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**SCIENTIFIC SESSION II**  
**PROTECTION AND DEVELOPMENT STATE OF FORESTS AND ENVIRONMENT – EDUCATION, RESEARCHING, TRAINING, NEEDS**

**PLENARY LECTURE**  
**SUSTAINABLE USE OF FORESTS AND FORESTS ECOSYSTEMS – THE CONDITION OF INDICATORS IN SERBIA**

*Mihailo RATKNIĆ, Ljubinko RAKONJAC, Milorad VESELINović<sup>1</sup>*

**Abstract:** *The definition of criteria and indicators of sustainable forest management and the possibilities of their use in the forest management planning are determined. The norms used directly in the theory and practice of the forest management planning in Serbia, which are in accordance with Pan-European criteria and indicators for sustainable forest management, are shown and evaluated in a great detail.*

*Criterion 1 The preservation and promotion of forest resources and their contribution to the global carbon cycle: The use of soil and forests (Quantitative indicator: Land covered by forests and other forest land and the change of land areas(classified according to the forest and vegetation types, land structure, ownership structure, age structure, the origin of the forest);*

*Total volume (Quantitative indicator: The changes in total volume, average tree trunk volume on the forest land- classified according to the vegetation zones or habitat types, age structure and indescrement stages); Carbon balance (Quantitative indicator: Total carbon stock and the changes of the stocks in the forest habitats).*

*Criterion 2 Forest health condition and vitality: Total amount and the changes in the last five years in the emitting of the air pollutants (estimation on the permanent areas); The changes in the forest defoliation and deforestation using UN /ECE and EU classification of defoliation (classes 2,3 and 4) in last five years; The*

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<sup>1</sup>Mihailo Ratknić, Ph.D., Ljubinko Rakonjac, Ph.D, Milorad Veselinović, Ph.D., Institute of forestry, Belgrade

Translation: Marija Stojanović

*serious damages caused by biotic and abiotic agents (serious damages caused by insects and illnesses, with the determination of the seriousness through dessication and increment loss, annual amount of the burnt forests, annual amount of areas damaged by storms and the scope of felling in these regions, the amount of the regenerated land damaged by game, cattle and damages caused by grazing);*

*Criterion 3: The productive functions of forest: Timber production (Quantitative indicator: Balance between increment and felling in last decade; The percent of forest land according to the management plan); Non-wood forest products (Quantitative indicators: Total amount and the changes of values and/or the quantity of non-wood forest products (hunting, game, fruit-woods, healing plants, fungi, etc.).*

*Criterion 4 Biodiversity: Typical, rare and endangered forest ecosystems (Quantitative indicators: The changes of land area – nature and preforest types, strictly protected reserves, forests protected by special management treatment); Endangered species (Quantitative indicator: The changes in number and percent of the endangered species according to total number of the forest species (using reference lists – IUCN, The European Council, EU Habitats Directive, etc.); Biodiversity in the productive forests (Quantitative indicator: The changes of the amount of habitats intended for the preservation and use of forest genetic capacity (genofond, seedling collection, etc.) differentiation between native and introduced species; The changes in the proportion of the mixed stands containing 2 or 3 tree types, The ratio between the annual amount of the land areas that are regenerated naturally and total land area) ;*

*Criterion 5 The protective functions in the forest management (with the emphasis on the land and water): Land erosion (Quantitative indicator: The percent of the forests with the primary land protection); The protection of water in forests: (Quantitative indicator: The percent of the forests with the primary water protection);*

*Criterion 6 Socio-economic functions and conditions. The importance of the forestry domain: (Quantitative indicator: The contribution of the forest sector in the Gross Domestic Income); Recreation (Quantitative indicator: maintenance of the recreational function: forest area per inhabitant, percent of total forest land); Employment: (Quantitative indicator: The changes of employment rate in the forestry, particularly in the rural areas (employees in the forestry, felling and wood industry); Research and education; Public consciousness; Public participation and Cultural heritage.*

**Key words:** forest resources, management, protection, ecosystem.

## **CRITERION 1. THE PRESERVATION AND PROMOTION OF FOREST RESOURCES AND THEIR CONTRIBUTION TO THE GLOBAL CARBON CYCLE**

Forests and forest ecosystems fall into the category of the most important bioecological resources and are the most comprehensive renewable natural resources which, along with the socioeconomic importance (through biomass production as the essential raw material for the

mechanic and chemical wood processing), represent the most stable ecosystems of invaluable importance to the environmental protection and the quality of the environment.

Forests are an indispensable factor for finding the solution to the problem of preservation, protection and promotion of the quality of the environment, not only in the regional scopes, but they have the global positive influence and are of biospheric importance to the all component of the environment.

We have become aware of the fact that the ecological imporatnce of forests and forest ecosystems significantly exceeds their economic importance.

The condition and level of the forest preservation reflect to the great extent the level of the enviromental preservation. Clearance, damaging and degradation of forests in Serbia resulted in the degradation of the other natural resources, particularly in the hilly-mountainous area, which had the adverse effect on the major component of the environment: air, soil, flora and fauna, landscape and the space as a whole.

The total area of forests and forest land according to the common basis is 2.190.924,79 ha. The total area of covered land accounts for 2.003.067,28 ha (91.42%), and the total area of the uncovered land accounts for 187.857,51 ha (8.57%). As the result of the large scale afforestation (mostly by conifers) and of the spontaneous forest spreading in the hilly-mountainous region, since the World War II, the relative area under timber expanded from 19.3% to 25.9%. The area of state-owned forests is 984.500 ha, which contitutes 49.1% of the total area of forests in Serbia, wheras the forests managed by private owners is 1.018.600 ha, which consitutes 50.9% of the total area of forests in Serbia (condition in 2005). (Forest managed by private owners in central Serbia make up 58.4%, and 4.7% in Vojvodina (Table 1).

**Table 1.** *The condition of covered land [000 ha]*

Year and the source of data <sup>1</sup>	Covered			Uncovered			total
	Total (area under timber)	State-owned	Private-owned	Total (forest land)	State-owned	Private-owned	
2005 (OOGŠ)	2003,1	984,5	1018,6	187,8	185,9	1,9	2190,9
1995 Jović et al.	2.349,5	1.179,5	1.170,0	303,6	148,8	154,8	2.653,1
1992 Jović et al.	2.232,9	1.143,3	1.169,5	1.415,7	281,4	1.134,3	3.728,5

The structure of the forest reserves is characterized by numerous stands with the dominant deciduous tree species. Deciduous trees account for

<sup>1</sup> Data for 1992 and 1995 refer to the territory of Serbia with KiM

64.1%(1.283.400ha), conifer trees account for 11.8%(237.000ha), where as mixed stands account for 24.1%(482.700ha)(condition in 2005). (Table2).

**Table 2.** *Area covered by forests [000 ha]*

Year	Total area (1000 ha)	Type of forest (1000 ha)		
		Conifer	Deciduous	Mixed
2005 <sup>1</sup>	2003,1	237,0	1283,4	482,7
2000 <sup>2</sup>	2349,5	329,0	1950,0	70,5
1992 <sup>3</sup>	2232,9	315,7	1888,8	68,4

The parcels are usually irregular, long and narrow, which is the result of the frequent divisions between the owners of the parcels during the process of inheritance. The small and chopped parcels are the hindrance to the forest management based on the principles of sustainable growth, providing of the efficient service and training of the owners, which would enable the prudent management with the environmental protection and biological diversity. Since this domain is ill-organized the condition of forests on private parcels have deteriorated, which has resulted in the timber production of thinner sortiments and lower quality.

The average volume of timber is 276.671.000 m<sup>3</sup> (2005) (Table 3).

**Table 3.** *Area, volume and volume increment in the Serbian forests [000 ha]*

Year	Area (000 ha)			Volume (000 m3)			Increment (000 m3)		
	total	State	Private	total	state	private	total	state	private
2005 OOGŠ	2003,1	984,5	1018,6	276.671 (138 m3/ha)	164.912 (167,5 m3/ha)	111.759 (109,7 m3/ha)	6.472 (3,23 m3/ha)	4.175 (4,24 m3/ha)	2.297 (2,25 m3/ha)

The average volume of timber in state forests in central Serbia is 167,5 m<sup>3</sup>/ha and 109.7 m<sup>3</sup>/ha in private-owned forests. The distribution of stands according to the age classes is presented in the Table 4. There are 61.35% land covered by forests in the classes younger than 40 years, whereas stands older than 100 years account for only 2.34% (condition in 2005.)

<sup>1</sup> Data for 2005 are found in the OOGŠ

<sup>2</sup> For 2000 from Condition and Problems of the private-owned forests (Ratknić et al, 2000)

<sup>3</sup> For 1992 from Development of Forestry and the Condition of Forests (Jović et al, 1992)

The basic parcel of the private-owned parcel covered by forest is characterized by its small size. There are about 500.000 owners of the private forests in Serbia which have approximately 5.000.000 parcels registered in 7.500 cadastral municipalities. The approximate parcel size of the Serbian private forests is under 0.5 ha (often smaller than 20 - 30 ares).

**Table 4.** *Distribution of the stands of the same age according to the age*

Category	Year	Age classes									
		(1000 ha)									
		<10 years	11-20	21-40	41-60	61-80	81-100	101-120	121-140	>140	Ostalo
Forests	2005	275.0	296.0	500.0	379.0	186.0	70.0	31.0	10.0	0.0	0.0
	2000	349.0	347.0	460.0	331.0	157.0	60.5	25.5	8.0	0.0	0.0
	1990	522.5	409.0	400.5	293.5	108.5	43.0	17.0	3.5	0.0	0.0
Of which forests for timber production	2005	241.5	260.0	439.0	333.0	163.0	61.5	27.0	9.0	0.0	0.0
	2000	309.0	307.0	408.0	293.0	139.0	53.5	22.5	7.0	0.0	0.0
	1990	458.0	358.5	351.0	257.0	95.5	38.0	15.0	3.0	0.0	0.0

In Table 5 and Graph 2 the average distribution of trees according to the diameter increment for the forests of the different age is presented. The maximum scope of the tree distribution ranges from 20 to 39 cm (168.7 m<sup>3</sup>/ha), whereas the average tree volume thicker than 60 cm is 22.9 m<sup>3</sup>/ha (condition from 2005).

**Table 5.** *Distribution of volume (forests of different age)*

Category	year	Forests of different age			
		Diameter classes (in cm)			
		(in m <sup>3</sup> /ha)			
		0-19	20-39	40-60	>=60
Forests	2005	30.2	168.7	135.7	22.9
	2000	28.4	161.0	126.6	18.1
	1990	24.9	145.9	108.2	8.4
Of which forests for timber production	2005	n.a.	n.a.	n.a.	n.a.
	2000	n.a.	n.a.	n.a.	n.a.
	1990	n.a.	n.a.	n.a.	n.a.
Conifer trees	2005	27.4	218.5	140.1	24.2
	2000	25.4	209.5	127.6	19.3
	1990	21.4	191.5	102.6	9.5
Deciduous trees	2005	23.4	115.0	127.4	27.8
	2000	22.2	109.9	122.0	22.5
	1990	19.8	99.7	111.2	11.9
Mixed	2005	39.8	172.5	139.7	16.7
	2000	37.7	163.5	130.1	12.4
	1990	33.5	145.5	110.9	3.8

The total volume of timber is 246.504.000 m<sup>3</sup> (year 1990), i.e.

241.275.000 m<sup>3</sup> (year 2005), which points to the decrease in the volume of about 5.229.000 m<sup>3</sup> or 327 m<sup>3</sup> averagely per annum (Data by Serbian Bureau for Statistics) – Table 6. Decrease in volume from 1990 to 2005 was reported in conifer (3.768.500 m<sup>3</sup>) and mixed forests (15.567.000 m<sup>3</sup>), whereas the volume increase was reported in the deciduous forests (14.106.500 m<sup>3</sup>). The average volume of timber in Serbia is 166.9 m<sup>3</sup>/ha (data refer to the state forests).

**Table 6. Volume according to the type of forest**

Category	year	Total volume (1000 m <sup>3</sup> )	Type of fores		
			(1000 m <sup>3</sup> )		
			Conifer	Decidious	Mixed
Forests	2005	237202,0	22134,5	146236,5	68831,0
	2000	237545,0	20188,0	136852,0	80505,0
	1990	243460,0	25903,0	133159,0	84398,0
Forests for timber production	2005	186550,0	17573,0	116625,0	52352,0
	2000	187158,0	17695,0	117050,0	52413,0
	1990	191658,0	18181,0	119969,0	53508,0
Other forest land	2005	4073,0	0,0	4073,0	0,0
	2000	3730,0	0,0	3730,0	0,0
	1990	3044,0	0,0	3044,0	0,0
Other forest land suitable for timber production	2005	0,0	0,0	0,0	0,0
	2000	0,0	0,0	0,0	0,0
	1990	0,0	0,0	0,0	0,0
The total number of forests and forest land	2005	241275,0	22134,5	150309,5	68831,0
	2000	241275,0	20188,0	140582,0	80505,0
	1990	246504,0	25903,0	136203,0	84398,0

The condition of forests in Serbia is unfavorable on the basis of the use of habitat capacity and the providing of the commonly useful forest functions. The average volume is 50%, and volume increment account for 40% of the maximum possible (determined according to the productive capacity of the habitat).

Forests of seed origin account for 40.68%, coppice forests 29.97%, artificially established forest cultures and plantations 18.31%, bushland 4.91% and scrub forests 6.13% of the total forest reserves managed by Public Enterprises "Srbijašume", "Vojvodinašume" and national parks.

**Table 7. Condition of stands according to the origin (volume)**

Origin	Srbijašume		Vojvodinašume		National parks		Total	
	m <sup>3</sup>	m <sup>3</sup> /ha	m <sup>3</sup>	m <sup>3</sup> /ha	m <sup>3</sup>	m <sup>3</sup> /ha	m <sup>3</sup>	m <sup>3</sup> /ha
Forests of seed origin	79521897	243.6	8072506	348.6	12417049	326.4	100011451	258.0
Coppice forests	2987877	130.8	2150118	89.6	6714443	202.9	38743339	135.7
Artificially established plantations and forest cultures	8911636	74.6	10519786	206.5	691299	176.0	20122722	115.5
Low forests	602	383.6			62	47.0	664	229.9
Bushland	62671	1.5			156	0.1	62827	1.3
Scrub forests	6989	0.1			-	-	6989	118.2

**Carbon balance.** Climate changes caused by the increase in the CO<sub>2</sub> level are to result in the warming up of the troposphere, which shall prompt the increase in air temperature and decrease in rainfall amount. The increase in the concentration of pollutants will lead to the increase in air temperature by 2<sup>0</sup>C in the winter and by 2-3<sup>0</sup>C in the summer. The decrease in rainfall by 5-15% in the summer is expected, which will result in the decrease of soil moisture by 15-25%. Thus, climate changes have to be incorporated in all long-term investments, particularly in biological works, such as meliorisation of the coppice and degraded forests and afforestation (particularly during the choice of the types, techniques and technology of works).

**Table 8. Carbon balance**

Category	Year	Carbon balance (1000 m <sup>3</sup> )	Type of forest		
			(1000 m <sup>3</sup> )		
			Conifer	Deciduous	Mixed
Forests	2005	143574925.0	92979446.0	32542806.0	18052673.0
	2000	143782523.0	93113886.0	32589860.0	18078777.0
	1990	147362752.0	95432448.0	33401357.0	18528947.0
Other forest land	2005	2544949.0	1653638.0	578773.0	312538.0
	2000	2330631.0	1514380.0	530033.0	286218.0
	1990	1901994.0	1235864.0	432552.0	233578.0
The total number of forests and forest land	2005	146119874.0	94633084.0	33121579.0	18365211.0
	2000	146113154.0	94628266.0	33119893.0	18364995.0
	1990	149264746.0	96668312.0	33833909.0	18762525.0

## **CRITERION 2. FOREST HEALTH CONDITION AND VITALITY**

### **Analysis of the pollutants in the air and precipitation**

**Pollutants in the air** In the territory of Serbia Kamenički Vis Station has implemented the programme of CO<sub>2</sub> content monitoring (since 1984) and NO<sub>2</sub> (since 1990) in the air, physical-chemical precipitation content (since 1984) and defining of the heavy metal content in precipitation. Critical concentration for SO<sub>2</sub> defined for forest ecosystems is 20 µg m<sup>-3</sup> and represents the average annual and winter concentration. The limit has been not exceeded since 1985 for any of the aforesaid periods. The critical concentration of average annual concentration SO<sub>2</sub> in the territory of Serbia (according to the results of Oiler's unified approach used in the Meteorological Synthesized Centre West for the needs of EMER Programme) was not exceeded in any square (50x50 km) of EMER net in 2002. The greatest SO<sub>2</sub> ranged from 4-9 µg m<sup>-3</sup> in Northwestern Serbia. Since nitrogen oxides have equally adverse effect on all ecosystems the unique critical level of the average annual concentration of 30 µg m<sup>-3</sup> was defined. The critical level was not exceeded in the investigated period.

**Moist deposition** Annual deposition of sulfur exceeds the deposition of nitrogen from ammonium ion and nitrate, whereas calcium contributes to the greatest extent to the baseness of the precipitation. The trend of the decrease in ionic types (H<sup>+</sup>, SO<sub>4</sub><sup>2-</sup>, -S, Mg<sup>2+</sup>, Ca<sup>2+</sup>, Cl<sup>-</sup>, K<sup>+</sup>) is the result of the reduced concentration of pollutants in the precipitation.

In the urban parts of Serbia acid precipitation occur in 30-45% cases. In the period from 1984 to 2003 the annual level of acid precipitation ranged from 14 to 39% (limit level pH=5.60). Extremely acid precipitation account for 0-6.2% of the total precipitation, moderately acid precipitation account for 4.8-25.7% and weak acid precipitation account for 5.2-17.1%.

**Heavy metals.** The results obtained by applying cross-border transport Cd, Pb and Hg owned by Meteorological Synthesized Centre EAST are presented. The maximum levels of lead depositions were reported in the city municipalities of Smederevo, Požarevac, whereas the maximum levels of cadmium deposition were reported in city municipalities of Bor, Negotin and Zaječar, and maximum levels of mercury depositions were reported in city municipalities of Obrenovac and Belgrade. The average levels of lead deposition range from the central parts of Vojvodina, by Ibar and Zapadna Morava Valleys and in the east by Timok Valley. The decrease in limit exceedings of acidification is expected, whereas no significant changes for nutritive nitrogen are likely to happen since ammonia emission will not change in the next 20 years.

The limit exceedings of the forest land acidification which was reported in 2000 (Bačka 50 egha<sup>-1</sup>year<sup>-1</sup>) shall occur in 2010 as well, whereas it shall reduce beyond the critical border in 2010. The greatest exceeding of nutritive

nitrogen for forest ecosystems was reported in 2000 in South Banat, north part of Braničevski County (over 1000 egha<sup>-1</sup>year<sup>-1</sup>) and in Šumadija (500-700 egha<sup>-1</sup>year<sup>-1</sup>). In the remaining part of the territory the reported exceeding ranges from 100 to 500 egha<sup>-1</sup>year<sup>-1</sup>. It is estimated that in 2010 exceeding will range from 1000 to 2000 egha<sup>-1</sup>god<sup>-1</sup>

and will encompass the whole countrz, except for southwest and southest parts (about 750 egha<sup>-1</sup>year<sup>-1</sup>). The greatest exceeding shall occur in south Banat and Braničevski County (about 2000-3000 egha<sup>-1</sup>year<sup>-1</sup>). The condition in 2020 shall be similar to that in 2000, and the scope of the critical burden for nutritive nitrogen of 1000 egha<sup>-1</sup>year<sup>-1</sup> shall spread to South Srem and Mačva.

**Serious damages caused by biotic and abiotic agents.** Forest damages<sup>1</sup> also influence the capacity of forest resources in Serbia to a great extent. Their scope is stated by the damaged wood volume, which decayed owing to many agents, or was used in an inappropriate way.

**Table 9. Forest damages**

Category	Year	Total area of damage	Primary damages caused by biotic agents		Primary damages caused by abiotic agents		Primary damages caused by human activities	
			Insects & diseases	Wild and domestic animals	Storm, wind, snow etc.	fire	Forest works	other
(1000 ha)								
Total number of forest and other forest land	2005	n.a.	33,0	1,5	1,5	0,5	n.a.	0,5
	2000	n.a.	3,0	0,0	3,5	20,5	n.a.	0,5
	1990	n.a.	0,5	0,0	0,5	2,5	n.a.	0,5
Damages according to the types of stands:								
Conifer	2005	n.a.	0,5	0,0	0,5	0,0	n.a.	0,0
Deciduous	2005	n.a.	25,5	1,5	1,0	0,5	n.a.	0,5
mixed	2005	n.a.	7,0	0,0	0,0	0,0	n.a.	0,0

**Table 10. Forest damages in the state forests according to the causes /ha**

year	Fire		Insects and plant diseases	Extreme weather conditions	Game	Domestic animals	Illegal land occupation	Total
	Floor	High						
1990.	927	156	3076	0	0	0	232	
2000.	17851	2667	2772	3359	1	13	222	16966
2005.	49	5	33404	1304	1259	38	40	36077
Conifer	17	1	348	277				643
Deciduous	8	3	26021	1011	1248	26	26	28344
Mixed	24		7035	16	11	12	13	7090

<sup>1</sup>All data refer to the state forests. There are no readily available data for the damages in the private-owned forests.

The total damages vary by age and are usually the results of the weather conditions, occurrence of the disease or gradation of the harmful insects.

**Strategic choice:** The number of bioindication points should be raised in order to obtain more reliable data on the condition of population dynamics and harmful organisms in the forests.

**Wildfires** Data on wildfires are processed only for state forests. Deliberately caused wildfires account for 1% of the total number of fires, whereas the remaining ones were caused by the careless and irresponsible behaviour displayed during the burning of the dry grass on the brims of the forest complexes. The wildfires are usually caused by throwing away cigarette butts and firelighting in the forests.

The state of anti fire equipment is unsatisfactory. The condition of anti fire railways in the bigger complexes covered by forest cultures is extremely bad. Building of the new anti fire railways is hindered by the lack of money. Existing anti fire railways are not wide enough, and the crowns of the edge trees have closed owing to the neglectance, which made them unfunctionable. Dry grass areas are to be found on them during the summer, which can prompt the spread of floor fires.

The Plans of Fire Protection were implemented in all state forests, the anti fire staff was trained by Public Enterprise "Srbijašume, in Deliblatska Sandy Terrain, Vlasinska Plateau and Ibarska Gorge (areas with the greatest complexes of conifer cultures). In addition, local measurement stations for defining the scope of danger of wildfires. The equipments for quick anti fire actions were formed in the forest administrations. The project of setting radio connection systems in the all territory of Serbia was supplemented. Nevertheless, there are not enough lookouts and microaccumulation for effective fight against wildfires in the regions with greater areas covered by conifer, antropogenic and nature forests.

**Primary damages caused by human activity.** In 1990 57.5% of annual volume increment was subjected to felling, and in 2005 55.3% (Table 11). Since the scope of felling is smaller than increment and pland, it should create preconditions at the state levels for improving the condition of forests by raising timber volume to optimal level<sup>1</sup>.

**Table 11.** *The scope of felling in Serbian forests (condition in 2005)*  
[000 ha]

The type of user	Area(ha)	Volume(m3)	Volume increment (m3)	Yield (m3)
State	984,5	164.912	4.175	2.705
Private	1.018,6	111.759	2.297	900
Total	2.003,1	276.671	6.472	3.605

According to the estimations and surveys in the mountain regions, the need for fuelwood per rural household accounts for at least 10.0 m<sup>3</sup>

<sup>1</sup> Data from common sources

annually, taking into account only so-called large wood which is a subject of statistics. It is estimated that 5-6 cubic metres from the total 10 cubic metres are derived from forests. The remaining part is obtained by so-called outstatistical timber volume, in the significant quantities although there not the subject of the statistical analysis, and derive from the line of trees which do are not treated as forests in cadastres. Solitary trees by brooks and rivers, on the diving lines, fruit trees, etc. fall into this category. The total scope of felling in private-owned forests is about 2.000.000 cubic metres, and the felling from so-called outstatistical timber volume is included in this quantity.

The numerous cases of illegal felling, as well as other forms of illegal use of forests are major problems. Illegal forests are typical in the municipalities in the vicinity of Kosovo- Bujanovac, Medveđa, Preševo and Kuršumlija. The usurpation of forests and forest land, the actions by local inhabitants aimed at prevention the use of forests established on rural leas and nationalised land, as well as the uncontrolled cattle grazing are also unfavourable conditions.

### **CRITERION 3. PRODUCTIVE FUNCTIONS OF FOREST**

**Timber production.** In 1990 57.5% of the annual volume increment was subjected to felling, whereas in 2000 56.3% was subjected to felling, and 56.3%, in 2005 (Table 12). Since the scope of felling is lower than increment, it should create preconditions at state level in order to improve the state of forests by increasing timber volume to optimal level<sup>1</sup>.

**Table 12.** *Scope of felling in state and private-owned forests*

year	Current annual increment	Total number of felling	Forest felling				Total number of felling	
			In state forests		In private forests		conifer	deciduous
			conifer	deciduous	conifer	deciduous		
2005.	5232.0	2484491	169567	1670262	41236	603426	210803	2273688
2000.	5232.0	2946617	213614	2060234	79659	593108	293272	2653342
1990.	5643.0	3243510	187032	2036547	53689	966242	240721	3002789

The average number of felled gross volume in Serbia ranges from 600.000 to 900.000 cubic metres, which is 8 to 12 times smaller than the estimated needs. In the private-owned forests 384.000 to 576.000 EUR is collected by 3% tax for felled timber driven out on the truck road. If the legalisation of the total felled timber is introduced, 4.608.000 EUR could be collected. This estimation is based on the assumption that the total felled timber is used as fuelwood. Since the technical timber accounts for 20-30% of the total volume felled in private-owned forests, it is possible to collect

<sup>1</sup> Since there are no readily available felling data for KIM in 2001, the percentage of felling refer only to central Serbia and Vojvodina.

the 6.000.000 EUR tax. This estimation of the felled timber points to one more fact, i.e. that the estimated scope of felling in private-owned forests exceed the annual volume increment of 6.180.000 cubic metres by 16.5%. If the feeling in state forests of is added to the felling in the state forests (averagely 2.000.000 cubic metres), it points to the fact that 48.9% is subjected to felling, which exceeds the estimated volume increment. The scope of felling in our state forests is always under the standard levels owing to the insufficiently open forests, unstimulating price, etc.

**By products.** Forests with pastures and other areas within them, as well as water areas within the forest localities represents the insufficiently used resource capacity, which is equally important as the timber production. There are huge possibilities for using forest habitats, such as establishing production of applicable biological and industrially healthy products without pests and other harmful agents (fungi, medicinal plants, fruits and forest fruits), organization of cattle husbandry with meat production, game meat production, beekeeping and fish production in natural water flows or fish ponds, as well as the agriculture crops growing. These activities will contribute to a great extent to the development of recreational- health, commercial and sports-hunting tourism. The trends of using products collected in forsts in the years (1990, 2000 and 2005) are shown in the Table 13.

**Table 13.** *Products collected in the forest*

Sold plant products	year	Sold plant products			Sold animal products	year	Sold animal products		
		size	Quantity	Value (1000 din)			size	quantity	Value (1000 din)
Christmas trees	2005	1000 pieces	50,0	20000,0	Game meat	2005	tob	909,1	454550,0
	2000		75,0	30000,0		2000		4171,9	2085950,0
	1990		n.a.	n.a.		1990		5738,1	2869050,0
Fungi and truffles	2005	ton	5498,1	8797960,0	Hunted game	2005	1000 pieces	331,3	662600,0
	2000		2300,0	4600000,0		2000		303,0	606000,0
	1990		n.a.	n.a.		1990		1199,0	2398000,0
Fruits, berries and edible kernels (walnuts, hazelnuts, etc.)	2005	ton	107,8	8624,0	Skin and trophies	2005	1000 pieces	10,6	254400,0
	2000		193,2	15456,0		2000		5,3	127200,0
	1990		119,0	9520,0		1990		12,8	307200,0
Decoration plants	2005	ton	n.a.	n.a.	Honey and beewax	2005	ton	3665,0	916,0
	2000		n.a.	n.a.		2000		2663,0	666,0
	1990		n.a.	n.a.		1990		2659,0	665,0
Resin, healing and aromatical plants, substances for dying	2005	ton	18,3	14640,0	Raw material for medicinal purposes	2005	ton	n.a.	n.a.
	2000		3,1	2480,0		2000		n.a.	n.a.
	1990		18,1	14480,0		1990		n.a.	n.a.

Sold plant products	year	Sold plant products			Sold animal products	year	Sold animal products		
		size	Quantity	Value (1000 din)			size	quantity	Value (1000 din)
Other plant products	2005	ton	557,5	446000,0	Other animal products	2005	ton	1230,5	984400,0
	2000		27,2	21760,0		2000		1100,0	880000,0
	1990		59,9	47920,0		1990		n.a.	n.a.

Trend of development represents the future economic base for prosperity of forest-industrial organizations which existed in the past almost solely on the production and timber placement as the only forest product.

The species which can be collected as forest fruits are important for the less fertile habitats. Since these products are very attractive they deserve a better place in the development planning. Thus, it is essential to establish a network encompasses all phases, from purchase to selling.

The parallel view of quantities of some plant and animal species gathered in 1993 and 2006 is shown in Table 14 and Graph 1. The gathering and circulation of these species are regulated by the Decree on taking control use and circulation of wild plant and animal species.

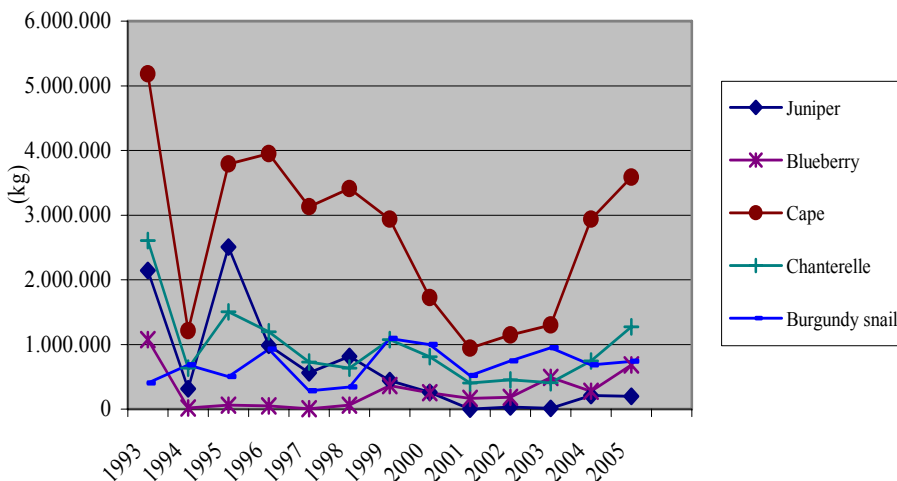
**Table 14.** *Quantities collected in nature in 1993 and 2005*

Species from the Decree	1993 (kg)	2005 (kg)
Marsh Mallow ( <i>Althea officinalis</i> )	2.000	8.322
Lemon Balm ( <i>Mellisa officinalis</i> )	1.000	704
Juniper ( <i>Juniperus communis</i> )	2.142.500	200.980
Dog Rose ( <i>Rosa canina</i> )	-	296.984
Blueberry ( <i>Vaccinium myrtillus</i> )	1.072.800	680.850
Cepe <i>Boletus edulis</i> )	5.186.100	3.584.300
Chanterelle ( <i>Cantharelus cibalius</i> )	2.605.500	1.274.700
Burgundy snail ( <i>Helix pomatia</i> )	404.600	740.152

The number of farms for snail raising has increased in the last few years to a great extent, as well as of the areas serving as plantations for healing and aromatical plants. Therefore, we expect that the pressure on the natural populations of resources will be reduced. However, the pace and scope of the reduction will undoubtedly depend upon the number and areas of the plantations and farms as well as of the pace of growth of market demands.

Apart from using spontaneously formed stands, groups or solitary fruit trees from forest plants, the establishment of stands of walnut, black walnut Turkish hazel, hazel, wild apple, wild cherry, rowan berry, and other attractive species for processing industry (raspberry, blackberry, blueberry, etc.).

**Graph 1.** *Some plant, fungi and animal species collected in the period 1993-2005.*



**Beekeeping.** Forests and forest formations are very important to the beekeeping development and they are the source of good beekeeping grazing in the certain period. Apart from melliferous tree types, there are also other melliferous species in the low and middle floors. The great importance is attached to the the forest as a natural resource in the organized and intensified beekeeping as a result of the chemistrization of agriculture and pollution of the area in the vicinity of settlements and industrial complexes. According to the estimated habitat capacities (Vlatković, S. 2001), the current number of beekeeping associations (350.000) could be quintupled. Therefore, we should pay more attention to this potential, not only because of direct economic benefit, but because of its importance to the enriching and preservation of flora and fauna richness, life processes in biosphere and enviromental protection.

**Hunting.** Game is an important compound in the forests and forest ecosystems, since it serves as a bioregulator and nature ornament. The importance of it is reflected in the multier potential benefits. The state of population of autochtonious, economically most valuble game species (deer, roe, wild hog) is the potential capacities of the forest areas in Serbia. The number of these game species per unit of area belnog to the lowest density in Europe. Inadequate and irational use of certain game species was multiannual practice and has resulted in the direct risk to their number and spread.

The current unsatisfactory condition of game populations is, above all, the concequence of the inappropriate state approach to the questions of ownership of game, estate-law problems which is the result of the rights concerning the ownership of the game and rights concerning the ownership of the areas for game breeding and growing, as well as of the inappropriate

definition of the hunting as the industrial activity and hunting as a way to satisfy the personal needs of an individuals or groups, i.e. hunting as a hobby. The strategy of sustainable game management and hunting development, based on the principles of prudent and rational land use, with the adequate intersector treatment and adopting multifunctional approach, will define the importance and need for improving the condition of the resources. The condition of hunting and hunting game in Serbia is shown in Table 15 and 16.

**Table 15.** *The state of hunting grounds and game in Serbia*

Region/ Number of hunting grounds	Area	Roe		Wild hog		Rabbit		Pheasant		Gray partridge	
	(ha)	m.f.	bag	m.f.	m.f.	m.f.	bag	Bag	bag	m.f.	bagl
Vojvodina 57	1.987.830	39975	2.747	1.198	127.893	53.562	569	47.158	265	288.419	38.131
Central Serbia 144	4.933.536	54.558	1.644	8.392	277.581	225.266	6.230	93.200	1.760	319.949	62.473
Total 229	7.904.006	94.533	4.391	9.590	405.474	278.828	6.799	140.358	2.025	608.368	100.604

**Table 16.** *Summary according to the type of game*

	Vojvodina	Central Serbia (without counties)	Ratio optimal/real
Optimal roe breeding stock	57.910	97.260	100 %
Optimal use	15 %	15 %	100 %
Primary <b>roe</b> fond	39.975	54.558	55,9 %
Bag	2.747	1.644	17,3 %
%	<b>6,9</b>	<b>3,0</b>	
Optimal wild hog breeding stock	5.000	20.000	100 %
Optimal use	40 %	40 %	100 %
Primary <b>wild hog</b> fond	1.198	8.392	27,4 %
Bag	265	1.760	14,5 %
%	<b>22,1</b>	<b>21,0</b>	
Optimal rabbit breeding stock	323.600	378.800	100 %
Optimal use	25 %	25 %	100 %
Primary <b>rabbit</b> breeding	288.419	319.949	78,6 %
Bag	38.131	62.473	52,0 %
%	<b>13,2</b>	<b>19,5</b>	
Optimal pheasant breeding stock	179.125	284.300	100 %
Optimal use	50%	50%	100 %
Primary <b>pheasant</b> fond	127.893	277.581	87,5 %
Bag	47.158	93.200	60,6 %
%	<b>36,9</b>	<b>33,6</b>	
Optimal gray partridge breeding stock	143.850	248.300	100 %
Optimal use	5 %	5 %	100 %
Primary <b>gray partridge</b> fond	53.562	225.266	59,4 %
Bag	569	6.230	30,0 %
%	<b>1,1</b>	<b>2,7</b>	

**Healing plants** Forests are the habitat of numerous healing plants of exceptional features, which are greatly valued in the European and world markets of pharmaceutical and cosmetics industries.

## **CRITERION 4. BIODIVERSITY**

**Typical, rare and endangered forest ecosystems.** The territory of Serbia is rich in endemic and relict associations considering the fact that 9% of the total flora of the country belongs to the endemic species 2% of which are local. Besides numerous weed, turf and water plant associations and especially a large number of endemic and sub endemic herbaceous fitocenosis. Edificators, subedificators and dominating species in these associations are relict and endemic. Endemic vegetation alliances and files<sup>1</sup> represent an exceptional quality. The largest number of higher endemic syntaxons and endemic associations appear in rock, turf and peat bog vegetation. Forest and shrub associations of endemic woody plants represent a special value. The greatest significance is attributed to spruce, whitebark pine, Balkan pine, Balkan maple, **polydominant** forest with *Acer intermedium* Pančić, *Corilus colurna* L., lilac osier-beds, etc.

**Protected areas.** There are significant activities in the field of international area protection (Ramsar Convention; Man and Biosphere; IBA areas; Transboundary area). Since Serbia is not an EU member, protected areas in Serbia are not included in EU protection mechanisms (EC Birds and Habitats directive). Certain international regulations and actions have gained importance in Serbia in recent years, so certain areas are included in different systems of international protection. Besides Ramsar convention, Serbia is included in UNESCO Man and Biosphere program, International Bird Habitats Protection (IBA), and through Park for Life Project Serbia is included into Transboundary areas protection program. Protected areas are regulated by a set of regulations: the Law on environment protection (2004), the Law on National Parks (1993), Book of Regulations on natural resources categorization (1992), Regulations on Registry Protected Nature Objects (1992), Regulations on ways of marking Protected Nature Objects (1992). The Bill on Nature Protection, which will contribute considerably to the nature protection quality, is in procedure. During last 25 years in Serbia there has been a significant increase in numbers of protected areas (for about 300%). The cumulative number of areas under protection in Serbia for a period from 1980 to 2005 is shown in Table 17.

Percentage of protected areas in Serbia is 6.59%, by 2010 protection of 3.41% is planned, and then the total protected area would be 10%, as is foreseen by the Regional plan of Republic of Serbia (1994).

The greatest part of protected areas belongs to Nature Parks. According to the IUCN Nature Parks belong to the V category; the protection degree of dominant category of protected areas in Serbia is very low. Having in mind a wide heterogeneousness in IUCN national parks categorization (II to V), a

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<sup>1</sup> 204 forest and border shrub associations are recognized in Serbia; they are divided in 36 alliances, 12 files and 6 grades. Since many authors did not take into consideration researches in other regions so there are a large number of different names for the same fitocenosis. Some subsections and facies, ecological and geographical subtypes have gained the rank of associations, new connections and sub connections have been established.

conclusion can be drawn that the protection level, then the significance attributed to the protected areas in Serbia is still very small. As it is stated in the National Regulations, national parks are grouped in the first category of natural resources of significant importance.

Taking into consideration the different categorizing levels in relation to the importance of certain areas, and bearing in mind the fact that Serbia as a part of Balkans represents an important diversity center of European and world scope, it is necessary to raise the protection level of especially valuable areas. Based on the concept of the new Law on Nature Protection, all protected areas will be classified according to the IUCN categorization which could lead to the change in structure and protection quality improvement.

**International protection programs.** Serbia joined Ramsar convention in 2002. 4 Ramsar areas have been declared on territory of Serbia spreading over approximately 21.000 ha in 2005. Golija Nature Park was included into the Golija – Studenica biosphere reservation list in 2001 within the UNESCO Man and Biosphere Project. Areas in Serbia protected by Ramsar convention and UNESCO Protection program still represent a small portion of the total number of protected areas. Based on IBA area criterion (Bird Life International) 35 bird habitats of international significance have been singled out.

**Table 17.** *Protected natural resources in Serbia (December 31, 2005.)*

Type of the protected natural resource	Serbia		Public Enterprise Srbijasume		Public Enterprise Vojvodinašuma	
	Number	Area/ha	Number	Area/ha	Number	Area/ha
National park	5	158 986.36	-	-		
Nature park	8	228 055.02	3	225 148.64	2	887.59
Regional nature park	10	24 200.29	4	11 561.64	1	4177.00
Amenity forest	20	273.00	1	19.65	1	4.71
Region of exceptional shapes	8	18 897.35	2	3 860.83	1	5369.90
Special nature reservations	6	73 428.00	1	115.72	5	70813.92
Nature reservations	84	3 791.00	42	2 143.86	7	198.56
Nature monuments	247	3 117.14	30	1 844.58	6	228.24
Memorial nature monuments	31	2 328.00	9	491.19		
Area around stationary cultural resources	14	1 926.00	5	769.24		
	433	515001.19	97	245954.35	23	81679.92

Within the framework of Support to protected transboundary areas – a part of the action plan Park for Life projects (IUCN, EUROPAC) nine areas have been singled out: Nature Park Suboticke sume, special nature reservations Selevenjska pustara and Zasavica, National Parks Fruska Gora, Djerdap, Tara and Sar –planina; Nature Park Stara Planina. 9 areas more have been nominated for biosphere reservations (Man and Biosphere UNESCO) as a part of initiative for declaring internationally significant

areas. Also, 5 areas have been suggested for the world culture and nature heritage UNESCO, 4 nominations are being prepared for another 4 Ramsar areas in Serbia.

**Condition of protected natural resources.** National Parks are classified into the first category of natural resources of exceptional significance.

According to the IUCN classification not all National Parks satisfy the IUCN criteria; in order to be classified National Parks Tara and Šarplanina partially meet these criteria (N.P. Tara 2 category; N.P. Šarplanina 2 category; N.P. Djerdap 4 category; N.P. Fruska Gora 5 category; N.P. Kopaonik 5 category). Dissatisfying conditions concerning protection and upgrading state of natural values, coordination and activity monitoring and performance have been stated; thus the implementation of all relevant monitoring parameters, controlling and development, cannot be carried out.

Protection and development programs contain protection criteria, preservation and upgrading of natural values through activities in National Parks. National Park public enterprises carry out National Park programs as company programs not as area programs. Part of the program task referring to the obligation of other area users is not being realized. This problem requires intersection solution and coordination starting from the users, then local community, state organs, scientific and professional institutions as well as funding. Certain authorizations in area managing, stopping of unauthorized actions and occurrences are not applied entirely. The occurrence of unauthorized building in areas of National Parks Kopaonik and Tara represents a particular problem. There is pronounced number of foreign investors wishing to build tourist centers with participation of local community in protected areas of National parks (e.g. on Zaovina Lake in N.P. Tara; building of a ski – center in area of Nature Park Stara Planina, etc.)

Monitoring has not been set up methodically; the analysis of the state of natural values has not been performed as well as the quality of environment, particularly regarding the state of biodiversities.

Based on the Acts (Law on environment protection), management plans were made (short term protection and development programs) for natural resources for which the Government passes the Act on protection. All protected natural resources have management plans and the percentage of execution directly depends on providing the funds.

The state of affairs in the management field: incomplete regulations (undefined concept of protected natural area management and concept of an administrator) undetermined conditions for entrusting business of natural resources protection; undeveloped system of integral natural resource management. The absence of financial support from the budget of the Republic and local governments to management plans, inability to access international funds; a unique information system is undeveloped and the

indicators for the biodiversity state monitoring are not prescribed; administrators are not organized according to the regulations or they do not have at their disposal trained staff; revision and categorization of natural resources is needed.

**Endangered and protected species.** Endangered species protection mechanisms are different on global, regional and national levels. Most species on the IUCN list of globally endangered species registered in Serbia are included in European protection mechanisms; it is necessary to include these species in national protection mechanisms. Having in mind the Balkans flora and fauna wealth, Serbia's responsibility in preservation is immense.

Due to the exceptional wealth in flora and fauna and a large number of endemic taxa, Balkan Peninsula represents one of the more important biodiversity centers in Europe. Based on the evaluation of endangerment on national and international level Serbia has, in pursuance of biodiversity preservation and upgrading, regulated the protection of rare and endangered species on national level. Although the large number of endangered species from the IUCN list registered in Serbia included European protection mechanisms (especially birds) it is necessary to continue the process of including globally endangered species in national protection mechanisms (foremost fish and mammals). Having in mind that territories of Balkans and Serbia are characterized by an extremely large wealth in invertebrates, through the understudy of this group, the scale of protection on a national level is inadequate.

Lists of endangered animal species differ on a global and national level. A large number of species treated as endangered by domestic experts (SRBIUCN), are not on the globally endangered fauna list. Bearing in mind the significance and specific Balkans and Serbia's flora and fauna it is necessary to enlarge the IUCN list with species which are endangered on these territories based on the judgment of the experts.

**Table 18.** *Total number of species in classes and number of endangered species according to IUCN and SRBIUCN*

	Number of species	IUCN	SRBIUCN
<b>Mammals</b>	100	11	8
<b>Birds</b>	345	11	117
<b>Reptiles</b>	24	3	13
<b>Amphibians</b>	23	0	14
<b>Fish</b>	100	12	12
<b>Insects*</b>	230	8	79

In order of biodiversities preservation and upgrading, a large number of animal species is protected by the Decree on Protection of Natural Rarities. Besides that, a number of species in the Decree is protected only in certain parts of the Serbian territory or is in the regime of permanent or periodical fence season. These protection mechanisms are not included in analysis, but their contribution to fauna preservation is considerable. The largest number of species from the list (mammals, birds, reptiles and

amphibians) is included in European protection status. Specified endangered fauna status in Serbia and EU members is mostly reflected in protection mechanisms of certain species on national and international level. Due to relatively good preservation of natural habitats in Serbia, a number of species from the EU25 protected species list, on this territory is not endangered and additionally protected. Having in mind the significance and remarkable flora and fauna in the Balkans and Serbia itself, it is necessary to coordinate national with European and global protection mechanisms<sup>1</sup>.

**Genofond preservation.** The presence of 122 kinds of fruit-trees sorted in 23 families and 38 genera is recognized foremost within natural forest ecosystems in Serbia. In autochthonous flora of Serbia are present progenitors of kinds of apple (*Malus silvestris*, *Malus florentina* and *Malus dasophyla*), pear (*Pirus communis*, *Pirus amygdaliformis*), and plums (*Prunus cerasifera*, *Prunus spinosa*), sweet cheery (*Prunus avium*), cheery (*Prunus fruticosa*), walnuts (*Juglans regia*), certain kinds of almonds (*Prunus amygdalis*), hazelnut (*Corylus avellana*), chestnuts (*Castanea sativa*), raspberry (*Rubus idaeus*), gooseberries (*Rubus glossularia*), red currants (*Ribes petraeum*, *Ribes moulitiflorum*), strawberries (*Fragaria vesca*, *Fragaria viridis*, *Fragaria moschata*), etc. It is supposed that the territory of Serbia is PRIMARY GENUS CENTER for most kinds of fruit which are grown today, pointing out to their great presence in natural, primarily in forest ecosystems. Based on the analysis of conditions in seed – production facilities in which were represented 73 types of trees 24 coniferous and 49 deciduous trees. 27 of the mentioned tree types are alien trees or decorative, so the number of autochthonous types in seed – production facilities is 46. A special problem in forest genofond preservation is felling down old trees hundreds of years of age. Unique trees or at least certain genotypes are irreversibly lost by removal of these trees within every kind of our forest flora. The seed – material of these trees contains genetic inscriptions and solutions to the survival in different and changing abiogenic and biogenic conditions. Whole micro habitats of the cenobionats are destroyed; without which the equilibrium of these ecosystems shaken and questioned (Jovanovic, S. 2001).

**The difference between indigenous and alien species.** The destruction and disappearance of certain species and habitats influences the reduction of genetic, species and ecosystem diversity on regional and global level. Causes are: complete destruction of natural habitats and replacement with secondary or completely artificial habitats unsuitable for survival of primary ecosystem indigenous species, natural ecosystem fragmentation, partial intervention leading to changes in structure and functions of ecosystems, excessive exploitation, and introduction of allochthonous types of flora and fauna, indirect or direct pollution of water, air and soil.

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<sup>1</sup> The data on taxa and endangerment categories have been obtained from referent institutions and experts. Data on national endangerment category (SRBIUCN) of certain animal groups are based on conditions up to 1995.

Introduction of allochthonous types of flora and fauna determines the changes in structure of autochthonous fauna, flora and ecosystem. The area under introduced and invasive types of trees is given in the table 19.

**Table 19. Introduced types of trees**

Category	Year	Habitats with dominant participation of introduced species (1000ha)	
		Total	Invasive ones
Forests	2005	1.6	0.0
	2000	1.3	0.0
	1990	2.0	0.0
Rest of forest land	2005	0,0	0.0
	2000	0.0	0,0
	1990	0.0	1.0
Forest and the other forest land total	2005	1.6	0.0
	2000	1.3	0.0
	1990	2.0	1.0

Introduced tree types include: *Pseutsuga taxifolia*, *Larix europea*, *Larix leptolepis*, *Cedrus atlantica*, *Pinus strobes*, *Pinus excelsa*, *Robinia pseudoacacia*, *Ailantus glandulosa*, *Amorpha fruticosa*, *Ulmus pumula*, *Populus euroamericana* (different clones). Invasive tree types include: *Robonia pseudoacacia*, *Ailantus glandulosa*, *Amorpha fruticosa*.

**Ratio between annually naturally renewable areas and total area.** Significant reduction in areas in 2005 in comparison with the state in 1990 and 2000 was reported in all types of renewal (natural renewal, natural renewal complimented by planting, renewal by planting and/ or seeding) (Table 20). The renewal l of coppice stands by resurrection felling is a method which is used in Serbia only in the cultures of black locust.

**Table 20. Renewal of forest land**

Category	Year	1000 ha			
		Natural renewal	Natural renewal complimented by planting	Renewal by planting and/ or seeding	Renewal of coppice forests by resurrection felling
Forest: Stands of the same age	2005	216,0	190,0	165,0	0,0
	2000	263,0	232,0	201,0	0,0
	1990	352,0	310,0	269,0	0,0
Forests: Stands of different age	2005	0,0	0,0	0,0	0,0
	2000	0,0	0,0	0,0	0,0
	1990	0,0	0,0	0,0	0,0
Other forest land	2005	0,0	0,0	0,0	0,0
	2000	0,0	0,0	0,0	0,0
	1990	0,0	0,0	0,0	0,0

Category	Year	1000 ha			
		Natural renewal	Natural renewal complemented by planting	Renewal by planting and/or seeding	Renewal of coppice forests by resurrection felling
Forest and other forest land-total	2005	216,0	190,0	165,0	0,0
	2000	263,0	232,0	201,0	0,0
	1990	352,0	310,0	269,0	0,0
<b>Forest and other forest land</b>					
<b>Conifer</b>	2005	76,0	51,0	114,0	0,0
<b>Decidious</b>	2005	140,0	139,0	51,0	0,0
<b>Mixed</b>	2005	0,0	0,0	0,0	0,0

### **CRITERION 5. PROTECTIVE FUNCTIONS IN FOREST MANAGEMENT (WITH EMPHASIS ON LAND AND WATER)**

There are readily available data for the forests at the different levels of protection (shown in Table 21) for 2005.

**Table 21. Protected areas**

Category	Year	MCPFE	MCPFE	MCPFE	MCPFE
		Class1.1	Class1.2	Class1.3	Class 2
		(1000 ha)			
Forest and forest land-total	2005	6,9	182,0	196,0	53,0
	2000	0,0	0,0	0,0	0,0

The land covered by forests include the following areas:

Class 1.1 – I zone of protection in national parks and strict nature reservations

Class 1.2 – II zone of protection in national parks and biospheric reservations

Class 1.3 – Nature parks

Class 2 – Protected areas (culture, ethnics, spiritual and historical)

**Protective forests-land, waters and other functions of ecosystems.** The areas under the protective forests which protect the land, waters and other functions of ecosystems include the following entities intended for special purposes: water protection - water supplying protection of the I degree (**code 19**); water protection - water supplying protection of the II degree (**code 20**), waterprotection forests of I degree (**code 21**), waterprotection forest of II degree (**code 22**), land protection of I degree (**code 26**), landprotection of II degree (**code 27**), climate protection (**code 31**), permanently protective forests (not included in ownership treatment) (**code 66**).

**Land erosion:**

land protection of I degree – <b>code 26</b>	130854.86 ha
landprotection of II degree – <b>code 27</b>	243.67 ha

It is estimated that 86% of the total area of Serbia is endangered by the water erosion of different intensity, and 72.29% in Vojvodina (Lazarević, P., 1983). The permanent land loss in Serbia is estimated at 3.117 ha with 0,3 metre diameter per annum. Torrent water is a consequence of the erosion processes. There are 12.424 torrent waters in Serbia (Vančetović, Ž., 1966) and they are all located in the hilly-mountainous area. The most severe forms of erosion falling into the I-III category are to be met in these regions, and account for 2.390.121 ha of the Serbian territory.

**Water protection in forests** Quantitative indicator: The percentage of forests with primary protection of water:

water protection – water supplying protection of the I degree – <b>code 19</b>	6494.42
water protection – water supplying protection of the II degree – <b>code 20</b>	3582.25
waterprotection forest of I degree – <b>code 21</b>	3412.86
waterprotection forest of II degree – <b>code 22</b>	279.84

**Table 22.** *Protective forests-land, waters and other functions of ecosystems*

Category	Year	land, waters and other functions of ecosystems
		Subclass MCPFE of Class 3
		(1000 ha)
Forests	2005	162.0
	2000	162.0
Forest land	2005	17.0
	2000	17.0
Forests and forest land – total	2005	179,0
	2000	179,0

**Other functions of ecosystems:**

climate protection-code 31	6494.42
permanently protective forests (not included in ownership treatment) – <b>code 66</b>	3582.25

**Negative habitat influences on forests and forest ecosystems.** The changes of the natural regime of waterflow as a consequence of the hydroenergetic system Đerpap caused the deterioration of the survival conditions, growing, use and renewal of the existing forests and forest cultures in the domain of influence which is felt as far as Novi Sad, and to the territory of Sremska Mitrovica on the Sava River. These changes resulted in the permanent melting of the lower parts of terrain in the lower part of accumulation, as well as to longterm flooding of the lower parts of

microrelief and extended the flooding in the higher parts of microrelief. All these had influenced the forest decay and desiccation, which resulted in the loss of huge areas for forest trees growing. In the existing poplar establishments the increment reduced to a great extent, and numerous poplar habitats have turned into the willow habitats, and the willow habitats are permanently lost for production. In Srem the building of wells for supplying of habitats resulted in the abrupt lowering of ground water levels, which prompted the physiological weakening, decay and desiccation of the lower forests of oak, ash, hornbeam and elms.

## **CRITERION 6. SOCIO-ECONOMIC FUNCTIONS AND CONDITIONS**

**The importance of forestry sector.** Forestry is a sector which has been neglected and inadequately treated by the economic policymakers for a long time. This approach is the result of the modest participation of forestry in GNP. The participation of forestry in GNP is extremely small and ranges from 0.34 to 0.57%. The result of these trends is the lack of money needed for investment in the biological reproduction of forests. The regime of the administrative control were for decades the guiding principle for the prices of the products. As a result, the prices of the most timber assortments are 2-4 lower than these on the world market, which greatly influenced the scope of forestry participation in GNI.

**Energy derived from timber.** The major coal deposits are located in Kolubarski, Kostolački and Kosovo-Metohijski Basins. There are estimated 16 billion tons of coal without taking into account reserves in KIM, which will suffice for 55 years of exploitations, if the current trend of use continues. In Serbia 14% of households use regional heating, 33 % use electricity for that purpose, 39% use coal, 7% use fuelwood and 7% natural gas.

**Recreation** Quantitative indicator: maintenance of the recreational function: forest area per inhabitant, percent of total forest land (Table 23).

**Table 23.** *Use of forests for recreational purposes*

Category	Year	Area which are legally approved for use		Area with capacity for using for recreational purposes		Use of areas for recreation as a primary purpose	
		total (1000 ha)	% of total	total (1000 ha)	% of total	total (1000 ha)	% of total
Forests	2005	1815.3	100.0	1815.3	100.0	5.0	0.3
	2000	1822.0	100.0	1822.0	100.0	5.0	0.3
Other forest land	2005	187.8	100.0	187.8	100.0	0.0	0.0
	2000	162.0	100.0	162.0	100.0	0.0	0.0
Forests and forest land-Total	2005	2003.1	100.0	2003.1	100.0	5.0	0.3
	2000	1984.0	100.0	1984.0	100.0	5.0	0.3

**Employment.** The number of employees in forestry has decreased in the last few years owing to the rationalisation and reorganization of the forest organizations. At the end of 2005 there were 4.383 employees in forestry sector in Serbia - 1.857 of which worked in the sector of forest establishment and growing, and 2.526 worked in the domain of exploitation (Table 24).

**Table 24. Employees in forestry**

Year	Total	Forestry	Forest establishment and growing	Forest exploitation	Other actions
2005.	6196	4383	1857	2526	1813
2000.	7960	6585	2356	4229	1375

**Cultural and spiritual heritage.** The number of some cultural heritage in 2005 is shown in the Table 25.

**Table 25. Cultural and spiritual heritage**

Year	The type of cultural and spiritual heritage					
	Archeological sites	Monuments of nature			Historical sites	Other areas with recognizes cultural and historical heritage
		Afforestation landscape	Trees	Other similar forests		
(number)						
2005	2	0	130	84	40	24

By assuming international responsibilities the Republic of Serbia has committed to preservation and improvement of the existent biological diversity, and sustainable use and forest management. In the past forest management planning practice norms and standards were not checked and compared with the criteria and indicators for sustainable forest management. The aim of this project is the comparison between the current planning forest management norms and standards and the criteria and indicators for sustainable forest management and the possibility of applying them in forest management planning. The norms and standards used directly in planning forest management theory and practice in Serbia should be given a detailed description and evaluation, in reference to the Pan – European Criteria and indicators for sustainable forest management. The evaluation of the complementarity, compatibility, and conflicts of existing norms and standards was done against the criteria and indicators for sustainable forest management and the level of quality of the available pieces of information according to MCPFE indicators.

## CONCLUSION

Ecosystems are large, complex and highly variable in time and space. Ecosystems are bringing elements of risk and uncertainty to decisions on forest management and policy, because complete knowledge of ecosystems and their response to management will never exist. Current forest policy gives priority to environmental, sociopolitical and economic values. Indicators are the tools that can be used to conceptualize, evaluate and implement multiple-value systems in sustainable forest management. The use of a proper set of indicators enables evaluation of performance and assists in understanding what sustainable forest management means.

The discord of the official data obtained from the different state institutions in Serbia was reported, as well as the insufficient readily available data on private-owned forests. It requires the strengthening of the forest sector aimed at condition monitoring and changes of the indicators of the sustainable use of forests and forest ecosystems. The realization of sustainability, however, will remain an ongoing dynamic process.

## REFERENCES

1. Blaženić, J., Cvijan, M., Laušević, R. (1995): Diverzitet slatkovodnih algi Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
2. Hunting association of Serbia (2005): Average weight and price of game, [www.ecolss.com](http://www.ecolss.com), Hunting association of Serbia, Belgrade
3. Institute of forestry, (2000): Christmas trees in 2000, Documentation, Institute of forestry, Belgrade
4. Institute of forestry, (2005): Christmas trees in 2005, Documentation, Institute of forestry, Belgrade
5. Institute of forestry (2005): Forest Condition Monitoring in the Republic of Serbia, Annual report ICP Forests 2004, 2005 (Level I), Ministry of forestry, agriculture and water management – Directorate for forestry, Belgrade
6. Institute of natura protection (2005): Register for protection of natural goals in Serbia, Documentation, Institute of natura protection, Belgrade
7. Ivančević, B. (1995): Diverzitet makromiceta u Jugoslaviji sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
8. Janković, D., Krpo-Četković, J. (1995): Diverzitet slatkovodnih riba (Osteichthyes) I kolousta (Cephalaspidomorpha) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
9. Jakovčev, D., Kalafatić, V., Martinović-Vitanović, V. (1995): Diverzitet oligoheta (Oligochaeta) kopnenih voda Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.

10. Jovanović, J. B. (1995): Diverzitet puževa (Gastropoda, Mollusca) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
11. Kalafatić, V. (1995): Diverzitet Rotatoria kopnenih voda Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
12. Kalafatić, V. (1995): Diverzitet Cladocera I Copepoda (Crustacea) kopnenih voda Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
13. Karaman, S., Stojanović, M. (1995): Diverzitet faune kišne gliste (Lumbricina; Oligochaeta; Annelida) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
14. Karaman, G. (1995): Diverzitet Amphipoda (Crustacea) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
15. Karaman, I. (1995): Diverzitet kmosaca (Opiliones, Arachnida) Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
16. Krnjajić, S., Krnjajić, Đ. (1995): Diverzitet kopnenih valjkastih crva (Nematodes) u Jugoslaviji, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
17. Ministry of science and environmental protection (2005): Contingents of plants and animals species which can be collected in 2005, Gazette No 36, Republik of Serbia
18. Milutinović, M. (1995): Diverzitet krpelja (Acari: Ixodidae, Argasidae) u Jugoslaviji, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
19. National parks Tara, (2005): General management plans for forestry in National park Tara, Documentation, Bajina Basta
20. National parks Kopaonik, (2005): General management plans for forestry in National park Kopaonik, Documentation, Kopaonik
21. National parks Djerdap, (2005): General management plans for forestry in National park Djerdap, Documentation, Donji Milanovac
22. National parks Fruska gora, (2005): General management plans for forestry in National park Fruska gora, Documentation, Karlovac
23. Petrov, B. (1995): Diverzitet Anostraca, Notostraca I Conchostraca Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
24. Petanović, R., Stojnić, B. (1995): Diverzitet fitofagnih I predatorskih grinja (Eriophyoides, Tetranychidae I Phytoseiidae, Acari) Jugoslavije, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
25. Public Enterprise "Srbijasume" (2005): Data for Forestry in Srbijasume, Documentation, Belgrade
26. Public Enterprise "Srbijasume" (2005): General management plans for forestry districts in Serbia, Documentation, Belgrade
27. Public Enterprise "Srbijasume" (2005): Data for General management plans for forestry districts in Serbia, Documentation, Belgrade
28. Public Enterprise "Vojvodinasume" (2005): Data for Forestry in Vojvodinasume, Documentation, Novi Sad

29. Public Enterprise "Vojvodinasume" (2005): General management plans for forestry districts in Vojvodinasume, Documentation, Novi Sad
30. Public Enterprise "Vojvodinasume" (2005): Data for General management plans for forestry districts in Vojvodinasume, Documentation, Novi Sad
31. Publik Enterprise "Srbijasume" (2005): Price-list of roundwood, www.srbijasume.co.yu, Belgrade
32. Puzović, S., Simić, D., Saveljić, D., Gergelj, J., Tucakov, M., Stojnić, N., Hulo, I., Ham, I., Vizi, O., Šćiban, M., Ružić, M., Vučanović, M. & Jovanović, T. (2003): Birds of Serbia and Montenegro – sizes of nesting populations and trends: 1990-2002.
33. Radović, I., Mesaroš, G., Pavićević, D., Mihajlović, Lj., Protić, Lj., Četković, A. (1995): Diverzitet entemofaune (Insecta) Jugoslavije, sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
34. Ratknic, M. (2002): Forestry sector in Yugoslavia, Documentation, Belgrade
35. Ratknic, M., Tokovic, Z. (2001): Condition, problems and management in private forests (book of methods), Ministry agriculture, forestry and water management, Belgrade
36. Report (2005): Carbon stock in forestry ecosystems in Serbia, Ministry for agriculture, forestry and wathermanagemant, Belgrade
37. Savić, S. (1995): Diverzitet lišajeva (Lichnes) Jugoslavije sa pogledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
38. Savić, I., Paunović, M., Milenković, M., Stamenković, S. (1995): Diverzitet faune sisara (Mammalia) Jugoslavije, sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
39. Statistical bulletin (1992): Forestry 1991, No 1961, Federal statistical office of the Yugoslavia, Belgrade
40. Statistical bulletin (2002): Forestry 2000, No 2326, Federal statistical office of the Yugoslavia, Belgrade
41. Statistical bulletin (2006): Forestry 2005, No 459, Statistical office of the Republic of Serbia, Belgrade
42. Statistical Document (2006): Energetic balance of accounts for electric and warmth energy, No 53, Statistical office of the Republic of Serbia, Belgrad
43. Stevanović, V., Pavić, S., Stevanović, B. (1995): Diverzitet flore mahovine (Bryophyta) jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
44. Stevanović, V., Jovanović, S., Lakušić, D., Niketić, M. (1995): Diverzitet vaskularne flore Jugoslavije sa pogledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
45. Čurčić, B. (1995): Poreklo I diverzifikacija fauna pseudoškorpija iz dinarskog i kapratsko-balkanskog krša (Srbija i Crna Gora), sa pregledom taksona od globalnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
46. Džukić, G. (1995): Diverzitet vodozemaca (Amphibia) i gmizavaca (Reptilia) Jugoslavije, sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet u Beogradu, Beograd.
47. Vasić, M. (1995): Diverzitet ptica Jugoslavije sa pregledom vrsta od međunarodnog značaja, Biodiverzitet Jugoslavije, Biološki fakultet, Beograd.