JOURNAL OF FOREST SCIENCE, *49*, 2003 (7): 291–301

Forest ecosystems of the Šumava Mts. and their management

S. VACEK[1], V. V. PODRÁZSKÝ[2]

[1]*Forestry and Game Management Research Institute, Research Station Opočno, Czech Republic*
[2]*Czech University of Agriculture, Faculty of Forestry, Prague, Czech Republic*

ABSTRACT: The introductory presentation summarizes natural conditions of the area of interest, state of local forest ecosystems and consequent management rules in this National Park and Protected Landscape Area. It describes area delimitation, natural conditions (geology, geomorphology, hydrology and climat, soils, vegetation, forest stands, their dynamics, healthy status). All these syntheses are a basis for forest management and forestry in this region, respecting forest state and forestry aims, as well as the nature protection targets.

Keywords: Šumava Mts.; National Park; mountain forests; forestry; nature protection

DELIMITATION OF THE TERRITORY

Šumava Mts. is the most extensive Central European highlands of the Hercynian massif (VALENTA et al. 1994). Its surface area with foothills amounts to more than 5,000 km^2. It stretches to Austria, Federal Republic of Germany and Czech Republic. The longitudinal axis of the Forest Natural Region in an NW–SE direction is 125 km long (Fig. 1). In the north-west it is a continuation of the Český les Mts. (Bohemian Forest) and of the Novohradské hory Mts. not far from the southeastern border. Šumava ridges reach the altitude of about 1,000–1,100 m a.s.l. The summits are Javor Mt. (1,457 m) and Roklan Mt. (1,454 m) lying in Bavaria, and Plechý Mt. (1,378 m) on the Czech side of the mountains. The cadastral surface area is 211,302 ha, and the forest area amounts to 140,378 ha with forest coverage 66%. Mountain forests amount 95.6% of forest land within the Forest Natural Region.

Fig. 1. Forest Natural Region 13 – Šumava

NATURAL CONDITIONS

The Šumava Mts. are a complex with relatively less disturbed and best preserved mountainous ecosystems (JENÍK et al. 1994). In spite of anthropic activities such as glass-making and timber industry dating back to the Middle Ages, this mountainous system is a territory with continuous forests and peat bogs. Neither do periodic windthrow disasters nor subsequent bark beetle disasters diminish the uniqueness of this area.

Geology and geomorphology

Geologically, the Šumava Mts. are built of metamorphic crystalline rocks of the Moldau-Danubian system (gneisses, paragneisses, mica schist gneisses, mica schists, orthogneisses, granulites, migmatites) through which granite and granodiorite bodies of the Moldau-Danubian pluton have penetrated. Amphibolites and limestones occur in the environs of the Lipno dam (KUNSKÝ 1968).

Geomorphologically, the Šumava Mts. are a residue of the old flush ground that has been maintained in the central part of the mountains. The connection of plateau-like mountainous plains called Pláně (above 1,100 m) with mountain ridges stretching in a NW and SE direction is

The presentation origin was supported by the Research Projects *Influence of Environment on Forest Regeneration* (S. VACEK) Grant Agency of the Czech Republic No. 206/03/1583 *Nutrient Cycles in Mountain Forest Ecosystem Saturated by Nitrogen: Past, Present and Future State of Water, Soil and Norway Spruce Stands* (V. V. PODRÁZSKÝ).

Table 1. Soil types in the Šumava Mts.

Soil type	Subtype	Occurrence	FSTG	Proportion (%)
Leptosols	Typical	Ridges, (rocky, boulder) slopes	5J, 5–6J	1.9
	Cambic	Ridges, (clayey) slopes	5–7Y	
Redzic Leptosols	Cambic	Various (skeletal) slopes	0C, 5W	0.3
Cambisols	Typical oligotrophic	Various slopes, ridges (lower mountain locations)	5–6 F, 5K, 5S	19.6
	Mesotrophic		5–6B, 5–6D	
	Distric (podzolic)		5M	
	Leptosolic	Various slopes, ridges (skeletal, lower mountain locations)	5–6M, 5N	
	Pseudogleyic	Moderate slopes	5O, 5U, 6–7V	
Entic Podzols	Oligotrophic	Various slopes and ridges (intermediate mountain locations)	6–7M, 6–7K	61.5
	Mesotrophic		6–8S, 6H, 6I, 7B	
	Leptosolic	Various slopes and ridges (skeletal intermediate mountain locations)	6–8N, 7F	
	Pseudogleyic	Depressions, moderate slopes	6–8O, 8V	
Haplic Podzols	Humus	Slopes and ridges (highest locations)	8K, 8M, 8Z	4.2
Fluvisols		Delluvia (enriched deposits)	3L, 5L, 6T	0.3
Luvisols	Gleyic	Plateaus, moderate slopes	5I, 5H	+
Stagnosols	Stagnogleyic	Plateaus, moderate slopes	6–8P, 6–8Q	3.4
	Podzolic	Plateaus, moderate slopes	6–8Q	
	Peaty	Plateaus, depressions	7T, 7G	
	Gley	Plateaus, depressions (highest locations)	8G, 8T	
Gleysols	Typical	Terrain areas of subsidence	1G, 5G	5.0
	Cambic	Moderate slopes and small depressions (slope headwaters)	5V, 6G	
	Peaty	Terrain areas of subsidence (higher locations)	1T, 7–8T, 7–8G	
Histosols	Fibric	Depressions	5–9R	3.8
	Mesic	Plateaus	0R	

Source: RPFD – FMI at Brandýs nad Labem

a typical feature of this area. Moderately arched knobs of summits are elevated above plateaus (DEMEK et al. 1987). Královský Hvozd rises above the plains towards north-west, and towards south-east the ridges of Boubín, Želnava and Trojmezí highlands separated by a broad valley of the Horní Vltava river.

Climatology and hydrology

The Šumava Mts. lie in a cold region, moderately cold district. A cold mountain district covers the summit parts only. The lowest locations are situated in a moderately warm region with moderately warm, very humid district. The climate is excessively humid, its oceanic character with rather cold spring and warm autumn prevails. Average annual temperature in elevated locations of Pláně (above 1,100 m) ranges from 3.7°C to 5.1°C and average annual precipitation sum is from 1,027 to 1,486 mm. The growing season lasts from 60 to 100 days. Average annual temperature in lower locations (600–1,100 m) ranges between 4.4°C and 6.5°C and precipitation between 863 and 997 mm. The growing season lasts from 90 to 140 days. Early and late frosts cause great damage in these localities. Dangerous winds mostly blow from W–NW (PLÍVA, ŽLÁBEK 1986).

The Šumava Mts. with many headwaters and peat bogs are a hydrologically important area intersected by the main European divide between the North Sea (Vltava watershed) and the Black Sea (Danube watershed). The rivers Úhlava, Otava, Volyňka, Blanice and Vltava belong to the Vltava watershed while the streams Řezná, Čertova voda, Wurmbraudbach and Schedebach drain the Danube watershed. Hydrologically important are glacial lakes (Černé jezero, Čertovo jezero, jezero Laka, Prášilské jezero and Plešné jezero) and extensive (low moors called: Tříjezerní slať, Jezerní slať, Chalupská slať, Rokytská slať) or small peat bogs. Šumava Mts. Protected Area of Natural Water Accumulation was declared in these localities in 1978.

Table 2. Characteristics of forest vegetation zones in the Šumava Mts.

Forest vegetation zones		Area	Proportion	Altitude	Average temperature	Annual precipitation	Growing season
		(ha)	(%)	(m)	(ºC)	(mm)	(days)
5	Beech with Fir	6,177	4.4	450–700	5.5–6.5	800–980	130–140
6	Beech with Spruce	79,314	56.5	650–900	4.5–5.5	900–1,050	115–130
7	Spruce with Beech	40,990	29.2	900–1,050	4.0–4.5	1,050–1,200	100–115
8	Spruce	12,072	8.6	1,050–1,350	2.5–4.0	1,200–1,400	60–100
9	Dwarf Pine*	1,825	1.3	> 1,050	< 2.5	> 1,300	< 70

*azonal communities of high moors including Swiss mountain pine woods. Source: FNR – FMI at Brandýs nad Labem

Soils

Altitudinal soil zonation from submontane to montane soils has evolved in the Šumava Mts. Cambisols occur in the lowest locations while the most frequent entic Podzols cover intermediate locations and haplic Podzols the highest locations. Gleysols, Stagnosols and Histosols frequently occur on flat depressions with negligible groundwater movement. The occurrence of Leptosols, Luvisols and Fluvisols is scarce (Table 1). The soils are loamy-sand, medium or strongly acid and base unsaturated (PRŮŠA 2001).

Vegetation

Lower species diversity is typical of the Šumava flora in comparison with e.g. flora of the Krkonoše Mts., Alpine or Carpathian areas. Sparse endemic species are field gentian (*Gentianella praecox* subsp. *bohemica*), rampion (*Phyteuma nigrum*), monk's hood (*Aconitum plicatum*) and Western marsh orchid (*Dactylorhiza majalis* subsp. *turfosa*). Peat bogs with glacial relicts such as dwarf birch (*Betula nana*), deergrass (*Trichophorum cespitosum*), rannoch rush (*Scheuchzeria palustris*) are on the opposite pole of species diversity. Rare quillworts (*Isoëtes lacustris*, *Isoëtes echinospora*) grow below the water surface of glacial lakes. Typical Alpine elements in the Šumava Mts. are Austrian leopard's-bane (*Doronicum austriacum*), mountain snowbell (*Soldanella montana*), Hungarian gentian (*Gentiana pannonica*) and white crocus (*Crocus albiflorus*) – cf. VALENTA et al. (1994).

Altitudinal vegetation zones and forest site type groups

According to the vertical structure of natural vegetation acidophilic mountain beech woods dominated in lower and intermediate mountain locations while there were waterlogged spruce woods, high moors and natural peat bogs in higher locations, and climax spruce woods in the highest locations. Floodplains and alder woods occurred along the middle and upper courses of streams.

Table 2 shows the characteristics of forest vegetation zones (FVZ). The most frequent is the 6th FVZ – beech with spruce (56.5%) and the 7th FVZ – spruce with beech (29.2%) – cf. VACEK and MAYOVÁ (2000a). Forest site type groups (FSTG) are shown in Table 3. These FSTG are dominant: 6K – acid beech with spruce wood (24.0%), 7K – acid spruce with beech wood (12.3%), 6S – fresh beech with spruce wood (8.6%) and 6V – humid beech with spruce wood (8.3%). Acid sites (acid and extreme ecological series) take up the highest proportion – 52% in comparison with waterlogged (water-enriched, gleyic, waterlogged ecological series) – 29% and fertile (fertile and humus-enriched ecological series) sites – 19% (BOUŠE et al. 2001).

FOREST STAND SITUATION

Colonization of the Šumava Mts. that started in the year 1200 ascended in river valleys to a height of about 700 m above sea level. Until 1700 settlement penetrated into the Šumava Mts. interior at several localities only, particularly along regional routes. Harvesting of timber was carried out there to be supplied to ore works, glass works and charcoal kilns. A large wave of settlement and subsequent fellings in the Šumava Mts. nucleus occurred in the mid-18th century accompanying a glass-making boom. Secondary deforestation was a result of the burning and clearing system. Overall forest devastation was so alarming at some places that planned regeneration of Šumava forests had to be realized at the beginning of the 19th century. As hardwood was largely preferred during fellings since the 17th century, beech woods and mixed woods receded a long time ago and the species representation changed considerably (JELÍNEK 1985).

Currently, commercial forests take up 41.4%, protection forests 3.3% and special purpose forests 55.3% (Table 4).

Species and age composition

Comparison of natural, present and target composition is presented in Table 5 and Fig. 2. The largest disproportion in the compositions exist in Norway spruce, silver fir and European beech (KUPKA 2000). The areas of age classes in the context of normal area in Šumava National Park (ŠNP) are rather disproportionate (Fig. 3). A slight surplus of age class 1 areas is a result of the just abating

Table 3. Proportions of forest type site groups in the Šumava Mts. (% of 140,378 ha of forest land)

F V Z	Ecological series																								(%)
	Extreme		Acid				Fertile					Enriched with						Gleyic			Watter-logged		Peaty	
												humus			water									
	Edaphic category																							
	Z	Y	M	K	N	I	S	F	C	B	W	H	D	A	J	L	U	V	O	P	Q	T	G	R	Σ
0	+								+															0.5	0.5
1																						+	+		+
3																+									+
5	+	0.1	0.1	1.4	0.3	+	1.3	+	+	0.1	+	+	+	0.1	0.5	0.1	+	0.2	0.2	+			+	+	4.4
6	0.1	0.9	0.3	24.0	4.5	1.0	8.6	0.4		2.1		0.2	0.9	2.0		0.1		8.3	1.7	0.6	+		0.4	0.4	56.5
7	0.1	0.4	0.1	12.3	1.7		2.6	0.1		+								2.4	3.2	1.7	+	0.4	3.2	1.0	29.2
8	0.1	0.2	0.1	4	0.4		0.2											0.3	0.3	0.2	0.8	0.1	0.7	1.2	8.6
9																								0.8	0.8
Σ	0.3	1.6	0.6	41.7	6.9	1	12.7	0.5	+	2.2	+	0.2	0.9	2.1	0.5	0.2	+	11.2	5.4	2.5	0.8	0.5	4.3	3.9	100.0
	1.9		50.2				15.6					3.5			11.4			8.7			8.7				

Source: RPFD – FMI at Brandýs nad Labem

disaster caused by bark beetles. The areas of age classes 4–9 are considerably below normal. The proportion of age class 5 is lowest due to lower intensity of regeneration in post-war years. Age classes 10–14 are highly above normal.

Growth and production conditions

Table 6 shows actual growing stocks for the particular tree species and forest categories. The proportion of softwood growing stocks (94.6%) consisting mostly of spruce (85.2%) is very high; beech (3.8%) is a major component of hardwood growing stocks (5.4%). Average standing volume per 1 ha amounts to 266 m^3 inside-bark of large timber (minimum top diameter 7 cm); it is by 16% more than the CR average. Average stocking is 0.86 and average rotation period 158 years. Average total current increment amounts to 6.4 m^3/ha, its values in the particular age classes in predominant management complexes are represented in Fig. 4. Average annual cuts of the last decade is 4.0 m^3/ha, it is by 23% less than the CR average (BOUŠE et al. 2001).

Stand health

The health of forest stands in the Šumava Mts. is impaired by the bark beetle (*Ips typographus*) disaster that has been in progress for about 15 years. Its origins date back to 1983, when an intervention-free territory 5,500 ha in size was declared in the National Park Bavarian Forest. Extensive wind breakage occurred on both sides of the border in 1983 and 1984, timber from this breakage was not processed in time. Explosive gradation of bark beetle followed in 1995 (VINŠ et al. 1999). Intensive measures, increasing the size of clearcut areas, have been taken since 1996 as a protection against the bark beetle damage. Since the mid-nineties ca. 4,930 ha of spruce stands have declined (3,500 ha on the Bavarian side, 1,430 ha on the Czech side). Clearcut areas originated during rehabilitation measures particularly along the intervention-free territory, where no interventions against bark beetles were carried out. On the Czech side of the Šumava Mts., where mountain spruce forests are not bordered by a belt of mixed forest, the continuous bark-beetle clearcut area of ca. 811 ha originated in 1995–2001 (FIALA 2002). Gradual consumption of food sources for the bark beetle in the territories where it was not controlled and efficient measures to reduce its gradation led to an abatement of bark beetle disaster. An important negative consequence of the disaster is introskeletal erosion on stony lands where all trees were felled, and under dry forest stands.

Local impairment of stand health in summit parts above 1,000 m a.s.l. since the end of the eighties can be ascribed to an increasing air pollution stress in the mountains manifested by macroscopic changes in assimilating organs (reduction in foliage, yellowing symptoms, necroses, etc.) – cf. VACEK and MAYOVÁ (2000b). Localization and

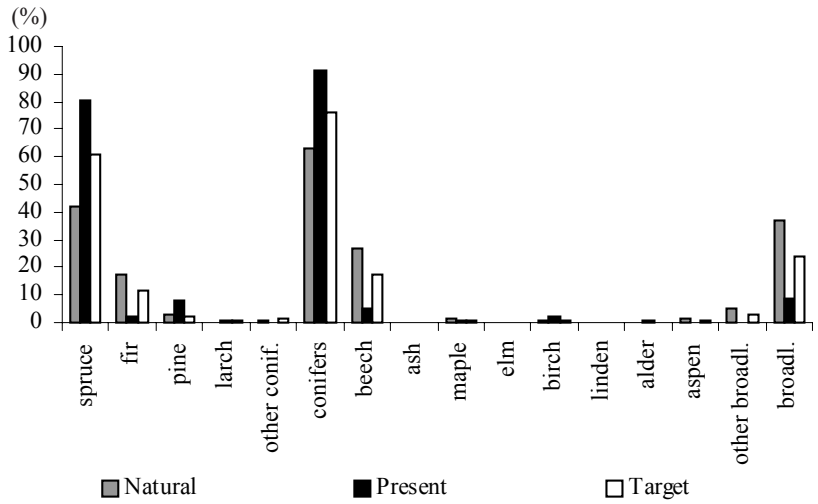

Fig. 2. Natural, present and target species composition in the Šumava Mts. (source: FMI at Brandýs nad Labem)

dynamics of forest damage are indirectly documented by the air pollution threat zones. Dynamics of forest decline corresponds to the origin of clearcut areas between 1996 and 2001 after forest stands damaged by bark beetle were felled (Fig. 5). Ca. 3,500 ha of forest have been felled in ŠNP during the bark-beetle disaster. This is the reason why timely control of bark beetle disaster is essential to slow down the unnaturally rapid, anthropically conditioned destruction of spruce ecosystems.

PARTICULARITIES OF THE AREA

Montane high moors are the most valuable and best preserved primary ecosystems of the Šumava Mts. They are a typical phenomenon of Šumava plains called Pláně at an altitude of about 1,000 m with headwaters of the Vydra and Vltava rivers. Typical features of this area are the presence of mountain dwarf pine on peat (*Pinus* × *pseudopumilio*) and the presence of about 30 species of bog moss (*Sphagnum* sp. div.). Species diversity of these phytocenoses is very low, but they include a number of unique relict species, e.g. great sundew (*Drosera anglica*), bog sedge (*Carex limosa*), and dwarf birch (*Betula nana*) – a glacial relict species.

Quite unique forms of natural nonforest vegetation of subalpine type evolved on the walls of lake cirques of Černé and Plešné jezero. High-stemmed floodplains with Hungarian gentian (*Gentiana pannonica*) are a typical community of snow-hollowed places. Rock fissures are colonized with rush (*Juncus trifidus*) and parsley fern (*Cryptogramma crispa*).

Introskeletal erosion has been an important phenomenon accompanying the bark beetle disaster in spruce stands in the last decade. This process is locally a threat to the maintenance of forest existence, especially on debris and highly stony soils – on block fields.

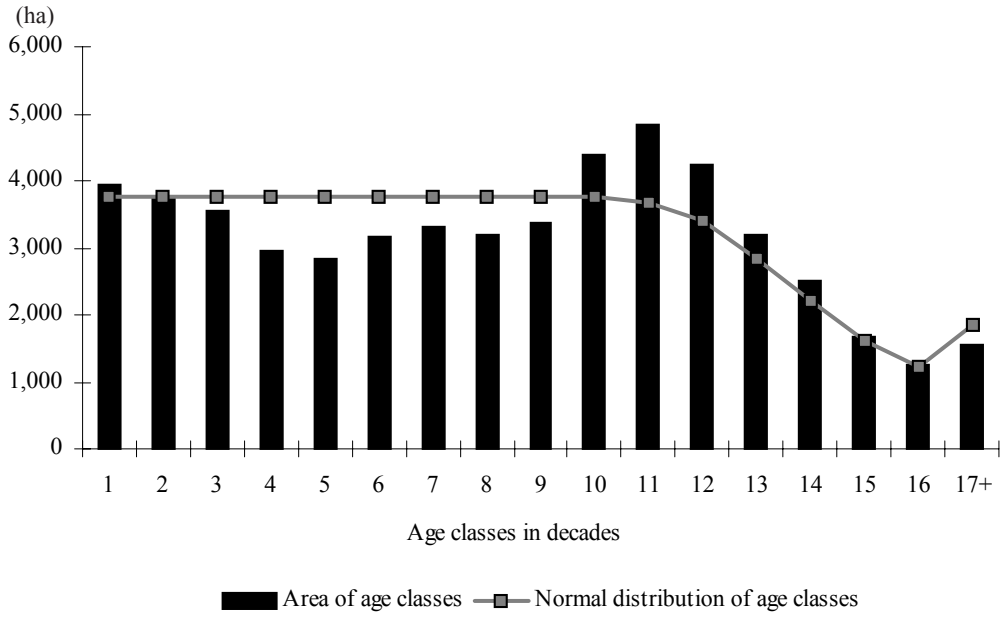

Fig. 3. Proportions of age class areas in the Šumava National Park (source: FMI at Brandýs nad Labem)

Table 4. Overview of forest categories declared in the Šumava Forest Natural Region

Forest category and subcategory	Stand area	
	(ha)	(%)
Commercial forests	55,692	41.4
Protection forests		
– at extremely unfavorable sites	4,359	3.2
– high-elevation forests under timberline	124	0.1
Protection forests in total	4,483	3.3
Special purpose forests		
– in water protection zones I	51	+
– in national parks and national nature reserves	56,063	41.7
– in nature reserves and zones I	1,075	0.8
– suburban and recreational forests	215	0.1
– intended for forest research	736	0.6
– with increased soil-, water-conservation, climatic and landscape-forming function	1,089	0.8
– essential to maintain biological diversity	906	0.7
– where another concern requires different management system	12,102	9.0
– in certified game preserves	2,095	1.6
Special purpose forests in total	74,332	55.3
Forests of the area in total	134,507	100.0

Source: RPFD – FMI at Brandýs nad Labem

Table 5. Comparison of natural, present and target species composition in the Šumava Mts.

Tree species	Species composition					
	Natural		Present		Target	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Spruce	55,826	41.9	107,554	80.7	81,141	60.9
Fir	23,050	17.3	2,720	2.0	15,722	11.8
Pine	4,130	3.1	10,558	7.9	2,531	1.9
Larch			632	0.5	533	0.4
Other conifers	1,066	0.8	95	0.1	1,599	1.2
Conifers total	***84,072***	***63.1***	***121,559***	***91.2***	***101,526***	***76.2***
Oak			38			
Beech	35,974	27.0	6,608	5.0	23,583	17.7
Hornbeam			1			
Ash	400	0.3	139	0.1	400	0.3
Maple	2,265	1.7	476	0.4	1,199	0.9
Elm	400	0.3	4		266	0.2
Birch	1,199	0.9	2,721	2.0	1,066	0.8
Linden	133	0.1	15		400	0.3
Alder	399	0.3	1,319	1.0	266	0.2
Other broadleaves	8,394	6.3	356	0.3	4,530	3.4
Broadleaves total	***49,164***	***36.9***	***11,677***	***8.8***	***31,710***	***23.8***
Total	**133,236**	**100.0**	**133,236**	**100.0**	**133,236**	**100.0**

Source: Summary Forest Management Plan 2000 – FMI at Brandýs nad Labem

Table 6. Actual growing stocks in m³ inside-bark of large timber (minimum top diameter 7 cm) for the particular tree species and forest categories in the Šumava Mts.

Tree species	Total		Forest category					
			Commercial		Protection		Special purpose	
	(m³)	(%)	(m³)	(%)	(m³)	(%)	(m³)	(%)
Spruce	33,134,443	85.2	12,268,319	83.1	2,525,133	91.4	18,340,991	85.9
Fir	1,117,699	2.9	422,903	2.9	65,467	2.4	629,329	2.9
Pine	2,326,305	6.0	1,332,217	9.0	74,613	2.7	919,475	4.3
Larch	148,365	0.4	110,930	0.8	7,671	0.3	29,764	0.1
Other conifers	47,496	0.1	7,167	0.0	–	–	40,329	0.2
Softwood	**36,774,308**	**94.6**	**14,141,536**	**95.8**	**2,672,884**	**96.8**	**19,959,888**	**93.4**
Beech	1,493,139	3.8	301,171	2.1	64,656	2.3	1,127,312	5.3
Maple	80,844	0.2	18,264	0.1	5,970	0.2	56,610	0.3
Birch	353,549	0.9	192,228	1.3	14,197	0.5	147,124	0.7
Alder	123,501	0.3	78,200	0.5	1,716	0.1	43,585	0.2
Other broadleaves	66,306	0.2	31,685	0.2	1,984	0.1	32,637	0.1
Hardwood	**2,117,339**	**5.4**	**621,548**	**4.2**	**88,523**	**3.2**	**1,407,268**	**6.6**
Total	**38,891,647**	**100.0**	**14,763,084**	**100.0**	**2,761,407**	**100.0**	**21,367,156**	**100.0**

Source: RPFD – FMI at Brandýs nad Labem

SPECIFIC FEATURES OF MANAGEMENT IN THE AREA

Table 7 shows the representation of target management complexes in the area concerned. Many facts underlie specific features of management. After Šumava National Park was declared in 1991 taking up 40% of the Forest Natural Region, the mission of forests and objectives of forest management changed in comparison with management in the past when timber production was the main goal. Near-natural management of forest ecosystems is currently applied in the ŠNP territory based on the Plan of the Care of the Šumava National Park (the latest version is from 2001). The care of forest ecosystems is differentiated taking into account zonality, FSTG and present condition of forest stands.

Except ŠNP a larger part of the Forest Natural Region belongs to the Šumava Protected Landscape Area surrounding ŠNP. A primary objective of sustainable management is to maintain harmonic landscape with typical structure including the mosaic of ecologically relatively stable forest ecosystems. The proportion of ecologically unstable spruce forests not suitable for these sites is high (bark beetle, air pollution, wind); their gradual conversion will be necessary. It also applies to ca. 3,000 ha of forest stands that were established by setting out spruce plants during the culmination of bark beetle disaster (1980–1990ies). This is the reason why

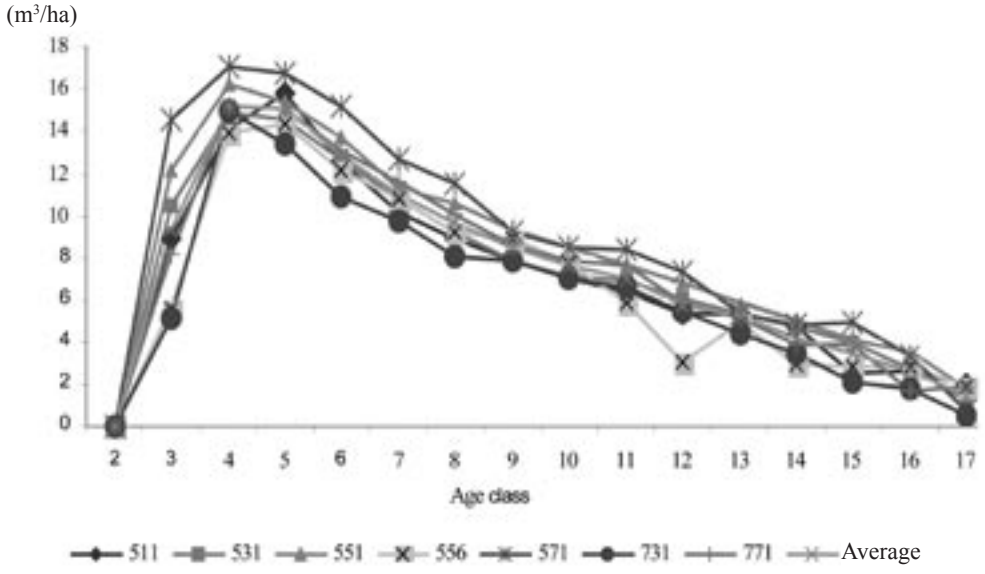

Fig. 4. The values of total current increment in m³/ha in the age classes in predominant management complexes (source: FMI at Brandýs nad Labem)

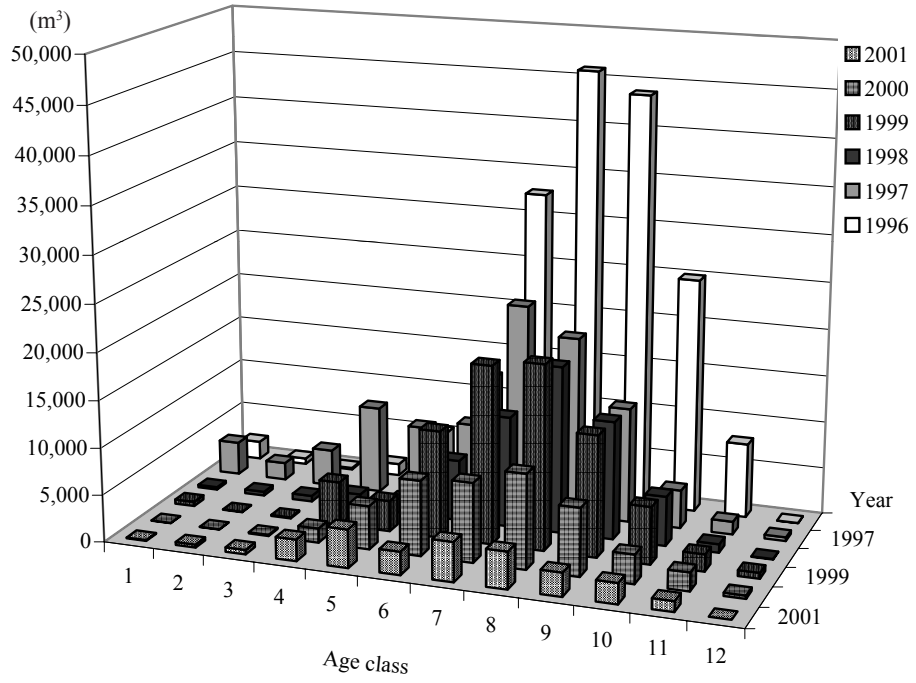

Fig. 5. Total cuts as a result of bark beetle disaster in 1996–2001 in the Šumava National Park (source: ŠNP Vimperk)

the decline of spruce stands facilitates the renewal of natural species composition. Underplantings are used in dry stands and autochthonous tree species are planted on clearcut areas induced by the disaster. The proportion of spruce in renewed stands in the Šumava NP decreased from 76.7% to 32.2% while the proportion of fir increased from 5.4% to 17.5%, beech from 8.2% to 26.5% and rowan from 0.6% to 19.0%. Natural regeneration of target and pioneer autochthonous species is increasingly used.

The abating bark beetle disaster has been among the greatest of its kind in the CR and in Šumava Mts. since 1871–1875 (PFEFFER, SKUHRAVÝ 1995). Similarly these spruce stands were damaged by nun moth calamity during the first half of 19th century. Mass bark beetle attack and subsequent disintegration of vast complexes of spruce forests that are located throughout the whole territory of the National Park were prevented in the Šumava NP by consistent remediation interventions combined with other measures. Fig. 6 shows the proportion of total fellings and salvage fellings with respect to their causes in 1989–2001. This graph documents the consequences of a great wind and snow disaster in 1989 that was followed by a huge bark beetle disaster.

Management in Army Forests and Farms of CR also has its specific features. These forests situated near the Lipno dam are used for military purposes (training of the CR Army and of other NATO countries), not allowing normal forest management.

NATURE CONSERVATION

The Šumava Mts. are a unique natural region in the south of the Czech Republic that is distinguished for the surface area of well-preserved forests also in the context of Central Europe. This is the reason why large specially protected areas could be established on the Czech and Bavarian side in the second half of the 20th century. Šumava Protected Landscape Area (PLA) taking up 163,000 ha originated in the CR in 1963. A UNESCO biosphere reserve was declared within the PLA in 1990 and Šumava National Park covering the nucleus territory of the biosphere reserve was declared in 1991 (its area is 68,520 ha). PLA of the same name 94,480 ha in size skirts ŠNP on its whole periphery.

Table 7. Representation of target management complexes (MC) in the Šumava Forest Natural Region (134,507 ha)

MC	29	51	53	55	57	59	
Area (ha)	243	10,665	35,439	17,591	14,654	920	
Proportion (%)	0.2	7.9	26.3	13.1	10.9	0.7	

MC	71	73	75	77	79	01	02
Area (ha)	2,808	16,258	3,427	11,434	8,207	6,399	6,462
Proportion (%)	2.1	12.1	2.5	8.5	6.1	4.8	4.8

Source: RPFD – FMI at Brandýs nad Labem

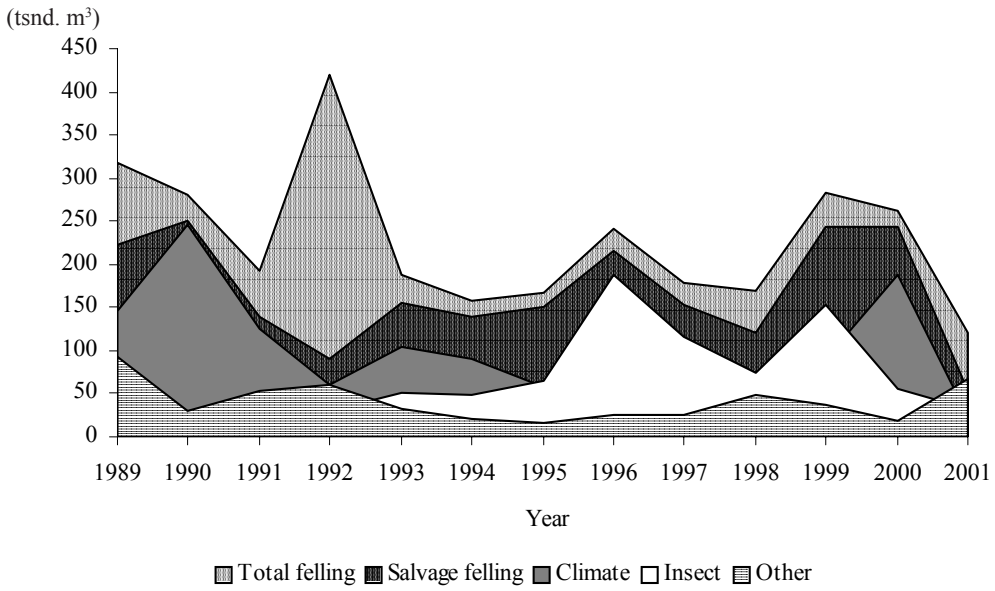

Fig. 6. Development of total and salvage fellings with respect to their causes in the Šumava NP in 1989–2001 (source: FMI at Brandýs nad Labem)

The special biogeographic location of the Šumava Mts. in the center of Central European landscape predetermined that these mountains became an important evolutionary crossing for the biota across which many Alpine species repeatedly migrated. It is reflected in a relatively high number of glacial relicts. Unique are particularly the most extensive peat ecosystems in the CR. Šumava NP is one of the important territories under Ramsar Convention. A Ramsar mission visited Šumava NP in 2001, and the high value and conservation of wetlands and peat bogs was appreciated.

The framework of the management and/or care of particular ecosystems is based on the Plan of the Care of Šumava National Park. National Park zonation (Fig. 7) and actual state of particular ecosystems underlie the differentiation of near-natural management. The zonation of nature conservation is dynamic: patches of zone I will gradually be joined to form continuous territories during the transient period of ca. 30 years. The first step of zone I enlargement (thousands of ha) is prepared at present. The proposal should be submitted by the end of 2002.

Fig. 7. Zonation of the Šumava NP and the Šumava PLA (source: Šumava NP Administration; GIS by K. MATĚJKA, IDS)

References

BOUŠE J. et. al., 2001. Oblastní plán rozvoje lesů – PLO 13 – Šumava. Brandýs nad Labem, ÚHÚL – pobočka Plzeň a České Budějovice: 271 + příl.

DEMEK J., 1987. Hory a nížiny. Zeměpisný lexikon ČSR. Praha, Academia: 643.

FIALA J., 2002. Kůrovcová kalamita na Šumavě. Vimperk, Správa NPŠ: nestr.

JELÍNEK V., 1985. Historie lesů Šumavy. Vimperk, Správa NPŠ: nestr.

JENÍK J. et al., 1994. Biosphere Reserves on the Crossroad of Central Europe, Czech Republic – Slovak Republic. Praha, Empora: 168.

KUNSKÝ J., 1968. Fyzický zeměpis Československa. Praha, SPN: 537.

KUPKA I., 2000. Přirozená, cílová a aktuální druhová skladba lesních porostů na území Národního parku Šumava. In: PODRÁZSKÝ V., VACEK S., ULBRICHOVÁ I. (eds.), Monitoring, výzkum a management ekosystémů Národního parku Šumava, Kostelec n. Č. l. 1999. Kostelec nad Černými lesy, Lesnická práce 2000: 55–60.

PFEFFER A., SKUHRAVÝ V., 1995. Lýkožrout smrkový a jeho problematika I., II. Lesn. Práce, *74* (3–4): 21, (5): 8–10.

PLÍVA K., ŽLÁBEK I., 1986. Přírodní lesní oblasti ČR. Praha, SZN: 313.

PRŮŠA E., 2001. Pěstování lesů na typologických základech. Praha, Lesnická práce, s. r. o.: 593.

VACEK S., MAYOVÁ J., 2000a. K problematice vegetační stupňovitosti NP Šumava. In: PODRÁZSKÝ V. (ed.), Monitoring, výzkum a management ekosystémů Národního parku

Šumava. Sbor. z celost. konf. Kostelec nad Černými lesy, 27.–28. listopadu 2000. Praha, ČZU: 138–141.
VACEK S., MAYOVÁ J., 2000b. Zdravotní stav lesních porostů na TVP v NP Šumava. In: PODRÁZSKÝ V. (ed.), Monitoring, výzkum a management ekosystémů Národního parku Šumava. Sbor. z celost. konf. Kostelec nad Černými lesy, 27.–28. listopadu 2000. Praha, ČZU: 142–152.
VALENTA M. et al., 1994. Šumava Biosphere Reserve. In: JENÍK J. (ed.), Biosphere Reserves on the Crossroad of Central Europe, Czech Republic – Slovak Republic. Praha, Empora: 50–64.
VINŠ B. et al., 1999. Ochrana přírody a péče o les v Národním parku Šumava. Praha, MŽP: 55.

Received for publication March 17, 2003
Accepted after corrections May 2, 2003

Lesní ekosystémy Šumavy a jejich management

S. VACEK[1], V. V. PODRÁZSKÝ[2]

[1]*Výzkumný ústav lesního hospodářství a myslivosti, Výzkumná stanice Opočno, Česká republika*
[2]*Česká zemědělská univerzita v Praze, Lesnická fakulta, Česká republika*

ABSTRAKT: Úvodní příspěvek shrnuje údaje o charakteru zájmového území, současném stavu a vývoji lesních ekosystémů a základní zásady managementu v Národním parku a Chráněné krajinné oblasti Šumava. Nejprve vymezuje hranice přírodní lesní oblasti a popisuje přírodní podmínky (geologii, geomorfologii, hydrologii, klimatická, půdní a vegetační specifika), dále pak porostní poměry (druhovou a věkovou skladbu, růstové a produkční poměry a zdravotní stav porostů). Tyto podklady jsou základem pro management lesních ekosystémů, respektující jak přírodní podmínky a porostní poměry, zejména pak ekologické vlastnosti dřevin, tak i požadavky ochrany přírody.

Klíčová slova: Šumava; národní park; horské lesy; lesní hospodářství; ochrana přírody

Šumava je nejrozsáhlejší středoevropská hornatina hercynského masivu. Katastrální rozloha přírodní lesní oblasti Šumava činí 211 302 ha a při lesnatosti 66 % se plocha lesů rozkládá na 140 378 ha. Horské lesy zaujímají 95,6 % lesů přírodní lesní oblasti. Jde o relativně nejméně narušené a nejlépe zachované horské ekosystémy v ČR.

Po geologické stránce je celá Šumava složena ze silně metamorfovaných krystalických hornin moldanubika (ruly, pararuly, svorové ruly, svory, ortoruly, granulity, migmatity), jimiž pronikají tělesa žuly a granodioritů moldanubického plutonu. Z klimatického hlediska náleží převážně do chladné oblasti, okrsku mírně chladného. Pouze nejvyšší partie pokrývá okrsek chladný horský. Nejnižší polohy pak patří do oblasti mírně teplé s mírně teplým, velmi vlhkým okrskem. Je zde vyvinuta výšková půdní stupňovitost od podhorských až po horské půdy. Nejnižší polohy pokrývají kambizemě, na ně navazují nejrozšířenější kryptopodzoly a nejvyšší polohy pokrývají podzoly. Pro květenu je charakteristická celkově nižší druhová diverzita ve srovnání např. s flórou Krkonoš, alpských či karpatských oblastí. Z ojedinělých endemických druhů se zde nachází hořeček mnohotovarý český (*Gentianella praecox* subsp. *bohemica*), zvonečník černý (*Phyteuma nigrum*), oměj šalamounek (*Aconitum plicatum*) a prstnatec májový rašelinný (*Dactylorhiza majalis* subsp. *turfosa*).

Z hlediska vertikálního členění přirozené vegetace v nižších a středních horských polohách dominovaly acidofilní horské bučiny, na které výše navazovaly podmáčené smrčiny, vrchoviště a přirozená rašeliniště a v nejvyšších partiích klimaxové smrčiny. Podél středních a horních částí toků se nacházely luhy a olšiny. Nejrozšířenější jsou LVS: 6. – smrkobukový (56,5 %) a 7. – bukosmrkový (29,2 %). Dominantní jsou SLT 6K – kyselá smrková bučina (24,0 %), 7K – kyselá buková smrčina (12,3 %), 6S – svěží smrková bučina (8,6 %) a 6V – vlhká smrková bučina (8,3 %). Lesy hospodářské v současné době zaujímají 41,4 %, lesy ochranné 3,3 % a lesy zvláštního určení 55,3 %. Největší disproporce mezi současnou a přirozenou druhovou skladbou jsou u smrku ztepilého (80,7–41,9 %), jedle bělokoré (2,0 až 17,3 %) a buku lesního (5,0–27,0 %). Přirozené zastoupení věkových stupňů je také značně nevyrovnané.

Zdravotní stav porostů na Šumavě je již asi 15 let narušován probíhající kůrovcovou kalamitou (*Ips typographus*). V průběhu kůrovcové kalamity bylo v NPŠ dosud vytěženo kolem 3 500 ha lesa. Doznívající kůrovcová kalamita patří k největším svého druhu v ČR a na Šumavě od let 1871–1875. Obdobným způsobem zde byly smr-

kové porosty v první polovině 20. století silně postiženy mniškovou kalamitou. V posledních pěti letech se proto rozpadu smrkových porostů využívá k obnově přirozené druhové skladby. Suché porosty se podsazují a kalamitní holiny zalesňují autochtonními dřevinami. Podíl smrku na obnově v NP Šumava tak klesl ze 76,7 % na 32,2 % a naopak se zvýšil podíl jedle z 5,4 % na 17,5 %, buku z 8,2 % na 26,5 % a jeřábu z 0,6 % na 19,0 %. Stále ve větším rozsahu se pracuje s přirozenou obnovou nejen cílových, ale i přípravných autochtonních dřevin.

Zvláštní biogeografická poloha Šumavy uprostřed středoevropské krajiny předurčila, že se toto pohoří pro biotu stalo významnou vývojovou křižovatkou, přes kterou opakovaně migrovaly četné alpské druhy. To se odráží v poměrně velkém množství glaciálních reliktů. Unikátní jsou zejména nejrozsáhlejší rašelinné ekosystémy v ČR. Z tohoto hlediska Národní park Šumava patří mezi významná území z hlediska Ramsarské úmluvy. Management, resp. péče o jednotlivé ekosystémy rámcově vychází z Plánu péče Národního parku Šumava. Základem pro diferenciaci přírodě blízkého managementu je především zonace národního parku a konkrétní stav jednotlivých ekosystémů.

Corresponding author:

Doc. RNDr. STANISLAV VACEK, DrSc., Výzkumný ústav lesního hospodářství a myslivosti, Výzkumná stanice Opočno, Na Olivě 550, 517 73 Opočno, Česká republika
tel.: + 420 494 668 391, fax: + 420 494 648 393, e-mail: vacek@vulhmop.cz