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BIODIVERSITY INDICATORS



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REPUBLIC OF SERBIA
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BIODIVERSITY INDICATORS
IN THE REPUBLIC OF SERBIA FOR 2015

BELGRADE, 2016

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NATURAL AND BIOLOGICAL DIVERSITY

1. PROTECTED AREAS (R)

Key points

- In the course of 2015, revision of all National Parks surface was made.
- Around 6.5 % of the territory of the Republic of Serbia is under protection, with cumulative area of 578,500 ha.

The indicator shows the total surface of protected areas and the percentage of the territory under protection from the total surface of the Republic of Serbia.

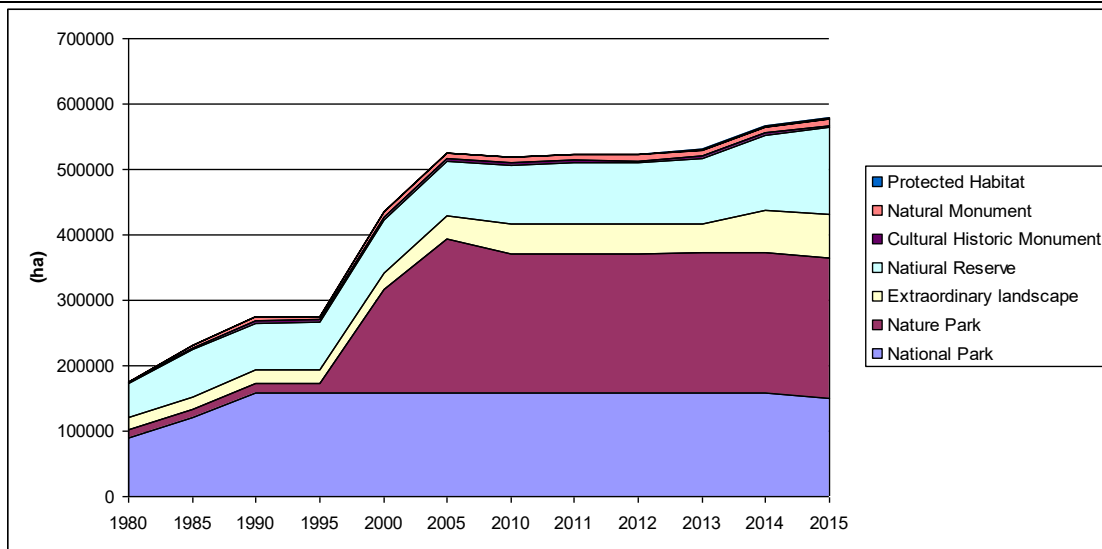


Figure 1. Cummulative surface of protected areas in the Republic of Serbia

Total surface of protected natural resources is around 578,500 ha, which makes around 6.5 % of the territory of the Republic of Serbia. Another 230 point objects, mostly trunks, are protected by the State. ([Figure 1](#))

During 2015, have been protected Special Nature Reserves “Pestersko polje”, “Suva planina” and Strict Nature Reserves “Iznad Tatalije”, “Zelenika”, “Tesne jaruge” with total surface of 31,239 ha, Extraordinary landscapes “Karas Nera” and “Tatkova zemunica” with total surface of 1,903 ha, Natural Monuments “Stabla Cacka”, “Topciderski park”, “Sumati sumar|”, “Lalinacka slatina”, “Tri stable crnog bora –Dobroselica”, “Bajfordova suma” and “Divlji kesten u Sremskim Karlovcima” with total surface of about 70 ha, and Nature Park “Tikvara” with surface of 555 ha.

Revision of all five National Parks surface was made according to changes in the Law of National Parks (“Official Gazette RS”, No. 84/15). Area of National Park “Tara” was increased for about 5,000 ha and National Park “Fruska Gora” for about 1,000 ha. Area of National Park “Sar planina” was decreased for about 17,000 ha. Area of eight more protected sites was changed. Because of all these revisions of sites areas, increase of cumulative protected area was only about 7,000 ha, in 2015.

The spatial plan of the Republic of Serbia („Official Gazette of RS”, No. 88/10), envisages that by the year 2015 around 10 % of the Serbian surface would be protected, and that by the year 2021 around 12 % of the territory of the Republic of Serbia would be under a form of protection.

Data source: Institute for Nature Conservation of Serbia, Institute for Nature Conservation of Vojvodina Province

2.ECOLOGICAL NETWORKS (R)

Key points

- An Ecological Network was established in the territory of the Republic of Serbia.
- A Pilot Project for NATURA 2000 was launched.

The Indicator outlines the surface and percentage of the territory of the ecological network under protection out of the total surface of the Republic of Serbia.



Figure 2. EMERALD sites in the Republic of Serbia

At the moment the Ecological Network of Serbia comprises 101 ecologically relevant areas. The Ecological Network includes EMERALD sites, Ramsar Convention protected areas, important plant areas (61 areas), important bird areas (42 areas) and important butterfly areas (40).

According to the criteria of the Convention on the Conservation of Wild Flora and Fauna and Natural Habitats, a list of the potential EMERALD areas was prepared, encompassing 61 sites.

The total surface of all these areas is 1,019,269 ha, which makes 11.54 % of the territory of the Republic of Serbia. The Regulation on the Ecological Network ([Figure 2](#)) („Official Gazette of RS” 102/10) provides detailed criteria of the operation of the ecological network.

NATURA 2000 provides a baseline for environmental protection and biodiversity policy of the European Union. Precisely, it is the EU network of protection areas, established in accordance with the 1979 **Bird Directive** and 1992 **Habitat Directive**.

NATURA 2000 is not a system of strict reserves where human activities are forbidden. Naturally, NATURA 2000 includes areas with a strict protection regime, but a large part of the network remains private ownership, where it is extremely important to ensure sustainable management of these areas, both in terms of the environment and economy.

Data source: Institute for Nature Conservation of Serbia, Institute for Nature Conservation of Vojvodina Province

3. ENDANGERED AND PROTECTED SPECIES (P-R)

Key points

- In the course of 2015 the following books were published: The Red Book of Amphibians and the Red book of Reptiles of Serbia.
- In the territory of the Republic of Serbia 2,628 species are protected, out of which 1,760 are strictly protected.

The Indicator provides the number of endangered and protected species in the territory of the Republic of Serbia.

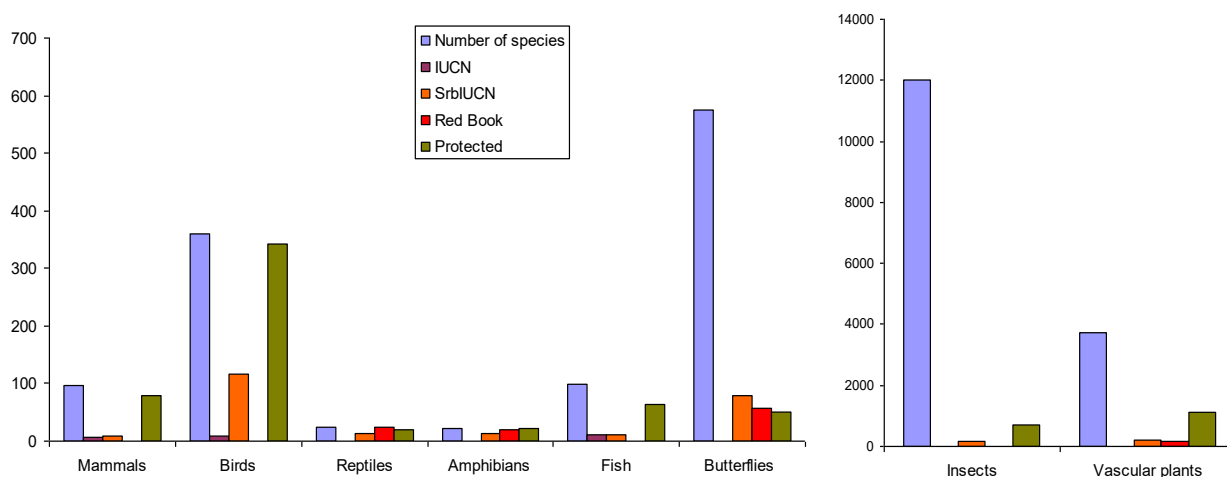


Figure 3. Endangered and protected species in Serbia

So far in the Republic of Serbia have been published:

Red Books of Plants 1- extinct and endangered species (1990);

Red Book of Daily Butterflies (2003);

Red Book of Amphibians (2015);

Red Book of Reptiles (2015).

It is estimated that around 1000 vascular flora species are endangered, according to the Preliminary Red List of Serbian Flora (2002). Most endangered plant species belong to the IUCN category of „rare species”.

In the course of 2010 the Rulebook on Declaration and Protection of Strictly Protected and Protected Species of Wild Plants, Animals and Mushrooms („Official Gazette of RS”, No. 5/10) was passed. According to the new Rulebook, 1.760 species are under strict protection and 868 species are under protection. Almost all mammals, birds, amphibians and reptiles are under a protection regime. Also, a number of insects (especially day butterflies) and plants is under protection.

Over 50% of strictly protected species are on the lists of international EU Conventions and Directives, mostly on the Berne and Bonn Convention lists and the Bird Convention list ([Figure 3](#)).

Data source: Institute for Nature Conservation of Serbia, Institute for Nature Conservation of Vojvodina Province

4.SPECIES DIVERSITY (BIRD POPULATION TREND)-(S)

Key points

- In the period of 2000 - 2012 forest birds populations became more stable and numerous in comparison with the previous period.
- Meadow bird populations were mostly stable and slightly decreased in numbers.

The Indicator shows the population trends of selected birds from forest and meadow habitats.

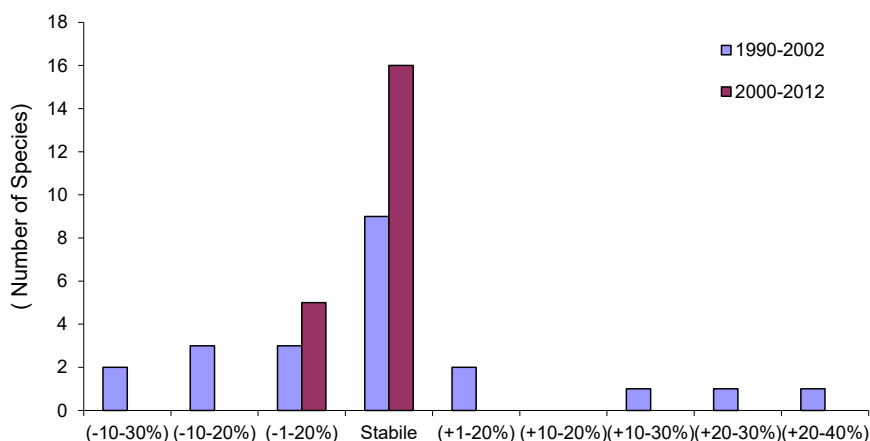


Figure 4. Meadow bird population trend (23 species)

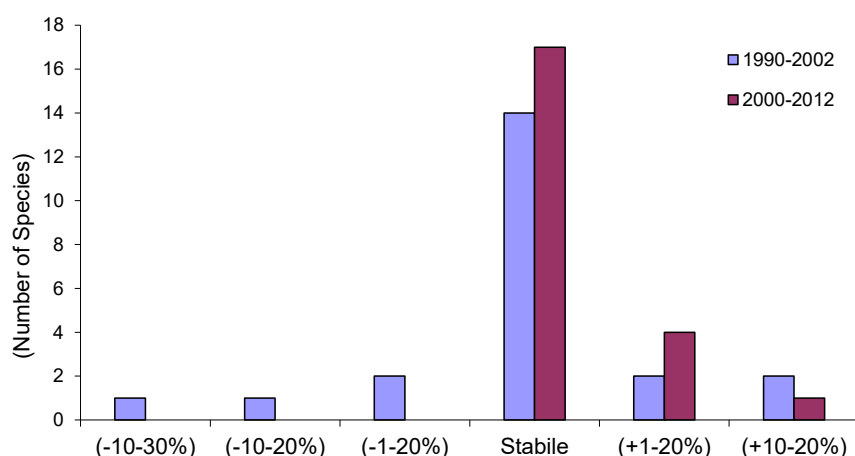


Figure 5. Forest bird population trend (23 species)

On the basis of bird monitoring in 2000-2012, most bird species from meadow habitats (16 species) had stable population growth. A slight population decline was reported in 5 meadow bird species. In comparison with 1990-2002, when 9 species had a stable growth, in 2000-2012 sixteen meadow habitat bird species had a stable growth. Eight species had a population decline in 1990-2002, while in 2000-2012 only 5 species had a population decline. ([Figure 4](#))

In 2000-2012 forest habitat bird populations were more stable and numerous. In comparison with 1990-2002, when 14 forest bird populations had a stable growth rate, in 2000-2012, seventeen bird species had a stable population growth, population growth rate of 4 species increased slightly and growth rate of one species increased considerably. There were no species that were reduced in numbers. ([Figure 5](#))

Data source: Institute for Nature Conservation of Serbia, Bird Protection and Study Society of Serbia

4.1.GRIFFON VULTURE

Key points

- The population increased 10 times in the last 20 years.

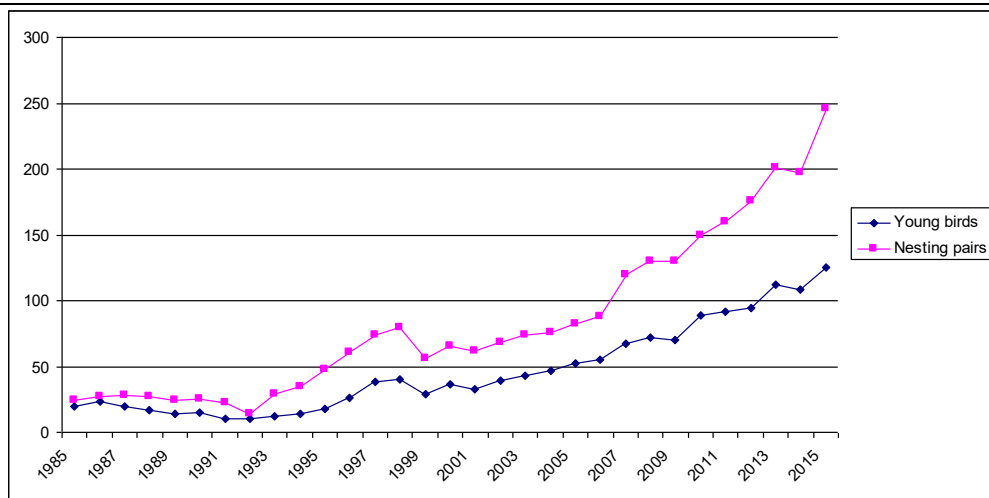


Figure 6. Population growth of the griffon vulture in the Republic of Serbia

Griffon vulture (*Gyps fulvus* Hablizl 1883) is a species that is not capable of piercing the skin of dead herbivores with its beak. Its head and long beak are covered with white fluff. Griffon vulture weighs around 8.5 kg and its wingspan can reach 2.8 m. Griffon vulture nests on the rocks, forming colonies of different size. Griffon vulture was a common species in the Republic of Serbia until 50ies of the last century, which nested in the canyons and in the mountains around the Pannonian basin. The populations decreased in the entire Balkan peninsula.

In comparison with 1991 and 1992, the number of nesting couples and their young in the canyons of Uvac, Tresnjice and Milesevka increased more than ten times. Permanent protection and improvement resulted in the population growth to 500 birds. 246 nesting couples and 125 young were recorded. (Figure 6)

Moreover, according to the Institute for Nature Conservation data, of the 18 selected birds of prey species from the ordo of hawks (*Accipitiformes*) from forested and combined forested-grassland habitats, about 10 species have had slight, average and high increase of populations.



The canyon of Uvac and Tresnjice were the most important sites for the return of the griffon vulture to the Balkans. Today two concurrent projects of reintroduction of the griffon vulture in Herzegovina and in two sites in Stara Planina being are implemented: one near Pirot (Republic of Serbia), and another on Kotel (Bulgaria).

Data source: Biological Research Institute „Sinisa Stankovic”

5.DIVERSITY OF SPECIES (BUTTERFLY POPULATION TREND)-(S)

Key points

- The Ministry of Agriculture and Environmental Protection financed the project „Enlargement of the Butterfly Accounting Network in Serbia”.
- Based on butterfly population growth monitoring in the period of 1990-2002, only 5 butterfly species (10%) from forest habitats increased in numbers.

The indicator shows the trend of population growth for selected butterfly species from forest and meadow habitats.

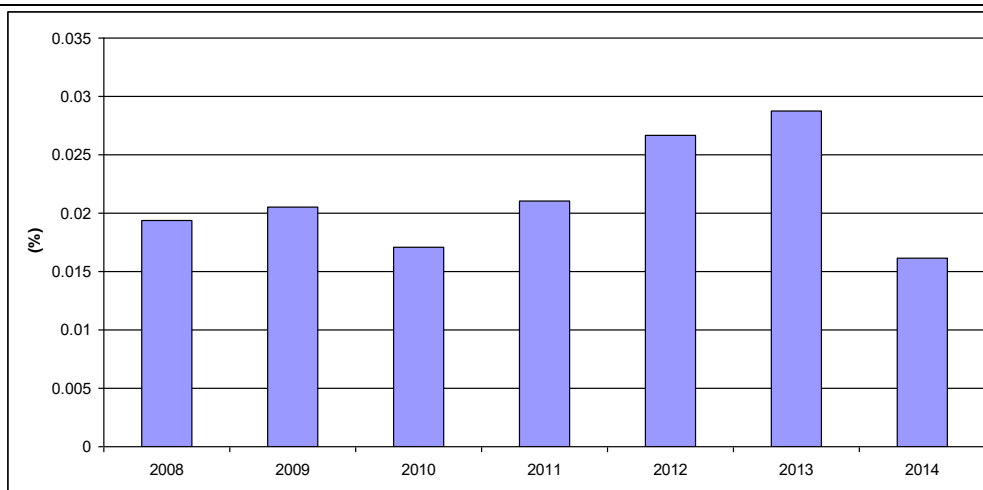


Figure 7. Percentage of scarce swallowtails in the total number of registered butterflies

Monitoring of the growth rate of butterfly populations in the period of 1990-2002 showed an increase in numbers in only 5 forest butterfly species (10 %). Changes in habitat surfaces do not show a clear link between the modified surfaces and population growth trend. Namely, forest habitats showed an extraordinary stability and a trend of surface increase in the second half of last century. On the other hand, only 3 species of meadow butterflies showed an increasing population growth rate. Most species have a stable population growth rate.

The Ministry of Agriculture and Environmental Protection financed a project „Enlargement of the Butterfly Accounting Network in Serbia”. Starting from December 2014 there is a website that serves as the user interface of the Alciphron database (<http://www.habiprot.org.rs/Alciphron>). The site was intended for butterfly data collection. The simplest way to explain how the site works is to use the example of the scarce swallowtail, a widespread but not the most common butterfly species.

Such a database can be very useful for protection of species and areas, as almost all data is georeferenced. Although it does not contain explicit information on the population growth rate, some information can be obtained indirectly. For instance, the frequency of findings related to the scarce shallowtail species as opposed to the total number of registered data indirectly points at the large population of this species. In the course of 2014 the number of reported findings decreased, which can be explained by adverse weather phenomena (an extremely rainy summer) that did not suit either the butterflies or the observers (Figure 7) and (Figure 8).

With further development of the monitoring network, more precise data on the trend of butterfly population growth will be provided.

Data source: Institute for Nature Conservation of Serbia, HABIPROT

<http://www.habiprot.org.rs/Alciphron>

440667	<i>Iphiclides podalirius</i>
Srpski naziv	Prugasti jedrilac
Familija	Papilionidae
Grupa	Dnevni leptiri



M. Popović

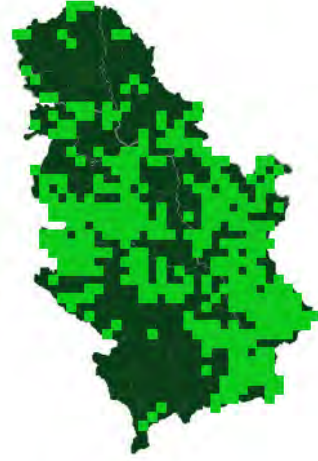


Figure 8. Photo, systematic and area of distribution of scarce swallowtails

6.DEAD WOOD (S-R)

Key points

- The total concentration of dead wood in our forests is 7.22 m³/ha.
- The average is 2-3 m³/ha.

The quantity of dead wood in the forests is a very important indicator of the state of forests and the ratio should be in accordance with sustainable forest management.

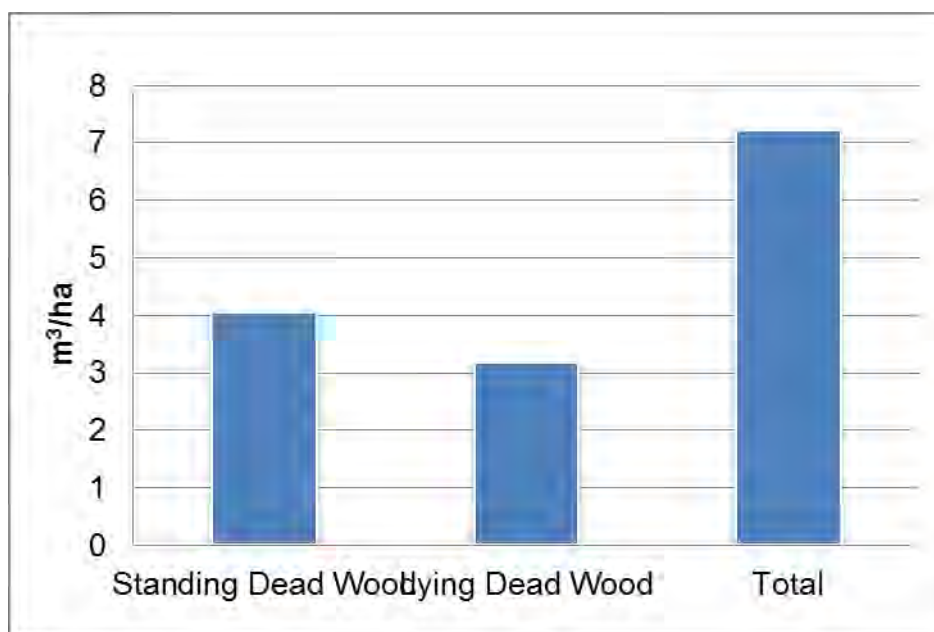


Figure 9. Dead wood in the forests of the Republic of Serbia

According to the data of the Forest Inventory, the total volume of dead wood in the forests of the Republic of Serbia is 16,260,414 m³. Average standing dead wood volume is 4.05 m³/ha, and lying dead woods volume is 3.17 m³/ha, in other words the total concentration of dead wood in our forests is 7.22 m³/ha, in central Serbia it is 7.18 m³/ha, and in Vojvodina 7.75 m³/ha, which is considerably above the norm of 2-3 m³/ha. ([Figure 9](#))

This quantity of dead wood ensures the continuity and sustainability of habitats (biotopes), especially for ornithofauna and entomofauna that live in our forests and whose habitat is sometimes limited to small parts of dead wood of specific type. At the same time, dumping of a part of yield in the forest is a significant renewable resource in the context of conservation of the production potential of the entire habitat.

Data source: Forest Inventory in the Republic of Serbia, Forest Directorate

FORESTRY, HUNTING AND FISHING

7. FOREST AREA (S)

Key points:

- Forested area in the Republic of Serbia is 31.956 km².
- Forested area was increased for about 100 % in comparison with the year 1953.

The Indicator monitors the forest surface, according to the classes of deciduous, conifer and mixed forests, together with the percentage of forested territory out of the entire surface of the Republic of Serbia.



Based on SPOT5 10-m resolution satellite shots 2010/2011 the forested surface was 31.956 km², which makes up around 36 % of the territory of the Republic of Serbia. (Figure 10)

The surface of deciduous forests was 29.442 km², the surface of conifer forests 1.965 km², and the surface of mixed forests was 549 km².

Figure 10. Forests in the Republic of Serbia as recorded by SPOT5 satellite images in 2010/2011

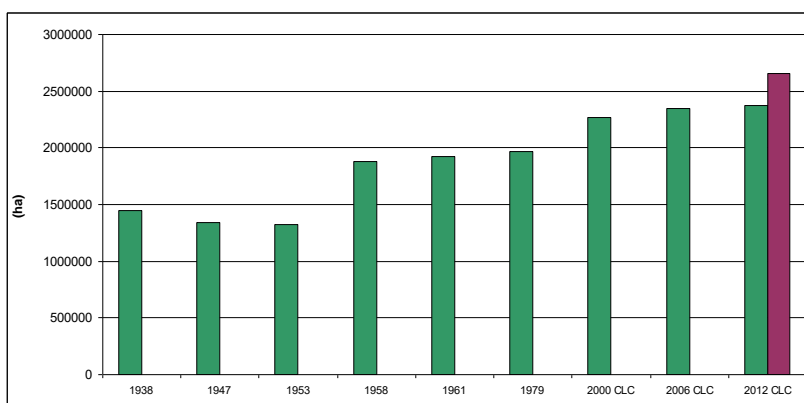


Figure 11. Trend of change of forested area in the territory of the Republic of Serbia (without the territory of Kosovo and Metohija)

According to the data of CORINE Land Cover for 2012, the forested area in the Republic of Serbia (without the territory of the AP of Kosovo and Metohija) was 2.373.740 ha, which makes up 30% of the territory. For the period of 1953 - 2012 forested surface increased by over 1,200,000 hectares, which is about 100 % increase in comparison with 1953. (Figure 11)

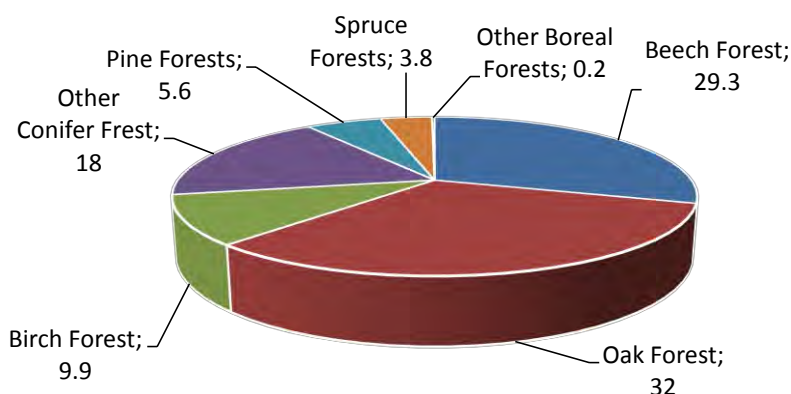
Data source: Republic Geodetic Authority, Environmental Protection Agency

8. TYPES OF FORESTS (S)

Key points:

- In the Republic of Serbia boreal forests are the most prevalent, occupying 2,068,418 ha or 91.27% of the forests.
- The most common are oak (32 %) and beech forests (29.3 %).

The indicator shows the percentage of each forest type in the total surface covered by forests.



In the Republic of Serbia boreal forests are the most common with 2,068,418 ha or 91.27 % of the total forests (29.66 % of the country territory), followed by mixed forests with 116,118 ha or 5.12 % of the total forests (1.5 % of the territory) and conifer forests with 81,797 ha or 3.61% of the forests (1.05% of the territory).

In Central Serbia deciduous forests take up 34.35% of the territory (91.04% of the forests), conifer forests have a share of 1.97 % (3.73 % of the forests) and mixed forests occupy 1.4% of the territory (5.23 % of forests). In Vojvodina, deciduous forests take up 6.26 % of the territory (94.72 % of the forests), conifer forests occupy 0.23% (1.82% of the forests) and mixed forests 0.12% (3.46 % of the forests).

Oak forests and beech forests are the most frequent (32% and 29.3% respectively). Out of all conifer forests, pine-tree forests are the most prevalent (5.6 %), along with spruce forests (3.8 %). ([Figure 12](#))

Data source: Forest Inventory, Forest Directorate

8. FOREST SPECIES (S)

Key points:

- During the inventory of species in 19th and 20th century, 68 tree species were registered.
- In the forests of the Republic of Serbia there are around 2,115,000,000 trunks with average density of cca 940 trunks per hectare.

The Indicator shows the number of trunks.

number of

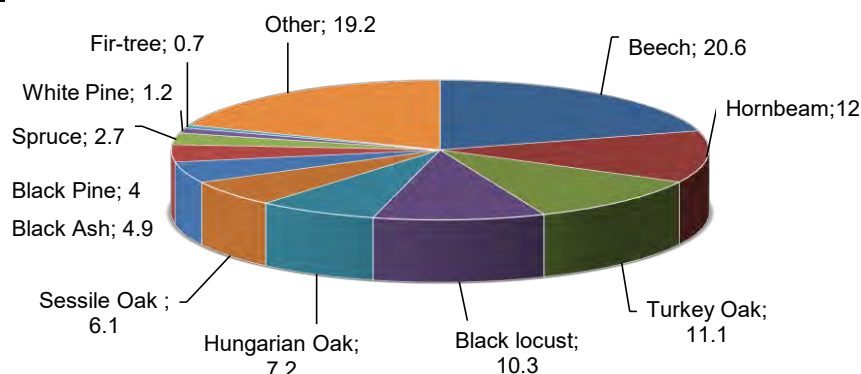


Figure 13. Tree species broken down by the number of trunks

According to the National Inventory of Forests in the Republic of Serbia, there are 49 tree species, the boreal ones being more numerous (40) than conifer species (9). The inventory conducted in 19th and 20th century reported 68 tree species.

The most common species is beech tree, with 20,6% of the total number of tree trunks; in terms of timber volume and annual increment beech is present with over 40%, or else 30%.

The number of most used tree species ranges from 10 to 14. According to the data of the National Forest Inventory, in the Republic of Serbia there are around 2,115,000,000 trunks with an average density of around 40 trunks per hectare. The number of trunks in boreal forests is 986 per hectare, while the number of trunks in conifer forests is 937 per hectare.

In Serbian forests beech (*Fagus sp.*) is the most common, with the share of 40.5% in the total volume, and with 30.6% in the annual increment, followed by turkey oak (*Quercus cerris*) with 13.0% of the share in the volume and 11.4 % in the annual increment, sessile oak (*Quercus petraea*) with 5.9 % of the share in the volume and 6.1% in annual increment, Hungarian oak (*Quercus frainetto*) with 5.8% of the share in the volume and 5.7% in annual increment, hornbeam (*Carpinus betulus*) with 4.2% of the share in the volume and 3.7 % in annual increment, black locust (*Robinia pseudoacacia*) with 3.1% share in the volume and 5.7% in annual increment, English oak (*Quercus robur*) with 2.5% of the volume and 1.7% in annual increment, and narrow-leaved ash (*Fraxinus angustifolia*) with 1.6% of the volume and 1.7% share in current annual increment. Of all conifer species Norway spruce (*Picea abies*) is the most common, with 5.2% of the volume and 6.7% in annual increment, black and white pine (*Pinus niger P. sylvatica*) with 4.5 shares in the total volume and 9.8% in annual increment, and finally fir-tree, with 2.3% contribution to the volume, and 2.2% to annual increment (Figure 13).

Data source: Forest Inventory, Forest Directorate

10.MIXED TREE SPECIES(S)

Key points:

- About 44% of forest area is composed of 4 to 5 main tree species.
- About 49% of forest area is composed of 2 to 3 main tree species.

The Indicator shows percentage share in the volume of tree species in the inventory unit.

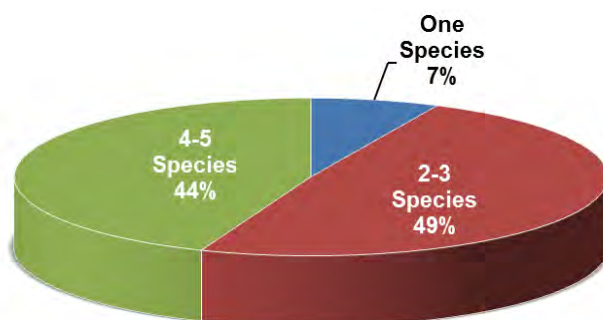


Figure 14. Mixed tree species

Species diversity and dynamics of forest eco-systems depend most of all on mixed tree species. Multi-species forests are in general richer in biodiversity than mono-species forests. Still many natural forests, such as the Sub-Alpine spruce forests, have one or two species.

The main criterion for determining a mixed nature of forests is the percentage tree species have in the volume of an inventory unit. A mixed forest is the group of tree species in which one species does not have a share larger than 25% in the total volume, but their presence (in terms of the number of trunks) significantly influences management of the main tree species (e.g. in two-level groups of trees, where at the second level there are another species trees mainly below taxation limit).

As 44% of the forests contain 4-5 tree species, and 49% of the forest 2-3 species, the forest eco-systems in the territory of the Republic of Serbia have a very favorable status. Only 7% of the forests are mono-culture forests, mostly plantation forests in the Autonomous Province of Vojvodina ([Figure 14](#)).

Data source: Forest Inventory, Forest Directorate

11. FOREST HEALTH CONDITIONS (P)

Key messages:

- In the course of 2015, 2.1 % of coniferous species has dead, which is 3 times more in comparison with the situation in 2014.
- About 85.5 % of coniferous and about 90 % of broadleaved are healthy trees without defoliation.

Forest health conditions are monitored through the trunk defoliation indicators in the ICP Forests Monitoring Network.

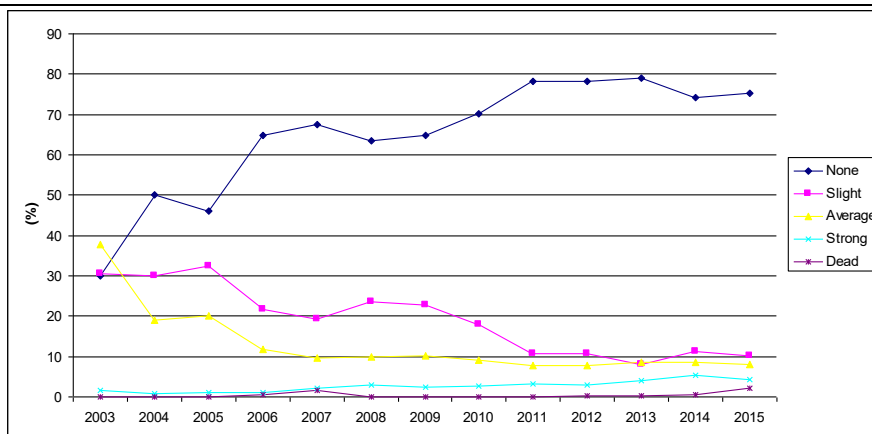


Figure 15. Coniferous species defoliation

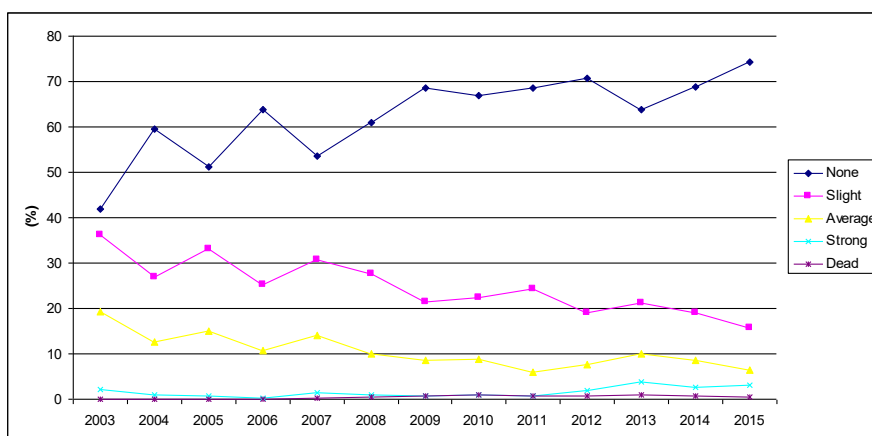


Figure 16. Broadleaved species defoliation

In 2015, assessment of forest species state was done at 130 bio-indication points on a total of 2,910 trunks. The trend of strong conifer species defoliation in 2014 was 5.4 %, which is the maximum value over the last 10 years, have resulted with the highest degree of dead trees during the 2015, of about 2.1 % which was 3 times more than in 2014 (Figure 15). The highest degree of dead trees was for Spruce (2.7 %), Scots pine (1.8 %), Fir (1.5 %) and Austrian pine (1.5 %). If we try to calculate how many dead trees we had, according to National Inventory of Forests in Serbia over to 3.5 millions of coniferous trees have been dried. Also, the percentage of dried conifer species doubled in comparison with 2013. Strong defoliation of broadleaved species has been increasing tough, but the number of dried trees was less than in 2014 (Figure 16).

When we look healthy trees without defoliation, general conclusion is that the state of coniferous and broadleaved species was better in 2015. Indeed, about 85.5 % of coniferous and about 90 % of broadleaved were healthy trees without defoliation.

ata source: Forestry Institute – National Focal Centre for Forest Conditions Monitoring

12. CLIMATE CHANGES AND BIODIVERSITY (P)

Key points:

- Since 2008, significant increase of dried trees has been registered.
- Since 2007, six summer seasons (June, July and August) have been extremely hot and dry.

The indicator shows connection between climate parameters and forest trees health condition registered by the Institute for Meteorology and ICP Forest Monitoring Network.

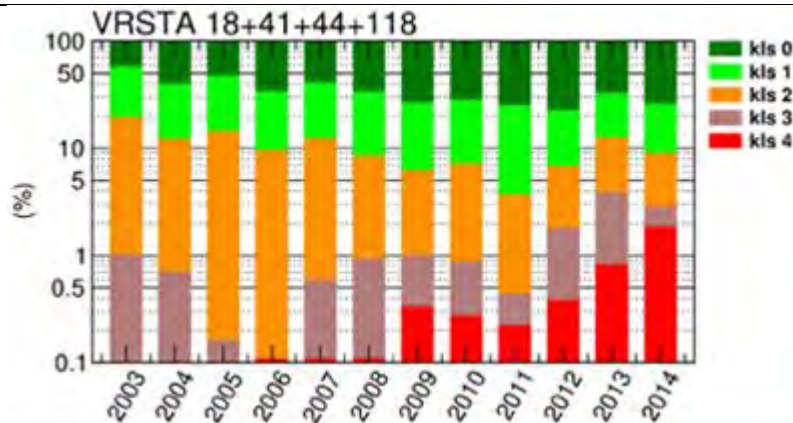


Figure 17. Defoliation class of 4 dominant species (Beech, Hungarian oak, Turkish oak and Spruce)

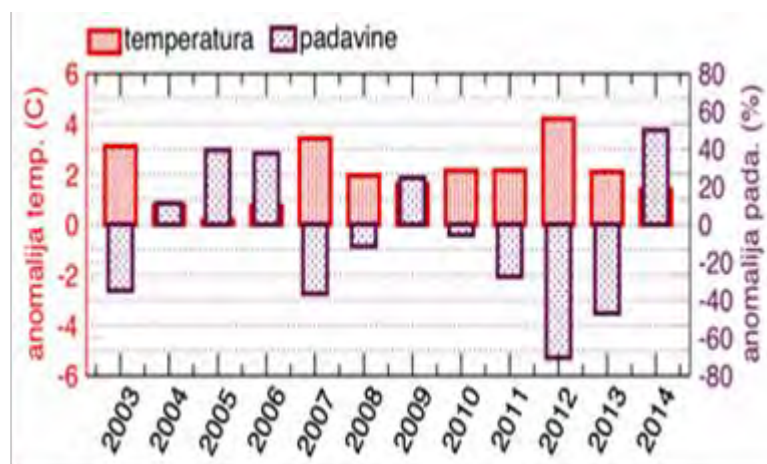


Figure 18. Temperature and precipitation anomalies for summer season (June, July and August)

Since 2008, significant increase of dried trees (class 4) and strongly defoliated trees (class 3) for 4 dominant species (Beech, Hungarian oak, Turkish oak and Spruce) have been registered. Increase of dried trees during 2014 was 5 times higher than in 2007 (Figure 17). Increase of strongly defoliated trees was 4 times higher during the same period.

Since 2007 temperature and precipitation anomalies for summer season (June, July and August) have shown 6 very or extremely hot and dry summers (Figure 18).

There was significant correlation between summer temperature and precipitation anomalies and dried trees, with one year lag after extremely dry summer season. Beech and Hungarian oak were extremely sensitive after summer temperature increase, while Turkish oak was sensitive only after extremely hot summer season during 2012.

Data source: Institute for Forestry, Institute for Meteorology, Serbian Environmental Protection Agency

13.FOREST DAMAGES (P)

Key points:

- During 2015 damage to forests intensified.
- Natural Disaster damage increased by 3.5 times than in previous year.

The indicator shows damage suffered by forests broken down by the agents, and expressed in cubic meters.

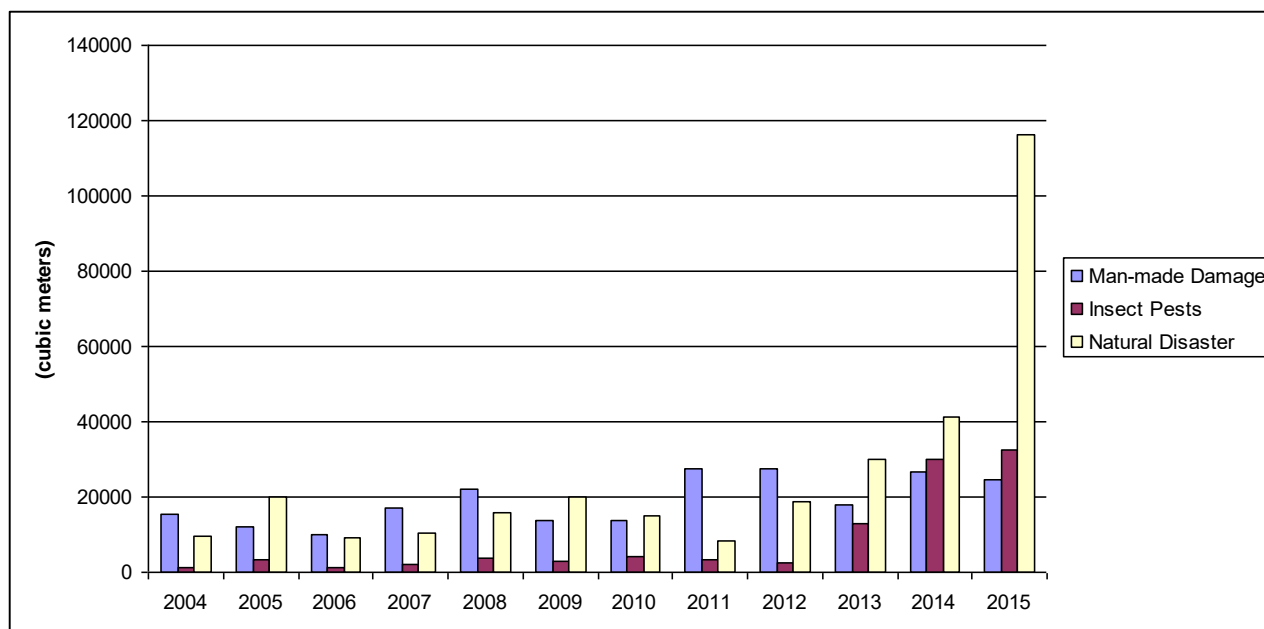


Figure 19. Damage suffered by forests broken down by agents

Agents causing damage to forests are biotic, abiotic and anthropogenic. Biotic agents include insects and illnesses, wild animals and forest grazing cattle. Abiotic agents include fire, storm, wind, snow, drought, layers of mud and avalanche. Anthropogenic agents include illegal logging or other damage in forests caused by wood cutting, which leads to impaired health and vitality of forest ecosystems.

During 2015, forests suffered by damage intensified ([Figure 19](#)). Damage caused by insect pests was the most serious in the last 10 years, and its magnitude increased by over 34% in comparison with 2014.

Damage caused as a result of natural disasters increased by 3.5 times in comparison with 2014, and reached its maximum level in the last ten years. Over 116,000 cubic meters of trees has destroyed by Natural Disasters.

Man-made damage decreased by about 8% in comparison with 2014. The pressure on the forests was also maintained by intensive tourism and recreation activities which caused forest fires, pollution and destruction by air pollution, traffic or grazing cattle.

Data source: Republic Statistics Office

14.FOREST FIRES (P)

Key points:

- During 2015 in 47 forest fires, 5,059 cubic meters of wood burnt.
- Forest surface of 827 ha was caught by fire.

The indicator monitors damage caused by forest fires, expressed in cubic meters and hectares.

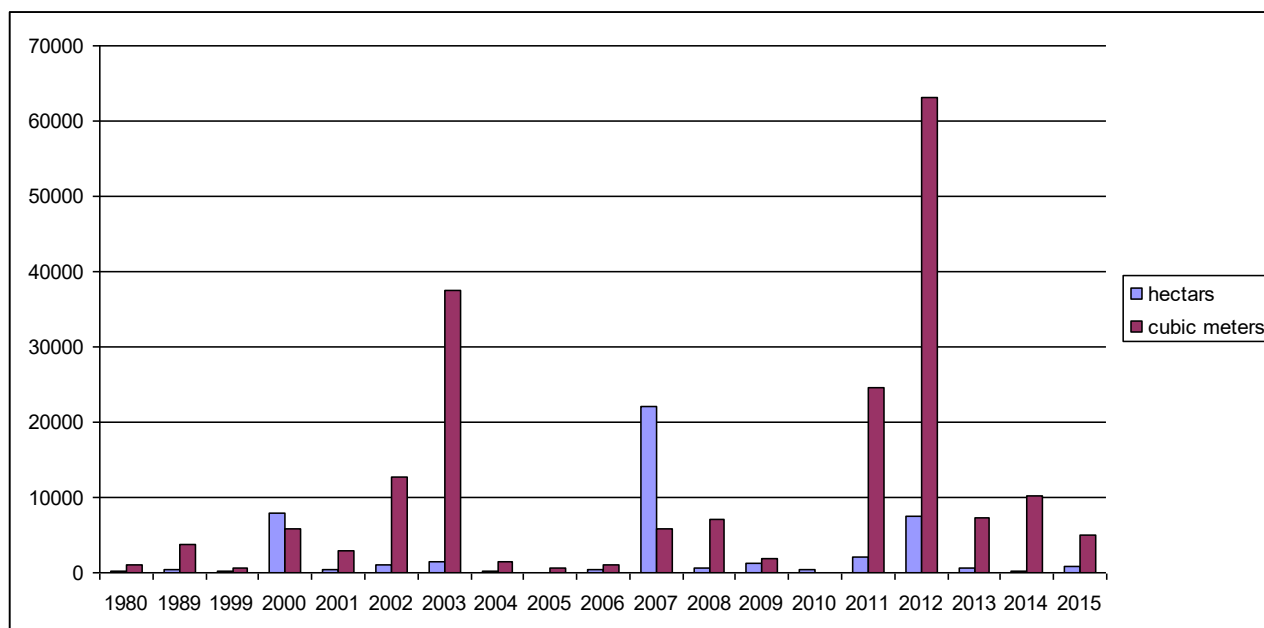


Figure 20. Damage caused by forest fires

Forest fires are one of the most important forms of forest damages. Although controlled burning may lead to increased biodiversity of species, uncontrolled forest fires have very negative effects on the eco-system: desertification, erosion, and water loss.

During 2015, 5,059 cubic meters of timber volume burned, which is around 50% less than in 2014 ([Figure 20](#)). In comparison with the previous year, when 284 ha were caught by forest fires, the surface caught by fire in 2015 amounted to 827 ha, which is about 3 times higher surface caught by fire.

Climate change, i.e. alternating dry and rain periods are increasingly causing the problem of forest fires and incurring damage to forests in the form of natural disasters. Also, direct damage in terms of the lost timber does not have such a large importance as the loss of beneficial functions of forests after fires (hydrological, protection, climate, hygiene and health care, tourist recreational etc.).

Data source: Republic Statistics Office

15. POPULATION DYNAMICS OF THE MAIN HUNTING SPECIES (P-S)

Key points:

- Rabbit, pheasant, boar populations have been decreasing.
- Doe and quail populations have been increasing.

The indicator shows the size of populations of the selected main hunting species in the Republic of Serbia.

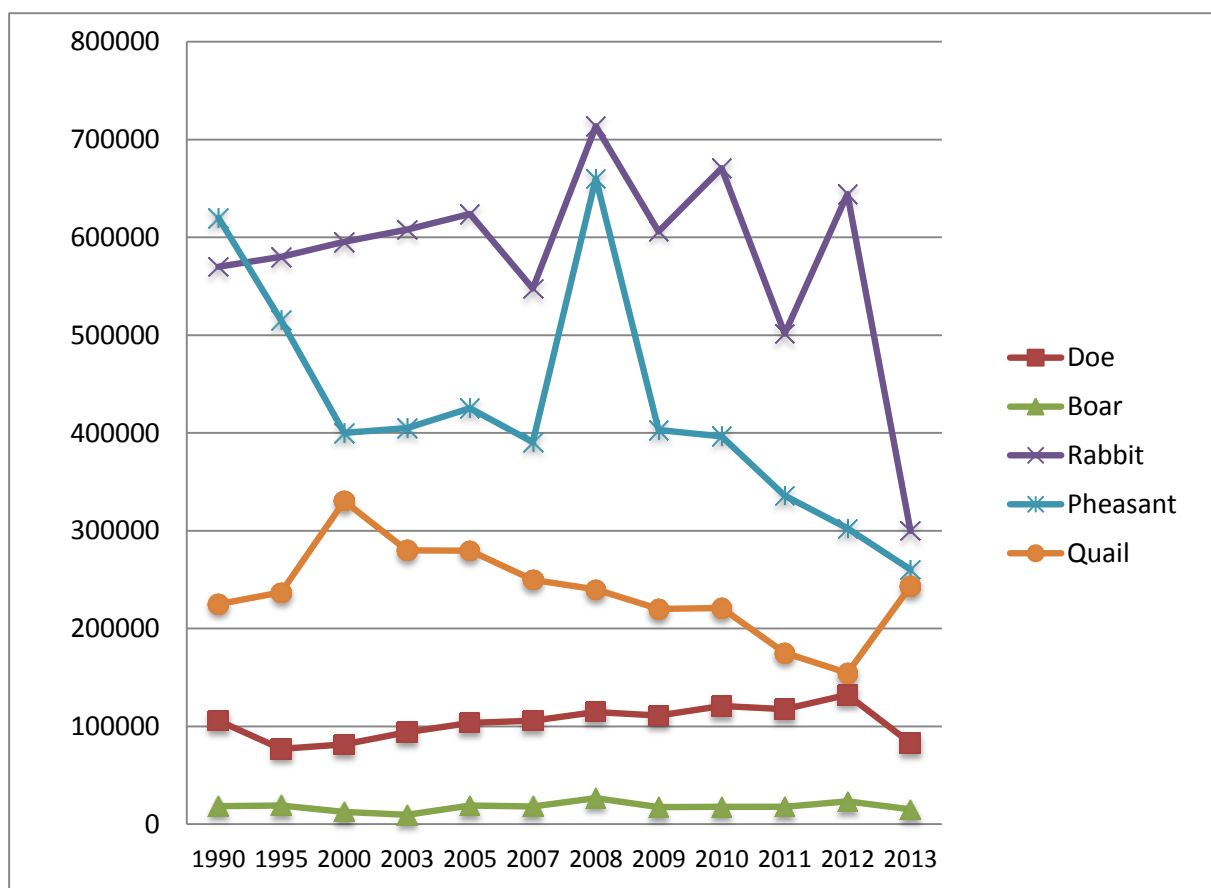


Figure 21. Size of populations of the main hunting species

According to the Forests Directorate Data, rabbit and pheasant populations decreased during the hunting year 2012/2013. The most significant decrease is in pheasant population (by around 14%). The size of rabbit population decreased by 9%, and the size of boar population is by 5% smaller.

Quail population size increased by around 57%, and doe population by 7% (Figure 21).

According to the data of the Forest Directorate, the size of wolf population is estimated at 2,032 specimens, bear population at 91, lynx population at 20, and beaver population at 15.

According to the data of the Institute for Nature Conservation, the size of wolf population ranges from 500 to 1400 specimens, the size of bear population did not exceed 53 specimens, population of lynx is reduced to several dozen specimens from the “eastern” sub-species and a couple of specimens of the “Western” sub-species.

Data source: Forest Directorate, Institute for Nature Conservation of Serbia

16.FRESH WATER SPECIES (S)

Key points:

- In the rivers of the Republic of Serbia there are 110 species of Clupeidae and lampreys.
- In the Danube catchment in the territory of the Republic of Serbia, there are 12 endemic species and sub-species of fish and one endemic species of cyclostomes.

The Indicator shows the taxonomic structure of fresh water fish species in the rivers and lakes in the territory of the Republic of Serbia.



Figure 22. European sturgeon (*Huso huso*) and starry sturgeon (*Acipenser stellatus*)

For inland water of the Republic of Serbia so far 110 species and sub-species of lampreys and Clupeidae were identified, 23 types of which are alien species (23.5%), and 12 of them may be considered as invasive. Out of the entire number of species, 53 fish species (54.1 %), including ten alien species are subject to commercial and sports hunting. From the point of view of commercial hunting, 29 species are important for the economy, and 12 of them are a target group for fishing activities. 45 species are the object of sports and recreational fishing.

In the Danube Catchment, there are 79 fish species from 16 families and 3 types of cyclostomes. According to the number of species and specimens, the most numerous is the family of *Cyprinidae*, with 50 present species. The specific nature of the Danube-Black Sea system is reflected in the seasonal presence of 5 species from the family *Acipenseridae* and 2 species from the family *Clupeidae*, which swim to the Danube from the Black Sea to spawn. This migratory route was cut across by Djerdap hydroelectric power plant, so the species in questions come as far as the Djerdap II dam. In the Serbian part of the Danube catchment, 12 endemic species, one endemic sub-species and one endemic cyclostome were identified ([Figure 22](#)).

The system Tara-Piva-Drina is an important system of mountainous water. There are around 32 fish species in this system. Out of 110 species and sub-species of fresh water fish, 12 species are among endangered categories, according to the IUCN and SRBIUCN. Out of this number 6 species are classified as “endangered” or “gravely endangered” species, according to IUCN, and they are included in the Preliminary Red List. Out of the mentioned group of species 5 species belong to the family *Acipenseridae*, one species to the family of *Salmonidae* (Salmons and Trouts) and they are included in the CITES Convention List. Almost all types within an endangered category are included in one of the lists of international conventions on the protection of endangered species.

Data source: Faculty of Biology of Belgrade University, Institute for Nature Conservation of Serbia

17.FRESH WATER FISHING (P)

Key points:

- Total freshwater fishing decreased by around 12% in the course of 2015.
- Commercial fishing reduced by 6% and sports fishing by 14 %.

The indicator represents the quantity and structure of caught fish.

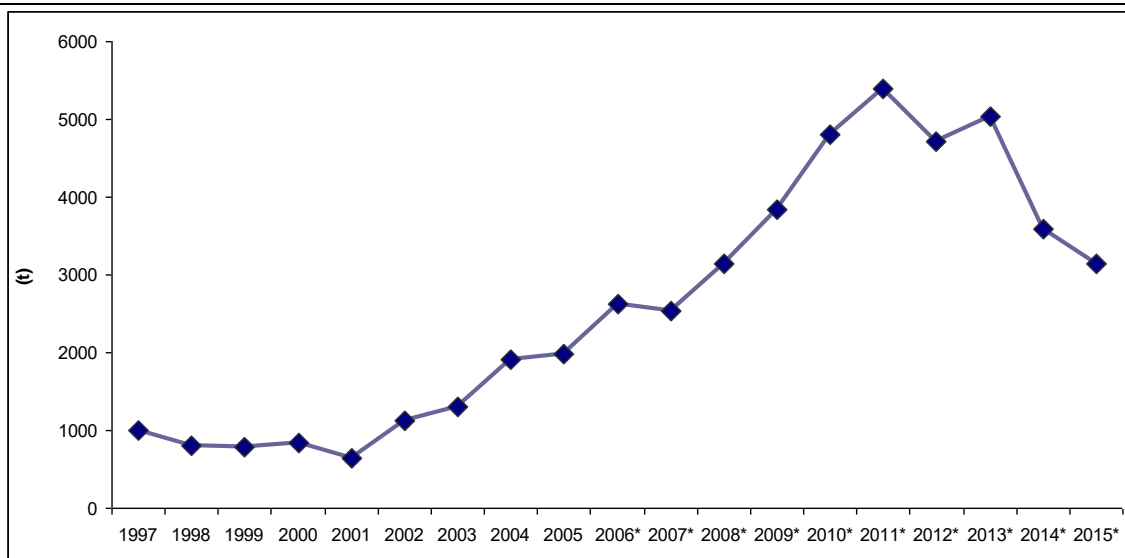


Figure 23. Total fresh water fishing in the Republic of Serbia (*New methodology of RSO and SEPA)

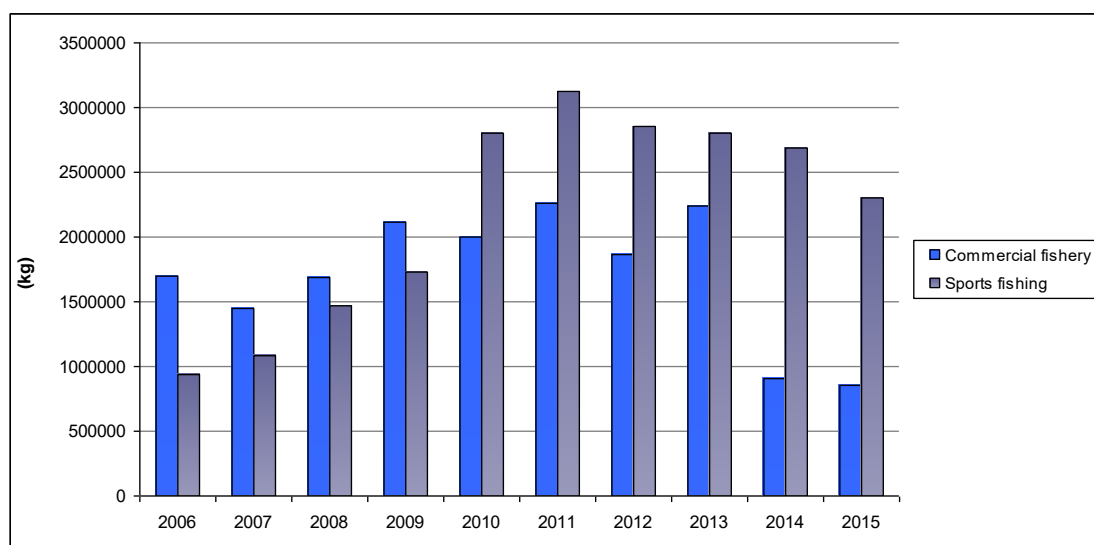


Figure 24. Volume of commercial and sports fishing in the Republic of Serbia

During 2015, 3,150 t of fish was caught, which is by 12% less than in 2014. Carp catch was reduced by 6 %, catfish by 2 %, and perch by 7 % (Figure 23).

The number of professional fishermen reduced (407), and the number of full-time professional fishermen (289) decreased by 15% in comparison with 2014. The total number of issued licenses for sports fishing was 77,109, which is around 7% more than in 2014. The volume of sports fishing reduced by around 14%, while that of commercial fishing reduced around 6% in comparison with 2014 (Figure 24).

Data source: Republic Statistical Office

18. FRAGMENTATION OF RIVER HABITATS (P)

Key points:

- About 170 dams have registered in the Serbian rivers. Fragmentation index is 0.01895.
- After Iron Gate 1 building have not been registered catch of eel, and catch of *Acipenseridae* species significantly decreased after Iron Gate 2 building.

The indicator represents a relation between the length of all rivers and number of dams in the rivers. The dynamic of the fish population or fish catch show effects of dams on biodiversity.

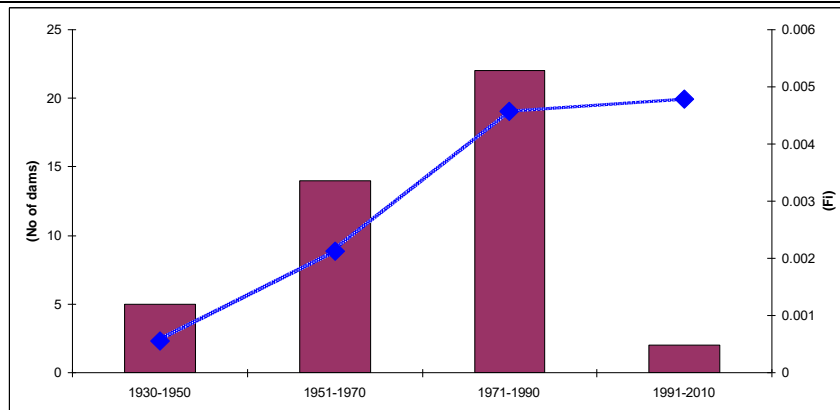


Figure 25. The number of dams and Fragmentation index increase.

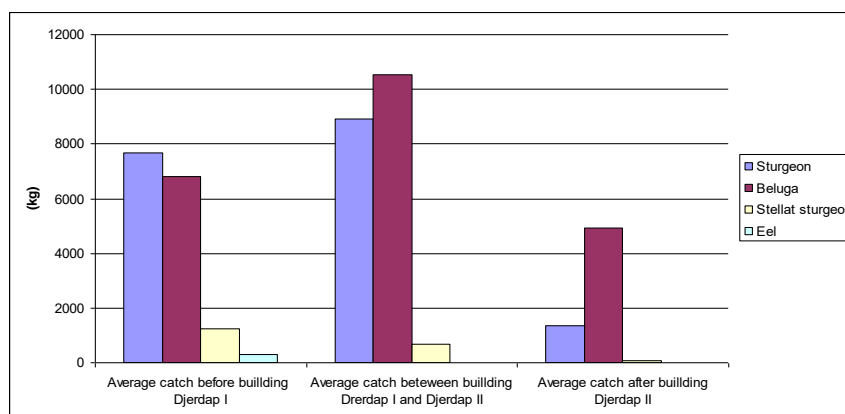


Figure 26. Average catch of eel and *Acipenseridae* species in Danube before and after building of 2 dams.

Fragmentation index of river habitats shows relation between the length of all rivers in Serbia and number of dams in the rivers. The total length of all rivers is about 8,972 km, and the total number of dams is 170, according to SELAR database until 2010. Fragmentation index in Serbia is 0.01895 with significant increase since 1930. Based on data for 43 dams with existing data on the year of construction, it may be noted Fragmentation index increase in the period 1930-2010 (Figure 25). The largest numbers of dams are with a height of up to 20 m, while 5 dams are height of about 100 m (Figure 25).

Fish catch of *Acipenseridae* species and eel is observed as an effect of 2 dams building in Danube. After Iron Gate 1 building (1970. year) catch of eel has not been registered. Catch of Stellat sturgeon significantly decreased after Iron Gate 1 building and after Iron Gate 2 building (1984. year) almost disappeared. Catch of Sturgeon and Beluga increased after Iron Gate 1 building, but significantly decreased after Iron Gate 2 building (Figure 26). Fish catch of *Acipenseridae* species had been registered until 2002, when Serbia ratified CITES Convention. Since 2009, almost all *Acipenseridae* species are under protection and catch is forbidden (Figure 26).

Data source: Republic Statistical Office

19.AQUACULTURE PRODUCTION (DF)

Key messages:

- Production of seafood decreased around 22 % than in previous year.
- Carp fish production decreased around 27 %, while trout fish production increased around 12 %.

The indicator shows the quantity of fish produced and taken out from fisheries.

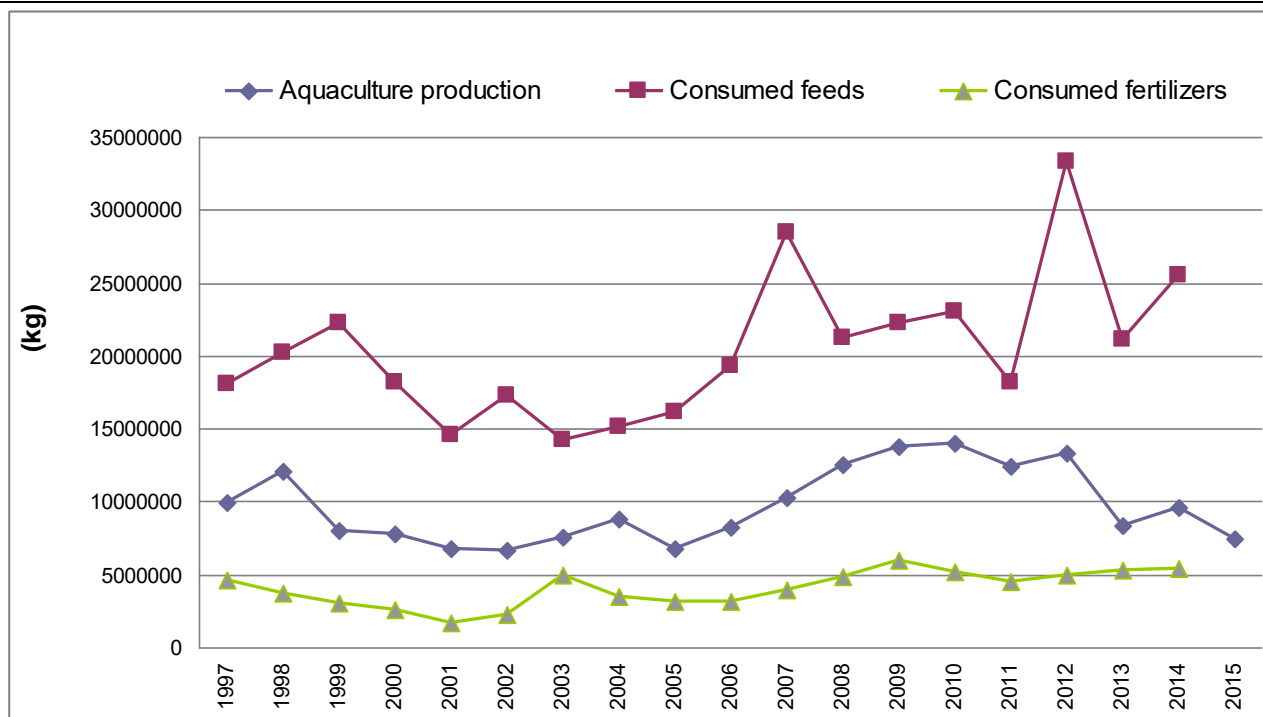


Figure 27. Production in aquaculture

Total production of seafood in 2015 amounted to 7,500 t, which is by 22 % less than in 2014 ([Figure 27](#)).

Production in carp fisheries decreased by around 27 %, while production in trout fisheries increased by 12 % in comparison with 2014.

Carp fisheries had total surface of 8,003 ha, while the surface of trout fisheries was about 7 ha.

Data source: Republic Statistical Office

SUSTAINABLE USE OF NATURAL RESOURCES

20.CHANGE OF INTENDED LAND USE (P)

Key points:

- Analysis of the change of intended land use in 2006-2012 period shows that most changes occurred under artificial surface category (3,037 ha increase).
- Agricultural land in the observed period reduced by 4,391 ha.
- Surfaces under the category of forests and semi-natural areas increased by 1,157 ha, 420 ha of humid regions – classified under inland wetlands – disappeared, while areas under water basins increased by 686 ha, mostly as a result of construction of new artificial lakes.

The indicator defines trends in the change of intended use of agricultural, forest and other semi-natural and natural land into urban land and other artificial surfaces. It shows surfaces occupied by construction activities and urban infrastructure, as well as urban green areas, sports and recreation surfaces. The indicator is calculated by analyzing charts based on images of the CLC base Landsat satellite for 1990, 2000, 2006, and 2012.

Table 1. Origin of urban land expressed through different land categories subject to change of intended land use

Classes	Occupied land in ha		
	90-00	00-06	06-12
Pastures and mixed agricultural areas	2,818	2,280	1,148
Arable fields and perennial plantations	2,468	939	1,777
Water basins	58	0	14
Bare lands with little or no vegetation	0	0	0
Natural grass areas	12	3	8
Forests and transitory areas	2,094	1,066	1,264
Swamps and marshes	21	36	30

Corine Land Cover database analysis for 2012 shows presence of 29 out of 44 classes of CLC nomenclature. Agricultural surfaces are dominant with over 55% of the entire territory of the country. Woods and semi-natural areas cover almost 40% of the land (broadleaves forests – 27 %). Land provided under *artificial surfaces* covers almost 3.6% of the territory, and the rest of approximately 1.6% is classified as humid areas and water basins ([Table 1](#)).

The analysis of contributions by specific categories of intended land use for urban development in Serbia in 1990-2012 period showed that mostly pasture land was occupied, as well as mixed agricultural areas ([Figure 28](#)), ([Figure 29](#)), ([Figure 30](#)) and ([Figure 31](#)).

Data source: Environmental Protection Agency

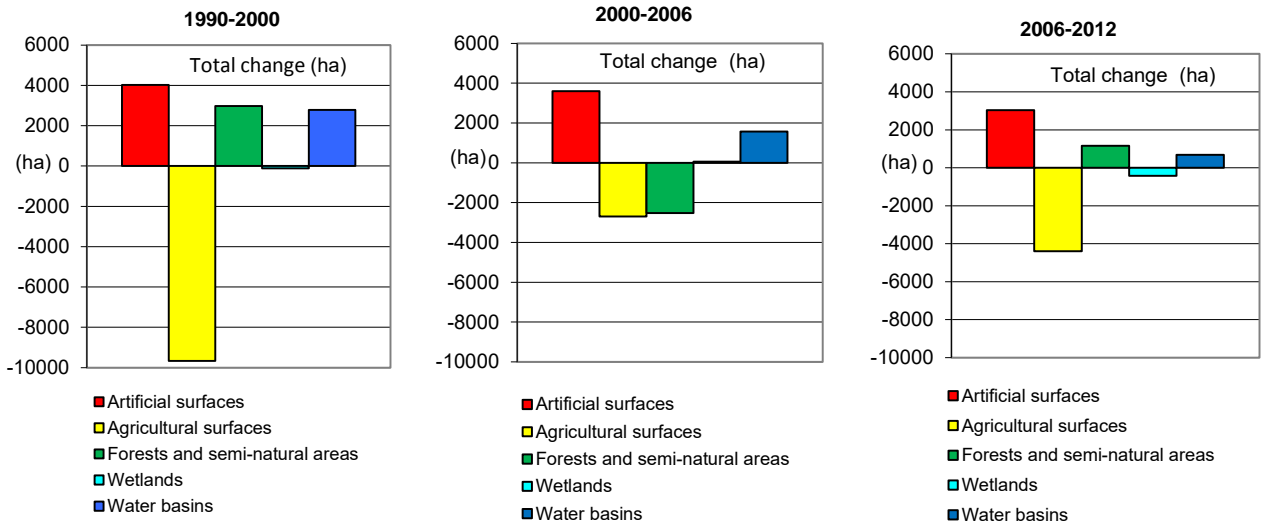


Figure 2

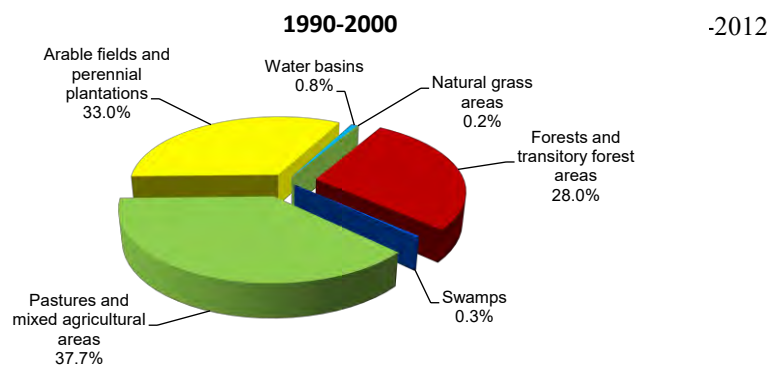


Figure 29. Origin of urba

which was changed in

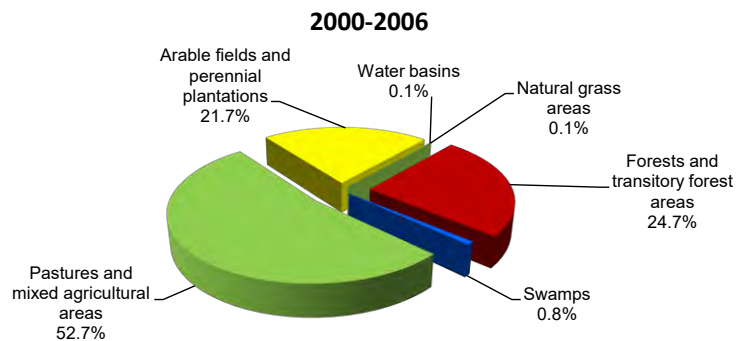


Figure 30. Origin

which was changed in

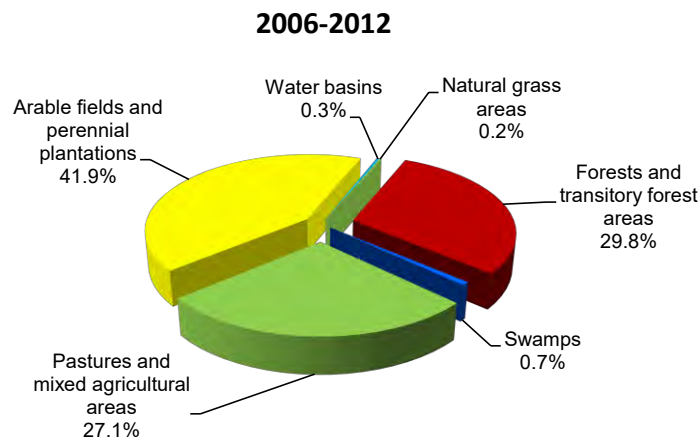


Figure 31. Origin of urban lands expressed in % of different land categories, the intended use of which was changed in 2006-2012

21. FOREST MANAGEMENT-(DF)

Key points:

- The total surface of commercial forests in Serbia is around 1,500,000 ha, or 65% of the forested surface.
- Commercial forests with planned management cover 1,100,000 ha.

The indicator shows the forested surface managed in accordance with plans, with respect of the principle of sustainable management of natural resources.

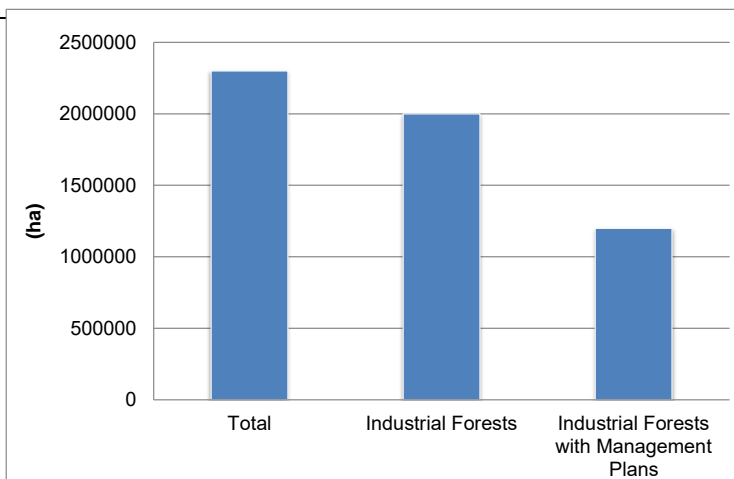


Figure 32. The s... l Serbian forests

52.2 % of Serbian forests are private property, 39.8% are state property, and 8% belong to other form of ownership. Forest quality parameters are different, depending on the ownership. Although state-owned forests make up under 40% of total Serbian forests, the overall timber volume contained in them amounts to 48.5% or 196 m³/ha, while timber volume in the privately-owned forests (which make over 52 % of the total forests) covers below 45%, or else 138 m³/ha.

Forests in the Republic of Serbia are managed by public enterprises. Most part of the state-owned forests are managed by: „Srbijasume”, „Sume Vojvodine”, „Borjak” – Vrnjacka banja and National Parks. PE „Srbijasume” manages 17 forest estates, and PE „Sume Vojvodine” is in charge of 4 estates.

State-owned forests allocated for use by forest estates and private forests outside the protected areas are considered to be commercial forests. The total surface of commercial forests in Serbia is around 1,500,000 ha, or around 65% of the total forest surface ([Figure 32](#)).

Every 10 years a Special Management Baseline is issued for the state-owned forests and forest land (over 1,100,000 ha), allocated for use by public enterprises. The Baseline is subject to approval of the Forest Directorate of the Ministry of Agriculture, Forestry and Water Management. The forest surface in Serbia included in management plans amounts to around 900,000 ha, which is around 45% of the entire forested surface or 53% of the total surface of the commercial forests.

Data source: Republic Statistical Office

22. TIMBER CONSUMPTION AND SALE (DF)

Key points:

- Over the last decade production of state-owned timber assortments increased from 0.7 to 0.9 m³/ha
- Sale of forest range of products increased by 40% in 2014.

The Indicator shows the quantity of produced and sold timber assortments.

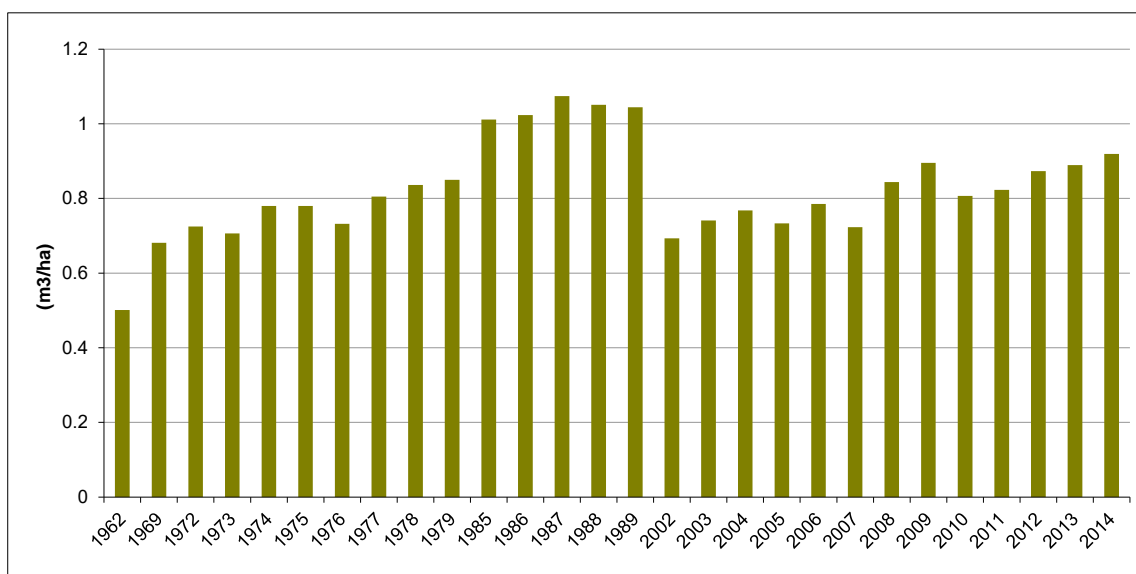


Figure 33. Timber assortments from state-owned forests

Over the last decade production of state-owned forest range of products increased from 0.7 to 0.92 cubic meters per hectare of forest ([Figure 33](#)).

The ratio of firewood to industrial wood at a global level was 51.2 : 48.8, while in Europe it was 17.8 : 82.2. In Serbia the ratio of firewood to industrial wood was 52 : 48, with the trend of increasing the share of industrial wood as opposed to firewood, which started in 2003.

The sold wood products include all wood taken out of the forests, either as logs, wood chops or in another form, and they are sold as timber assortments. The sold timber assortments are an income for owners or users of the forests. Sale of forest products increased by 40% in 2014 in comparison to the previous year, amounting to 0.855 cubic meters per hectare ([Figure 34](#)).

Estimates have shown that the consumption of the main wood products (logs, paper, timber) will increase in the next 30 years. The use of solid bio-fuel in power generation can be three times higher by the year 2030. The consumption of logs will have increased by 50 % to 75% by the year 2050.

Data source: Republic Statistical Office

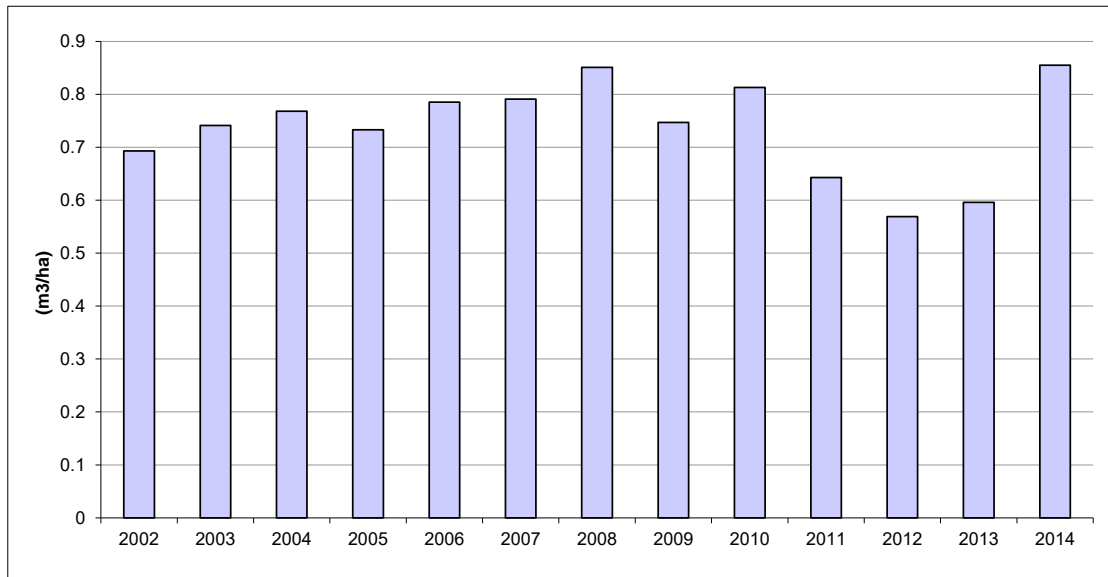


Figure 34. Sold timber assortments

23.FOREST PATHWAYS (R)

Key points:

- In 2013 solid roads were reduced by around 100 km, while the length of non-solids increased by around 250 km.

This is one of the important indicators of forest exploitation. It points at the manner of use and management of forests. The longer the forest paths are, the more sustainable the exploitation of forests is, based on planned concentration and clearance.

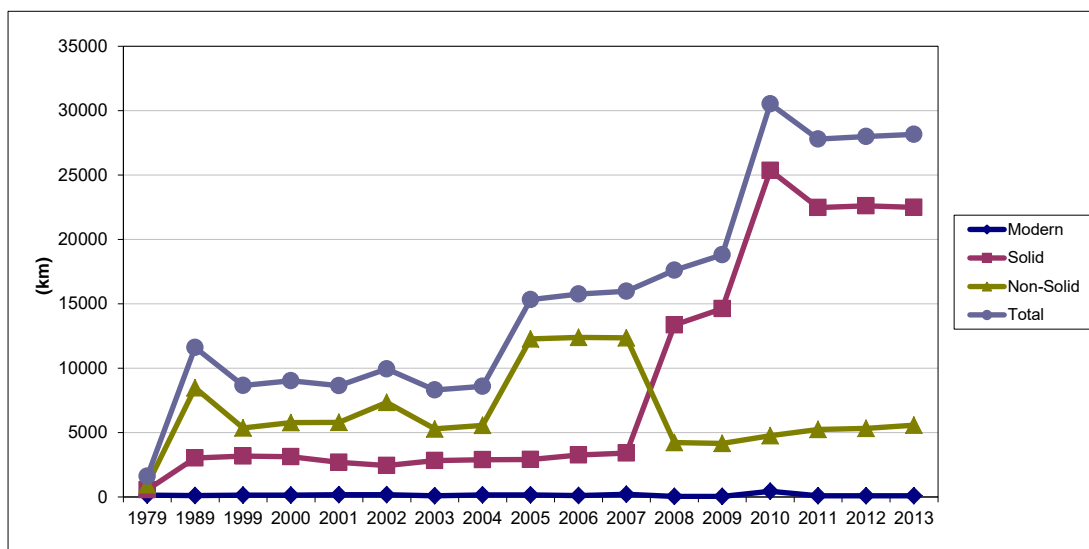


Figure 35. Forest Roads

The overall length of forest roads increased over 300% since 2000. In comparison to 2009 the overall length increased by 50%. An abrupt increase in length (over 12 times) was the most visible in forest pathways with built pavement, while the number of solid base roads rose by over 80%. The length of pathways without the built-in pavement increased slightly.

During 2014 the length of solid roads was reduced by 100 km and the number of non-solid paths increased by around 250 km. ([Figure 35](#))

Data source: Republic Statistical Office

24. INCREMENT AND WOOD CUTTING (S-P)

Key points:

- The ratio of annual increment (around 9 million m³) to annual cutting (2,700,000 m³) is lower than 3:1.

The indicator measures sustainability of timber production as a potential for future availability of timber and wood cutting in forests.

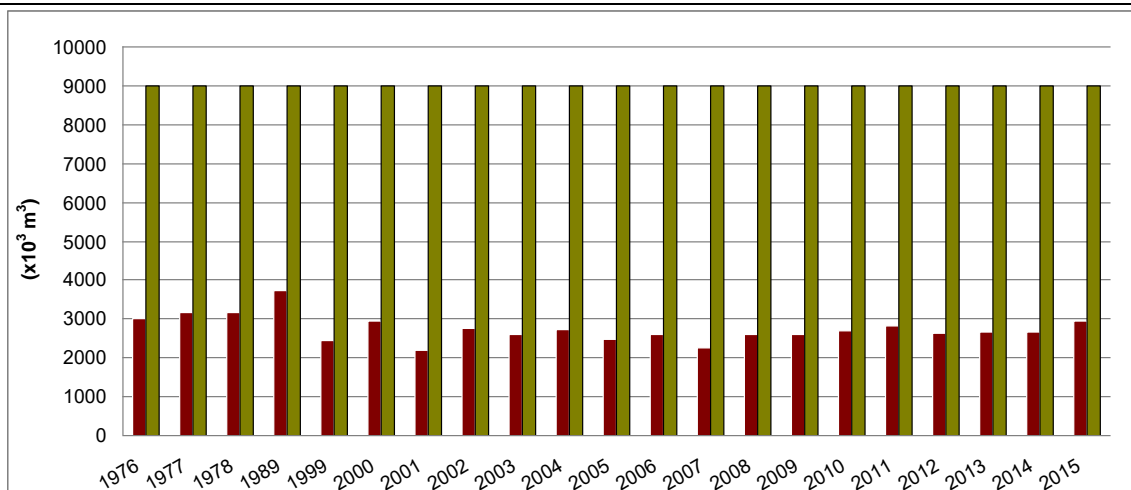


Figure 36. Wood cutting in the forests of the Republic of Serbia

Increment

Timber volume in the forests of the Republic of Serbia amounts to 363 million m³, which is around 161 m³/ha. In broadleaved forests the volume was around 159 m³/ha, while in conifer forests the volume was around 189 m³/ha. Annual increment was around 9 million m³, or else around 4 m³/ha. Annual increment in broadleaved forests was around 3.7 m³/ha, while in conifer forests it was around 7.5 m³/ha. Depending on the productivity of a species, its age distribution and species diversity, as well as on the type of ownership, annual increment varies considerably.

Logging

Wood cutting is the most important indicator of forestry as a commercial sector, but at the same time an indicator of the anthropogenic pressure. In 2015 in the forests of the Republic of Serbia around 2,954,000 m³ of wood was logged, which was about 10 % more than the previous year (Figure 36). During recent years wood logging has increased by around 100,000 m³ per year, but it was still less intensive than in 2000. Analysis of the trend of wood cutting in the last 30 years has shown that over the last 30 years or so wood cutting ranged from 2,500,000 to 2,800,000 m³, which is less intensive than it was in 70-ies and 80-ies of the last century. Unofficial expert estimates were somewhat lower than the official data – around 3,000,000 m³ per year. According to the data of the FAO/TCP/YUG/3201 project from 2011, as well as the UNECE report, the total amount of the logged timber in Serbia in 2012 was 6,099 million m³ (including wood cutting outside forests amounting to 1,441 million m³). (Figure 35)

It is very important to outline that the amount of timber being cut was one-third of annual increment of timber volume of the forests. The ratio of annual increment (around 9,000,000 m³) to annual wood cutting (2,600,000 m³) is less than 3:1. According to the least favorable data, the ratio of annual increment to cutting is 3:2. Such a ratio may be considered satisfactory, both from the point of view of forest volume that will remain, and from the point of view of the quality of forest ecosystems.

Data source: Republic Statistical Office

25.AFORESTATION (R)

Key points:

- During 2015 in Serbia around 1,550 ha of forest land was forested.

The indicator shows the surface of the forested forest land.

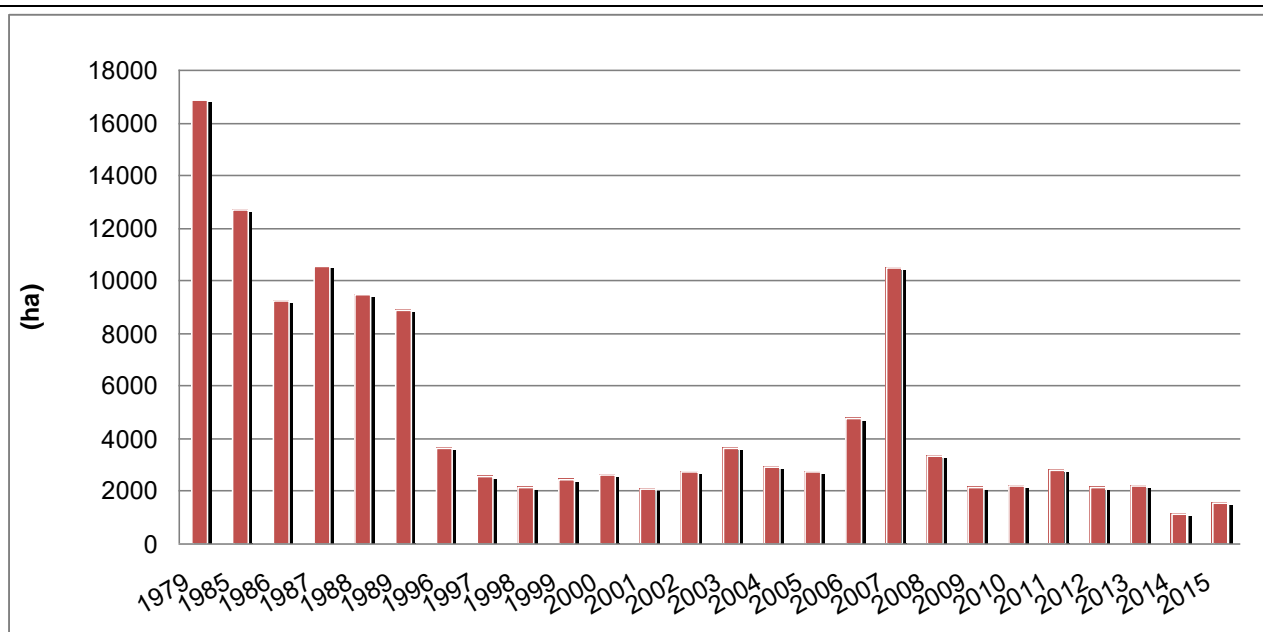


Figure 37. Afforestation in the Republic of Serbia

Natural regeneration takes part in conservation of genetic diversity and improves natural structure and ecological dynamics of the species. What should also be taken into consideration, though, is that natural regeneration does not always satisfy the quality of management and fulfillment of industry goals.

During 2015 in the Republic of Serbia around 1,550 ha of forest land was forested, which is by around 35% more than in the previous year. 601 ha of conifer trees (Spruce and Austrian pine) and 949 ha of broadleaved trees (Poplars, oak and acacia) were planted. It is worth mentioning that such a rate of afforestation is by almost 8,000-9,000 hectares lower than in 2007 and in 80-ies of the last century, when annual afforestation amounted to around 10,000 ha ([Figure 37](#)).

Data source: Republic Statistical Office



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