

An Overview of Forest Management in Austria

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Abstract – Nacrtak

Austrian forests and forest management have undergone great change during the past 500 years. From the 16th century on, the unregulated extraction of wood in order to cover the needs for energy in iron industry and saltworks as well as the increasing demand for firewood in the growing cities led to deforestation in great parts of the country. Since 1961, when the first forest inventory data of Austrian forests has been collected, the total forest area in the country has increased by 300,000 ha. Today, with an area of nearly 4 million ha, 47.6% of Austria is covered with forests. With a share of 61.2%, spruce is the most common tree species in Austrian forests. The vulnerability of these trees to climate change and the resulting damages by storms and bark beetles is currently leading to a change in the forest structure. The Austrian state forests are focused on more resistant but still fast-growing tree species like larch or Douglas fir.

Keywords: Austrian forest management, spruce, Austrian forests, forestry overview

1. Introduction – Uvod

Austrian forests and forest management have undergone great change during the past 500 years. From the 16th century on, the unregulated extraction of wood in order to cover the needs for energy in iron industry and saltworks as well as the increasing demand for firewood in the growing cities led to deforestation in great parts of the country. In addition, litter use and forest pasture caused soil degradation and prevented regeneration. As a result, floods, avalanche disasters and mud slides occurred with increasing frequency. In the 18th century, the government finally started regulating the forest management to ensure sustainability in Austrian forests, and in 1852 the first Austrian forest law was established. From then on, the preservation of the four functions of forests have been part of Austrian law as well as the sustainability of forestry management (Johann 2013). According to Austrian forest law, clear cuttings of an area bigger than 2 ha are forbidden, and those of an area larger than 5000 m² require official permission. The law is primarily focused on the preservation of forests and forest soils and on providing sustainable forest management aimed at preserving production power and effects of forest soils (RIS 2016).

From 1961 on, data about Austrian forests have been collected periodically. In order to provide sustainability in forest management, knowledge of the amount of wood stock, forest area and growth is of major importance. The last inventory has been completed in 2009, the next will be published in 2018.

The aim of this paper is to give an overview of Austrian forestry and forest management.

2. Forest management in Austria *Gospodarenje šumama u Austriji*

Since 1961, when the first forest inventory data of Austrian forests has been collected, the total forest area in the country has increased by 300,000 ha. The increase of the forest area has been steady in the last 50 years, as shown in Fig. 1 below. Today, with an area of nearly 4 million ha, 47.6% of Austria is covered with forests. The main part of the new forest land is located on what used to be agricultural land (60%) and also extreme stands, such as slopes or rocky terrain, are turned into forests (Russ 2011).

Table 1 shows the proportion of different management types in 1996, 2002 and 2009, the last three forest inventories in Austria. 76.3% of forest land are pro-

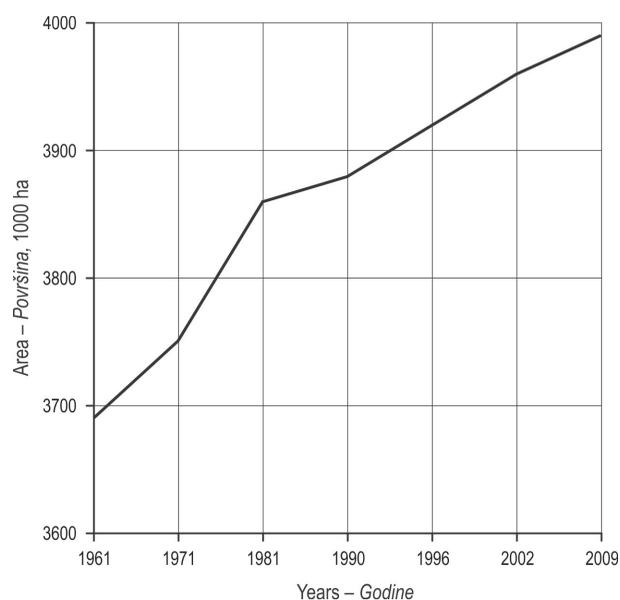


Fig. 1 Area of Austrian forests from 1961 to 2009

Slika 1. Površina austrijskih šuma od 1961. do 2009. godine

ductive forests used for wood production. As on steep terrain there is risk of avalanches and mud slides, 820,000 ha of Austrian forests are declared protective.

Forest land is divided in three categories of ownership: Private forests of an area smaller than 200 ha,

which makes more than half of the forests in Austria, private forests of an area larger than 200 ha and state forests. With less than 600,000 ha, only 15% of the total forest area are state forests. Table 2 shows that the proportion of these categories has been quite stable through the last ten years.

The majority of forests are high forests (97.7%), meaning that the growth is based on generative reproduction. Only 1.5% of the total forest area is registered as coppice, reproducing vegetatively. The mix of an upper class of generatively reproducing trees with a vegetatively reproducing lower class, so-called coppice-with standard forests, has become very rare in Austria (0.8%).

Not only the area of forests increased until 2009, but wood stock has increased from 988 million m³ to 1.14 billion m³ since 1996 (Table 3). Also the amount of harvested wood has increased from 71% to 85% (ÖWI 2010). However, in the last years logging has decreased again and the latest estimation of timber logging in 2015 shows an amount of only 17.55 million m³ of timber (BMLFUW 2016). Data for wood stock and increment in 2015 was not available.

A great variety of landscapes in Austria, mainly structured by the Alps, causes a large variety of ecological communities. Therefore, Austria is divided into 22 growing areas, combined into 9 main growing areas. They are defined as areas with the same ecological

Table 1 Development of different forest land categories in Austria from 1996 to 2009

Tablica 1. Nastajanje različitih vrsta šumske površine u Austriji od 1996. do 2009.

Forest Categories <i>Vrste šuma</i>	1996		2002		2009	
	ha	%	ha	%	ha	%
Protective forest (productive) – <i>Zaštitne šume (proizvodne)</i>	289,000	7.4	303,000	7.7	320,000	8.0
Protective forest (non-productive) – <i>Zaštitne šume (neproizvodne)</i>	467,000	11.9	474,000	12.0	500,000	12.5
Productive forest – <i>Gospodarske šume</i>	3,063,000	78.1	3,068,000	77.5	3,046,000	76.3
Unstocked areas (roads etc.) – <i>Neploдне površine</i>	101,000	2.6	115,000	2.8	125,000	3.2
Total forest land area – <i>Ukupne šumske površine</i>	3,920,000	46.8	3,960,000	47.2	3,991,000	47.6

Table 2 Development of forest ownership categories from 1996 to 2009

Tablica 2. Vlasništvo nad šumama Republike Austrije od 1996. do 2009.

Ownership <i>Vlasništvo</i>	1996		2002		2009	
	ha	%	ha	%	ha	%
State forests – <i>Državne šume</i>	588,000	15.0	591,000	14.9	593,000	14.9
Private forests <200 ha – <i>Privatne šume manje od 200 ha</i>	2,097,000	53.4	2,130,000	53.8	2,153,000	53.9
Private forests >200 ha – <i>Privatne šume veće od 200 ha</i>	1,235,000	31.6	1,239,000	31.3	1,245,000	31.2

Table 3 Amount of wood stock, increment and allowable cut in Austrian forests**Tablica 3.** Podaci o drvnoj zalihi, prirastu i etatu u austrijskim šumama

Data – Podaci	1996	2002	2009	2015
Wood stock, million m ³ Drvna zaliha, milijuni m ³	988	1.095	1.135	–
Increment, million m ³ Prirast, milijuni m ³	27.3	31.3	30.4	–
Removal, million m ³ Etat, milijuni m ³	19.5	18.8	26.0	17.6

conditions, such as climate and geomorphology, and therefore show the same potential natural vegetation (Kilina et al. 1994). Due to the large share of mountains in the country's area, a great part of the forest area is located on steep terrain. As shown in Fig. 2, 25% of the forest area is located on a more than 60% slope. This made and still makes timber harvesting and transport difficult and requires modern and soil conserving technologies.

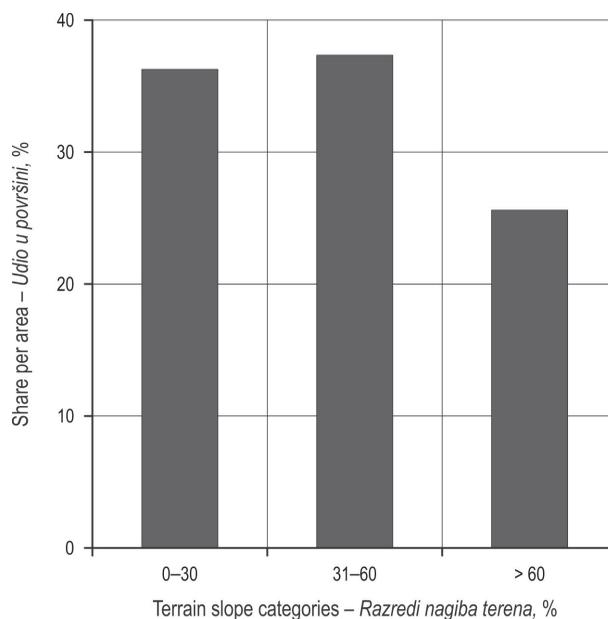
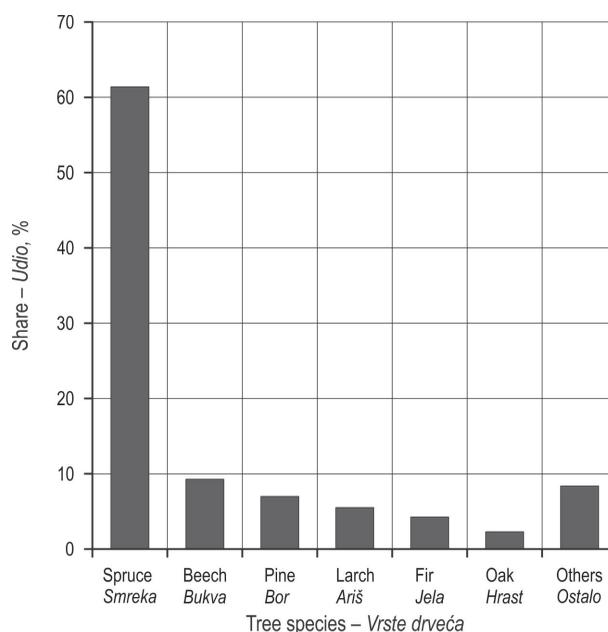
Fig. 3 shows the proportions of the most important tree species in Austria. With 61.2%, spruce makes the biggest part of all tree species in Austria, followed by beech with only 9.6%. The share of conifer trees as opposed to broadleaved is 80%.

Conifer forests are not only found in their original range in the mountains, but also in lower regions, where the natural forest community is a mix of beech and other broadleaved species. These forests, planted by humans because of faster growth, are called secondary conifer forests. Per definition they are forests with 80% share of conifers in what is originally broadleaved species-habitat. About 354,000 ha in Austria are secondary conifer forests. The problem of this structure is that the climate in lower regions is not ideal for spruce and other conifers, which leads to a greater risk of biotic and abiotic damage (Gschwantner and Prskawetz 2005).

As shown in Table 4, half of the forest stands are in the age classes 41 to 100. The share of even-aged for-

Table 4 Age structure of Austrian forests**Tablica 4.** Dobni razredi stabala austrijskih šuma

Age – Dobni razredi	0–20	21–40	41–60	61–80	81–100	101–120	121–140	>140	Snags – Pričuvci
1000 m ³	9,832	132,552	208,485	186,308	186,672	154,706	88,288	114,000	53,936
%	0.9	11.7	18.4	16.4	16.5	13.6	7.8	10.0	4.8

**Fig. 2** Share of average terrain slopes in Austrian forests**Slika 2.** Udjeli nagiba terena u austrijskim šumama**Fig. 3** The most common tree species in Austria**Slika 3.** Najrasprostranjenije vrste drveća u Austriji

ests in Austria has continually decreased from 47% of the total forest area in 1996 to 39% in 2009. In comparison to the area of productive forests, even-aged forests account for 51% (ÖWI 2010, Gschwantner and Prskawetz 2012).

3. Harvesting operations in Austria *Pridobivanje drova u Austriji*

Estimated amount of logging in 2015 was 17.55 million m³, with a share of 83% of coniferous wood. The amount of logging in the last forest inventory was nearly 26 million m³ and therefore much higher. As shown in Table 5, the greatest amount of harvested timber was coniferous wood, while broadleaved species had a share of only 16.3%. In 2002, the share of 15.4% of broadleaved harvested wood was even smaller.

Table 6 below shows the average amount of logging per year broken down by type of use and ownership for the period 2007 to 2009. While harvesting in the Austrian state forests accounted for only 13% of the total logging in 2009, harvesting of 14.3 million m³ timber in small private forests accounted for 55.1%. These proportions strongly correspond to the propor-

tion of ownership areas (see Table 2). Private forests smaller than 200 ha had the biggest share of clear cuttings smaller than 500 m², while the state forests showed the biggest focus on clear cuttings of an area bigger than 500 m².

In 2015, the share of logging of the state forests (9.23%) was much smaller than the average from 2007 to 2009, while the share of timber in privately owned forests increased, as shown in Table 7. The amount of incidental use in 2015 was very high, accounting for 42.3% of the total harvested timber (see Table 8). Due to an unusually hot and dry summer in Austria, the forests had to cope with a large attack of bark beetles that profited of the weather conditions (Steyrer and Hoch 2015).

Due to the country's topography, as well as the big share of small privately owned forests, the main felling technology is the assortment method with chainsaw (about 60%). The estimated share of logging done with harvester is 20–25% (BFW 2012).

As the felling technology depends on the slope, the methods of skidding used in Austrian forests also depend on terrain type, as 25% of forests are located in steep terrain with more than 60% slope. Around 20% of total harvested timber is transported with cable systems, a method that is soil-saving. In less steep terrain, an increase of mechanized transport systems could be noticed in the past: while in 1993 the share of timber skidded with forwarder was around 6%, in 2003 it had increased to 15% (Umweltbundesamt 2004). Skidding with tractor and cable winch or trailer is especially popular in small forests owned by farmers (Seebacher 2014).

In order to protect soil and forest stand, forest roads are important for harvesting and timber transport. The last inventory of forest roads in 1996

Table 5 Amount of harvested timber from 1996 to 2015

Tablica 5. Užiti drvni obujam u Austriji od 1996. do 2015. godine

Felling volume, 1000 m ³ Užiti drvni obujam, 1000 m ³	1996	2002	2009	2015
Conifers – Četinjače	16,132	15,902	21,657	~ 14,566
Broadleaves – Listače	3389	2895	4231	~ 2984
Total – Ukupno	19,521	18,797	25,888	~ 17,550

Table 6 Amount of harvested timber by types of use and ownership (average from 2007 to 2009)

Tablica 6. Užiti drvni obujam u Austriji s obzirom na vrstu sječe i vlasništvo (prosječno od 2007. do 2009. godine)

Felling volume in 1000 m ³ Užiti drvni obujam, 1000 m ³	Clear cutting, area >500 m ² Čista sječa, površina >500 m ²		Clear cutting, area <500 m ² Čista sječa, površina <500 m ²		Thinning Prorede		Others Ostalo		Total Ukupno
	1000 m ³	%	1000 m ³	%	1000 m ³	%	1000 m ³	%	1000 m ³
State forests – Državne šume	1639	46.2	271	7.6	203	5.7	1432	40.4	3545
Private forests <200 ha Privatne šume manje od 200 ha	4428	31.1	2760	19.4	1628	11.4	5439	38.2	14,255
Private forests >200 ha Privatne šume veće od 200 ha	2674	33.1	977	12.1	903	11.2	3534	43.7	8088
Total – Ukupno	8741	33.8	4008	15.5	2734	10.6	10,405	40.2	25,888

Table 7 Amount of harvested timber in forests by ownership structure in 2015**Tablica 7.** Užiti drvni obujam prema vlasničkoj strukturi šuma u 2015. godini

Ownership structure <i>Vlasništvo</i>	Harvested timber, million m ³ <i>Užiti drvni obujam, milijuni m³</i>	Share, % <i>Udio, %</i>
State forests – <i>Državne šume</i>	1.63	9.29
Private forests <200 ha <i>Privatne šume manje od 200 ha</i>	10.01	57.06
Private forests >200 ha <i>Privatne šume veće od 200 ha</i>	5.91	33.65
Total – <i>Ukupno</i>	17.55	100

Table 8 Harvested timber by categories of use in 2015**Tablica 8.** Užiti drvni obujam prema vrsti prihoda u 2015. godini

Type of cut – <i>Vrsta prihoda</i>	Volume, million m ³ <i>Obujam, milijuni m³</i>	Share, % <i>Udio, %</i>
Final cut – <i>Glavni prihod</i>	5.1	29.09
Thinning and other cut – <i>Prethodni prihod</i>	5.02	28.61
Unregulated cut – <i>Izvanredni prihod</i>	7.43	42.3
Total – <i>Ukupno</i>	17.55	100

showed an average road density of 45 m/ha for truck-suited roads in Austrian forests (Table 9). The total length of forest roads, including public roads in forests, was 150,300 km. The average length of newly

built forest roads per year was 2160 km (ÖWI 2010). Compared to the last inventory of forest roads in 1990, the amount of newly built roads had decreased (Umweltbundesamt 2004). Not paved logging trails that are often temporary showed a density of 44 m/ha and a length of 147,000 km. Opening density in protective forests was significantly lower than in productive forests.

Regarding the different categories of ownership, as shown in Table 8, the average road density in privately owned forests smaller than 200 ha with 49.1 m/ha, as well as of logging trails with 59.4 m/ha, is significantly higher than in other forests. The state forests showed the lowest road length (14,800 km) and density (33.7 m/ha).

More than half of the Austrian forest area is divided into small properties. Around 40% of private owners of forest land smaller than 200 ha come from an agricultural background or are part time farmers (Hogl et al. 2003). The biggest forest owner is the republic of Austria together with the Austrian state forests, that were outsourced as stock corporation in 1997 and own 511,000 ha of forest land. The second biggest property of forest land belongs to the city of Vienna, the capital of the country. The main part (69%) of the 28,000 ha are a spring protection area providing the city's drinking water. Following this, the forest business Franz Mayr-Melnhof-Saurau consists of 27,400 ha and is also developing and constructing cable crane systems. Around 11,200 ha of Austrian forest land belong to the Bavarian state forests in Germany (proHolz Austria 2016).

Table 9 Road density and total length of primary and secondary road network in Austrian forests**Tablica 9.** Duljina i gustoća primarne i sekundarne mreže šumskih prometnica u Austriji

Network type <i>Vrsta mreže</i>	Forest type – <i>Vrsta šume</i>		Total length, km <i>Ukupna duljina, km</i>	Density, m/ha <i>Gustoća prometnica, m/ha</i>
	Secondary forest traffic infrastructure <i>Mreža sekundarnih šumskih prometnica</i>	High forest <i>Visoke šume</i>	Productive forest – <i>Gospodarske šume</i>	138,100
Protective productive forest – <i>Zaštitne proizvodne šume</i>			1000	3.5
Total – <i>Ukupno</i>			139,100	42.7
Coppice – <i>Panjače</i>		7900	83.9	
Total – <i>Ukupno</i>		147,000	44.0	
Primary forest traffic infrastructure <i>Mreža primarnih šumskih prometnica</i>	High forest <i>Visoke šume</i>	Productive forest – <i>Gospodarske šume</i>	142,700	48.1
		Protective productive forest – <i>Zaštitne proizvodne šume</i>	2900	9.9
		Total – <i>Ukupno</i>	145,600	44.7
	Coppice – <i>Panjače</i>		4800	50.8
	Total – <i>Ukupno</i>		150,400	45.0

Table 10 Density of primary and secondary forest roads and total road length in different types of ownership**Tablica 10.** Duljina i gustoća primarne i sekundarne mreže šumskih prometnica s obzirom na vlasništvo

Ownership category <i>Vlasništvo</i>	Primary forest traffic infrastructure <i>Mreža primarnih šumskih prometnica</i>		Secondary forest traffic infrastructure <i>Mreža sekundarnih šumskih prometnica</i>	
	Total length, km <i>Ukupna duljina, km</i>	Road density, m/ha <i>Gustoća prometnica, m/ha</i>	Total length, km <i>Ukupna duljina, km</i>	Road density, m/ha <i>Gustoća prometnica, m/ha</i>
State forests <i>Državne šume</i>	14,800	33.7	8,000	18.1
Private forests <200 ha <i>Privatne šume manje od 200 ha</i>	92,600	49.1	112,000	59.4
Private forests >200 ha <i>Privatne šume veće od 200 ha</i>	42,900	41.8	2,400	27.6
Total <i>Ukupno</i>	150,300	45.0	122,400	44.0

4. Final remarks – Završna razmatranja

The Austrian forest area has increased from 3.7 million ha in 1961 up to nearly 4 million ha, that is 47.6% of the country's total area. The special structure of ownership in Austrian forests with a big share of small properties owned by farmers has great influence on forest management. Small scale planning of forest roads leads to a higher road density in these forest stands. Also harvesting technology depends on the size of the business, as large investments in fully mechanized technologies are often not profitable with the small amount of timber extracted in those forests. In 2015, 42.3% of the total logging were registered as fallen timber.

Spruce is the most common tree species in Austrian forests with a share of 61.2%. The vulnerability of these trees to climate change and the resulting damages by storms and bark beetles is currently leading to a change in the forest structure: The Austrian state forests are more and more focused on more resistant but still fast-growing tree species like larch or Douglas fir (Öbf 2015).

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Sažetak

Pregled gospodarenja šumama u Republici Austriji

Austrijsko je šumarstvo doživjelo velike promjene u posljednjih petsto godina. U početku se drvo pridobivalo brojnim neorganiziranim sječama šuma za potrebe industrije željeza i solana kada su mnoga šumska područja ogoljena i šume izgubljene, dok se danas površina šuma iz godine u godinu povećava. Od šezdesetih godina 20. stoljeća, kada je napravljena prva inventura šuma, pa sve do danas šumska se površina u Republici Austriji povećavala za 300 000 hektara. Danas austrijske šume zauzimaju gotovo četiri milijuna hektara, odnosno 47,6 % države je pod šumom. Najrasprostranjenija je smreka s udjelom od 61,2 %. Prema podacima iz 2009. godine državnim šumama pripada tek 14,9 % udjela u ukupnoj šumskoj površini, dok su ostalo privatne šume koje se prema veličini površine mogu podijeliti na one veće od 200 hektara (udio od 31,2 %) i one manje od 200 hektara (udio od 53,9 %). Drona zaliha tijekom godina raste, pa je tako od 1996. godine s 988 milijuna m³ danas porasla na 1,14 milijuna m³ drva. S obzirom na to da se 25 % šuma nalazi na terenima strmih nagiba (većih od 60 %), oko 20 % posječenoga drva privlači se šumskim žičarama. Užita je drona zaliha 2015. godine iznosila 17,55 milijuna m³ s udjelom crnogorice od 83 %.

Ključne riječi: gospodarenje šumama u Republici Austriji, smreka, austrijske šume, pregled gospodarenja šumama

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