,259.0 | 4,275.3 | 10,378.9 | 5,186.4 | 12,590.9 |
| 14 | 2,678.0 | 370.2 | 2,569.0 | 374.4 | 2,598.1 |
| 17 | 2,182.1 | 407.5 | 3,071.1 | 301.6 | 2,273.3 |
| 21 | 122.6 | 11.9 | 186.7 | 9.7 | 152.1 |
| 22 | 1,017.7 | 215.0 | 1,014.1 | 190.5 | 898.5 |
| 24 | 615.1 | 684.4 | 833.7 | 790.3 | 962.7 |
| 25 | 359.0 | 903.8 | 732.6 | 654.3 | 530.4 |
| 27 | 309.2 | 235.3 | 527.7 | 154.5 | 346.4 |
| 30 | 3,758.6 | 3,158.5 | 6,616.5 | 3,729.1 | 7,809.8 |
| 100 | 10,606.6 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total** | **35,643.0** | **11,082.2** | **28,595.3** | **12,216.2** | **30,627.5** |

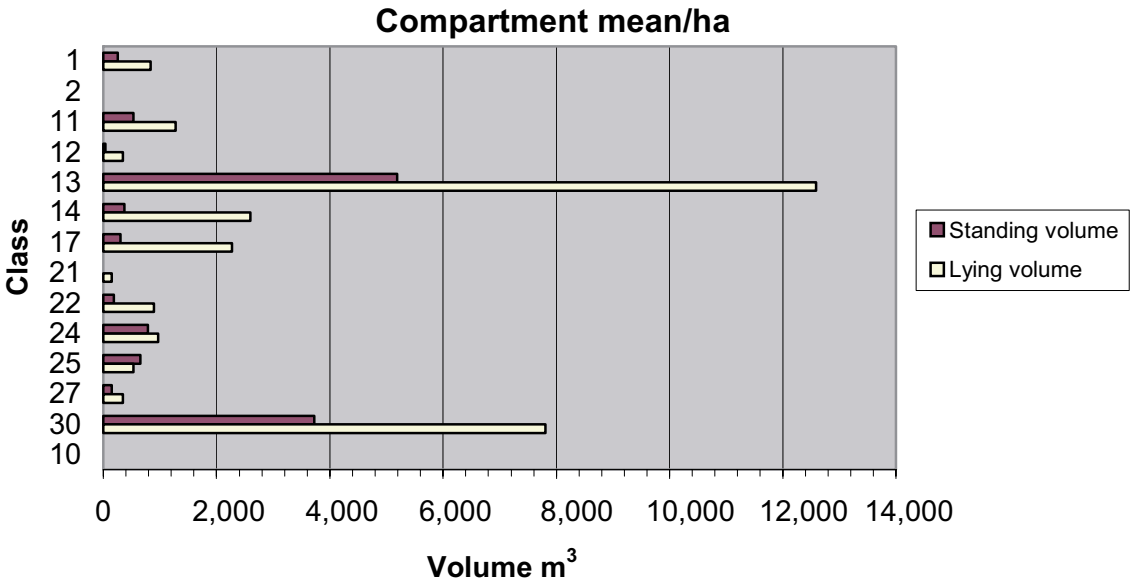


***Figure 3-6.*** *Volume of dead wood for different vegetation classes in the total area in Oskarshamn, where SKB are conducting vegetation monitoring.*

# 4 Summary and discussions

## 4.1 All vegetation sample sites

VPY 1 (ASM002300) is a very dry, nutrient poor area with flat rocks, dominated by the vegetation class of old pine. The exception is the agricultural lower parts, which are deforested. 57% of the standing volume dead wood and 47% of the lying volume dead wood consists of pine. 30% of the standing wood and 13% of the lying wood consists of brood leafs. 89% of the standing dead wood and 66% of the lying dead wood are in decomposition class 1.

VPY 2 (ASM002301) contains more brood leaf than VPY 1, especially in the south and in the northwest. 79% of the standing volume dead wood and 49% of the lying volume dead wood consists of spruce. 8% of the standing wood and 14% of the lying wood consists of brood leafs. 99% of the standing dead wood and 81% of the lying dead wood are in decomposition class 1.

VPY 3 (ASM002302) are also pine dominated, with the exception of some richer areas with oak in the west. 67% of the standing volume dead wood and 64% of the lying volume dead wood consists of spruce. 27% of the standing wood and 19% of the lying wood consists of brood leafs. 99% of the standing dead wood and 79% of the lying dead wood are in decomposition class 1.

VPY 4 (ASM002303) is the island of Ävrö that is very dry and totally pine dominated. The difference towards the other VPY is the absence of agricultural land. Only a few small, more or less overgrown, areas have been used for farming or grazing in modern times. 40% of the standing volume dead wood and 56% of the lying volume dead wood consists of pine. 40% of the standing wood and 26% of the lying wood consists of brood leafs. 92% of the standing dead wood and 72% of the lying dead wood is in decomposition class 1.

## 4.2 All vegetation sample sites in total

Within the 437 hectare total area of VPY 1–4, where was found 208 $m^3$ (29%) standing dead wood and 510 $m^3$ (71%) lying dead wood. Both standing and lying dead wood are dominated by spruce, in spite of the fact that the dominating tree layer class is “old pine”, class 13. The commonness of spruce is probable due to the shallow root system in and the preference to slightly more nutrient rich areas with higher turnover rate.

As much as 97% of the standing dead wood was in decomposition class 1 i.e. very little decomposed. No standing dead wood was found in class 4 and 5, probably due to the fact that heavily decomposed logs easily falls. Lying dead wood has 75% of the volume in decomposition class 1, decreasing down to 0.8% in decomposition class 5.

The percentage of dead hard wood is quite high. 29% of the standing dead volume and 20% of the lying dead volume is hard wood. Birch and oak are the most common hard wood in the data set.

## 4.3 Vegetation monitoring area

The total investigation area is over 35 000 hectares and reaches several kilometres around the area of Simpevarp and the nuclear power plant, see Appendix 5. The total amount of dead wood in this area, both by total volume per hectare and by compartment mean per hectare, are about 40 000 $m^3$. Approximately a fourth of the volume is standing dead wood and the rest is dead wood on the ground. Vegetation class 13, “old pine”, covers the largest area and are as much as 16 times more common than the class 11, “old spruce”.

## 4.4 Comparison of the region of Småland and the country of Sweden

In comparison to the other studies on dead wood, the amounts found in the area of Simpevarp are comparable low. The county of Kalmar had between the years 1996–2000 in average 3.8 $m^3$ per hectare /Anon, 2001/. Same data for the country of Sweden showed an average of 6.5 $m^3$ per hectare. The average for VPY 1–4 are 1.89 $m^3$ per hectare. The trend for Sweden is a decrease in volume dead wood from north to south but a small increase over the country for each passing year /Anon, 2001/.

There are several explanations to a lower value in the area of Simpevarp. The dry coast near area contains less spruce and more pine. Pine creates less amount of dead wood due to the lower total production in this nutrient poor area (see example in Appendix 4).

Another explanation could be the difference in the investigation technique. This data are based on total investigation of the area. The surveys made by The Swedish National Forest Inventory for example, are based on line taxation. Dead wood created by logging and thinning activities are not regarded in this study, but they are in the reference study and should explain some of the difference.

Also the landowner situation could affect. In the area of Simpevarp, with a lot of small landowners, there is the possibility that they have collected dead wood from the forest for heating their houses. On company owned land, this will probably not happened due to unprofitable economical reasons.

## 4.5 Comparison with Forsmark

In the investigation area of Forsmark, a dead wood inventory has been conducted on bases of the same method as used in region of Simpevarp. A comparison shows that Forsmark has an overall slightly higher average volume dead wood than in Oskarshamn, 2.01 $m^3$ to 1.89 $m^3$. But, there is a higher percentage of standing dead wood in Oskarshamn (29%), compared to Forsmark (21%). Also when comparing in dead hard wood, both standing and lying, Oskarshamn has a higher percentage.

One of the largest differences between the areas is the degree of composition. Higher percentages of the dead wood, both standing and lying, are found in a more decomposed state in Forsmark. This could be to the higher share of hardwood, which (except perhaps beech and oak) decomposes faster than conifers. This due to higher ground temperature, higher abundance of soil fauna and more nutrient litter etc /Johansson, 1995/.

This could also have other explanations, such as that a heavy storm knocked down a large number of trees in Forsmark several years ago, which now are in a high decomposition class.

When comparing the total investigation areas around Simpevarp and Forsmark, it is shown that Simpevarp has four times the amount of dead wood (approximately 10,000 $m^3$ compared to 40,000 $m^3$). The reason is that the Simpevarp area has 24,300 hectares of productive land (see Appendix 5) and Forsmark only 7,500 hectares within the investigation area.

## 4.6 General

There are several factors influencing the data of this inventory. Some of the main difficulties are discussed below.

- There were sometimes some difficulties in covering the entire study area during the fieldwork, without walking the same area twice or losing a spot due to natural obstacles. Only the use of modern GPS equipment and track logging made this viable.
- Some of the numbers of volumes per hectare could be too high due to randomness in a very limited area. When up scaling there could be large differences between the mean and the median in a specific tree layer class.
- Some difficulties to compare this study to the reference material all the way due to different approach in collecting data. But most of the classification and data collected are the same.
- In terms of classification for up scaling the dead wood data on a landscape level, the tree layer classification is a little bit to course. The trees goes into “old forest” when they goes into the cutting class of thinning /Boresjö Bronge and Wester, 2003/, but the difference in dead wood depository between forest that are 30 years old and 200 years old are severe. The “no tree layer, outside forest area”, could be anything from farmlands and wetlands to roads and buildings. The “no tree layer, inside forest area” could be both clear cuts as well as thin pine forest with a very low canopy cover.

# References

**Ahti Hämet-Ahti, Jalas J, 1968.** Vegetation zones and their sections in northwestern Europe. Ann. Bot. Fennici. 5, 169–211.

**Andersson J, 2004.** Vegetation inventory in part of the municipality of Oskarshamn. SKB, in manus.

**Anon, 1994.** Praktisk skogshandbok. 14: e upplagan. Sveriges skogsvårdsförbunds tidskrifts förlag, Stockholm.

**Anon, 1999.** Fältinstruktion för undersökningstyperna inom delprogrammet Extensiv övervakning av skogsbiotopers innehåll mot inriktning mot biologisk mångfald. Version 1, 1999-03-11, Naturvårdsverket.

**Anon, 2001.** Skogsdata 2001. Riksskogstaxeringen, SLU.

**Boresjö Bronge L, Wester K, 2003.** Vegetation mapping with satellite data of the Forsmark, Tierp and Oskarshamns regions. SKB P-08-83. Svensk Kärnbränslehantering AB.

**Inventory manual, 1999.** Vitality. National board of forestry. Unpublished.

**Johansson M-B, 1995.** Quantity, decomposition and nutrient dynamics of litterfall in some forest stands at Hålebäck, southern Sweden. Rapporter i skogsekologi och skoglig marklära, nr. 62.

# Appendix 1

## Principle for calculating the volume of standing wood

The table shows the principle for estimating the volume in standing dead wood. The diameters are measured in centimetres and the height in meter. The volumes are measured in forest cubic decimetres. The table are based upon “Näslunds mindre volymsfunktion” /Anon, 1994/.

| Standing wood Diameter\ Height | 4 | 6 | 8 | 10 | 12 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 20 | 30 | 40 | 45 | 50 | 80 | | | |
| 15 | 35 | 50 | 70 | 90 | 110 | 150 | 200 | | |
| 20 | 60 | 90 | 130 | 150 | 180 | 250 | 320 | 410 | |
| 25 | | | | 230 | 270 | 370 | 470 | 590 | 720 |
| 30 | | | | | 380 | 500 | 640 | 800 | 970 |
| 35 | | | | | 500 | 660 | 840 | 1,040 | 1,260 |

# Appendix 2

The table shows the principle for calculating the volume in lying dead wood. The diameters are measured in centimetres and the length in meter. The volumes are measured in cubic decimetres.

| Lying wood<br>Diameter \ Length | 2 | 4 | 6 | 8 | 12 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 16 | 31 | 47 | 63 | 94 | 126 | 157 | 188 | 220 |
| 15 | 35 | 71 | 106 | 141 | 212 | 283 | 353 | 424 | 495 |
| 20 | 63 | 126 | 188 | 251 | 377 | 503 | 628 | 754 | 880 |
| 25 | 98 | 196 | 295 | 393 | 589 | 785 | 982 | 1,178 | 1,374 |
| 30 | 141 | 283 | 424 | 565 | 848 | 1,131 | 1,414 | 1,696 | 1,979 |
| 35 | 192 | 385 | 577 | 770 | 1,155 | 1,539 | 1,924 | 2,309 | 2,694 |

# Appendix 3

This is an example of how the in data form looks like, in Swedish. The form was used during the fieldwork, combined with the tables in Appendix 1 and 2.

## Fältblankett för insamling av dödvedsvolymer

| | |
|---|---|
| Inventerare | VPY |
| Datum | Avdelning |

| **Stående ved** | **Nedbrytningsklass** | | | | | |
|---|---|---|---|---|---|---|
| **Trädslag** | **1** | **2** | **3** | **4** | **5** | **Summa** |
| Gran | | | | | | 0 |
| Tall | | | | | | 0 |
| Björk & Asp | | | | | | 0 |
| Ek & Bok | | | | | | 0 |
| Övrigt ädellöv | | | | | | 0 |
| Övrigt triviallöv | | | | | | 0 |
| Obestämt | | | | | | 0 |
| **Summa** | 0 | 0 | 0 | 0 | 0 | 0 |

**Kommentarer:**

| **Liggande ved** | **Nedbrytningsklass** | | | | | |
|---|---|---|---|---|---|---|
| **Trädslag** | **1** | **2** | **3** | **4** | **5** | **Summa** |
| Gran | | | | | | 0 |
| Tall | | | | | | 0 |
| Björk & Asp | | | | | | 0 |
| Ek & Bok | | | | | | 0 |
| Övrigt ädellöv | | | | | | 0 |
| Övrigt triviallöv | | | | | | 0 |
| Obestämt | | | | | | 0 |
| **Summa** | 0 | 0 | 0 | 0 | 0 | 0 |

**Kommentarer:**

# Appendix 4

The photo shows two examples of vegetation class 13, a class that generate very modest amounts of dead wood, but dominate vast areas in the Simpevarp region.