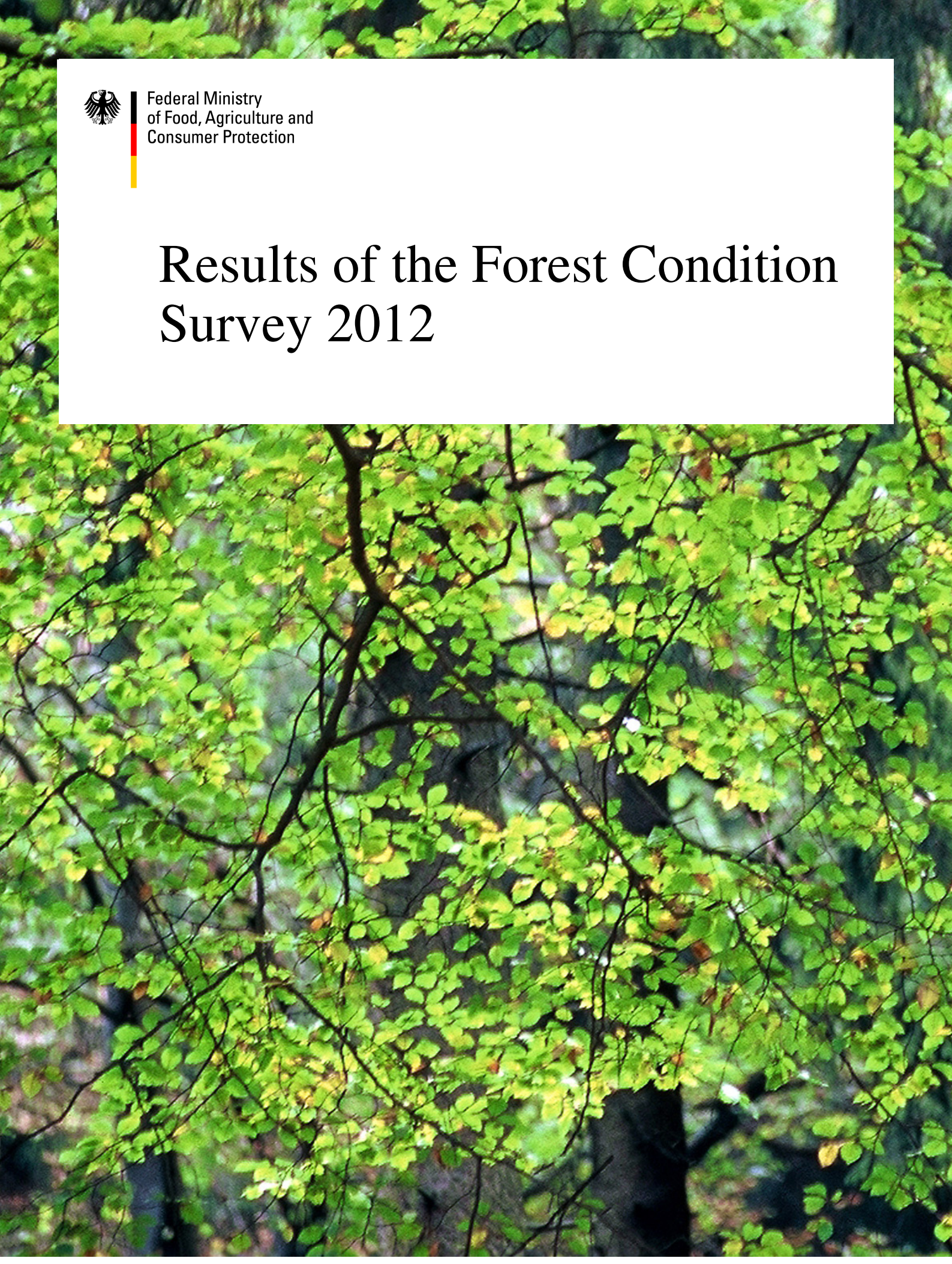

Federal Ministry
of Food, Agriculture and
Consumer Protection

Results of the Forest Condition Survey 2012

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Summary

Forest condition has slightly improved in comparison to the previous year. Beech trees recovered from previous year's very poor crown condition. The crown condition of Scots Pine also improved, while Spruce shows hardly any change. In contrast, oak trees further deteriorated from an already high degree of defoliation.

On average throughout all tree species, **25 %** (2011: 28 %) of the forest area was assessed as damaged, i.e. showing more than 25 % of crown defoliation (damage classes 2 to 4). 36 % (2011: 35 %) were in the warning stage. 39 % (2011: 37 %) showed no defoliation. The mean crown defoliation decreased from 20.4 to 19.2 %.

Spruce: the percentage of damage classes 2 to 4 is **27 %**, which shows no change compared to the previous year. 35 % (2011: 33 %) of the trees were in the warning stage. 38 % (2011: 40 %) showed no defoliation. Mean crown defoliation increased from 19.1 to 19.3 %.

Scots Pine: the share of damage classes 2 to 4 decreased from 13 % to 11 %. 39 % (2011: 42 %) are in the warning stage. 50 % (2011: 45 %) showed no defoliation which is the best result since the beginning of the survey in 1984. Accordingly the mean crown defoliation of Pine decreased to 14.5 % which is the lowest score since the beginning of the surveys.

Beech: the share of damage classes 2 to 4 decreased by 19 percentage points from 57 to **38 %**. 40 % (2011: 31 %) were classified in the warning stage. The share of trees without defoliation increased from 12 to 22 %. Mean crown defoliation decreased from 30.4 to 24.3 %. The high defoliation rates in 2011 were mainly due to a prolific mast year. In 2012 almost no fruiting was recorded and the trees were able to recover. However the defoliation rates of beech are still higher than they were in the period before 2004. In 2004, the crown condition of beech trees worsened due to a mast year and due to the extreme drought and heat in summer 2003. Trees have not yet completely regenerated.

Oaks: the share of damaged trees increased to **50 %** (2011: 41 %). The share of the warning stage was 33 % (2011: 38 %). Only 17 % (2011: 21 %) of the oaks showed no defoliation. Mean crown defoliation was 29.4 % (2011: 26.3 %). High defoliation rates in oaks have already been recorded during the past ten years. Damages caused by defoliators, namely the caterpillars of a number of moth species, play an important role, and the second shoots are often affected by mildew.

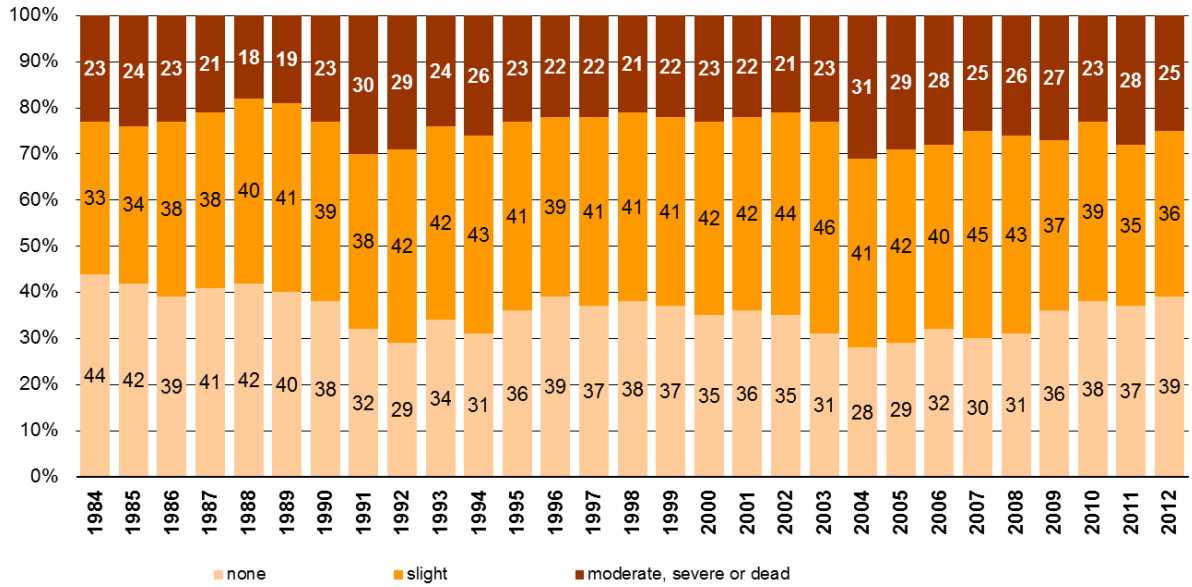
Calculation of the Results 2012

The national results have been calculated by the Institute for Forest Ecosystems of the Thünen Institute based on the crown condition data sampled by the *laender* on the national 16 km x 16 km grid. The survey of 2012 is comprised of 9,992 sampled trees which were assessed on 415 plots. The assessment covers 38 different tree species. About 80 % of all trees sampled belong to the four main tree species: spruce, Scots pine, beech and oak (note that the two oak species *Quercus robur* and *Quercus petraea* are assessed together). The remaining tree species are grouped under two separate species groups: "other conifers" and "other broadleaves". For explanations on the assessment methods please see the Annex: Forest condition survey - assessment and classification methods.

The results of the Forest Condition Survey 2012 are presented in the following figures and tables. It is important to note that the results before 1990 do not include the new *laender*. The information on the percentage of forest area covered by the respective tree species or species group originates from the Inventory Study 2008, which was carried out to obtain up-to-date forest information for reporting to the Climate secretariat.

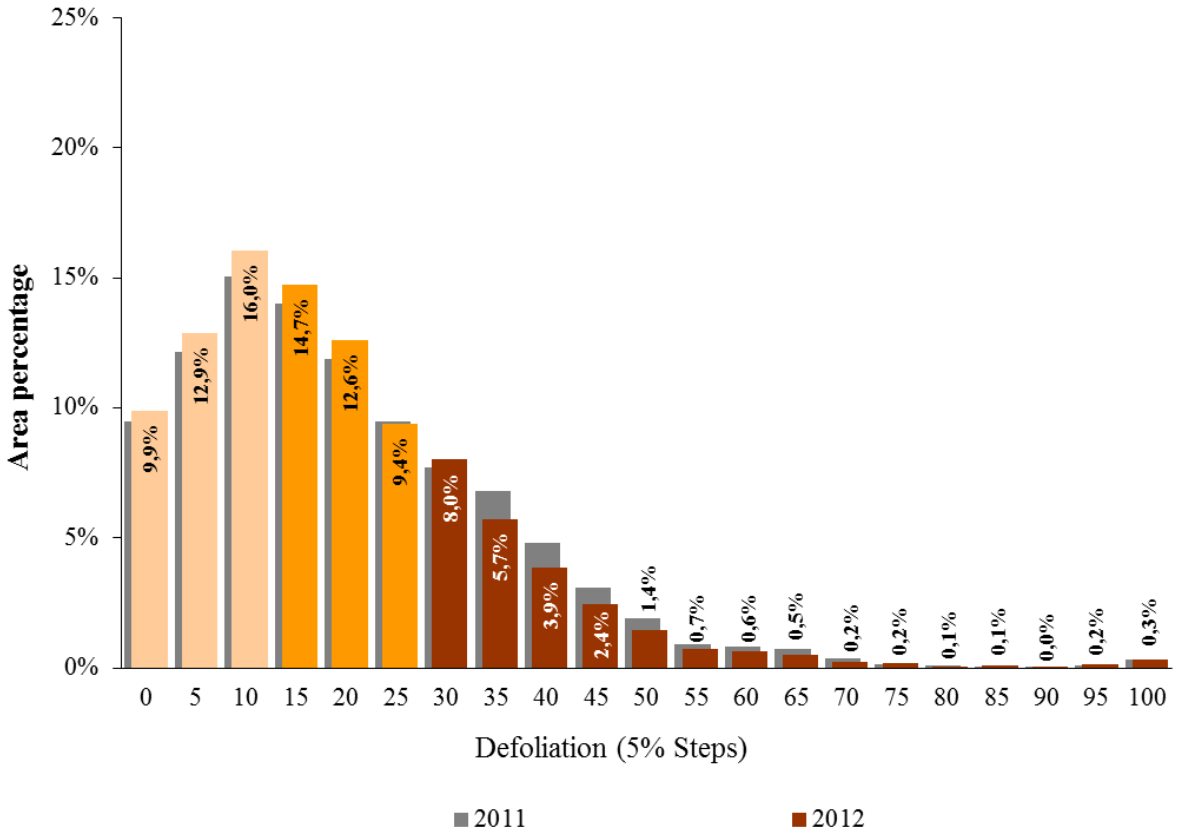
All Tree Species

Figure 1: All Tree Species: development of defoliation classes since 1984



Until 1989 without the new *laender*; 9,992 trees assessed in 2012.

Figure 2: **All tree species - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012**



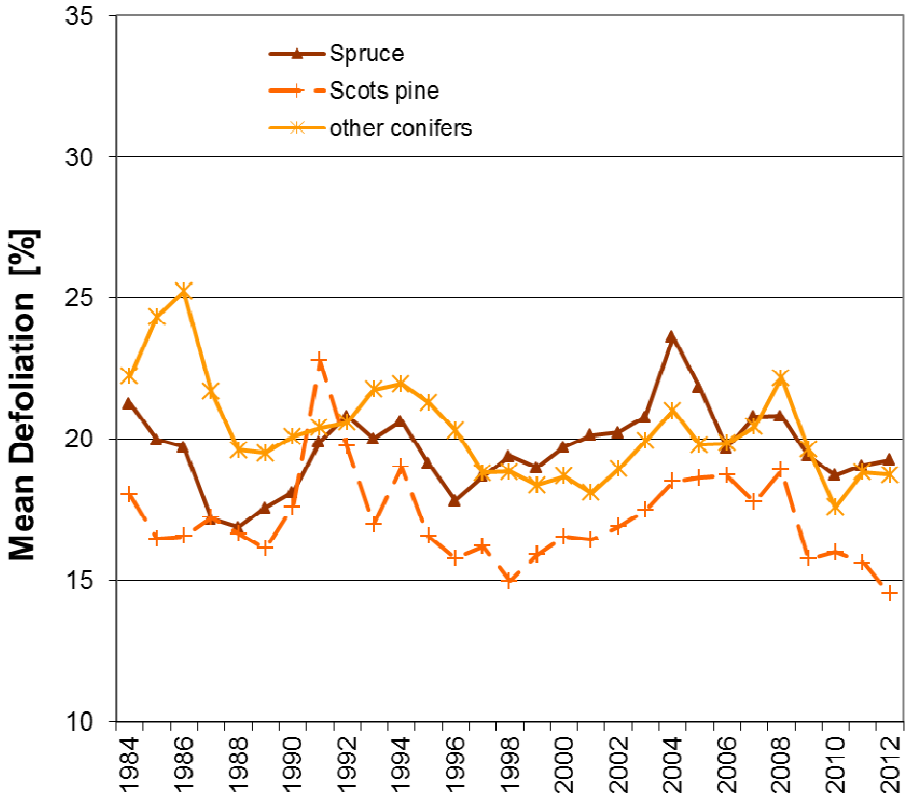
Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

Conifers

Mean Crown Defoliation

The following figure displays how mean defoliation developed for spruce, Scots pine and other conifers since the beginning of the survey (until 1989 without the new *laender*).

Figure 3: Conifers: Development of mean crown defoliation

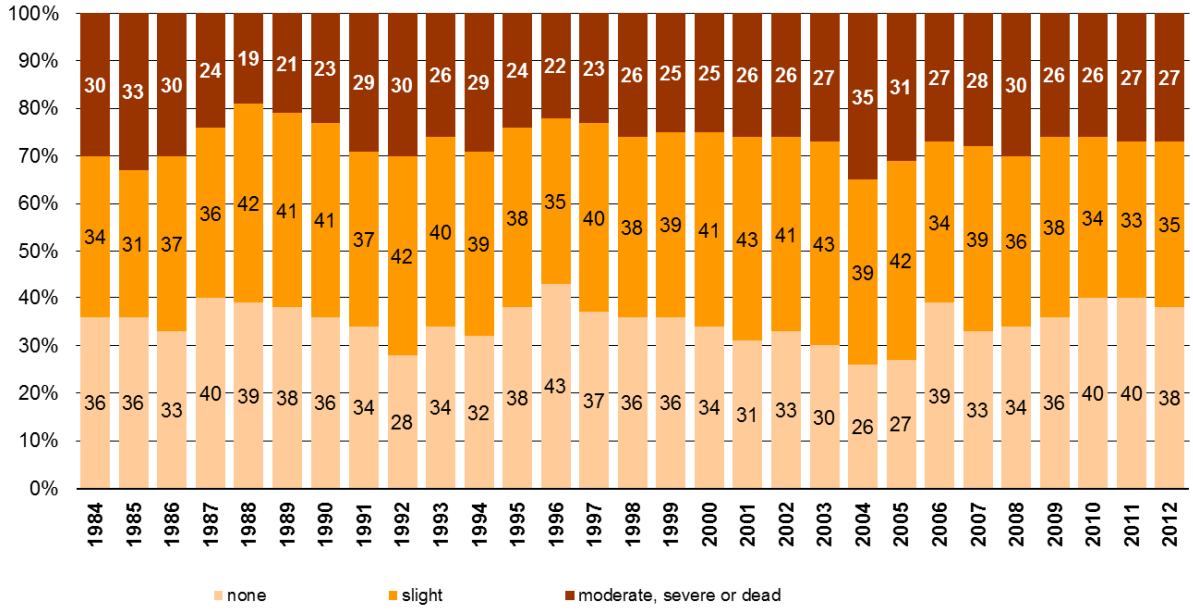


Spruce

Scientific name: *Picea abies*

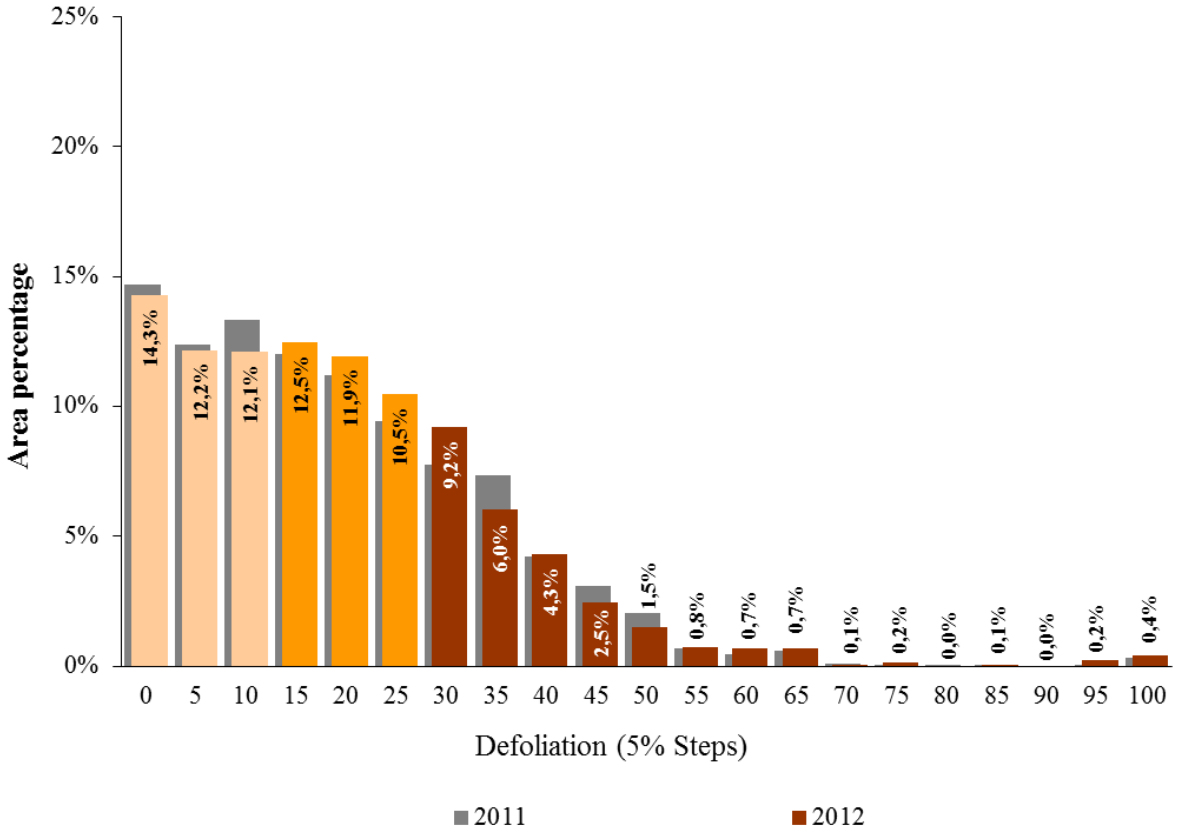
Percentage of forest area: 26 %

Figure 4: Spruce: Development of defoliation classes since 1984



Area percentage in defoliation classes; until 1989 without new *laender*; 2,649 trees in 2012.

Figure 5: Spruce - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012



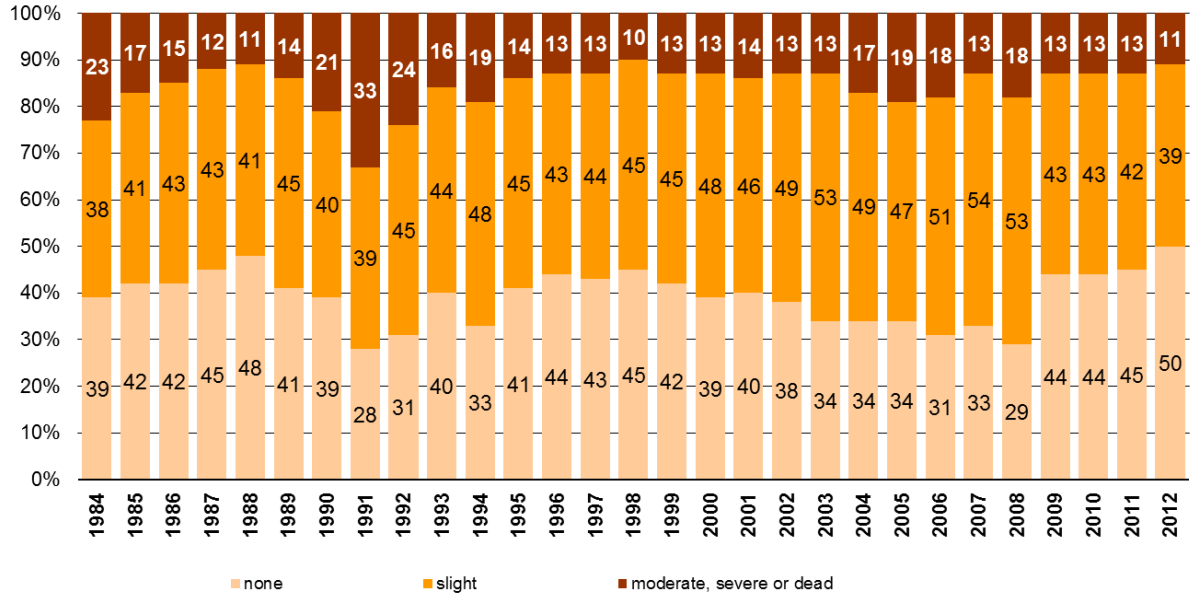
Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

Scots Pine

Scientific Name: *Pinus sylvestris*

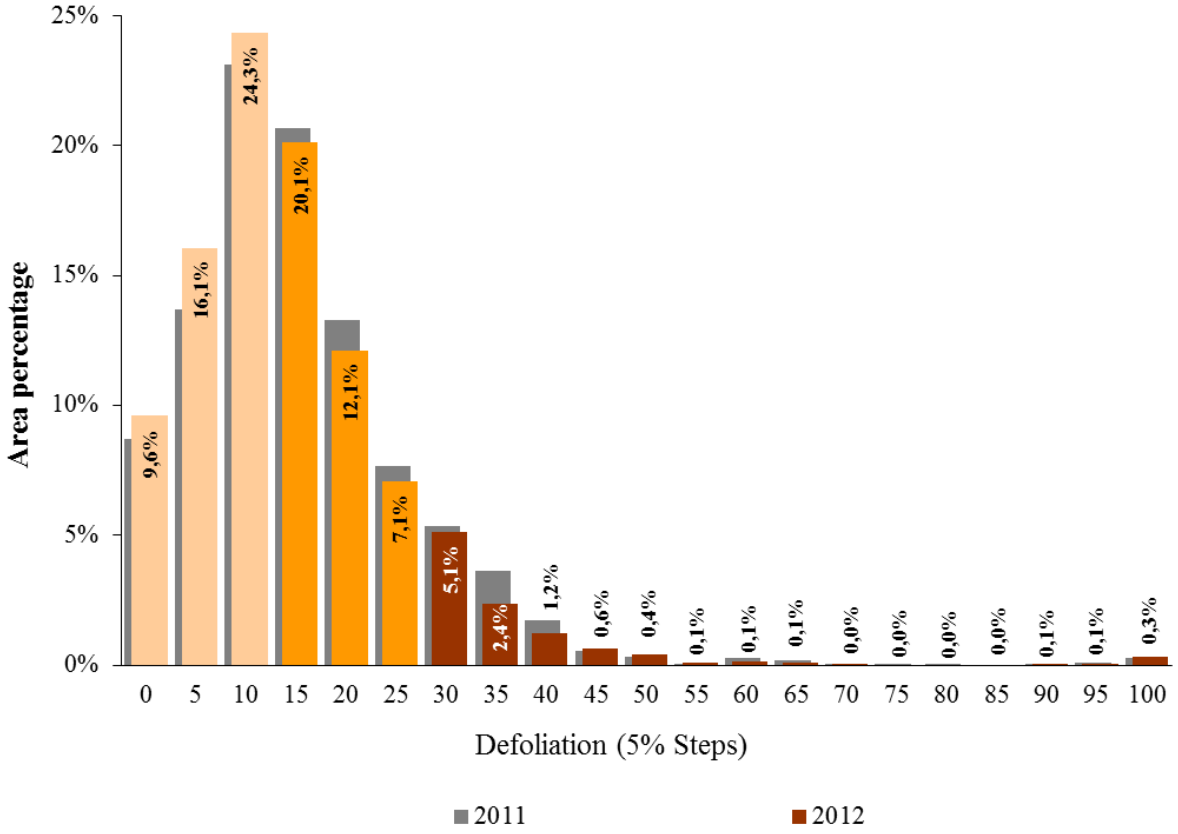
Percentage of forest area: 23 %

Figure 6: Scots pine: Development of defoliation classes since 1984



Area percentage in defoliation classes; until 1989 without new *laender*; 2,721 trees in 2012.

Figure 7: **Scots pine - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012**

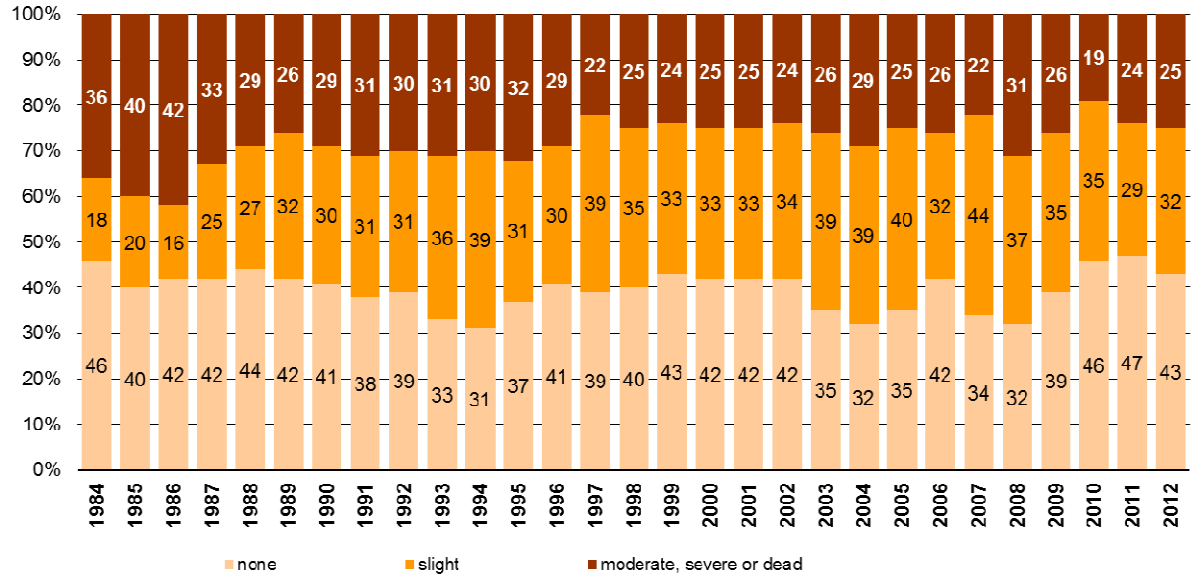


Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

Other Conifers

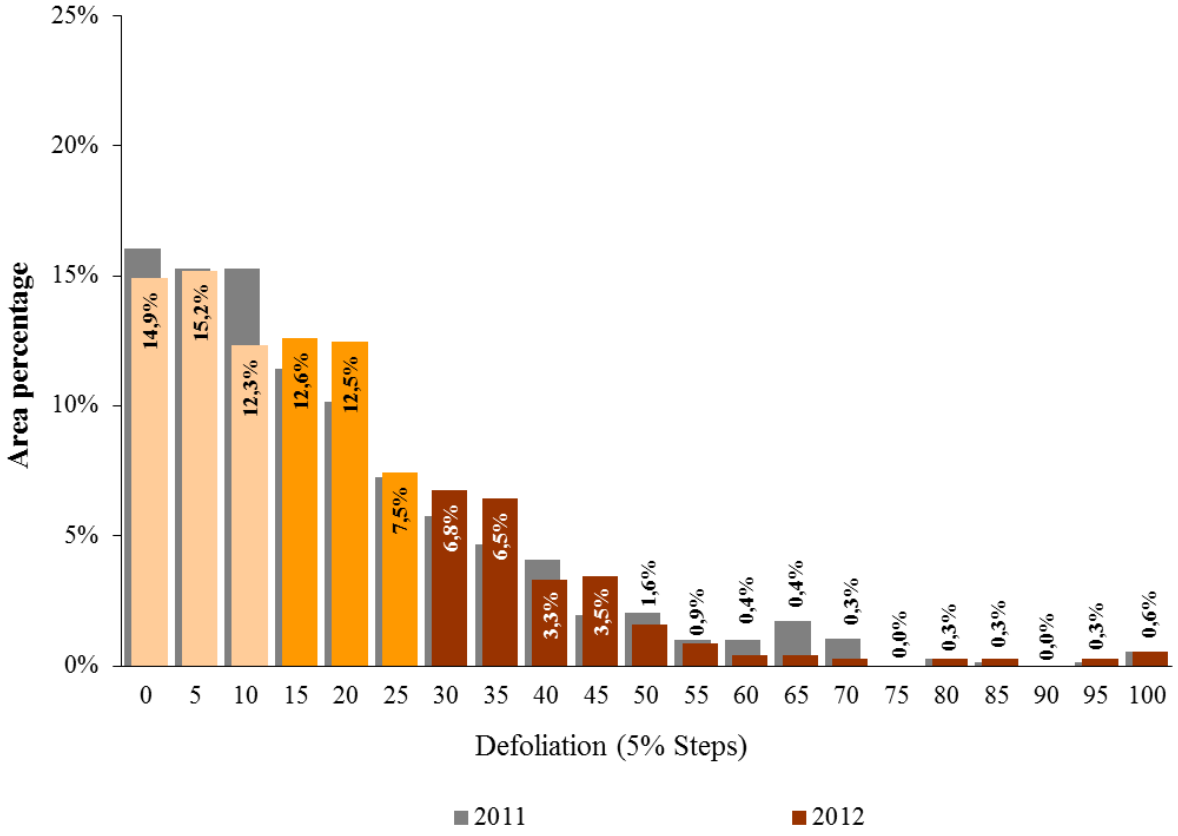
Percentage of forest area: 7 %

Figure 8: Other conifers: Development of defoliation classes



Area percentage in defoliation classes; until 1989 without new *laender*; 697 trees in 2012.

Figure 9: **Other conifers - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012**



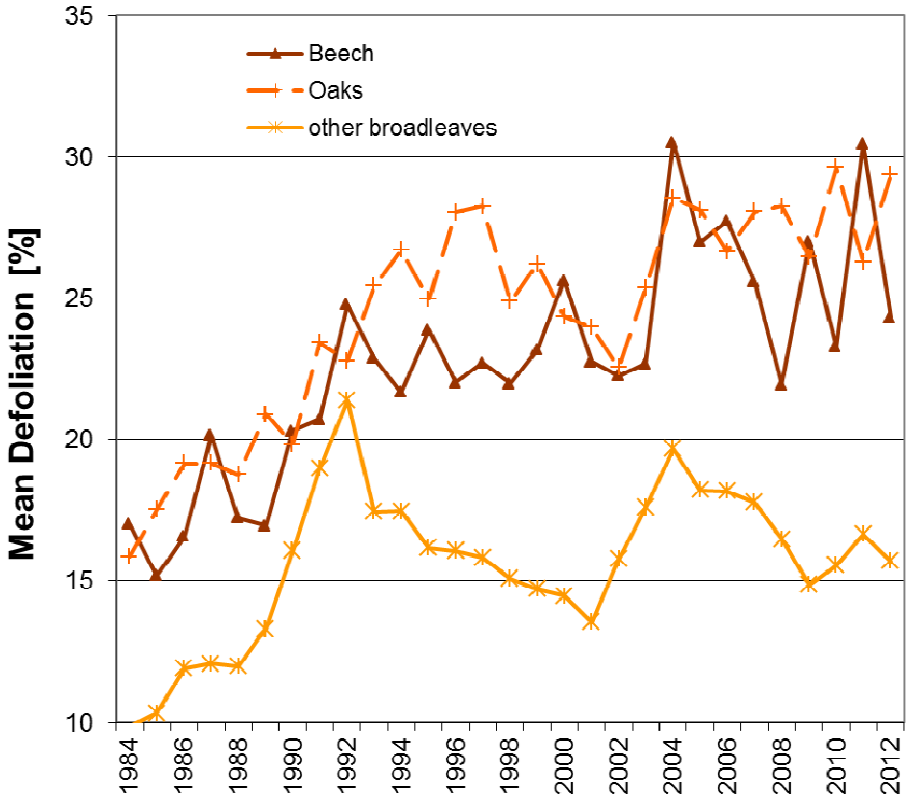
Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

Broadleaves

Mean Crown Defoliation

The following figure displays how mean defoliation developed for beech, oaks and other broadleaves since the beginning of the surveys (until 1989 without the new *laender*).

Figure 10: Broadleaves: Development of mean crown defoliation

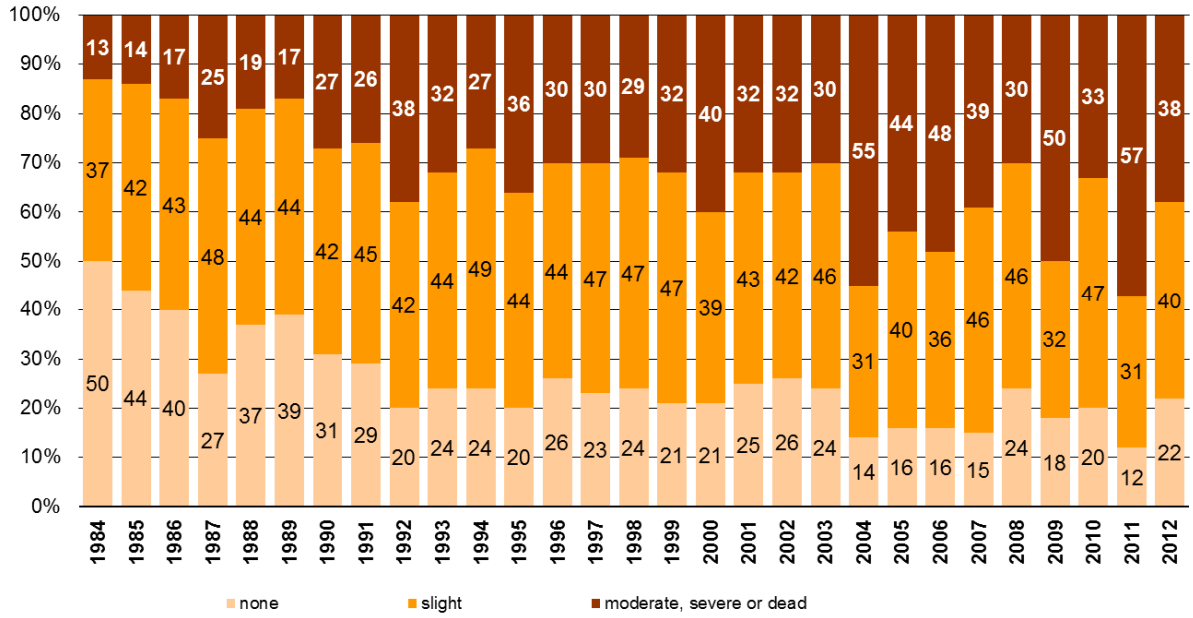


Beech

Scientific name: *Fagus sylvatica*

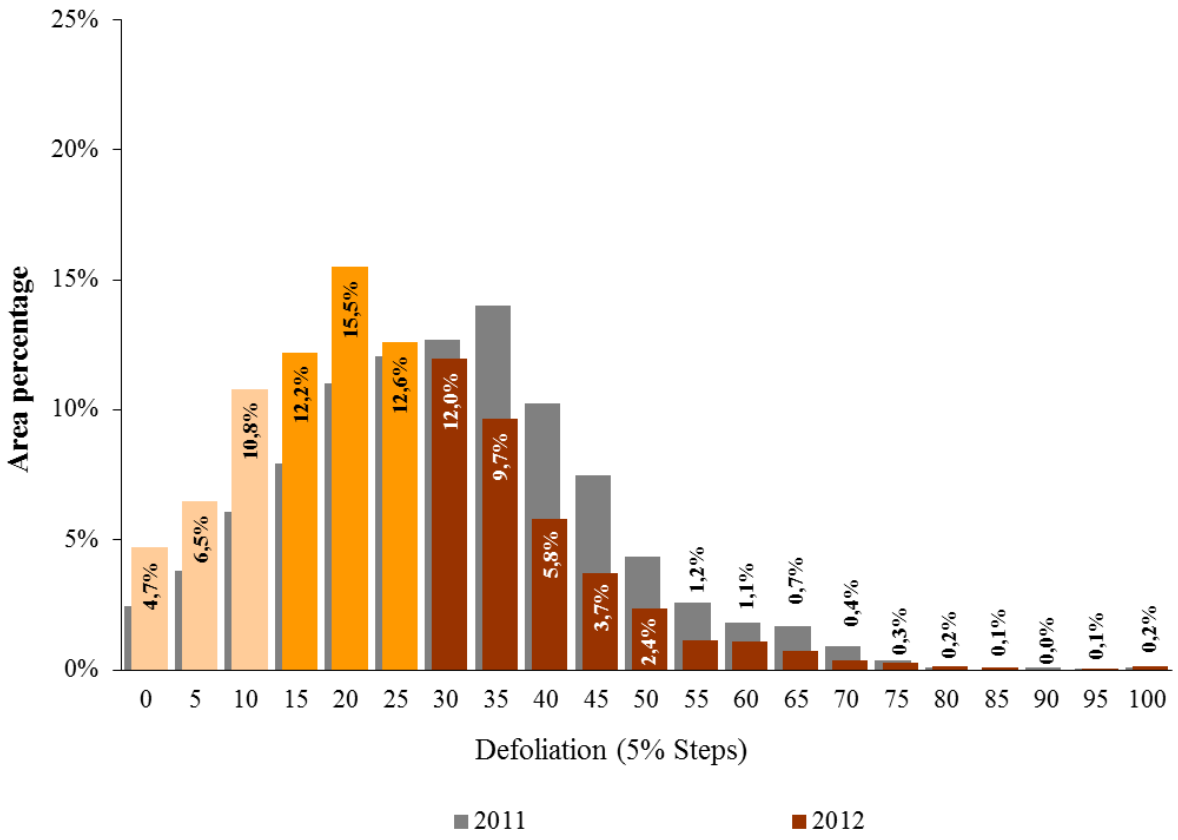
Percentage of forest area: 16 %

Figure 11: Beech: Development of defoliation classes



Area percentage in defoliation classes; until 1989 without new *laender*; 1,816 trees in 2012.

Figure 12: Beech - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012



Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

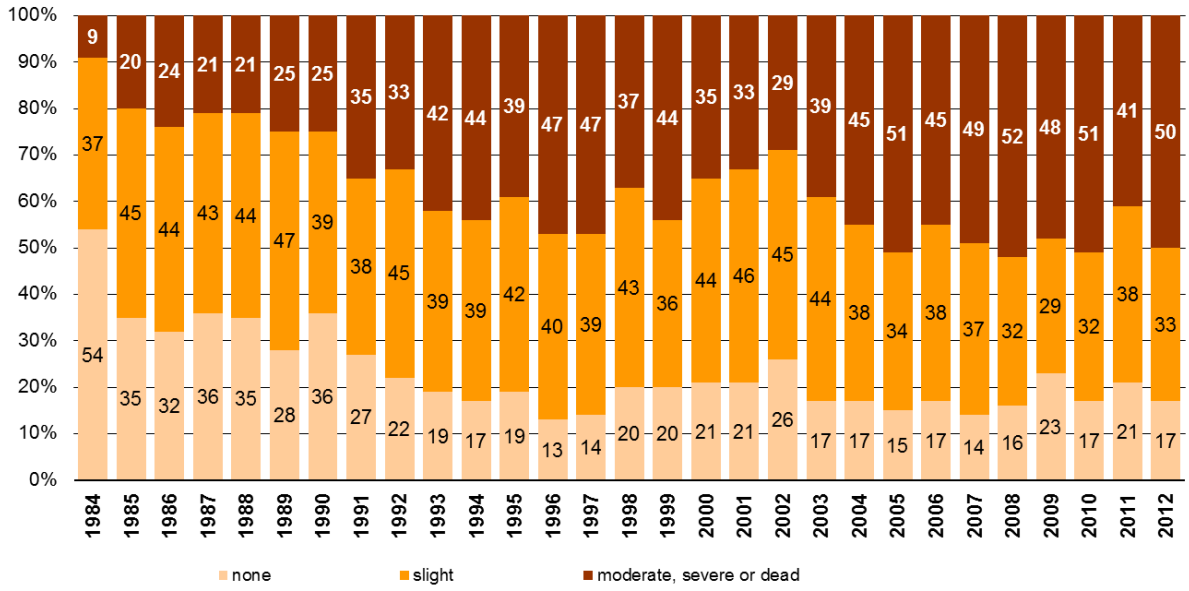
Oaks

The two indigenous species European and Sessile oak are assessed together. The third indigenous oak species *Quercus pubescens* is very rare in Germany, requires specific dry and warm site conditions and does not occur within the sampled plots. The North American Red oak (*Quercus rubra*) is included under "Other broadleaves".

Scientific names: *Quercus robur, Quercus petraea*

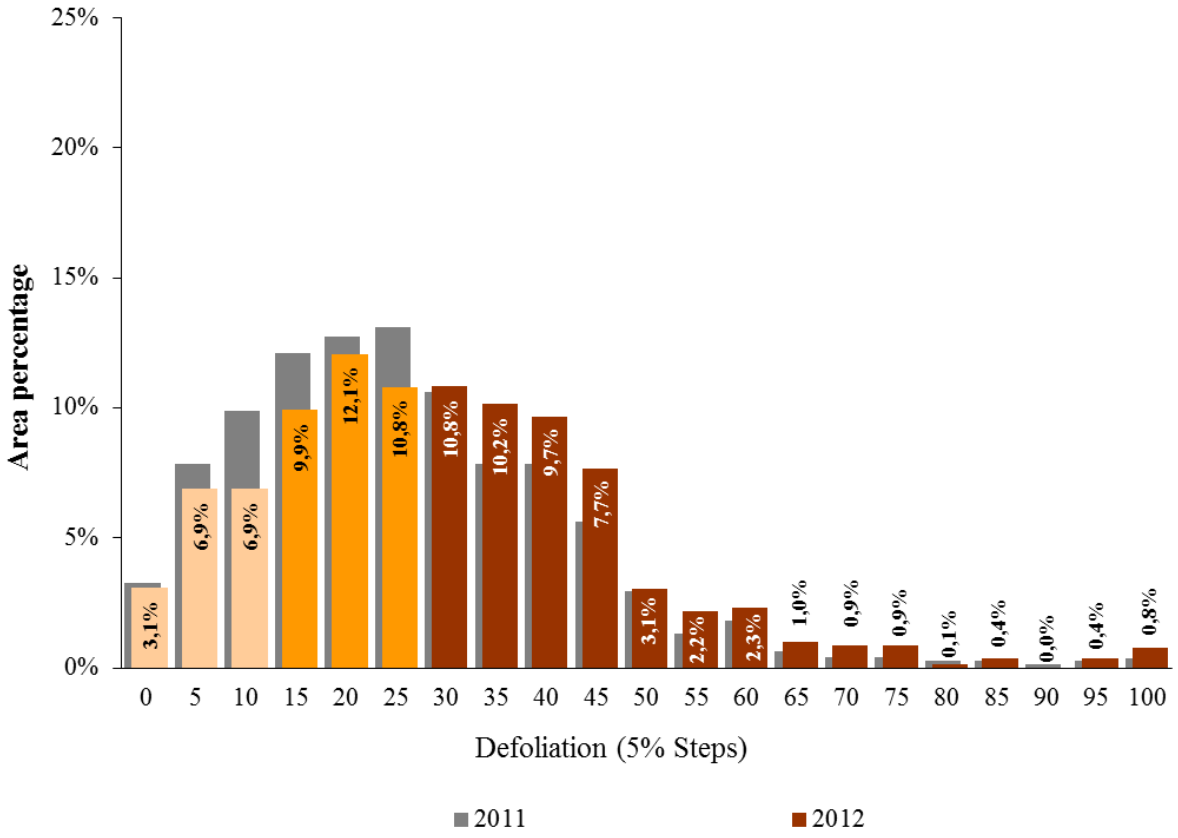
Percentage of forest area (both oak species together): 9 %

Figure 13: Oaks: Development of defoliation classes



Area percentage in defoliation classes; until 1989 without new *laender*; 785 trees in 2012.

Figure 14: Oaks - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012

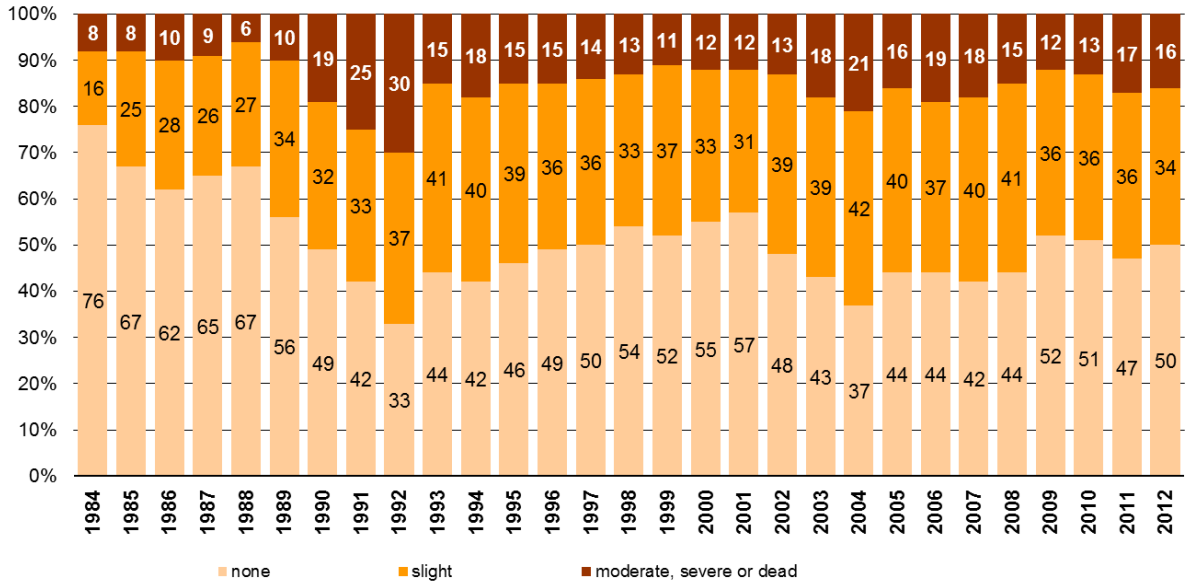


Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

Other Broadleaves

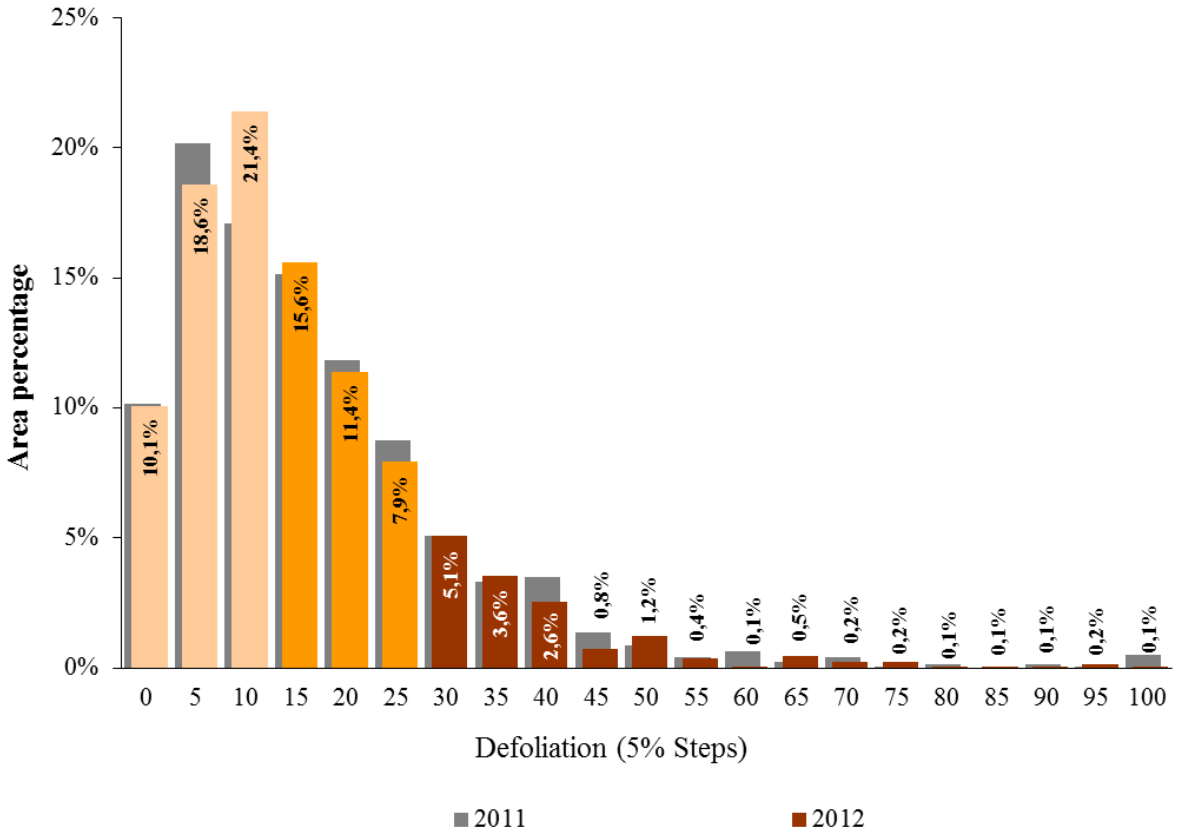
Percentage of forest area: 17 %

Figure 15: Other broadleaves: Development of defoliation classes



Area percentage in defoliation classes; until 1989 without new *laender*; 1,324 trees in 2012.

Figure 16: **Other broadleaves - Distribution of crown defoliation assessed in 5 % steps in 2011 and 2012**

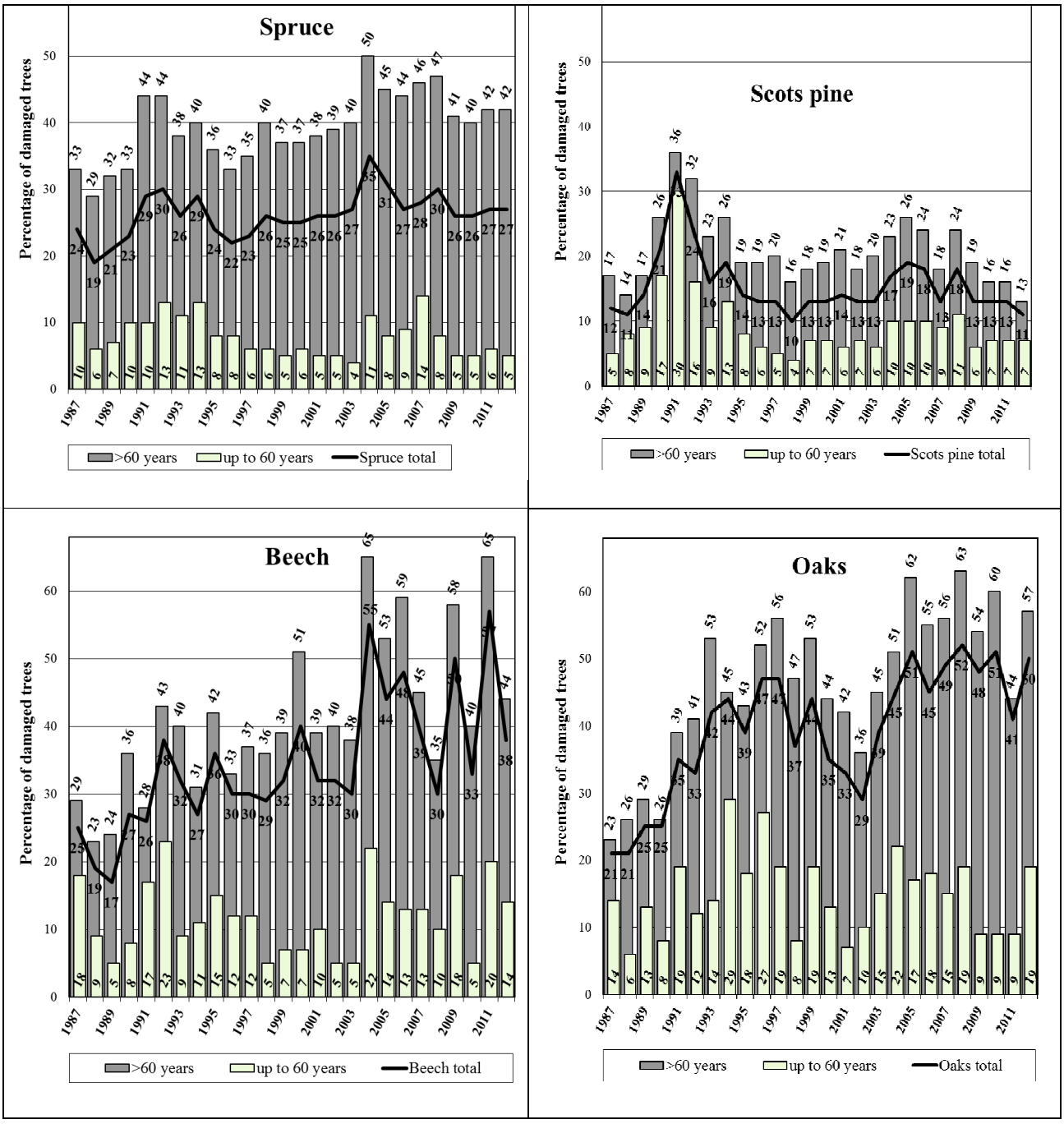


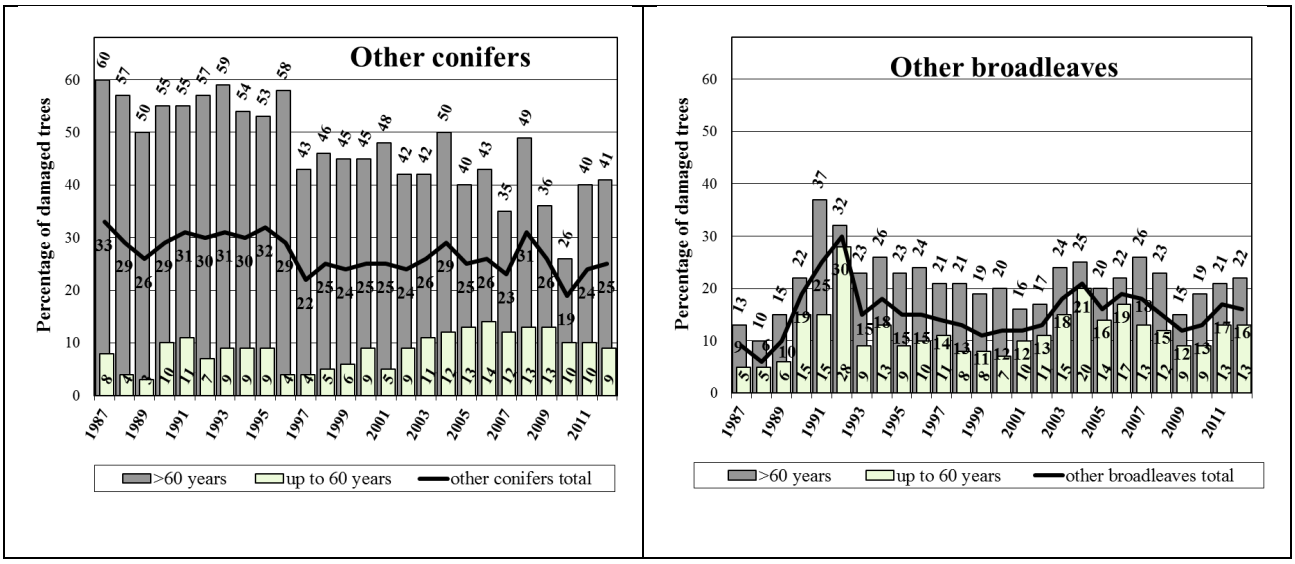
Colours represent the defoliation class: defoliation class 0 tuscan, defoliation class 1 orange, defoliation classes 2 – 4 brown.

Influence of Tree Age on Defoliation

Older trees are in general more affected by crown defoliation than younger ones. This can be seen in figure 17 which shows the percentages of defoliation classes 2 – 4 separately for young trees (up to 60 years) and older trees.

Figure 17: Development of the percentage of damaged trees (defoliation classes 2 – 4) by tree species and age classes




Other conifers
Percentage of damaged trees
>60 years
up to 60 years
other conifers total
Other broadleaves
Percentage of damaged trees
>60 years
up to 60 years
other broadleaves total

Annex

Tables

Table 1: **Mean crown defoliation in percent by tree species or species groups**

Year	All Tree species	Spruce	Pine	Beech	Oaks	Other conifers	Other broad-leaves
1984	18.9	21.3	18.0	17.0	15.9	22.2	9.9
1985	17.7	20.0	16.5	15.2	17.5	24.3	10.3
1986	18.1	19.7	16.6	16.6	19.2	25.2	11.9
1987	17.7	17.2	17.2	20.1	19.2	21.7	12.1
1988	16.8	16.9	16.6	17.2	18.8	19.6	12.0
1989	17.2	17.6	16.1	17.0	20.9	19.5	13.3
1990	18.3	18.1	17.6	20.3	19.8	20.1	16.1
1991	21.1	19.9	22.8	20.7	23.4	20.4	19.0
1992	21.2	20.8	19.7	24.8	22.8	20.6	21.4
1993	19.7	20.0	17.0	22.9	25.4	21.8	17.5
1994	20.4	20.6	19.0	21.7	26.7	22.0	17.5
1995	19.2	19.1	16.6	23.9	25.0	21.3	16.2
1996	18.4	17.8	15.8	22.0	28.0	20.3	16.1
1997	18.8	18.7	16.2	22.7	28.2	18.8	15.8
1998	18.3	19.4	15.0	22.0	24.9	18.8	15.1
1999	18.6	19.0	15.9	23.2	26.2	18.4	14.7
2000	19.3	19.7	16.6	25.6	24.4	18.7	14.5
2001	18.8	20.1	16.4	22.8	24.0	18.1	13.5
2002	19.1	20.2	16.9	22.3	22.5	18.9	15.8
2003	19.9	20.8	17.5	22.7	25.4	19.9	17.6
2004	22.8	23.6	18.5	30.5	28.5	21.0	19.7
2005	21.5	21.8	18.6	27.0	28.1	19.8	18.2
2006	21.0	19.7	18.7	27.7	26.6	19.9	18.2
2007	20.7	20.8	17.8	25.6	28.0	20.4	17.8
2008	20.4	20.8	18.9	22.0	28.3	22.2	16.5
2009	19.7	19.4	15.8	27.0	26.5	19.7	14.9
2010	19.1	18.7	16.0	23.3	29.6	17.6	15.5
2011	20.4	19.1	15.6	30.4	26.3	18.8	16.7
2012	19.2	19.3	14.5	24.3	29.4	18.7	15.7

Table 2: **All tree species: Development of defoliation classes since 1984 [% of area]**

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	44	33	23
1985	42	34	24

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1986	39	38	23
1987	41	38	21
1988	42	40	18
1989	40	41	19
1990	38	39	23
1991	32	38	30
1992	29	42	29
1993	34	42	24
1994	31	43	26
1995	36	41	23
1996	39	39	22
1997	37	41	22
1998	38	41	21
1999	37	41	22
2000	35	42	23
2001	36	42	22
2002	35	44	21
2003	31	46	23
2004	28	41	31
2005	29	42	29
2006	32	40	28
2007	30	45	25
2008	31	43	26
2009	36	37	27
2010	38	39	23
2011	37	35	28
2012	39	36	25

Table 3: **Spruce: Development of defoliation classes since 1984 [% of area]**

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	36	34	30
1985	36	31	33
1986	33	37	30
1987	40	36	24
1988	39	42	19
1989	38	41	21
1990	36	41	23
1991	34	37	29
1992	28	42	30
1993	34	40	26
1994	32	39	29
1995	38	38	24
1996	43	35	22
1997	37	40	23

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1998	36	38	26
1999	36	39	25
2000	34	41	25
2001	31	43	26
2002	33	41	26
2003	30	43	27
2004	26	39	35
2005	27	42	31
2006	39	34	27
2007	33	39	28
2008	34	36	30
2009	36	38	26
2010	40	34	26
2011	40	33	27
2012	38	35	27

Table 4: **Scots pine: Development of defoliation classes since 1984 [% of area]**

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	39	38	23
1985	42	41	17
1986	42	43	15
1987	45	43	12
1988	48	41	11
1989	41	45	14
1990	39	40	21
1991	28	39	33
1992	31	45	24
1993	40	44	16
1994	33	48	19
1995	41	45	14
1996	44	43	13
1997	43	44	13
1998	45	45	10
1999	42	45	13
2000	39	48	13
2001	40	46	14
2002	38	49	13
2003	34	53	13
2004	34	49	17
2005	34	47	19
2006	31	51	18
2007	33	54	13
2008	29	53	18
2009	44	43	13

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
2010	44	43	13
2011	45	42	13
2012	50	39	11

Table 5: Other Conifers: Development of defoliation classes since 1984 [% of area]

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	46	18	36
1985	40	20	40
1986	42	16	42
1987	42	25	33
1988	44	27	29
1989	42	32	26
1990	41	30	29
1991	38	31	31
1992	39	31	30
1993	33	36	31
1994	31	39	30
1995	37	31	32
1996	41	30	29
1997	39	39	22
1998	40	35	25
1999	43	33	24
2000	42	33	25
2001	42	33	25
2002	42	34	24
2003	35	39	26
2004	32	39	29
2005	35	40	25
2006	42	32	26
2007	34	44	22
2008	32	37	31
2009	39	35	26
2010	46	35	19
2011	47	29	24
2012	43	32	25

Table 6: Beech: Development of defoliation classes since 1984 [% of area]

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	50	37	13
1985	44	42	14
1986	40	43	17

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1987	27	48	25
1988	37	44	19
1989	39	44	17
1990	31	42	27
1991	29	45	26
1992	20	42	38
1993	24	44	32
1994	24	49	27
1995	20	44	36
1996	26	44	30
1997	23	47	30
1998	24	47	29
1999	21	47	32
2000	21	39	40
2001	25	43	32
2002	26	42	32
2003	24	46	30
2004	14	31	55
2005	16	40	44
2006	16	36	48
2007	15	46	39
2008	24	46	30
2009	18	32	50
2010	20	47	33
2011	12	31	57
2012	22	40	38

Table 7: **Oaks: Development of defoliation classes since 1984 [% of area]**

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	54	37	9
1985	35	45	20
1986	32	44	24
1987	36	43	21
1988	35	44	21
1989	28	47	25
1990	36	39	25
1991	27	38	35
1992	22	45	33
1993	19	39	42
1994	17	39	44
1995	19	42	39
1996	13	40	47
1997	14	39	47
1998	20	43	37

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1999	20	36	44
2000	21	44	35
2001	21	46	33
2002	26	45	29
2003	17	44	39
2004	17	38	45
2005	15	34	51
2006	17	38	45
2007	14	37	49
2008	16	32	52
2009	23	29	48
2010	17	32	51
2011	21	38	41
2012	17	33	50

Table 8: Other broadleaves: Development of defoliation classes since 1984 [% of area]

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
1984	76	16	8
1985	67	25	8
1986	62	28	10
1987	65	26	9
1988	67	27	6
1989	56	34	10
1990	49	32	19
1991	42	33	25
1992	33	37	30
1993	44	41	15
1994	42	40	18
1995	46	39	15
1996	49	36	15
1997	50	36	14
1998	54	33	13
1999	52	37	11
2000	55	33	12
2001	57	31	12
2002	48	39	13
2003	43	39	18
2004	37	42	21
2005	44	40	16
2006	44	37	19
2007	42	40	18
2008	44	41	15
2009	52	36	12
2010	51	36	13

Year	0 (undamaged)	1 (warning stage)	2 – 4 (damaged)
2011	47	36	17
2012	50	34	16

Crown Condition in the German *Laender*

While the national results are based on the data from the national 16km x 16km grid, the *laender* use denser grids to gain reliable information at regional level. The following table shows the main results as communicated by the laender to the Federal Ministry of Food, Agriculture and Consumer Protection.

Table 9: Forest Condition in the German *laender* 2012
Percentage of defoliation classes 2 to 4 and change compared with 2011

Land	All Tree species Area percentage [%] (*Change in percentage points*)	Spruce Area percentage [%] (*Change in percentage points*)	Scots pine Area percentage [%] (*Change in percentage points*)	Beech Area percentage [%] (*Change in percentage points*)	Oaks Area percentage [%] (*Change in percentage points*)	Grid Grid width [km²]
Baden-Württemberg	**36** *(+3)*	**31** *(+6)*	**34** *(+6)*	**49** *(-11)*	**59** *(+20)*	8x8
Bayern	**21** *(-6)*	**17** *(-3)*	**14** *(-8)*	**30** *(-16)*	**52** *(-4)*	16x16[1]
Berlin	**26** *(-3)*	**o. A.**	**12** *(-4)*	**o. A.**	**74** *(-1)*	2x2
Brandenburg	**8** *(-1)*	**o. A.**	**3** *(-2)*	**26** *(-7)*	**41** *(+7)*	16x16
Bremen	**8** *(-2)*	**9** *(-9)*	**2** *(±0)*	**11** *(-1)*	**23** *(-5)*	0,1x0,2
Hamburg	NE	NE	NE	NE	NE	16x16
Hessen	**33** *(-3)*	**27** *(-1)*	**28** *(+6)*	**43** *(-14)*	**47** *(+12)*	8x8
Mecklenburg-Vorpommern	**17** *(-2)*	**22** *(+1)*	**14** *(-2)*	**14** *(-23)*	**36** *(+3)*	8x8
Niedersachsen	**20** *(-2)*	**33** *(-2)*	**5** *(+1)*	**39** *(-13)*	**54** *(+4)*	8x8[2]
Nordrhein-Westfalen	**25** *(-8)*	**21** *(-5)*	**13** *(-5)*	**28** *(-27)*	**54** *(+8)*	4x4
Rheinland-Pfalz	**28** *(-5)*	**25** *(+6)*	**11** *(-5)*	**40** *(-27)*	**46** *(+7)*	4x12
Saarland	**34** *(+7)*	**19** *(+3)*	**27** *(-17)*	**35** *(-15)*	**51** *(+33)*	2x4
Sachsen	**16** *(±0)*	**15** *(-1)*	**7** *(±0)*	**36** *(-20)*	**43** *(±0)*	4x4
Sachsen-Anhalt	**16** *(±0)*	**29** *(-1)*	**3** *(±0)*	**44** *(-7)*	**46** *(±0)*	4x4
Schleswig-Holstein	**21** *(-8)*	**27** *(-18)*	**5** *(-9)*	**31** *(-17)*	**34** *(+6)*	4x4[3]

[1] additional plots in a 8 by 8 km grid for Oaks
[2] Oaks and beech additional plots on a 4 by 4 km grid (Level I plots where at least 6 beech or oak trees can be found)
[3] locally denser grids (2x4, 4x2, 2x2)

Land	**All Tree species** Area percentage [%] (*Change in percentage points*)	**Spruce** Area percentage [%] (*Change in percentage points*)	**Scots pine** Area percentage [%] (*Change in percentage points*)	**Beech** Area percentage [%] (*Change in percentage points*)	**Oaks** Area percentage [%] (*Change in percentage points*)	**Grid** Grid width [km²]
Thüringen	**32** *(-4)*	**23** *(-1)*	**42** *(-3)*	**40** *(-13)*	**55** *(+4)*	4x4
Germany	**25** *(-3)*	**27** *(±0)*	**11** *(-2)*	**38** *(-19)*	**50** *(+9)*	16x16

N.E.: no information; sample size too small

Accuracy of the Forest Condition Assessment 2012

The forest condition survey is based on sampling on a systematic grid. Figure 18 shows the percentage of defoliation classes 2 to 4 in 2012 along with the standard error. The latter describes the accuracy of the estimates. The whiskers indicate the borders which include the true value with a probability of 68 %.

Figure 18: Percentages of Defoliation Classes 2 to 4 and Standard Error

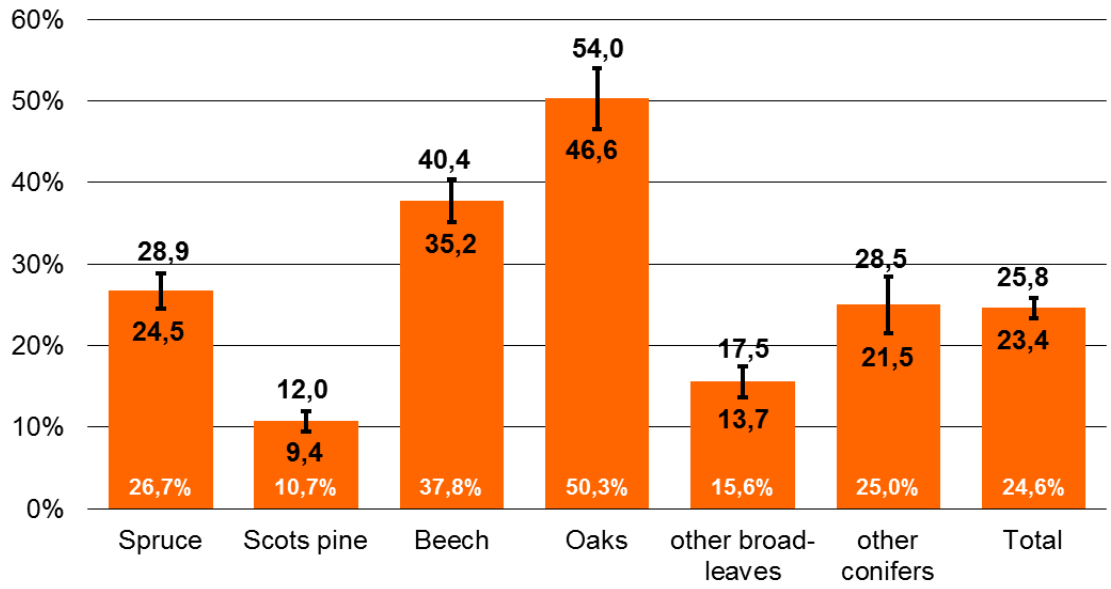


Table 10: Percentage of Defoliation classes 2 to 4 by tree species in 2012: Mean and Standard Error

Tree species	Mean [%]	Standard Errror Percentage points]
Spruce *(Picea abies)*	26.7	±2.2
Scots pine *(Pinus sylvestris)*	10.7	±1.3
Beech *(Fagus sylvatica)*	37.8	±2.6
Oaks *(Quercus petraea, Q. robur)*	50.3	±3.7

Tree species	Mean [%]	Standard Errror Percentage points]
Other broadleaves	15.6	±1.9
Other conifers	25.0	±3.5
Total (all tree species)	**24.6**	**±1.2**

Environmental Forest Monitoring – ICP Forests

The national forest condition survey is part of the environmental monitoring of forest ecosystems. It has been developed since the 1980s to monitor and describe environmental changes and their impact on forest ecosystems. Environmental problems however, do not stop at national borders. Therefore, in 1985 the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was founded within the framework of the UN-ECE Convention on Long-Range Trans-boundary Air Pollution (CLRTAP). Today 41 countries assess inputs of air-born pollutants in forests, crown-condition of forest trees and many other parameters influencing forest condition, using methods harmonized at European level. They also co-operate with similar monitoring programmes in North America and Asia. The environmental monitoring of forest ecosystems includes large scale assessments on a **systematic grid** (referred to as "**Level I**") and **intensive monitoring** of various environmental parameters on a number of permanent plots (**Level II**). For more information please visit www.icp-forests.org.

For more than 20 years the European Union participated in the programme and co-financed the measurements conducted by the member states. Meanwhile the regulation on which this co-operation was based as well as funding by the EU has expired.

Environmental Forest Monitoring in Germany

In Germany, forest monitoring is implemented by the *laender*. They are responsible for large-scale assessments on the systematic grid (referred to as "Level I") and intensive monitoring on permanent plots (Level II). The assessments are co-ordinated at the federal level and the Institute for Forest Ecosystems of the Thünen Institute is responsible for national evaluations and accompanying studies. The Federal Forest Act as amended on 31 July 2010 provides a legal basis for forest monitoring in section 41a paragraph 6.

The crown condition survey which takes place every year is one of the periodic large-scale assessments conducted on the Level-I-grid. For more information see the chapter on "Forest Condition Survey – Assessment and Classification Methods".

The national Forest Soil Inventory also takes place on the Level I grid. The grid width for this survey is 8 km x 8 km. It is a joint project by the Federal Government and the *laender* aimed at improving knowledge on the status of forest soils and changes in this status over time. This knowledge is needed to develop and evaluate the measures to prevent soil deterioration. The first national forest soil inventory took place between 1987 and 1993. The field sampling of the second inventory took place from 2006 to 2008. Data evaluation is still ongoing.

The intensive monitoring on permanent plots (Level II) has been developed and implemented since the 1990s to complement the large-scale assessment of forest condition. It aims to give insights into cause-effect-relationships and impacts on forest condition. The programme on level II plots includes the measurement of air pollutant concentrations, deposition of air-borne pollutants in forests, meteorological measurements, acid and element concentrations in soils and soil solution. The periodic measurement of element contents in leaves and needles allows assessments to be made of the nutritional status of forests. Measurements of soil moisture and the calculation of water budgets will allow water supply and risk from drought stress to be assessed. Furthermore, biological parameters are assessed such as growth in height and stem diameter of the trees, the amount and composition of litter-fall, phenological observations and the composition of soil vegetation. The assessment of crown condition as well as damage symptoms is conducted every year on level II plots in the same period as the respective survey takes place on the large scale grid.

Forest Condition Survey – Assessment and Classification Methods

The national forest condition survey takes place yearly in July and August on a 16 km x 16 km grid. At national level, it yields reliable representative information on the main tree species. The national grid is a sub-sample of the denser grids established by the *laender* to gain information at regional level. The most common plot design is a 4-point cross-cluster oriented along the main compass directions at a distance of 25 m from the grid point. On each of the four sub-plots, the 6 nearest trees are chosen, resulting in 24 sample trees per plot.

Forest condition has been assessed annually in the old *laender* since 1984 and in the new *laender* since 1990. The statistical sampling of crown condition on a systematic permanent grid is currently the most effective method used to obtain large-scale and timely information on the vitality of forests at national level at reasonable costs. Crown condition is considered an indicator of tree vitality. Defoliation is defined as a loss of leaves or needles as compared to a reference tree with full foliage and assessed in 5% steps. The 5 % classes are aggregated to defoliation classes of different bandwidth (cf. table 11). A defoliation of more than 25 % is conventionally taken as a threshold for damage. Therefore, defoliation classes 2, 3 and 4 are

often presented together and referred to as “damaged”. Defoliation class 1 can be considered as a warning stage.

The results of the survey can also be expressed as **mean defoliation**, i.e. the average defoliation found on all sample trees.

In addition to defoliation, further characteristics of the crown (e. g. the degree of flowering and fruiting) as well as the presence of symptoms of abiotic and biotic damage are assessed. The assessment methods are harmonized at European level and are described in detail in the ICP Forests manual (http://www.icp-forests.org/Manual.htm).

Table 11: Definition of Defoliation classes

Defoliation class	Needle/leaf loss	Description
0	0 – 10 %	no defoliation
1	11 – 25 %	slight defoliation (warning stage)
2	26 – 60 %	moderate defoliation
3	61 – 99 %	severe defoliation
4	100 %	dead tree

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