Rapport *Report*

Biomass of sallow (*Salix caprea* L.)

Sälgens (Salix caprea L.) biomassa

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ABSTRACT

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The amount of biomass for fractions and distribution of sallow trees growing on forest land was studied. The allometric relationship between breast height diameter (DBH) and the weight of total tree, stem, branches and leaves was quantified. The studied trees were 37±14 (5-66) years old and the stem number 1030±727 (222-3000) stems ha^{-1}. Equations for estimating the tree weight or the fractions from diameter at breast height (DBH) are presented.
The mean total standing dry weight above stump level (≈ 200 mm) for sallow was 95±50 tonnes ha^{-1} with a range of 4-203 tonnes ha^{-1}. In addition to estimating conventional dry weights of trees and tree components, SLA and PLA, among other measures, were estimated.

Key words: *Salix caprea*, Sallow, Biomass equation

SAMMANFATTNING

Studien har skett i bestånd som växer på skogsmark. Ett stamrikt bestånd kan medföra att produktionen hämmas om marken inte är tillräckligt näringsrik eller lider av brist på vatten.
Sambandet mellan brösthöjdsdiameter (DBH) och trädvikt studerades också. De studerade träden var 37±14 (5-66) gamla och stamantalet 1030±727 (222-3000) stammar ha^{-1}.

Ekvationer för bestämning av trädvikten eller fraktioner vid olika diametrar i brösthöjd (DBH) presenteras. Medelvikten för de studerade bestånden var 95±50 tons ha^{-1} med variationen 4-203 ton ha^{-1}. Utöver skattningen av torrvikter för träd och deras komponenter beräknades SLA och PLA för träden.

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INTRODUCTION

Inherent *Salix*-species are important for the landscape development. *Salix*-species are growing as solitaires, in groups or mixed with other broadleaved species. But some species as grey willow (*Salix cinerea* L.) are also growing in small stands (0.5-2 ha) on wet lands. Solitaries or groups of sallow (*Salix caprea* L.) are growing in the borderline between farm- and forest land. Sallows growing in the borderline and as solitaries should be protected as in early spring sallow flowers are important as food for insects, such as, honey bees (*Apis* spp.) and Bumble-bees (*Bombus* spp.). Sallow is also growing on forest land in mixed or homogenous stands (≈0.5 ha). Sallows are attractive as fodder for moose (*Alces alces* L.), roedeer (*Capreolus capreolus capreolus* L.), hares (*Lepus capensis* L., *Lepus timidus* L.) and rabbits (*Oryctolagus cuniculus* Pallas) with decreased growth and low timber quality as a result.

In Sweden the total growing stock of sallow is 22 million m^3 or 0.7 % of the total growing stock (Anon., 2010). The amount of trees > 35 cm DBH is most frequent (14 % by total growing stock in the region) in southern Sweden (Table 1). However about 50 % of the growing stock is represented by trees < 20 cm DBH. Sallow wood is attractive for practicing handcraft for making boxes, small cupboards, butter knives etc.

Tabell 1. Growing stock for sallow (*Salix caprea* L.) by diameter classes. Period 2005-2009. (Anon., 2010)

Region	Lat. ° N.	Diameter (cm), DBH									
		0-9	10-14	15-19	20-24	25-29	30-34	35-44	45-	Total	Percentage, %[1]
		Million m^3									
Sweden	55-69	3,4	3,2	3,5	3,5	2,3	1,6	2,2	2,3	22,0	0,7
N. Norrland	64-69	0,7	0,6	0,8	0,6	0,4	0,2	0,3	0,2	3,8	0,5
S. Norrland	60-64	1,3	0,8	0,8	1,1	0,7	0,4	0,4	0,5	6,0	0,7
Svealand	59-62	0,8	0,8	0,8	0,7	0,7	0,4	0,4	0,5	5,1	0,6
Götaland	55-59	0,6	1,0	1,2	1,1	0,5	0,5	1,1	1,0	7,1	0,8

1) Percentage by total growing stock for the regions

In Sweden there is an increasing interest in utilizing wood for bioenergy purposes. The main arguments are: decrease the use of petroleum for heating households, decrease the $C0_2$-emissions and focus on renewable energy sources. In Nordic countries some broadleaf species, European aspen (*Populus tremula* L.), black and grey alder (*Alnus glutinosa* (L.) Gaertner and *Alnus incana* (L.) Moench), pendula and pubescent birch (*Betula pendula* Roth and *Betula pubescens* Ehrh.) regenerate easily after clear cutting and on abandoned farmland (Björklund and Ferm, 1982; Ferm and Kaunsto, 1983). Today these species are harvested for production of chips or wood pieces for energy supply in heating plants.

Stands naturally regenerated represent a resource that could be cost effective when sites are available for commercial use. Sallows have a rapid and high regrowth capacity by sprouts. However coppice regrowth is marginally practiced in Northern Europe. Coppicing has been practiced for many generations in some countries (Ellenberg, 1975). Today some countries have large areas managed under intense short rotation forestry (Auclair, 1985). In Sweden clones of *Salix* have been practiced on former farmland since early 1970.

The most widely used species in short rotation forestry (SRF) belong to the genera *Eucalyptus*, *Populus* and *Salix*. Genetic and environmental factors can be optimised for dry matter production (Sirén et al., 1983). In Sweden abandoned farmland of was planted with among others Salix trees in the end of 1980. The Swedish government subsidized the conversion. The aim was to decrease the farmland area with 0.5-1 million hectares. This resulted in 15000 hectares of Salix plantations. The density of Salix coppice was 12000 cuttings ha^{-1}. The coppice is harvested every 3-5 years and replanted after 20-25 years.

Leaf and canopy characteristics such as projected leaf area (PLA), leaf area index (LAI) and specific leaf area (SLA) are important structural parameters of forest ecosystems. Measurements of leaf were made, but LAI was not measured mainly depending on the small plots. LAI has an important influence on the exchange of energy, gas and water in trees. LAI is a key component of biochemical cycles in ecosystem (Bréda, 1979). Information on it is demanded by scientists and forest managers.

This study is a part of a series on the biomass of broadleaf species, mostly self regenerated and growing on rich sites, such as former farmland.

The aim was to measure the biomass of sallows and their components (stem, branches and leaves). The results should be used to predict the biomass production and initiate attempts to optimise their productivity. Data for construction of biomass fractions was based on sallow stands growing on rich sites. Characteristics such as PLA and SLA were estimated and calculated.

OBJECTIVES

One objective was to quantify the amount of biomass for different fractions of sallow (*Salix caprea* L.) growing on forest land. A second objective was to examine the allometric relationships between breast height diameter (DBH) and weight of stem, branches and leaves. Data from survey studies were used for the study.

MATERIALS AND METHODS

Estimation of stand and tree characteristics

Samples from 27 sallow stands located in southern and central Sweden (Lat.57-63° N.) were investigated, Figure 1. The study was focused on biomass amount of young to middle aged stands of sallow. Sallow trees mostly were mixed as single individuals or in small groups (2-10 trees) mixed with other broadleaved species. But among all visited localities areas of pure sallow trees was identified and registered. The stand area varied between 75 and 1800 m^2, Table 2.

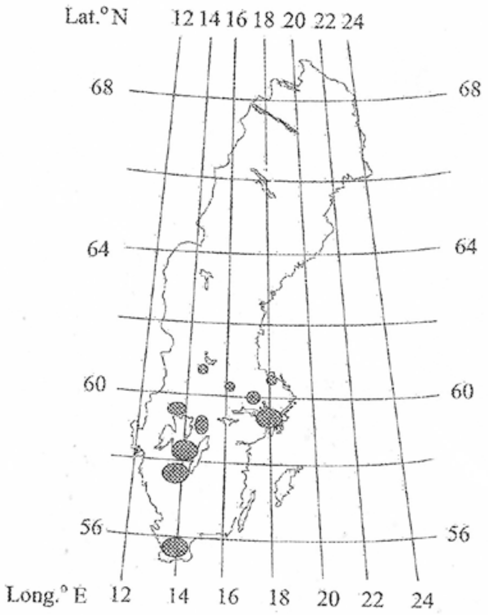

Figure 1. Localities of sample sallow trees.

Most stands were growing on rich sites as farmland and small areas close to farmland. Studied stands had not been managed. But some sallow individuals growing in mixed stands might have been cut when the main species was thinned.

Diameter at breast height (DBH) and the number of stems for all sallow trees in the plot was registered. Based on diameter distribution 3-5 trees were chosen as samples. One sallow with a diameter close to the estimated arithmetic mean diameter, one in the upper and lower quartile respectively and one close to maximum and minimum diameter respectively was selected. In some cases, one tree in the upper and lower quartile of the diameter distribution respectively and one close to the arithmetic mean diameter was selected. Totally diameter and height of 139 sample trees was recorded.

Table 2. Main stand characteristics for sallow (*Salix caprea* L.) growing on 27 locations in Sweden

Plot no	Lat. N	Long. E.	Alt. m	Plot size m^2	Age years	DBH, mm mean±SD	No. of stems ha^{-1}	Basal area m^2 ha^{-1}
1	63° 05’	18° 21’	39	195	39	166±50	1231	26,6
2	60° 17’	15° 59’	110	180	22	79±26	3000	14.7
3	60° 17’	15° 59’	84	176	34	135±50	743	10.6
4	60° 17’	15° 59’	98	700	37	157±64	343	6.6
5	59° 50’	17° 39’	4	744	46	170±46	685	15.5
6	59° 50’	17° 39’	4	301	43	167±38	1264	27.7
7	59° 50’	17° 39’	4	640	35	153±46	891	16.4
8	59° 24’	18° 21’	12	1291	43	187±34	604	16.6
9	59° 10’	15° 55’	28	600	55	207±55	583	19.6
10	57°55’	12° 21’	118	1260	21	146±72	1133	18.7
11	57°55’	12° 21’	108	540	29	145±72	1296	21.4
12	57°55’	12° 21’	101	100	26	172±142	500	11.6
13	57° 43’	12° 56’	166	540	32	159±38	222	4.4
14	60° 17’	15° 59’	120	300	66	309±70	367	27.5
15	60° 07’	16° 14’	56	300	5	10±2	2100	0.2
16	60° 15’	16° 01’	77	250	9	28±11	1880	1.2
17	60° 11’	16° 07’	101	527	45	101±44	1917	15.4
18	62° 53’	17° 32’	39	1800	45	233±63	294	12.5
19	62° 53’	17° 32’	31	255	43	223±84	824	32.2
20	59° 58’	16° 42	60	100	53	203±51	500	16.2
21	60° 15’	16° 01’	71	75	38	82±33	2918	15.4
22	60° 15’	16° 01’	71	300	37	113±33	2500	25.1
23	59° 48’	17° 36’	14	1225	47	305±69	351	25.6
24	59° 48’	17° 36’	14	540	52	226±77	907	36.4
25	59° 48’	17° 36’	14	450	44	184±44	1489	39.6
26	60° 27’	16° 08’	98	1200	40	169±59	417	9.4
27	60° 27’	15° 49’	125	400	19	62±16	1550	4.7
Mean±SD				555±441	37±14	159±71	1030±727	17±10
Range				75-1800	5-66	10-309	222-3000	0.2-39.6

Biomass estimation

Totally 139 sample trees were felled and cut as near the ground as possible. Their height and DBH was recorded (Table 2). The age of these trees was determined in the laboratory by counting annual rings in discs taken from the base of the stem (total age) and at breast height (breast height age). Totally 54 of the sample trees were analyzed. All twigs on the tree were then cut and weighed with leaves. The stem was weighed fresh in the field. Samples of stem and twigs were then taken for estimating basic wood density. A disc at 4 m height was taken and frozen. Four samples of twigs were taken close to the stem base and frozen, two in the upper and two in the lower part of the crown.

The sampling procedure to quantify the leaf mass is laborious. To facilitate the procedure a “mean leaf technique” method was used for dry mass estimation (Johansson and Karačić, 2011). Most of the leaves were sampled in August. All leaves from five sallow trees from each of five localities were sampled and weighed fresh. The samples were taken from trees with stem diameters of 50, 100, 150, 200 and 250 mm DBH. An allometric equation was derived, relating DBH to percentage fresh leaf weight by fresh weight of branches + leaves, and used for estimating the leaf weight of all sampled trees.

A sample of 200 leaves from sample trees in all stands was taken from the top, middle and lower parts of the crowns then frozen for analyses in the laboratory.

The basic density of stems and branches was estimated according to the water-immersion method described by Andersson and Tuimala (1980). Samples of stems and branches were saturated in water for 24 h and then weighed and their volume (cm^3) was determined. The dry matter content of the wood proportion (g) of the samples was determined after drying at 105° C in an air-ventilated oven for 3-5 days, depending on their dimensions. Dry weight (g) to fresh volume (cm^3) ratios of the debarked disk and branches were then calculated as basic density (g cm^{-3}), Table 3. Based on the percentage dry mass by fresh weight for the stem and branch samples the dry mass for the stem and all twigs on sample tree was calculated. The moisture content in stem and branches was expressed in per cent of its dry weight.

Table 3. Characteristics of sampled sallows (*Salix caprea* L.)

Plot no	Age years	DBH, mm	Height, m	MAI kg $year^{-1}$	Basic density g cm^{-3}
1	39	222	15.1	3.72	0.481
2	22	87	12.3	1.24	0.483
3	34	155	16.5	3.43	0.464
4	37	250	19.7	1.26	0.485
5	46	233	18.9	2.37	0.455
6	43	215	17.3	5.59	0.431
7	35	169	16.7	1.92	0.466
8	43	235	19.1	1.01	0.525
9	55	209	22.6	1.58	0.444
10	21	195	17.2	1.88	0.458
11	29	234	15.5	3.30	0.485
12	26	167	16.8	4.59	0.470
13	32	232	14.5	2.47	0.497
14	66	240	19.8	0.84	0.493
15	5	12	2.7	1.48	0.400
16	9	50	8.2	1.82	0.309
17	45	255	16.9	3.50	0.513
18	45	405	24.5	2.67	0.484
19	43	325	19.7	2.08	0.492
20	53	157	14.2	3.17	0.467
21	38	118	12.5	4.60	0.516
22	37	116	14.2	1.95	0.492
23	47	307	17.8	1.71	0.485
24	52	246	21.6	5.29	0.513
25	44	180	17.3	4.33	0.520
26	40	177	18.1	2.38	0.526
27	19	72	9.0	0.77	0.415
Mean±SD	37±14	195±86	16±5	2.63±1.37	0.473±0.046
Range	5-66	12-405	3-25	0.77-5.59	0.309-0.526

The sampled 200 leaves per tree were weighed fresh, and then the estimation of PLA, mm, of the sample was determined with a leaf-area meter (LI-3000, LI-COR, Inc. Lincoln. Neb.). The samples were then dried at 105° C in an oven for 48-72 h until the leaves were dry and then weighed. The percentage dry mass by fresh weight for the leaves was calculated and the dry mass for all leaves on the tree was calculated. The SLA (cm^2 kg^{-1}) was calculated as the total leaf area (cm^2) of a sallow tree divided by the dry weight (kg) of the leaf mass.

Curves describing the correlation between DBH and dry mass production (kg $tree^{-1}$) for tree fractions, derived from data from data collected from all of the measured trees were developed for describing the dry mass production per tree.
Three equations were tested:

$M = \beta_0 + \beta_1 xD + \beta_2 xD^2$ (Polynom) (1)
$M = \beta_0 xD^2$ (Power function) (2)
$M = \beta_0 x(1-e^{-bxD})^{\beta}$ (Richard Chapmans function) (3)

Where
M = dry mass, kg $tree^{-1}$
D = diameter at breast height, over bark (ob), mm
β_0, β_1 and β_2 are parameters

When predicting dry mass these equations are often used; the power model is frequently used for dry mass predictions (Kittredge, 1944; Payandeh, 1981; Satoo and Madgewick, 1985; Bolstad and Gower, 1990; Johansson, 1999), Richards's equation is a flexible equation (Richards, 1959) and a second or third order polynomial is also frequently used.

Based on the arithmetic diameter, the dry mass of each of the sallow stands was estimated.

Biostastical analyses
Data were analyzed by non-linear regression using the SAS/STAT system for personal computers (SAS Institute, 2006). A measure of the fit of the non-linear regressions was based on the coefficient of determination (Zar, 1999):

$R^2 = 1 - (SSE/SST\ (corrected))$ (4)

Where SSE is the sum of squares of the error terms and SST is the total sum of squares. Throughout the report, means are presented together with standard error (SE).

RESULTS

Equations1 (1 and 2) fitted the data relating to dry mass to DBH for small and large trees. But when processing the data on equation (3) the statistical programme could not convert a solution. When comparing the other two equations the differences in R^2 and RMSE for them are small. However equation (2) fitted the data best. Further information about parameter estimations is given in Table 4. Curves relating to the dry mass of the various fractions per sampled trees are presented in Figure 2.

Table 4. Estimated parameters of equations (1) and (2) for dry weight estimations of sallow

Components	Parameter	Parameter estimates	Standard errors of parameters	R^2	RMSE
		Equation (1) Polynomial			
Total	B_0	0.4790	0.0774	0.93	37.75
	B_1	0.0014	0.0003		
Stem	B_0	0.3804	0.0602	0.91	29.39
	B_1	0.0007	0.0002		
Twigs	B_0	0.0860	0.0293	0.90	14.28
	B_1	0.0006	0.0001		
Leaves	B_0	0.0126	0.0030	0.80	1.44
	B_1	0.0001	0.0001		
		Equation (2) Power function			
Total	B_0	0.0843	0.0398	0.94	35.90
	B_1	1.4167	0.0848		
Stem	B_0	0.0878	0.0471	0.92	28.34
	B_1	1.3400	0.0916		
Twigs	B_0	0.0087	0.0053	0.90	13.90
	B_1	1.6084	0.1134		
Leaves	B_0	0.0035	0.0031	0.80	1.42
	B_1	1.2902	0.1607		

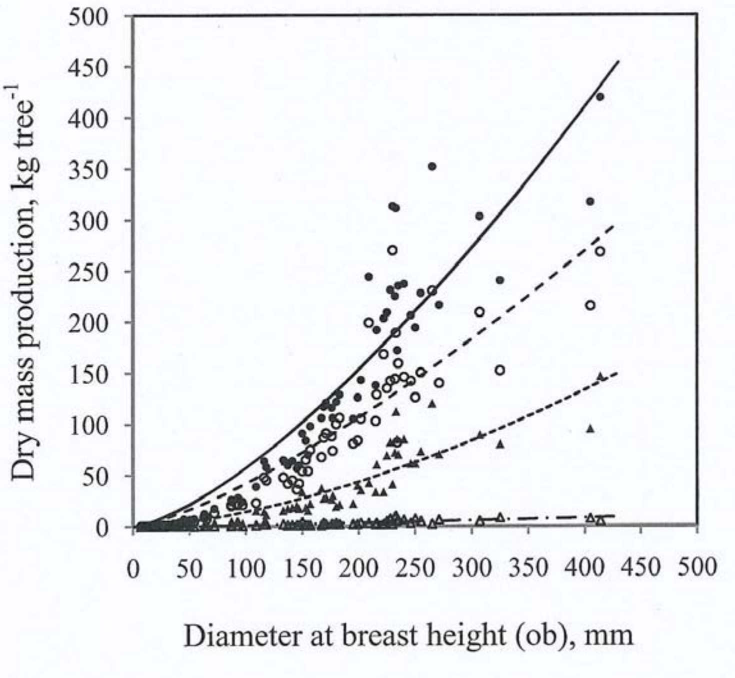

Figure 2. Dry mass per tree, kg tree^{-1}, in relation to diameter at breast height (DBH), mm of total (——●), stem (- - - ○), branches (—— ▲) and leaves (– · - △) for sampled sallow trees.

The mean moisture content in wood of stems and branches was 81 and 82 % respectively. In Table 5 the mean percentage ± SE of the total dry weight of sampled trees accounted for by the dry weight of stem, branches and leaves is presented: 69±8 (48-86), 25±8 (11-49) and 6±6 (1-25) respectively.

Table 5. Fresh and dry biomass production (kg tree^{-1}) and mean percentage of total tree fresh and dry weight accounted for by stem, branches and leaves for sampled sallow trees.

		Fresh weight, kg tree^{-1}			Percentage of total fresh weight		
	Total	Stem	Branches	Leaves	Stem	Branches	Leaves
Mean ± SD	177±191	121±127	51±63	6±7	68±9	23±8	9±9
Range	1-697	1-440	1-232	1-25	49-86	8-37	1-33
		Dry weight, kg tree^{-1}			Percentage of total dry weight		
Mean ± SD	97±107	67±73	28±34	2±2	69±8	25±8	6±6
Range	1-419	1-270	1-146	1-10	48-86	11-49	1-25

The mean basic density for sallow trees (27 stands) was 0.473±0.046 (0.309-0.526), Table 3.
Mean MAI for the sampled trees was 2.63±1.37 ton ha^{-1} year^{-1} (0.77-5.59), Table 3.

Data on the dry mass of sampled trees and the stem number in the studied stands was used when the dry mass production per hectare was calculated, Table 6. The mean total dry mass above ground was 95±50 ton ha^{-1} (4-203). The mean MAI was 2.6 ton ha^{-1} year^{-1} (0.8-5.6).

Table 6. Dry mass (ton ha^{-1}) and mean annual increment, MAI, (ton ha^{-1} year^{-1}) of whole sallow stands.

	Total	Stem	Branches	Leaves	MAI
Mean ± SD	95±50	68±35	26±14	2±1	2.63±1.37
Range	4-203	4-141	1-57	15	0.77-5.59
		Percentage of total dry weight			
Mean ± SD		72±7	28±34	2±2	
Range		67-100	1-31	1-3	

At DBH > 225 mm the variability in biomass estimates increased markedly, Figure 2.

Results from the leaf analyses are shown in Table 7.

Table 7. Leaf weight per tree (g) in sallow stands, individual leaf dry weight (mg), number of leaves per tree, projected leaf area (PLA, mm^2) and specific leaf area (SLA, m^2 g^{-1}) of sample trees.

	Weight, d.w. leaf^{-1}, mg	No. of leaves tree^{-1}	Weight, d.w., tree^{-1} kg	PLA, cm^2	SLA, cm^2 g^{-1} d.w.
Mean ± SD	149.79 ± 50.59	13055 ± 13652	2.05 ± 2.39	20.14 ± 6.60	143.72 ± 52.25
Range	68-306	150-49230	0.02-9.50	8.14-41.98	59.35-344.02

DISCUSSION

In most of the studied stands the sallows were the dominant species. However the stems were slow growing and some of them had a medium to low timber quality. But they have a big importance for the level of biodiversity on forest land as food and host for insects and fungi among others. There is an interest for sallow timber as a raw material for handcraft manufactures. A few stands had been managed resulting in sallow stems with good timber quality.

When estimating biomass by sampling the dominant trees in a stand the main advantage is that these trees are the least disturbed in the stand. The production of foliage has been estimated either on the basis of all leaf biomass on sampled trees or fitted by the derived allometric equation. The sampling process was made on sample trees in August- middle of September. This method assumes that the stands are closed or the between age variation is small (Tadaki, 1966). In a young closed stand the variations in crown length, crown width and the ratio of the dry weight of leaves and branches to total weight is greater than in old stands.

The moisture content in stems and branches for the present study was 81 and 82 % respectively.
In the study made by Sennerby-Forsse the corresponding values were 82 and 79 % respectively.
There are few studies about biomass production of sallow stems and stands. In a report by Korsmo (1995) trees with DBH 100 and 140 mm accounted for 84.2 and 86.9 % for stems, 13.2 and10.3 % for branches and 2.6 and 2.8 % for leaves of total above ground dry mass respectively. In the present study corresponding values were 73.7 and 71.0 %; 24.6 and 26.9; 1.7 and 2.1 % respectively. As shown the percentage stem biomass was 10 percentage units higher in Korsmo's study than in the present study. On the other hand the percentage branches were 10 units higher in the present study. The differences might depend on a higher stem density in the Norwegian stands resulting in a higher level of self pruning of branches than in the Swedish stands. In Korsmo's study the total biomass yield above ground for a tree with a breast height diameter of 100 mm was 38 kg t.s. and for 140 mm DBH 107 kg, In the present study mass yield per corresponding DBH is 57 and 93 kg respectively.

The mean biomass production per hectare was 95±50 (4-203) ton and MAI was 2.6±1.37 (0.77-5.59) ton ha^{-1} $year^{-1}$. The annual growth is lower than for other broadleaf species: pendula birch (4.1); pubescent birch (2.7); European aspen (5.7); grey alder (3.4); black alder (3.5).

The density of sallow stems is high, 0.47±0.05 (0.31-0.53) g cm^{-3}. In a study on sallow trees growing in southern to northern Sweden Sennerby-Forsse (1989) reported 0.48±0.03 g cm^{3} for stem and 0.46±0.04 for branches. No geographical pattern was evident in values for the basic density levels in the study.

As there is no information about PLA and SLA from other reports the findings in the present study; 20.14±6.60 (8.14-41.98) cm^2 and 143.72±52.25 (59.35-344.02) cm^2 g^{-1} are only noted.

CONCLUSIONS

Findings in the present study might be used as input to ecological studies of sallow. But the results also indicate the level of biomass in small stands of sallow, in some cases useable as bioenergy. Among the stands in the study there were two stands with older sallows, which had been managed. The remaining stems (300-500) were fresh and the timber quality was good and might be a valuable product for handcraft manufactures.

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Appendices

Appendix 1

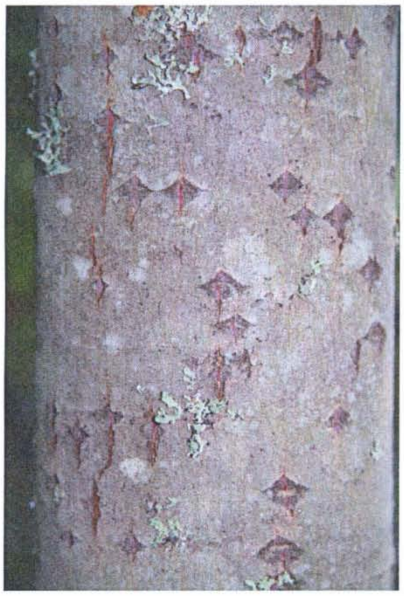
Growing stock, m^3 by diameter class, 2005-2009. Anon, 2010.

Region	Diameter (cm), dbh									
	0-9	10-4	15-19	20-24	25-29	30-34	35-44	45-	Total	Percentage, % [1]
	Million m^3									
Country	**3,4**	**3,2**	**3,5**	**3,5**	**2,3**	**1,6**	**2,2**	**2,3**	**22,0**	**0,7**
N. Norrland	0,7	0,6	0,8	0,6	0,4	0,2	0,3	0,2	3,8	0,5
S. Norrland	1,3	0,8	0,8	1,1	0,7	0,4	0,4	0,5	6,0	0,7
Svealand	0,8	0,8	0,8	0,7	0,7	0,4	0,4	0,5	5,1	0,6
Götaland	0,6	1,0	1,2	1,1	0,5	0,5	1,1	1,0	7,1	0,8
Nbtn. lappm	0,1	0,1	0,2	0,2	0,1	0,0	0,0	0,1	1,0	0,5
Nbtn. kustl	0,3	0,2	0,2	0,1	0,1	0,0	0,1	0,0	0,9	0,5
Norrbotten	0,4	0,3	0,4	0,3	0,2	0,1	0,1	0,1	1,9	0,5
Vbtn. lappm	0,1	0,2	0,2	0,2	0,2	0,1	0,1	0,2	1,4	0,7
Vbtn. kustl	0,1	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,5	0,3
Västerbotten	0,3	0,3	0,4	0,3	0,2	0,2	0,1	0,2	1,9	0,6
Jmtl. Jämt.	0,4	0,3	0,3	0,3	0,3	0,2	0,3	0,1	2,2	0,8
Jmtl. Härj	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,6	1,0
Jämtland.	0,4	0,3	0,4	0,8	0,3	0,2	0,3	0,1	2,8	0,8
Vnrl. Ång.	0,2	0,2	0,2	0,1	0,2	0,0	0,0	0,0	1,0	0,6
Vnrl. Medel	0,1	0,1	0,1	0,1	0,1	0,1	0,0	0,1	0,8	0,9
Västernorrland	0,3	0,3	0,3	0,2	0,3	0,1	0,1	0,1	1,8	0,7
Gävl. Häls.	0,6	0,1	0,1	0,1	0,1	0,1	0,0	0,0	1,1	0,6
Gävl. Gästr.	0,1	0,1	0,0	0,0	0,0	0,0	0,0	0,2	0,4	0,7
Gävleborg	0,7	0,2	0,2	0,1	0,1	0,1	0,0	0,2	1,5	0,7
Dala. Övr.	0,2	01	0,1	0,2	0,1	0,2	0,1	0,0	0,9	0,4
Dalarna	0,2	0,1	0,1	0,2	0,1	0,2	0,1	0,0	0,9	0,4
Värmland	0,1	0,2	0,1	0,2	0,2	0,0	0,0	0,0	0,9	0,4
Örebro	0,1	0,1	0,2	0,1	0,0	0,1	0,0	0,0	0,5	0,5
Västmanland	0,0	0,2	0,1	0,0	0,0	0,0	0,1	0,3	0,7	1,1
Uppsala	0,0	0,0	0,1	0,1	0,1	0,0	0,1	0,1	0,6	0,7
Stockholm	0,1	0,2	0,1	0,1	0,2	0,0	0,0	0,2	1,0	1,5
Södermanland	0,2	0,1	0,1	0,1	0,1	0,1	0,1	0,0	0,6	0,9
Östergötland	0,1	0,3	0,2	0,1	0,0	0,0	0,1	0,0	0,8	0,7
Skaraborg	0,3	0,2	0,2	0,3	0,1	0,1	0,7	0,1	2,0	3,0
Älvsb. Dalsl.	0,0	0,1	0,1	0,1	0,0	0,1	0,0	0,0	0,4	1,1
Älvsb. Västg.	0,1	0,1	0,2	0,0	0,1	0,0	0,1	0,1	0,6	0,6
Göteborg	0,0	0,1	0,1	0,1	0,1	0,1	0,0	0,0	0,5	1,1
V. Götaland	0,4	0,4	0,5	0,6	0,3	0,3	0,8	0,2	3,5	1,4
Jönköping	0,0	0,1	0,1	0,1	0,1	0,0	0,0	0,0	0,4	0,3
Kronoberg	0,0	0,1	0,1	0,1	0,0	0,1	0,1	0,0	0,5	0,5
Kalmar	0,0	0,0	0,1	0,1	0,0	0,1	0,0	0,0	0,3	0,2
Gotland	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,5
Halland	0,0	0,0	0,1	0,0	0,0	0,0	0,1	0,0	0,3	0,5
Blekinge	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,9	2,2
Skåne	0,0	0,1	0,1	0,1	0,0	0,0	0,0	0,0	0,3	0,3

1) Percentage, total growing in regions

Appendix 2

Different types of bark on sallow trees



Appendix 3

Sallow timber



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