THE SIXTH NATIONAL REPORT ACCORDING TO THE CONVENTION ON BIOLOGICAL DIVERSITY (CBD) OF THE REPUBLIC OF SERBIA

Ministry of Environmental Protection,

Environmental Protection Agency

INTRODUCTION

Chronological review of the preparation of the sixth national report according to the Convention on Biological Diversity (CBD) of the Republic of Serbia

- Invitation of the Convention Secretariat concerning the use of the Global Environment Fund (GEF) for the preparation of the sixth national report;
- UNEP office in Nairobi is responsible for the transfer of GEF funds for the preparation of this report;
- The Ministry nominated the Environmental Protection Agency as the competent institution for GEF and CBD;
- The Environmental Protection Agency in the Republic of Serbia is the contact institution for the Clearing House mechanism of the Convention;
- Agreement on Financing the Implementation of the Project entitled **"Supporting the Preparation of the Sixth National Report according to the Convention on Biological Diversity (CBD)".**

The global and national documents on the basis of which the Report was drafted are:

1. The Strategic Plan of the Convention on Biological Diversity for the period from 2011 to 2020. The "Aichi objective" includes 20 goals elaborated in five strategic areas;

- Reduce the causes of loss of biodiversity through the integration of biodiversity into the activities of government and society;
- Reduce direct pressure on biodiversity and promote sustainable use;
- Improve the status of biodiversity by preserving diversity at all levels (ecosystem, species and genetic diversity);
- Increase profits that biodiversity and ecosystem services provide
- Improve implementation through participatory planning, knowledge management and capacity building.

2. Revision of the Biodiversity Strategy of the Republic of Serbia for the period 2011-2018

- Article 6 of the Convention on Biological Diversity;
- Decision 2 of the Tenth Conference of the Convention members on Biological Diversity held in 2010 in Japan (CBD COP X / 2);
- The Ministry of Environmental Protection of the Republic of Serbia coordinated the revision of the Biodiversity Strategy of the Republic of Serbia for the period from 2011 to 2018 within the framework of the project **"Planning for Preservation of Biodiversity at the National Level in support of the implementation of the Strategic Plan of the Convention on Biological Diversity for the period from 2011 to 2020 in the Republic of Serbia";**
- The project was funded by the Global Environment Fund (GEF), in cooperation with the United Nations Development Program (UNDP) as an implementation agency;
- Within the framework of the project, the Fifth National Report was prepared according to the Convention on Biological Diversity.
- An integral part of this strategy was revised Biodiversity Strategy of the Republic of Serbia for the period from 2011 to 2018 with the extension related to the period until 2025
- The Law on the Planning System of the Republic of Serbia ("Official Gazette of RS", No. 30/18) prescribes that a planning document of this type is called a **program** instead of **strategy**;
- The program, for the purposes of this law, is a public policy document, it more closely encompasses the idea than the term strategy that, as a rule, elaborates the specific goal of the strategy or some other planning document in accordance with which it is passed (Development Plan, Government Program, Local Government Development Plan, concept policies);

3. Proposal of the Nature Protection Strategy of the Republic of Serbia for the period 2019-2025.

- Introduction;
- Chapter 2 - a brief overview of the nature of the Republic of Serbia;
- Chapter 3 - legal, institutional and financial framework for nature protection;
- Chapter 4 - Review of the requirements of the Convention on Biological Diversity;
- Chapter 5 - "tree of problems" and "tree of goals";
- Chapter 6 - Strategic areas, objectives and indicators of nature protection;
- Chapter 7 - Action Plan;
- Chapter 8 - Final part;
- Annexes

4. Strategic goals for nature protection in the Republic of Serbia General objective: Improving the nature protection system

Specific objectives:

- **Objective 1.** Biodiversity protection
- **Objective 2.** Improvement of the system of protected areas and ecological networks
- **Objective 3. S**ustainable use of natural resources
- **Objective 4.** Enhancing public policy and public participation in decision-making

EXECUTIVE SUMARY

The main objectives of the Convention on Biological Diversity (CBD) involve the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies.

According to the Article 26 of CBD (Reports), each Contracting Party shall provide to the Conference of the Parties, periodic reports on measures which it has taken for the implementation of CBD and the effectiveness in meeting the objectives of the Convention.

So far Serbia published five Reports. This Report describes progress in legal transposition and implementation of the CBD. Moreover, the Report provides information on pressures, threats and current status of biodiversity components (genetic resources, species and ecosystems) in Serbia. The assessment was performed using

- indicators of environmental change (air and water pollution indicators, climate change indicators)
- indicators of population dynamics (population size trends of some top predators, invasive alien species and pest species that are disease vectors) and
- indicators of ecosystem and habitat heterogeneity
- indicators of effectiveness in implementation of CBD in Serbia (indicators of effectiveness in combating illegal killing, trapping and trade of wild species, indicators of ex situ and in situ conservation as well as indicators of information share and establishment of an integral national information system for biodiversity with a database (INISB)
- indicators of protected areas, habitats changes and management effectiveness
- indicators of ecological network and habitats changes
- indicators of landscape and habitats changes
- indicators of sustainable use of forests
- indicators of sustainable use of non-wood products
- indicators of fresh water fishing and game animals hunting
- indicators of renewable energy production and resources use
- indicators of organic and high nature value agriculture
- indicators of endangered and protected species
- indicators of biodiversity knowledge and science
- indicators of financing environment and nature protection
- several case studies

Priority Area	Aichi target(s)	Progress Assessment	Final Assessment
1. Protection of Biodiversity	C12, C13, D15, E19, E18		
2. Improvement of the system of protected areas and ecological networks	C11, B5, D14		
3. Sustainable use of natural resources	D14, D15, D16		

4. Improving public policy and public participation in decision-making	A1, A2, A3, E20, E19		

CONTENT

National Target 1

Protection of Biodiversity

Rate of progresses toward the implementation of the selected target

- On track to achieve target 

Priority Area	Priority actions	Aichi target	Progress Assessment	National Progress Assessment
Priority Area 1. Protection of Biodiversity	Priority action 1.1.	C12		
	Priority action 1.2.	C13		
	Priority action 1.3.	D15		
	Priority action 1.4.	E19		
	Priority action 1.5.	E18		

The causes that lead to the reduction of biodiversity include disappearing, fragmentation and degradation of habitats, illegal hunting, fishing and collecting, illegal and inadequate forest cutting, inadequate preservation of genetic diversity of autochthonous populations of plant and animal species, introduction of invasive and allochthons species and genetically modified organisms. In order to preserve biodiversity in Serbia it is necessary to establish mechanisms for economic valuation of biodiversity, areas and ecosystem services and integrate these values into national policies, plans, budgets and strategies in relevant sectors.
At present, there is a developed system of compensation for the use of natural resources in Serbia, which includes fees for the use of resources in protected areas, which was established on the basis of various legal acts.

Climate change and biodiversity are interconnected. Preserving natural ecosystems and restoring degraded ecosystems (including their genetic diversity and species diversity) is essential for the overall objectives of the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change, as ecosystems play a key role in the global carbon cycle and adapt to climate change while at the same time providing a wide range of ecosystem services that are essential for human well-being and development. Thus, the preservation of biodiversity can greatly contribute to mitigating the negative effects of climate change.

The functional information system for biodiversity is a prerequisite for achieving efficient nature protection. At the national level, it is necessary to introduce an organized collection of biodiversity data as well as a monitoring system in order to determine the status and monitor the trends of the biodiversity state at the national level. Certain databases that exist in public and scientific institutions need to be networked and granted access rights.

The main anthropogenic factors that adversely affect biodiversity involve:

- degradation of natural ecosystems to cultivated agroecosystems, sylvicultures or (sub)urban area,
- fragmentation of habitats

- overexploitation of genetic and biological resources
- introduction of allien species from remote areas
- contamination of air, water and soil by toxic pollutants
- increased level of ionizing and nonionizing radiation
- induced climate changes

Priority Actions toward National Target 1

1.1 Stopping the trend of vulnerability and loss of biodiversity

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target C12

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

Due to effect of numerous negative anthropogenic factors, in recent period the trend of vulnerability and loss of biodiversity is registered worldwide and in Serbia as well. Most important cause of this is destroying or disturbance of habitats, followed by various direct threats from invasive species and over-exploitation to intent killing, harming, disturbing and fatal incidents caused by traffic, infrastructure, pollution etc. Official administrative measures in Republic of Serbia (RS) towards stopping the trend of vulnerability and loss of biodiversity are signing and ratification of relevant conventions, especially Convention on Biodiversity, as well as Bern, CMS, CITES and other, and within national system, through Law on Nature Conservation and following laws and bylaws.

Most prominent aspect of the trend of vulnerability and loss of biodiversity is extinction of species, with most obvious examples from RS since middle XX century European Mink *Mustela lutreola*, Little Bustard *Tetrax tetrax*, Egyptian Vulture *Neophron percnopterus*, Bearded vulture (*Gypaetus barbatus*), White-headed Duck *Oxyura leucocephala* and Nodding Sage *Salvia nutans*. Some plant species are lost not only for Serbia, but Globaly, since they were endemic. These species are Kragujevac Marshmallow (*Althaea kragujevacensis*), Vranje Marshmallow (*Althaea vranjensis*) and Morava Water Chestnut (*Trapa annosa*). Additionally, many species in RS are recently very rare and endangered, such as Balkan Lynx *Lynx lynx martinoi*, European Souslik *Spermophilus citellus*, Great Bustard *Otis tarda*, Lanner Falcon *Falco biarmicus*, Meadow Viper *Vipera ursinii,* Blck Salamander *Salamandra atra,* Huchen *Hucho hucho*, European Sturgeon *Huso huso*, Tench *Tinca tinca,* Goldfish *Carassius auratus*, Pančić's Grasshopper P*yrgomorphella serbica*, Edelweiss *Leontopodium alpinum*, Banat Peony *Paeonia officinalis* subsp. *banatica*, Yarrow of King Alexander (*Achilleaalexandri-regis)* with decreasing trend of population, area or ecological status. For these species, and other with similar status, measures are taken in order to stop the trend of vulnerability and loss of biodiversity. These measures, although clearly orientated, certainly didn't fully stop this negative process. Among most important measures is its strict protection, according to Regulation on proclamation and protection of strictly protected and protected wild species of plants, animals and fungi (Official gazette of Serbia; br. 5/10) to with 1769 strictly protected and 853 protected species. Additionally, establishing of protected area is mainly orientated towards biodiversity conservation. Protected areas established with main cause of conservation of certain species, named after species, such as Strict Nature Reserve "Zeleničje" and Special nature Reserve "Pastures of Great Bustard" are especially interesting cases. Officially, within protected areas and in nature areas in general, all human activities are harmonized to minimize or exclude damage to biodiversity, mainly through conditions within licenses issued by INCS and INCVP. Besides these measures, some active conservation measures of habitats and species are taken.

In Sebia, there is a system for monitoring of some birds and butterfly species for several years. There are data collected regardnig the trend of changes in population abundance of selected butterfly and bird species from forest and meadow habitats. The change in the population of butterfly indicates the loss, but also changes in the structure of their habitats, due to fragmentation and isolation, as well as other changes in the environment that directly or indirectly affect the change in population structure. This measure is monitored throught indicator which relates to the number of population of selected butterfly species and population growth through the time and by habitats. Changes of the most important types of habits is presented according to CORINE Land Cover and EUNIS.

AIR QUALITY: The most prominent air pollutants include: sulfur dioxide, nitrogen oxides, tropospheric ozone, suspended particles, persistent organic pollutants and haevy metals. Direct exposure to these polutants may result with acute and chronic physiological disorders of organisms, irrespective on their taxonomic status. Besides the direct harmful effects, sulphur and nitrogen oxides indirectly degrade ecosystems by the acidification process, or process of forming strong mineral acids from precursors (sulphur and nitrogen oxides).

1.1.1. Indicator name: Main pollutants concentration and deposition trend

Author / Institution: Lidija Marić/ Environmental Protection Agency

Key message: The trend of air pollution In Serbia has deteriorated

Assessment: 

The deposition of pollutants from the air is one of the main exogenous ones factors that affect health the state of forests and vegetation, as well as the quality of forests land influencing the stability of the ecosystem. Also, like the deposition result also results in a reduction in forest resistance to drought, but also on attacks of insects and fungi.

Methodology used to determine the deposition of air pollutants is defined by the criteria of *European Monitoring and Evaluation Programme*- EMEP.

(https://www.emep.int/)

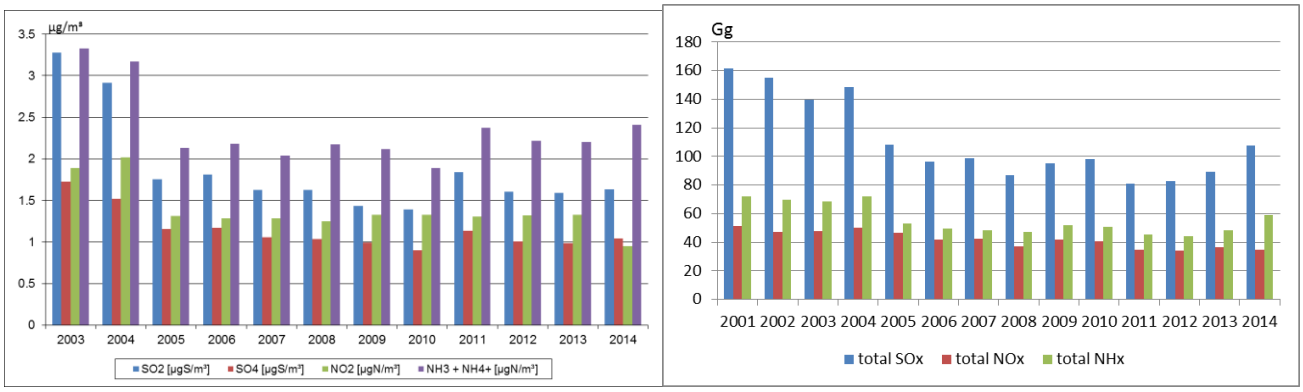


Fig. 1.1.1.1. Concentration and deposition of main pollutants trend.

Based on the results, it can be concluded that there has been a significant reduction in the concentration of the air pollution deposition since 2001.

1.1.2. Indicator name: Biomonitoring of air-pollution

Author / Institution: dr. Mira Anicic-Urosevis/ Institute for Physics, University of Belgrade

Key message: In Serbia there is a declining trend of air pollution with potentially toxic elements

Assessment: 

The bio-indicator species of moss *Hypnum cupressiforme* are used in Serbia for the research of air quality in out-of-town / rural areas (so-called passive bio-monitoring). In Serbia, from 2000 to 2015, there is a declining trend of air pollution with potentially toxic elements (a potential cause: the cessation of the operation of numerous industrial plants)

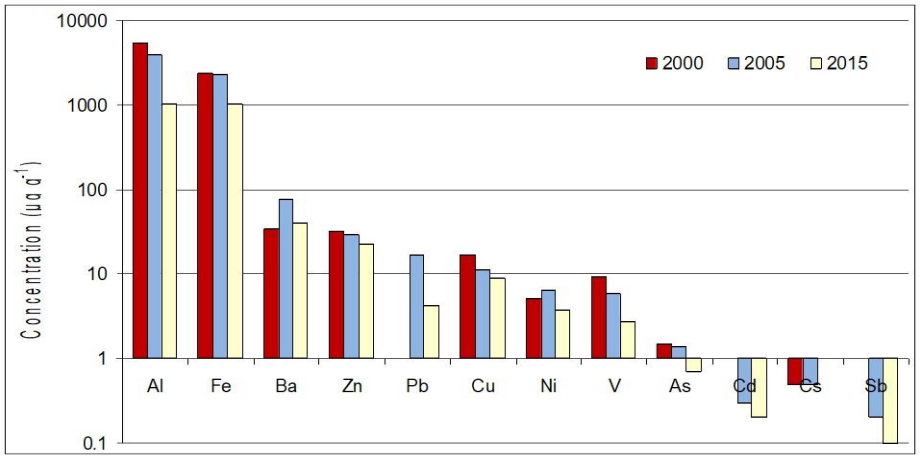
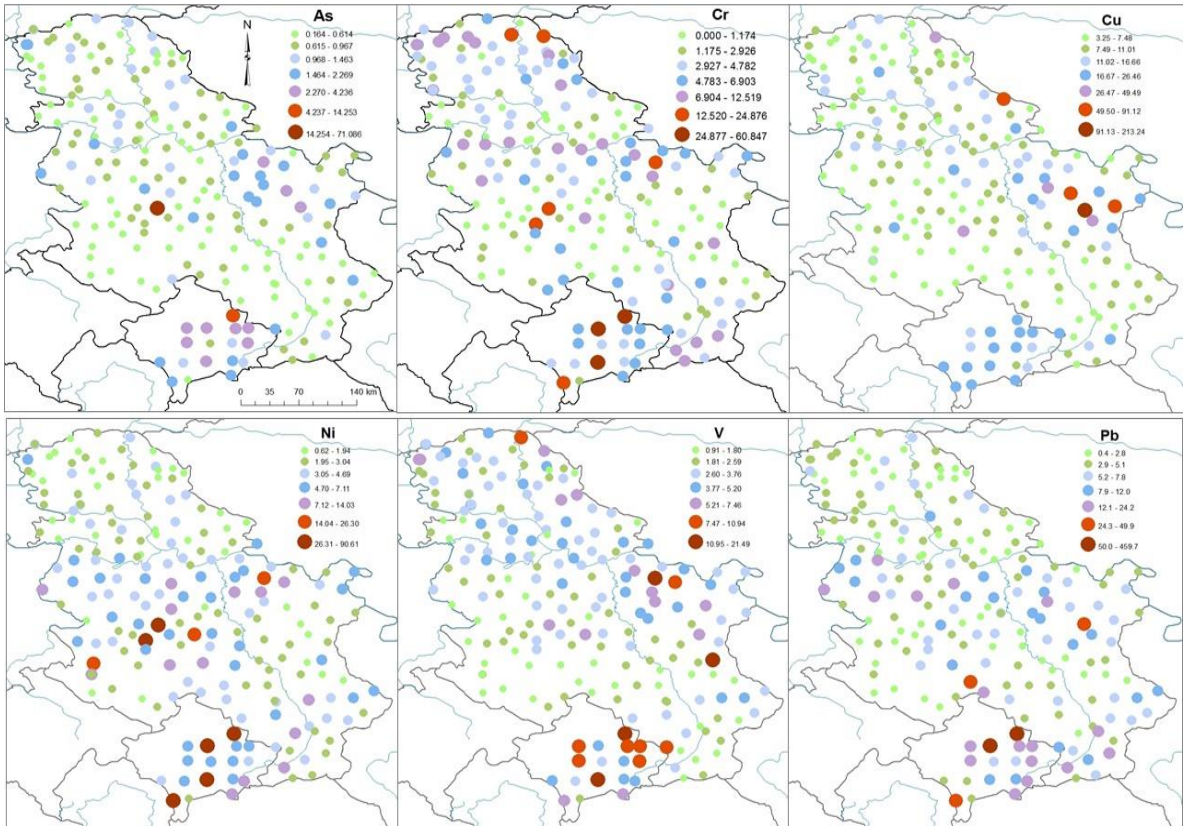


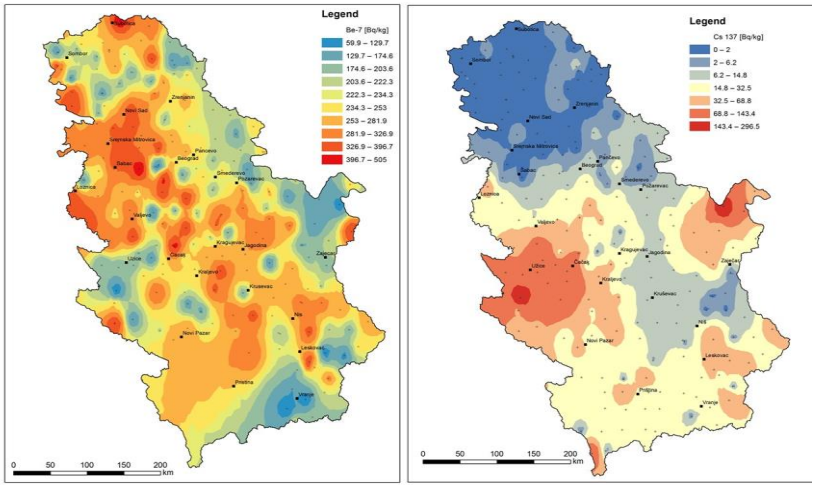
Fig.1.1.2.1. Concentration of heavy metals in mosses as indicators of air pollution

Spatial distribution of the element concentrations in the moss across Serbia in 2015 highlighted the southern part of the country (Kosovo and Metohija) as the most loaded with the elements, especially As, Cd, Cr, Ni, Pb, Sb, V and Zn. This area is characterised by complex geological settings, followed by the mining, and the other accompanied activities. Besides, the highest concentrations of Cu found in the region of the copper-mining basin in the north-eastern part of Serbia.



Map. 1.1.2.2.Distribution of heavy metals in Serbia

Spatial distribution of natural radionuclides and ^{137}Cs were assessed in the moss samples collected in 2015. Particular interest was on the spatial distribution of ^{7}Be, cosmogenic radionuclide, produced by cosmic radiation in lower stratosphere and upper troposphere. This radionuclide can be used as natural radiotracer in estimation of atmospheric transport paths. Higher concentrations of ^{137}Cs were found in the moss growing in forests of mountain regions than in agricultural areas. Spatial distribution of ^{7}Be was non-uniform across Serbia, and varied even for the order of magnitude.



Map. 1.1.2.3. Distribution of Cs and Be in Serbia.

1.1.3. Indicator Name: Air quality in the selected protected areas

Author / Institution: Lidija Maric/ Environmental Protection Agency

Key message: Since 2010, there have not been exceedences of limit values for air quality parameters SO_2, NO_2 and PM10 in protected areas. Only in the summer period there were exceedences of target value for ground level ozone.

Assessment: 

The indicator shows the exceedences of annually limit values for air quality parameters SO_2, NO_2, PM_{10}, and O_3 in the protected areas.The indicator describes the state of the environment in terms of air quality pollution The indicator is calculated based on the data of the national and local networks for monitoring of air quality from daily SO_2, NO_2, PM_{10} concentrations and max eight-hour values for O_3 concentration.

Since 2010, there have not been exceedences of limit values for air quality parameters SO_2, NO_2 and PM_{10} in protected areas. Only in the summer period there were exceedences of target value for ground level ozone.

Protected areas are only part of the territory of the Republic of Serbia where operational air quality monitoring is carried out. Parameters that are measured because they have negative effects on people, plant and animal world are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO, suspended particles smaller than 10 micrometers (PM_{10}) and diameters smaller than 2.5 micrometers ($PM_{2.5}$) and ground-level ozone (O_3). The graphs show the concentrations of the mentioned parameters in protected areas over the limit values of concentrations are not recorded for any parameter exept the target value of ground-level ozone for protection of vegetation of TV AOT40, Kopaonik, Kamenicki Vis and Obedska Bara.The graph below shows trend of a slight increase concentrations SO_2 and trend of reducing concentrations NO_2 in the selected protected areas since 2014.

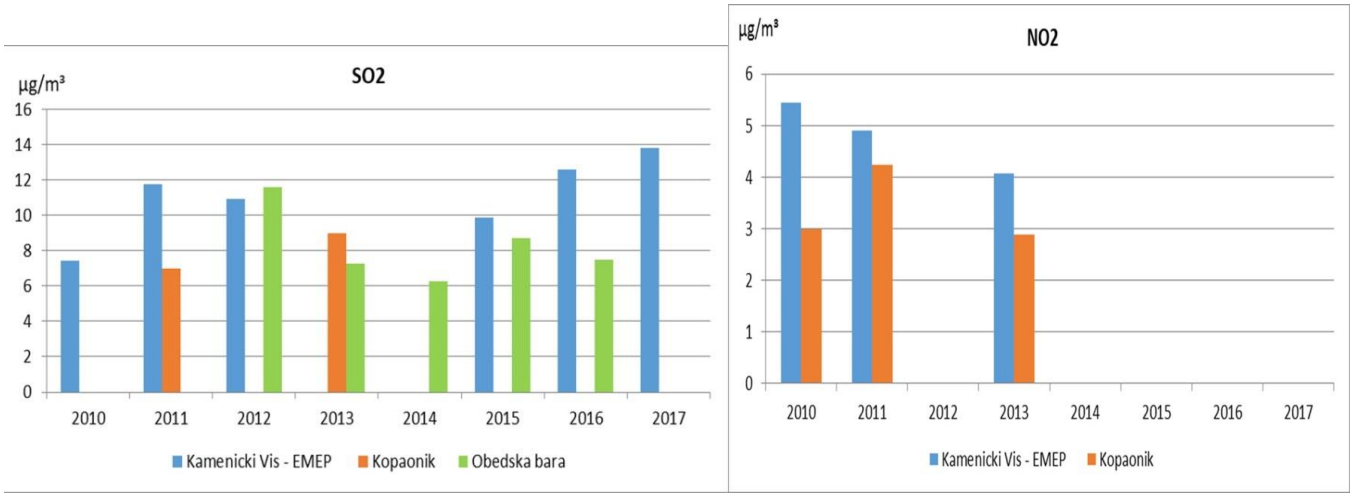


Fig. 1.1.3.1. Trend of SO_2 and NO_2 in the selected protected areas

The graph below (left) shows trend of reducing concentrations PM_{10} at the location Kamenicki Vis since 2012. The graph below (right) shows trend of concentrations ground-level ozone for protection of vegetation (AOT40), on four locations: Kopaonik,

Kamenicki Vis, Obedska Bara and Deliblatska pescara. Ground-level ozone had the biggest negative impact on vegetation in 2012 in the selected protected areas.

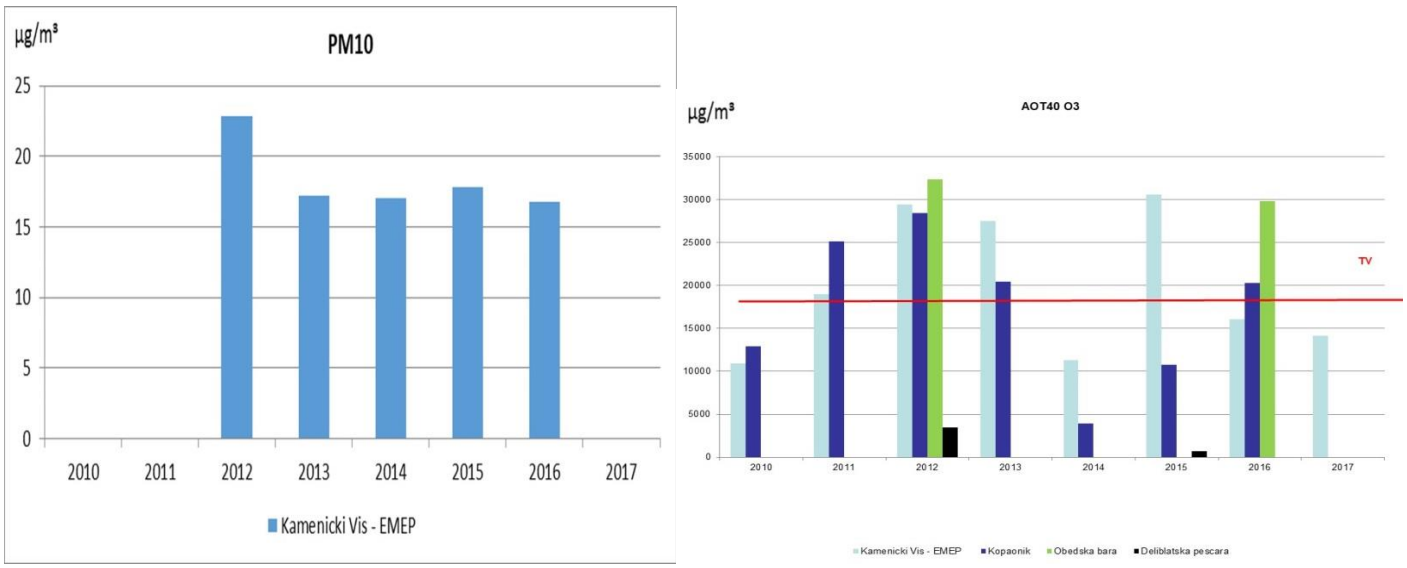
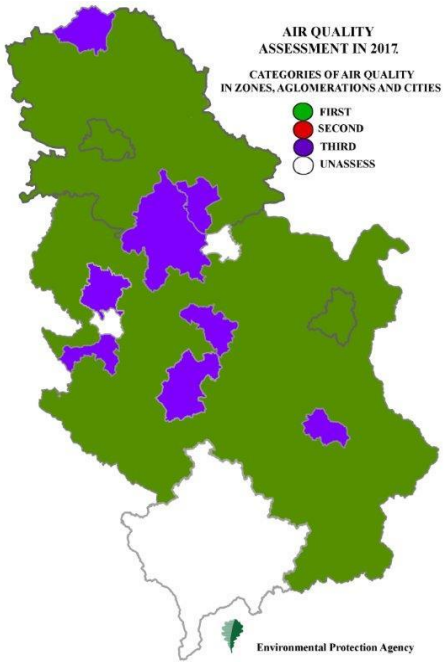


Fig. 1.1.3.2. Trend of PM_{10} (left) and ground level ozone (right) in the selected protected areas

Additional information and comments

The Environmental Protection Agency carries out operational monitoring of air quality in the national network for air quality monitoring in the Republic of Serbia. In accordance with the Law on Air Protection, the national network has been established for the purpose of measuring air quality in settlements, industrial and non-urban areas, in areas affected by traffic, protected natural areas and for the purpose of measuring transboundary atmospheric transport of pollutants in the air.

The assessment of the quality of air is carried out on the basis of exceeding the limit and tolerance values of the average annual concentrations for SO_2, NO_2, PM_{10}, CO, and O_3 pollutants and the only legally defined and binding assessment of the degree of pollution in the Republic of Serbia. There are three categories of air quality: category I, i.e. clean or slightly polluted air, category II, i.e. polluted air, category III, i.e. over-polluted air. The assessment of the air quality in the Republic of Serbia in 2017, by zones, agglomerations and cities is shown on the map.



		CATEGORIES OF AIR QUALITY							
		2010	2011	2012	2013	2014	2015	2016	2017
ZONE	SRBIJA	II	I	I	I	I	I	I	I
	City Kragujevac					II	III	III	III
	City Kraljevo								III
	City Valjevo			III	III	III	III	III	III
	VOJVODINA	II	I	I	I	I	I	I	I
	City Sremska Mitrovica					II	III	III	I
	City Subotica							III	III
AGLOMERATION	Novi Sad	III	III	I	I	I	II	I	I
	Beograd	III	III	III	III	II	III	III	III
	Pančevo		III	III	I	I	III	I	III
	Smederevo		III	III	III	III			
	Bor	III	III	III	III	III	III	I	I
	Kosjerić		III	III	II	I			
	Užice		II	II	III	III	III	III	III
	Niš	III	III	II	I	I		I	III

Map. and Tab. 1.1.3.3. The change in air quality by categories of air quality in agglomerations in the period from 2011 to 2017

Over time, the percentage of agglomerations with heavily polluted air has changed so that in 2011 over 80% of agglomerations had heavily polluted air, which was the largest share, while in 2012 and 2016 it was the smallest with about 20% of the total number of agglomerations. The number of agglomerations with excessively polluted air increased in 2017, while the number of agglomerations for which categorization could not be maintained remained unchanged. The largest number of agglomerations had clean air in 2014 and 2016.

WATER POLLUTION: Water enrichment and overloading with nitrate and phosphorus initiate the eutrophication process. Eutrophication is the result of synergistic effects of multiple factors. Inorganic phosphorus and nitrogen are the major limiting compounds for aquatic photoautotrophs (cyanobacteria, micro- and macroalgae, as well as angiosperms). High input of these compounds to waters may provoke a rapid phytoplankton production. Algal blooms (overgrowth of algal populations) may disturb the structure and functions of aquatic ecosystems. Freshwater cyanobacteria produce several bioactive secondary metabolites with diverse chemical structure, which may achieve high concentrations in the water, when cyanobacterial blooms occur. Some of the compounds released by cyanobacteria have allelopathic properties, influencing the biological processes of other phytoplankton or aquatic plants. Allelopathy can influence the competition between different photoautotrophs for resources and change the structure of phytoplankton communities. Allelochemical compounds produced by dominant species eliminate weak competitors, reducing biodiversity of phytoplankton communities. Gross described allelopathic mechanisms of cyanotoxins. Excessive growth of *Cyanobacteria* (previously misclassified as blue-green algae or Cyanophyta) can produce cyanotoxins in such concentrations that they are poisonous to fish, cattle, and humans. When dead phytoplankton sink to the bottom, their decomposition may reduce the oxygen concentration in the water to levels too low to support fish and benthic invertebrates. Enhanced biological production and other associated effects of eutrophication usually occur in lakes, reservoirs, coastal areas, and large, slowly flowing rivers.

1.1.4. Indicator Name: Aquatic macrophytes water pollution biomonitoring

Author / Institution: dr Snežana Branković/ Institute of biology and ecology, Faculty of Science, Kragujevac

Key message: Increase in heavy metals concentration in aquatic ecosystems

Assessment: 

The aquatic macrophytes were investigated in the period 1996 - 2018. Research results show a general trend in increasing the concentration of investigated metals in aquatic ecosystems.

The monitoring of accumulation of 8 metals (Fe, Mn, Zn, Cu, Ni, Pb, Cd, Cr) in aquatic macrophytes covered the period of 1996-2018. On the basis of literature data and research, data were used for 11 years (1996, 1998, 2002, 2003, 2004, 2006, 2010, 2013, 2014, 2015, 2018). Samples of water plants were taken from the sites with the greatest multitude and cover on several locations in different part of Serbia; up to 200- 1000 g of fresh aquatic species in each subsample; scientists and support staff should collect the aquatic macrophytes.

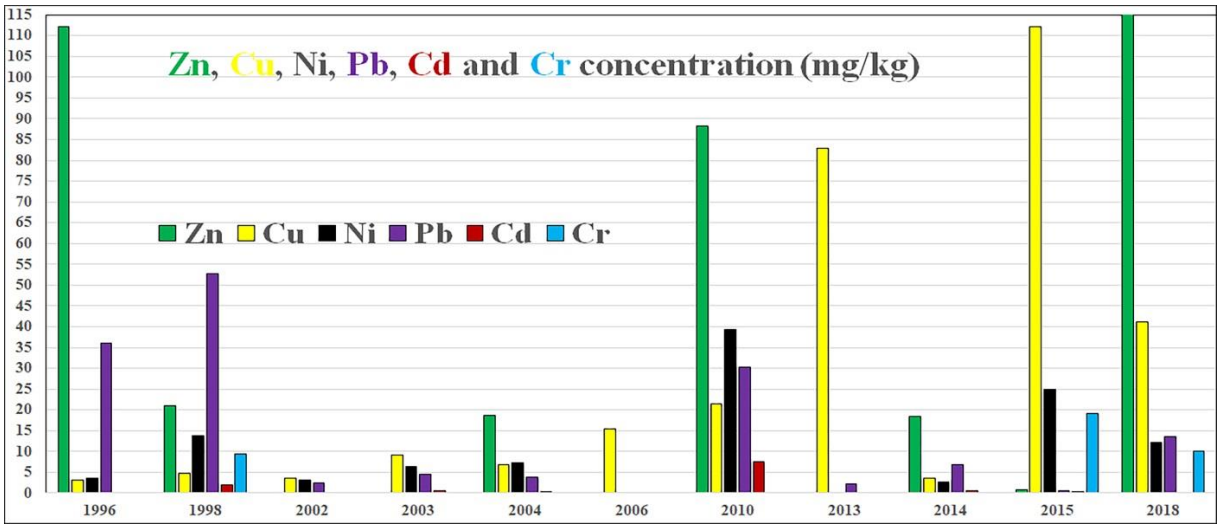


Fig. 1.1.4.1. Concentration of heavy metals in water bodies in Serbia.

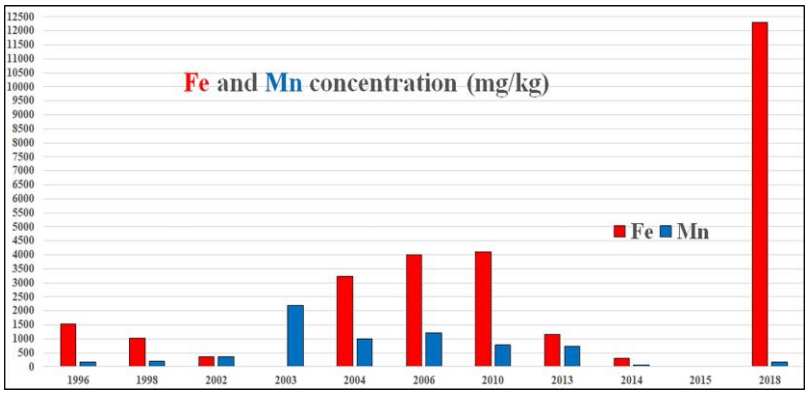


Fig. 1.1.4.2. Concentration of Fe and Mn in water bodies in Serbia.

On the base of published works and researches in the indicator passport: "WATER MACROPHYTES - WATER POLUTION MONITORING", the results of metals accumulation monitoring in water macrophytes are presented. The time period for monitoring of the accumulation of 8 metals (Fe, Mn, Zn, Cu, Ni, Pb, Cd, Cr) encompassed the period from 1996 to 2018. During processing of literature data and results of researches, data were used for 11 years (1996, 1998, 2002, 2003, 2004, 2006, 2010, 2013, 2014, 2015, 2018). Results of metal accumulation for 31 species of aquatic macrophytes at 65 sites throughout the Republic of Serbia were presented. The obtained results for the water macrophytes application show a tendency to increase of the concentration of the tested metals in water plants in the period of 11 years of the rivers, reservoirs and lakes monitoring.

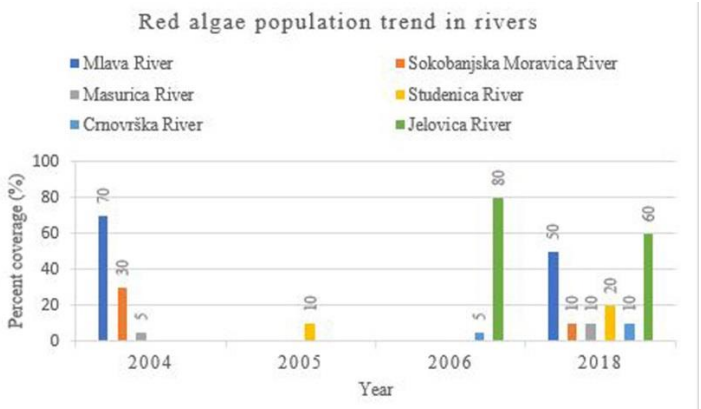
1.1.5. Indicator Name: Red algae population trend

Author / Institution: Aleksandar Mitrović, dr Snežana Simić/ Institute of biology and ecology, Faculty of Science, Kragujevac

Key message: It is recorded increment of population cover of red algae

Assessment: 

The indicator shows trend of the percent cover (%) changes of red algae population in aquatic ecosystems. The change in the percent cover (%) of red algae population indicates changes in environmental conditions in the habitat, which influences the composition of the benthic algae community in general, including red algae.



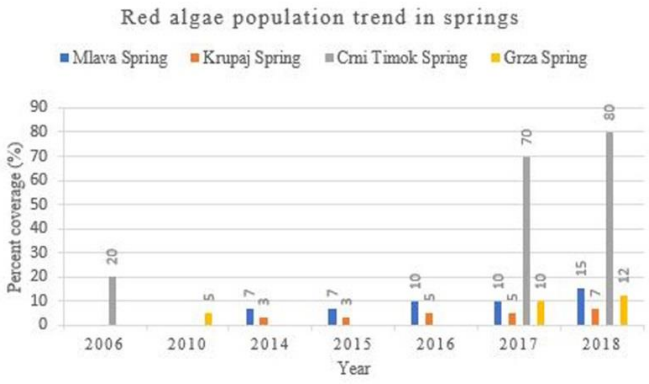


Fig. 1.1.5.1. Red algae population cover trend

One part of the data used for the production of indicators (data from 2004, 2005, 2006 and 2010) was taken from the published work (Simic & Djordjevic, 2017), while data from other years (2014, 2015, 2016, 2017 and 2018) obtained by research for the needs of final work and doctoral dissertation. The indicator was built on the basis of data on the diffusion percentage of red algae in four springs and six rivers. Based on the available data on the coverage of red algae in four sources (the Mlava well, the Krupa well, the Grze well, the spring of the Black Timok) of Serbia, we conclude that the trend of the population in all sources is on the rise.

The well of Mlava, Krupa and Grze are protected natural assets (Monuments of nature), so an increase in the population of these algae can indicate efficiency in the management of protected areas. Further monitoring of the trend is expected to increase the population, if the well is not exposed to a negative anthropogenic factor. The Black Timok spring is protected from all potential threats, so in the future it predicts a stagnation or further increase in the population of this group of algae

The increase in the red algae population was also observed at the locations of Studenica, Crnovrska reka and Masurička Reka. The Masurička Reka site is protected from all potentially negative impact factors (it is over 10 km away from the first inhabited place, and the water catchment area of this river is at least 5 km downstream of the sites where the red algae was found), so in further monitoring The trend is expected to increase the red algae population. It is assumed that a slight increase in their population is a consequence of the fact that the site is in full shade of deciduous vegetation, and the red algae recorded at this site prefer sunny habitats. In the Studenica and Crnovrška rivers the population trend is on the rise. However, as the construction of derivative mini hydropower plants is ongoing in these rivers, further downsizing of the trend is expected to reduce the red algae populations, and ultimately their complete disappearance from the mentioned ecosystems. On the sites of Moravica of Sokobanja, Mlava and Jelovica rivers, there is a trend of decrease of red algae populations cover.

Negative impacts were not noticed on the Jelovička River site, except for the possible impact of tourism, so that a further reduction in the red algae population is not expected in further monitoring of the trend. On the Moravica of Sokobanja and Mlava, the derivative mini hydropower plants have been built, so the downward trend in the population is expected. Further monitoring of the trend should predict further reduction of the red algae population, and ultimately their complete disappearance from the mentioned ecosystems.

Literature:

Simić S., Đorđević N. (2017): Morphology, distribution and ecology of the freshwater red algae Paralemanea (Batrachospermaceae, Batrachospermales, Rhodophyta) in Serbia. Archives of Biological Sciences, 69 (1): 167-174. DOI:10.2298/ABS160211093S. ISSN 0354-4664.

1.1.5.1. Case study: Invasive cyanobacteria *Cylindrospermopsis raciborskii* in the waters of Serbia

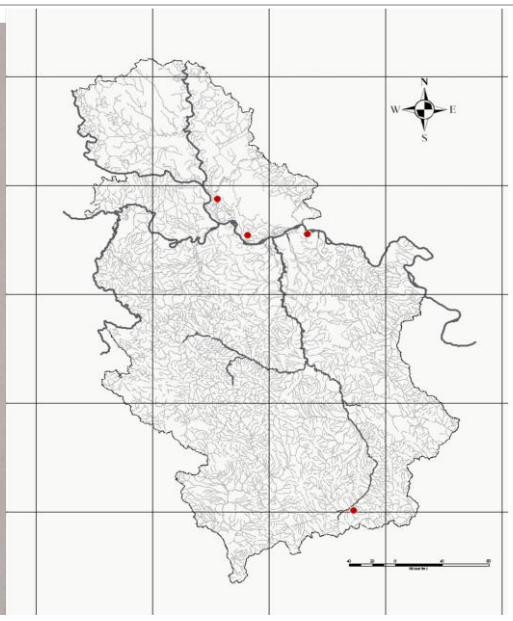
Author / Institution: *Aleksandra Mitrović* / Institute of Biology and Ecology, Faculty of Natural Sciences and Mathematics, University of Kragujevac

Assessment: 

In the conditions of climate change and increasingly frequent burden of nutrients, the phenomenon of cyanobacterial flowering is increasingly present in the waters, which can be accopmanied by the production of toxins dangerous to all aquatic organisms.
Cyanobacteria is characterized by strong tolerance to different environmental conditions,which is why they successfully populate a wide range of habitats. Toxins of cyanobacteria are very poisonous substances and when released into the water pose a threat to both aquatic and terrestrial organisms (Sedmak & Sirčev), 2011). Cyanotoxins can accumulate in different fish and other hydrobiotic organs, and their consumption poses a potential risk to human health.

In Serbia, a mass accidental death of fish is also caused by blooming of cyanobacteria. Thus, the massive fish die-off in the Aleksandrovac lake near Vranje in 2012 coincided with the blooming of the invasive cyanobacteria *Cylindrospermopsis raciborskii* (Woloszyńska) Seenayya et Subba Raju.

This thread like invasive cyanobacteria commonly inhabits tropical and subtropical ecosystems around the world (Karadžić, 2011). However, in the last thirty years the species has significantly expanded its area on moderate terrain of all continents.The species has a high level of adaptation to different environmental factors. In Serbia, it was recorded for the first time in a salt marsh near the Tamiš river (Cvijan & Fužinato), while its first flowering was recorded in the river Ponjavica (Karadžić et al., 2013), and then in Aleksandrovac lake (Đorđević & Simić, 2014 Đorđević et al., 2015).A significant presence of this type was also recorded in the lake Srebreno jezero ,a reservoir dedicated to tourism and recreation (Simić et al., 2018). Data on the presence of this pecies in a growing number of waters indicate the expansion of its area, and its expansion is predicted in the future. The fact that the species is growing more and more in the waters of Serbia is significant given the fact that the species is known as the producer of toxic substances, primarily hepatoxic cylindrospermopsin. Đorđević et al. (2015) were the first to detect a cylindrospermopsin toxin in Serbia, after a massive fish die-off in the Aleksadrovac lake. It is believed that the effect of various factors, but above all the presence of toxins and the lack of oxygen caused by the flowering of C.raciborskii, led to this alarming situation when 3 t of cyprinid fish died-off (Đorđević et al., 2015).



Pic and Map. 1.1.5.1.1. Invasive cyanobacteria *Cylindrospermopsis raciborskii* in the waters of Serbia

SOIL QUALITY: The great heterogeneity of the geological base in Serbia, its climate, vegetation and pedo-fauna contributed to the formation of extremely heterogenic soils in Serbia. There are nine edaphic climatic regions on Serbian territory. In each of the regions, several soil types are represented and their combinations reflect the general characteristics of these units. According to the Serbian soil map the most extensive groups are Cambisols (27.99%), Chernozems (17.68%), Leptosols (15.9%) and Vertisols (8.32%).

Agricultural areas dominate in Serbia and spread over 55% of the country's total area, while about 27% is occupied by arable land, 12% by complex cultivation and 12% by principally agricultural land with areas of natural vegetation. The share of agricultural and arable land in the total area of the Republic of Serbia is primarily the consequence of geomorphological and pedogenetic factors. These factors have had influence not only on the total areas under these land uses, but also on their distribution within the country. The largest areas subject to the above land uses are in the northern part of the country, the Autonomous Province of Vojvodina, as well as in the valleys of the large rivers in central Serbia. The share of agricultural land in the total area of AP Vojvodina is significantly higher, at the level of 71.3%, while the arable land is at the level of 65.8%. The average rate of soil organic carbon in the top 30 cm of the agricultural soils is 1.98 %, which can be considered as low.

The occurrence and progress of soil erosion is one of the major soil degradation processes and a cause of deteriorated soil quality. It is estimated that soil erosion (of various degrees) affects about 80% of agricultural soil. In the central and hilly-mountainous regions water erosion is predominant, while in the Vojvodina province in the north of Serbia, eolic erosion prevails, affecting approximately 85% of the agricultural soil with an annual loss of over 0.9 ton of soil per ha. A number of measures have been defined in agriculture related law aiming at the protection of agricultural land against the harmful effects of erosion.

Soil quality in the Republic of Serbia is also affected by uncontrolled and inadequate dumping of waste and by contamination stemming from industrial complexes. The largest number of registered sources of local soil pollution is related to municipal waste disposal and industrial and commercial activities. The risk from chemical pollution of soil in urban areas was monitored on 170 sites (2015) and 240 samples were analysed in the territory of the eight towns. The highest percentage of exceeded limit values was recorded for Cd, Cu, Zn, Ni and Co on the locations of frequent traffic, in the vicinity of business commercial zone and on agricultural land (Vidojevic et al., 2017).

1.1.5.2. Case study: Spatial distribution of soil organic carbon stocks in Serbia

Author/Institution: dr Dragana Vidojevic/ Environmental Protection Agency

Spatial distribution of soil organic carbon (SOC) were investigated in the soils of the Republic of Serbia (Vidojević et al., 2017). The database included a total of 1,140 soil profiles which corresponded to 4,335 soil horizons. To establish the relationship between organic carbon content and soil type, a soil map of Serbia was adapted to the WRB classification and divided into 15,437 polygons (map units). We calculated the SOC stock values for each reference soil group based on mean values of SOC at 0-30 and 0-100 cm and their areas. The largest SOC stocks for the soil layers 0-30 cm were found in Cambisol 194.76 x 10^{12} g and Leptosol 186.43 x 10^{12} g, and for the soil layers 0-100 cm in Cambisol 274.87 x 10^{12} g and Chermozem 230.43 x 10^{12} g. Based on the size of the reference groups, total area of Republic of Serbia, and the mean SOC values for each reference group, we calculated the total SOC stocks. The obtained values for the soil layers 0-30 cm and 0-100 cm amounted to 705.84 x 10^{12} g and 1,159.55 x 10^{12} g, respectively. The spatial distribution of organic carbon stocks and its variability is caused by various factors, such as clay content, land use pattern, altitude, and climate. In general, the distribution of the content of organic carbon at 0-30 cm showed higher values in Central Serbia, where forestland occupied a larger area than agricultural land. This study is the first comprehensive assessment of organic carbon stocks in the soils layers 0-30 cm and 0-100 cm done in the Republic of Serbia. The compilation of data on organic carbon stocks and its distribution in the different soil reference groups is the first step in the evaluation and monitoring of changes of organic carbon stocks in the soils of Serbia.

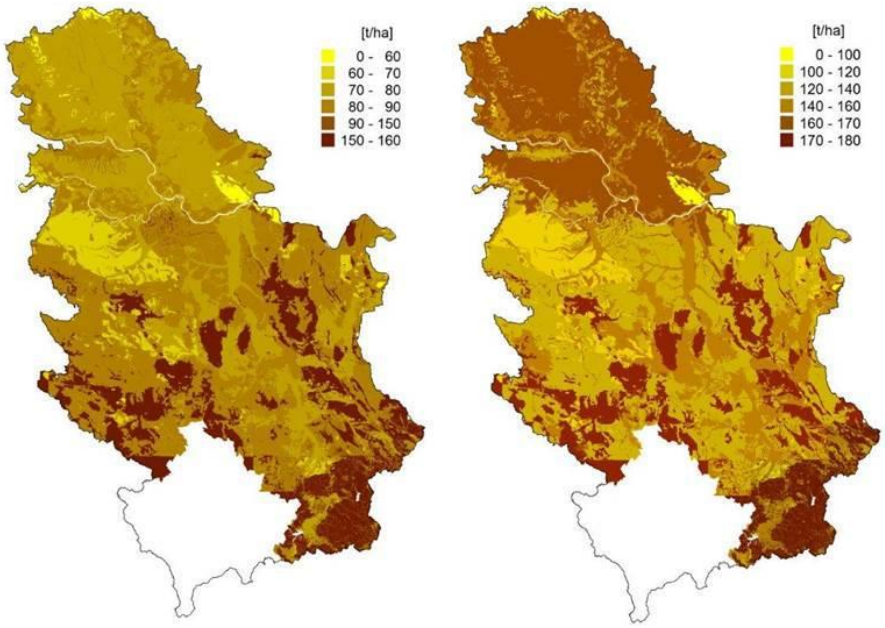


Fig. 1.1.5.2.1. SOC stocks distribution by soil type, to the depths of a) 0-30 cm and b) 0-100 cm

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1.1.5.3. Case study: Contaminated sites in the Republic of Serbia – potential risk to ecosystems and natural resources

Author/Institution: dr Dragana Vidojevic/ Environmental Protection Agency

Assessment: 

Serbian Environmental Protection Agency (SEPA) is responsible for establishment and management of a national Cadaster of contaminated sites which is an integral part of the information system for environmental protection in the Republic of Serbia.

Already upon its establishment in 2006, SEPA started with data collecting and systematization of information on potentially contaminated and contaminated sites for the Cadaster. According to the Law on Soil Protection, the Cadaster of contaminated sites *is a set of relevant data on vulnerable, contaminated and degraded soils*. The collected data includes sites where processes of degradation and destruction are manifested. The main purpose of the Cadastre is to provide systematic data on sources of pollution, such as type, quantities, method and location of discharges of pollutants into the soil, in order to implement prevention and remediation measures.

The latest update of the Cadastre database shows that on the territory of the Republic of Serbia, 709 potentially contaminated and contaminated sites were identified and recorded, of which 557 sites are registered and 152 are estimated. Out of 709 sites, 478 are in need of investigation or still to be investigated and 103 are currently under investigation. Rehabilitation and remediation (re-cultivation) are completed on 52 sites where after-care measures are currently being applied (Figure 1,2). Sites such as former military locations, petrol and filling stations, dry cleaners, wastewater treatment installations and pipelines for the transport of dangerous substances are not included in Cadaster.

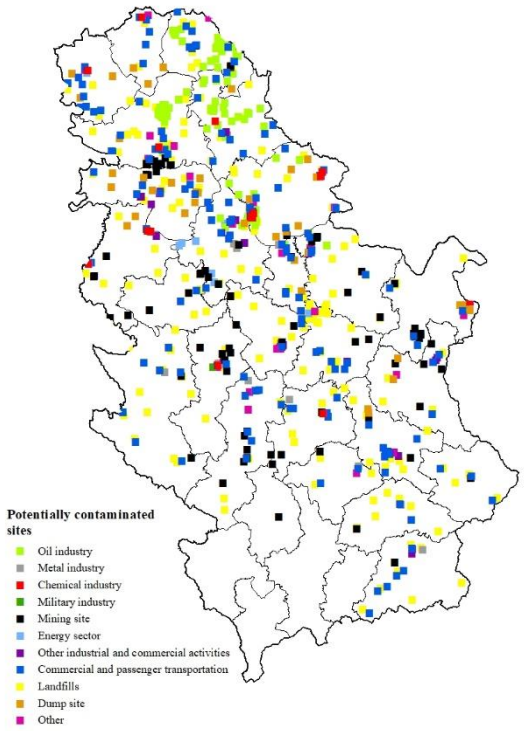
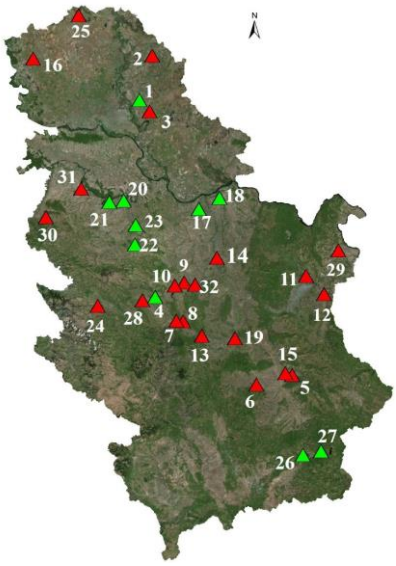


Fig. 1.1.5.3.1. Map of potentially contaminated sites in the Republic of Serbia

Identified sites	
Potentially contaminated sites in need of investigation	478
Contaminated sites under investigation	103
Sites where main sites investigation have been completed	76
Remediated sites	52
Total number	709

Tab. 1.1.5.3.2.Current status in Cadaster of contaminated sites of the Republic of Serbia

The UN Environment/GEF project "*Enhanced Cross-sectoral Land Management through Land Use Pressure Reduction and Planning*" funded by the Global Environment Facility (GEF), started in October 2015 and is executed by UN Environment Europe Office – Vienna Programme Office. The main objective of this project is to develop instruments and mechanisms for integrated land use management, remediation, and capacities to reduce pressures on land as a natural resource from competing land uses in the wider landscape, while supporting reversal of land degradation. To date, project has supported development of a legal framework for soil protection, a Contaminated Sites module and application for data submission for the Cadaster, in addition to preliminary investigation applied at 32 industrial sites across the country (Figure above).



Localities with exceeded remediation values of analyzed parameters	
2	Zn
3	PCB
5	Pb
6	Cr, Cu, Ni, Zn, C10-C40
7	Cu, Pb, Ni, As
8	As, Ni, Cu,
9	As, Cu, Ni, Zn
10	Cu
11	As, Cu
12	Cr, As, Pb
13	As, Cu, Ni, Cd, Zn
14	Ni
15	Cu, Zn, Pb, Ni, As, Cr
16	Pb, C10-C40
19	Hg, Cr, Cu, Ni, Zn, Pb, As, Cd
24	Cu, Zn, Ni
25	As, Cu, Zn
28	Ni
29	As
30	As,Cd, Cu, Ni, Pb, Zn
31	As, Cd, Cr, Cu, Ni, Pb, Zn DDE/DDD/DDT, PAH
32	Cr, Cu, Ni, Zn

Map. and Fig. 1.1.5.3.3.Investigated industrial contaminated sites in the period 2015-2018

1.1.5.4. Case study: Specific activity of ^{137}Cs in soil in southern Serbia

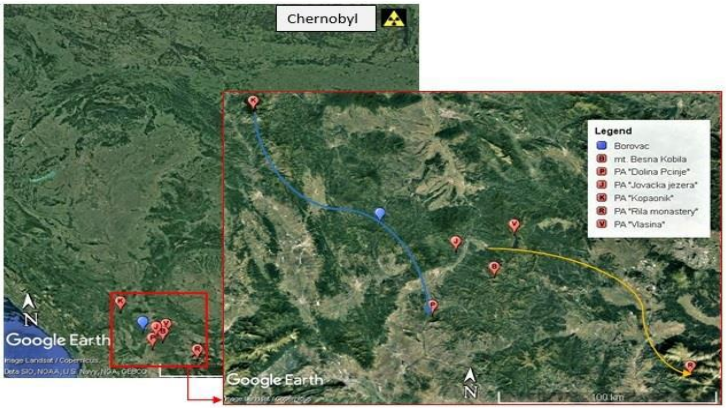
Author/Institution: dr Jovana Dzoljic, College of applied professional studies, Vranje

Assessment: 

The total amount of ^{137}Cs has reached the environment after nuclear tests in the post-war period from 1945 to 1980, and after the incident in Chernobyl in 1986. Based on data from the Agency for the Registration of Toxic Substances and Diseases(ATSDR,2004),the radiological effect of ^{137}Cs was released on the teritoryof Europe during the Chernobyl disaster was high.

Authors Bossew et al. (2001) state that Austria is one of the countries whose territory was significantly contaminated by the ^{137}Cs after the Chernobyl disaster. The same authors also state that higher values of contamination can only be foundin Ukraine, Belarus, Russia as well as in some parts of Scandinavia.
On the territory of Serbia distribution of ^{137}Cs is heterogeneus. Authors Jankovic-Mandic et al. (2014) point out that the variability of the specific activities of ^{137}Cs in samples of non-cultivated soil from the territory of Belgrade (3 – 87 Bq kg^{-1}) is due to topographical differences and non homogeneous surface contamination of the soil after the Chernobyl accident.

The specific activity of ^{137}Cs in the soil of central and southern Serbia is different, however, two regularities can be noticed.
According to the detected values, two curves of distribution can be separated, western and eastern (Map below).



Map.1.1.5.4.1. Locations for soil sampling

On graph below maximum value of the specific activity follow the western curve and increase further from the Kopaonik National Park (NP) (Džoljić et al.,2017) to the area of exceptional qualities (PIO) “Dolina Pčinja” (average value 101 Bq kg^{-1} (Petrović et al., 2016; Džoljić, 2017)).

In the countries of the region a similar specific activity of ^{137}Cs was also detected west of the the sites covered by the study.Authors Antovic,Vukotic, Svrkota i Andrukovich (2012) indicate that in the soil of Montenegro the average specific activity is 81.1 Bq Kg^{-1}. Also the same authors point out that ^{137}Cs detected in the soil of Montenegro was mainly due to the Chernobyl accident.

The specific activitiy of ^{137}Cs at sites that follow the eastern curve show lower detected values than the wetern curve. The highest value was measured on the eastmost site, the Natural Park (PP) “Rilski Monastery” in Bulgaria (49 Bq kg^{-1}), (Džojić, 2017). In the south,for example in Northern Macedonia, aspecific activity of ^{137}Cs was recorded in uncultivated soil by authors Todorovik et al. (2015) ranges from 6.63 to 14.94 Bq kg^{-1}. Values in Norther Macedonia are similar to the values at sites PIO “Vlasina” the monument of nature (SP) “Jovačka jezera” and the mountain “Besna Kobila”.

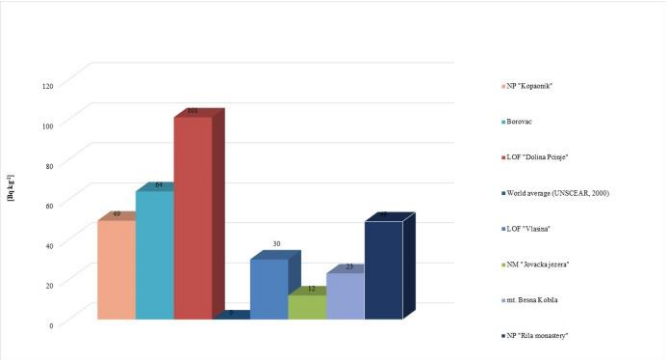


Fig. 1.1.5.4.2. Detected specific ativity of ^{137}Cs in the soil

By inspecting the literature data it can be concluded that the specific ativity of ^{137}Cs in the soil is significantly higher in countries that were exposed to the radioactive clloud from Chernobyl, icluding Bulgaria, R. Srpska, Serbia, Montenegro, North Macedonia, etc. Compared to other countries where the specific activity of ^{137}Cs is the result of nuclear testing.

The importance of determining the distribution of specific activities of this radionuclide in the soil is primarily due to the development of traditional forms of agriculture, as well as local and organic products of this region, in order to improve the living standards of people living in this area.

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INVASIVE ALIAN SPECIES (IAS) AND PESTS OUTBREAKS

The first preliminary national list of invasive plant species for the territory of the Republic of Serbia date from 2012, while at that time a list of invasive species of plants and animals on the territory of the Autonomous Province of Vojvodina was already existed. The first mentioned above for the territory od Serbia was printed under the paper "Preliminary List of Invasive Species in the Republic of Serbia with General Measures of Control and Suppression in Support of Future Legislative Acts". In 2018, a comparative Table of invasive plant species of the Republic of Serbia and countries in the region was prepared, but general problem faced on was that criteria for proposing invasive species differamong WB countries. The results was published under the internship research paper (2018): "Revision of the preliminary national list of invasive plant species with proposed measures on control and suppression." Considering that the species is invasive on the territory of a country if it is listed on the "official" list of invasive species of that country, a total of 165 species of invasive plants have been recorded for the Republic of Serbia and eight countries in the WB region.

According to the last inventory of the invasive species of plants and animals for the Republic of Serbia, which was made in 2016 under the ESENIAS (regional portal for information on invasive alien species in the countries of eastern and south-eastern Europe - http://www.esenias.org), There are a total of 346 invasive species on the territory of our country. In addition to the species of plants that are invasive to there are 11 other invasive species in Serbia (Amaranthus blitum L., Bromus catharticus Vahl, Catalpa bignonioides Walter, Centaurea biebersteinii DC, Helianthus annuus L., Helianthus scaberrimus Elliott, Impatiens balsamina L., Oenothera villosa Thunb, Portulaca grandiflora Hooker, Symphyotrichum novae-angliea (L.) GL Nesom and Tragopogon porrifolius L. subsp. Australis (Jordan) Nr. -Bl.), which should also be taken into consideration when drafting a national inventory of invasive species and determining their status.

1.1.6. Indicator name: Invasive insect species

Author / Institution: Bojana Nadazdin/ Non-governmental organization “HabiProt”, Belgrade

Key message: The number of invasive species of insects in Serbia is on the rise

Assessment: 

By reviewing the entry into the online insect database of Serbia "Alciphron", the total number of invasive insect species at the moment is 30. When we look at the earlier data, we will see that the number in 2009 was only 10 insect species, in the following years the number varies and is mainly increasing. Exceptions are 2012 and 2016 when the number dropped compared to the previous one, but it is most likely a consequence of overseeing the factual state, and not the actual disappearance of one species from the territory of Serbia, due to the lack of targeted research into invasive insect species and possibly a small number of individuals of the given species.

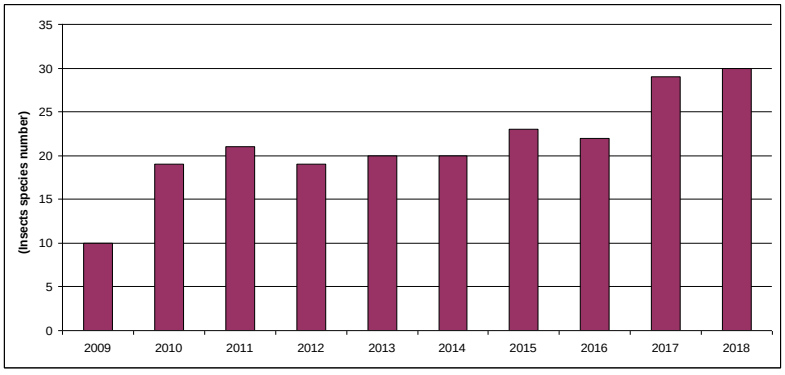


Fig. 1.1.6.1. Trend of invazive insects species number.

It is very difficult and rare that the invasive species disappears from the habitat by itself. This data shows clearly that the number of invasive insect species in Serbia is on the rise and suggests that it is necessary to compile a list of priority invasive species, as well as develop a strategy for controlling the influx of invasive species, preventing their spread and defining measures for the protection of autochthonous biodiversity.

Halyomorpha halys is a type of bug-insect from the *Pentatomidae* family, which is native to the area of East Asia. The species is invasive and is first seen outside its natural area in the US. The first published data on the findings in the area of Europe are from 2004, although it is assumed that it was previously present in Europe. H.halis is considered a pest of agricultural crops and uses a large number of plant species in its diet.

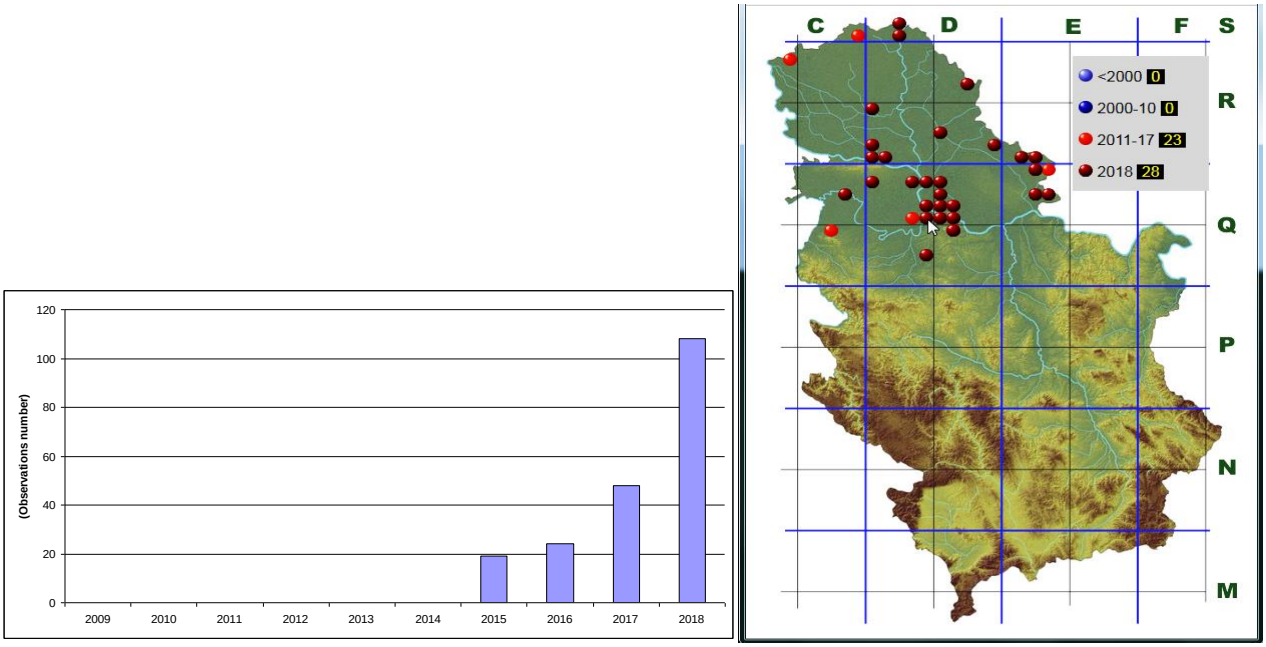


Fig. 1.1.6.2. Trend of *Halyomorpha halys* findings per year and distribution map.

The "Alciphron" database of insect propagation of Serbia is an excellent tool for assessing the status and distribution of this invasive species. Data analysis shows that Halyomorpha halys is first recorded in Serbia in 2015 (Graph 1). In 2016, a slight increase in the findings is observed, and in 2017 this number is doubled. Analysis of the data from 2018 shows us clearly that the species is in the process of spreading its area, the number of findings is more than twice as high as in the previous year. Map 1 shows UTM fields (10x10km) in which an invasive species is recorded per year (period up to 2000, 2000-2010, 2011-2017 and 2018). On the map, we notice that the growth of "infected" UTM fields is not great, but it is evident that it is growing. By analyzing all the data from the database, it is clear that the number of encounters with the species is steadily growing, and for now, the species is localized in Vojvodina, precisely because of the development of agriculture, as well as the climate that favors this invasive species. What is expected in the following period is the spread of the H.halys at the southern region of Serbia, as well as at higher altitudes due to the invasive character of the species and climate change (milder and shorter winter periods). This is a species that must be taken into account in the processes of planning biodiversity protection measures against invasive species, given the current data, the growing number of recorded species findings in Serbia, as well as the significant detrimental economic consequences that it leaves.

The species *Cydalima perspectalis* (Box tree moth) is a butterfly from the *Crambidae* family, which is native to the region of East Asia. The diet is related to plant species of the genus Buxus, which grow in the form of bush and are often used in horticulture. The first species was recorded in Europe in 2006, followed by the spread of its area.It is assumed that it has been introduced into Europe through the transport of plant species. Larvae of this kind of butterfly feed on leaves of the genus *Buxus* and they can almost completely lead to defoliation of the bushes for a short period of time. As there are autochthonous species of the genus Buxus in Europe, it is clear that the butterfly represents a threat to native plant species. The analysis of data from the "Alciphron" database shows that the type of *Cydalima perspectalis* was first recorded in Serbia in 2014 with just a few finds. As of next year, there is an

increase in the findings (even 10 times higher in 2015 than in 2014). In the following period, the number of findings were growing and falling slightly over the years. Map 1 shows UTM fields (10x10km) in which an invasive species is recorded per year (period up to 2000, 2000-2010, 2011-2017 and 2018).

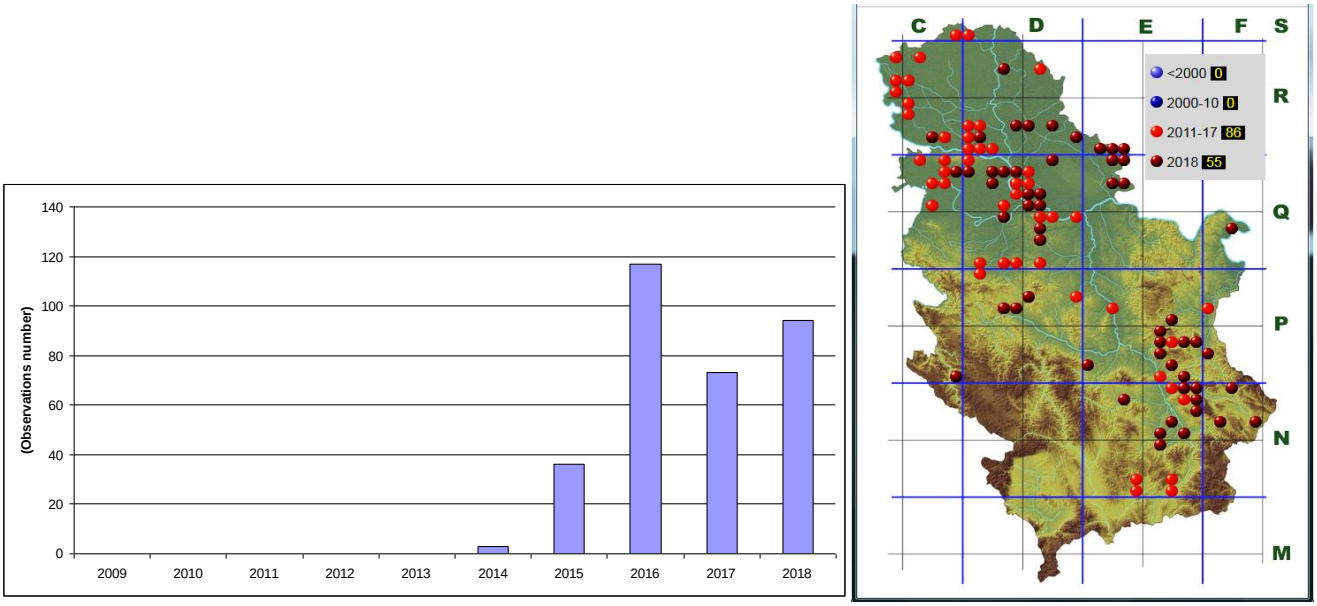


Fig. 1.1.6.3. Trend of *Cydalima perspectalis* finding per year and distribution map.

In addition to harmful economic effects (destruction of plantings in parks, gardens, etc.), the most serious consequence is the destruction of native species of the genus *Buxus* (in the territory of Europe, these are *Buxus sempervirens* and *B. balearica*). We can say that the situation is not alarming, but it is definitely that the invading species of *Cydalima perspectalis* has space for expansion and that it will most likely come in the upcoming period if appropriate control and protection measures are not taken, and this can have undoubtedly serious consequences.

1.1.7. Indicator Name: Monitoring and gradation of gipsy moth (*Limantria dispar*) in the forests of Serbia

Author / Institution: Dejan Miletic/ Public Enterprise Srbijasume

Key message: More frequent gradation period and decrease of latency

Assessment: 

Insect gypsy moth (*Lymantria dispar* L.) is the largest pest of the deciduous forests in Serbia, and also is a significant pest in fruit growing. Its overpopulation (gradation) often has the character of a natural disaster requiring significant engagement of labor and financial resources for the purpose of suppression. In the forests defoliation of gypsy moth leads to a decrease in the growth and weakening of the vitality of trees, and if this damage is in a chain reaction it can also lead to the occurrence of drying of forests.

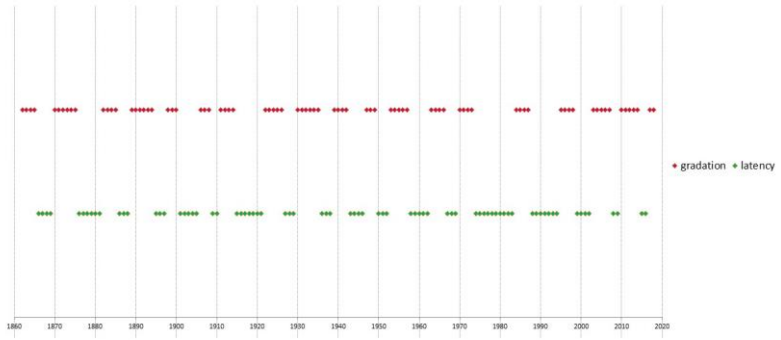


Fig. 1.1.7.1. Gradation of gypsy moth in the forests of Serbia.

Overpopulation of gypsy moth usually lasts from 3 to 6 years. In the period from 1862, since the time when it is being monitored in the territory of our country, to date 18 gradations have been registered, and the new (19th) gradation of the gypsy moth is underway in 2017, with the increased presence of gypsy moth nests, on relatively small surfaces, so that the gypsy moth came out of the latency and entered the first phase of gradation - progradation. During 2018, the trend of increasing its number and expanding territory under attack, which is mainly of low intensity.

Science has not yet established the reason for the occurrence of gradations, however, the analysis of the appearance of gypsy moth in Serbia in the period from 1862-2019 clearly shows the trend of increasing the frequency of gradations during the past 20 years. It is clearly visible that the duration of the latency period is reduced, which is only two years after the last three gradations.

There are some scientific researches that presuppose that the frequency of occurrence of gradations can be dramatically increased by the increase in temperature, change of precipitation regime and climate change.

Literature:

Predviđanje prenamnoženja gubara (*Limantria dispar* L.) u svetlu klimatskih promena - Dejan Stojanović, Milena Kresoja, Milan Drekić, Leopold Poljaković-Pajnik,Nataša Krklec-Jerinkić, Nataša Krejić, Saša Orlović
https://scindeks-clanci.ceon.rs/data/pdf/0563-9034/2016/0563-90341698015S.pdf

BIODIVERSITY AND HUMAN HEALTH

Health is often considered as a basic human right, and is defined by the World Health Organization (WHO) as not simply being free from illness, but in a state of complete physical, mental and social well-being. Biodiversity can be considered as the foundation for human health as it underpins the functioning of the ecosystems on which we depend for our food and fresh water; aids in regulating climate, floods and disease; provides recreational benefits and offers aesthetic and spiritual enrichment. Biodiversity also contributes to local livelihoods, to both traditional and modern medicines and to economic development.

All human health ultimately depends on ecosystem services that are made possible by biodiversity and the products derived from them. While the inter-linkages between biodiversity, ecosystem services and human health are inherently complex, inter-disciplinary research is aiming to develop a more thorough understanding of these essential relationships

1.1.8. Indicator name: Trend of concentration of allergenic pollen of ambrosia (*Ambrosia artemisifolia*) in Serbia

Author / Institution: Ana Ljubicic/ Environmental Protection Agency

Key message: Increase in the concentration of allergenic pollen of ambrosia from north to south of Serbia

Assessment: 

The indicator shows the spatial distribution of the total amount of pollen grains of the ambrosia on the territory of the Republic of Serbia and is presented through data from three stations, from north to south. The data presented includes a period of seven years. This indicator was monitored on three stations from the network: Subotica, Belgrade (Zeleno Brdo, ZB) and Vranje. The total quantities of pollen grains of the ambrosia were taken into account throughout the entire period of pollination.

The analysis of this indicator on these three stations in the period from 2012 to 2018 has shown that the concentration of allergenic pollen of ambrosia is increasing in recent years. At the same time, geographic inequality of distribution is perceived as the total amount of this strongest allergen decreases from north to south. However, it must be taken into account that the quantity of pollen depends on several factors. It depends primarily on the plant-geographic characteristics of the area. Quantities can be significantly modified primarily by meteorological and anthropogenic factors. Also, the amount of pollen depends on the agricultural region, which Vojvodina is distinguished with more than the south of the country. The factor that should not be neglected is the mowing and the influence of the wind that carries the pollen at long distances. Subotica is on the border with Hungary in which Ambrosia is extremely represented, despite numerous campaigns of suppression.

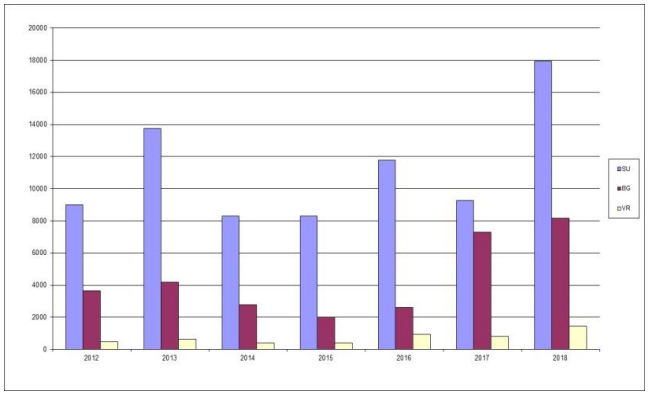
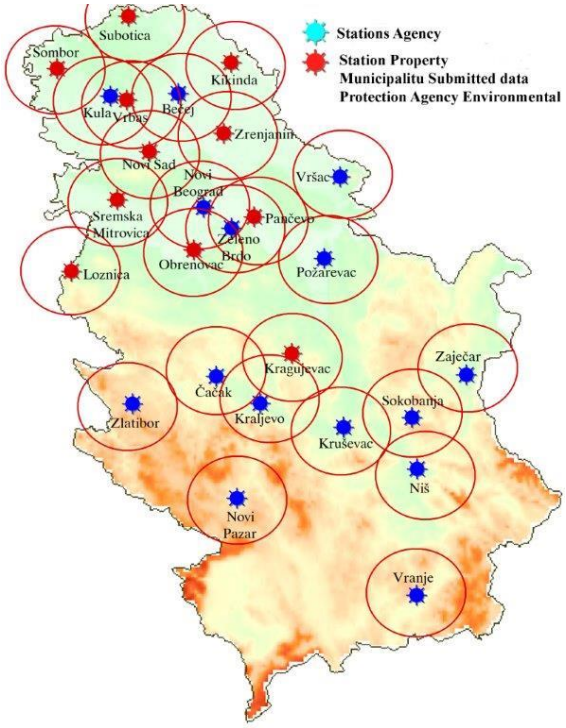


Fig. 1.1.8.1. Trend of ambrosia pollen air concentration change

Ambrosia artemisiifolia is the largest weed allergen. It originates in North America, whilst it is widespread in Central and South Europe. It was brought to Europe in the mid-nineteenth century with the clover seed. In southeastern Europe, this species is recorded by Hungarian botanist Javorka in 1908, in the vicinity of Orsava, in the Romanian Danube area in 1910. The first data in our country appeared in 1953, in Sremski Karlovci, Petrovaradin and Novi Sad.

It is believed that these it was brought to this area from Romania, most likely transported by the ships operating on the Danube. Later, these sites became centers from which *Ambrosia artemisiifolia* spread very aggressively throughout Vojvodina towards the south. It was also established in the vicinity of Belgrade in 1994 and further spread south to Paracin and Nis, and as a rare plant was also found in the Sićevačka gorge in 1999. It is widespread and expanding thanks to the great power of flexibility.



Map. 1.1.8.2. Distribution of stations for ambrosia pollen detection.

1.1.9. Indicator name: The trend of the areas where the ambrosia has been threatened

Author / Institution: Slaviša Popović / Environmental Protectin Agency, Danica Popin / Provincial Secretariat for Urban Planning and Environmental Protection, dr Ivan Aleksic/ Institute for Biocides and Medical Ecology

Key message: The area of ambrosia suppression is increasing

Assessment: 

In the last 20 years significant population increase of this plant has been documented on the territory of Serbia and the city of Belgrade. Long-term presence of ambrosia in this area and high reproductive potential created substantial seed reserves in the soil, resulting in its presence on cultivated and non-cultivated land on the territory of Vojvodina province and Belgrade area representing a long lasting problem. All social entities that can contribute to the issue within their competencies must be included in the resolution of the problem. In the system of measures that need to be implemented (preventive, physical, chemical, biological, agro-technical, administrative) in order to combat ambrosia, it is important to constantly educate and raise awareness of the need for timely preventive health measures in order to protect and improve their own health and preservation of the environment.

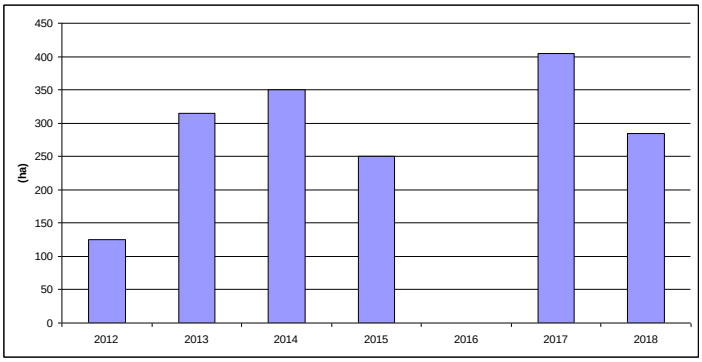
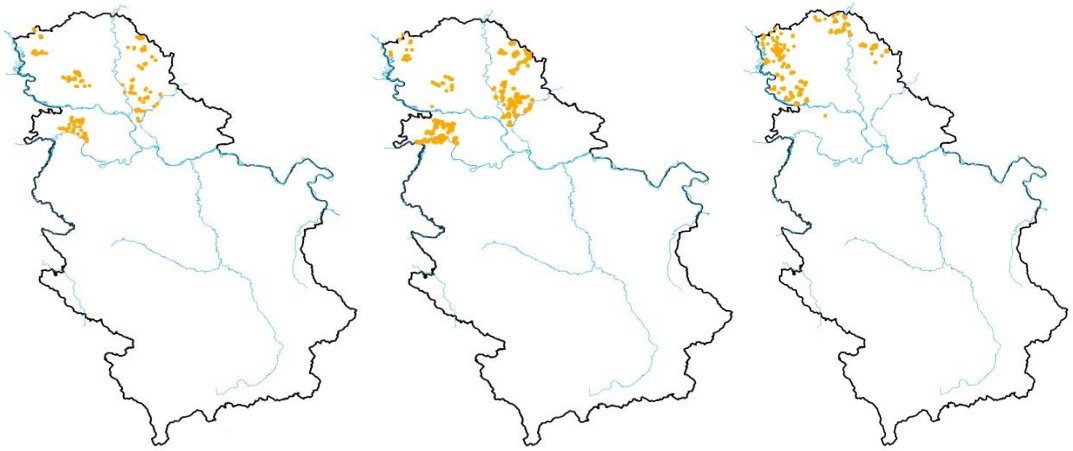
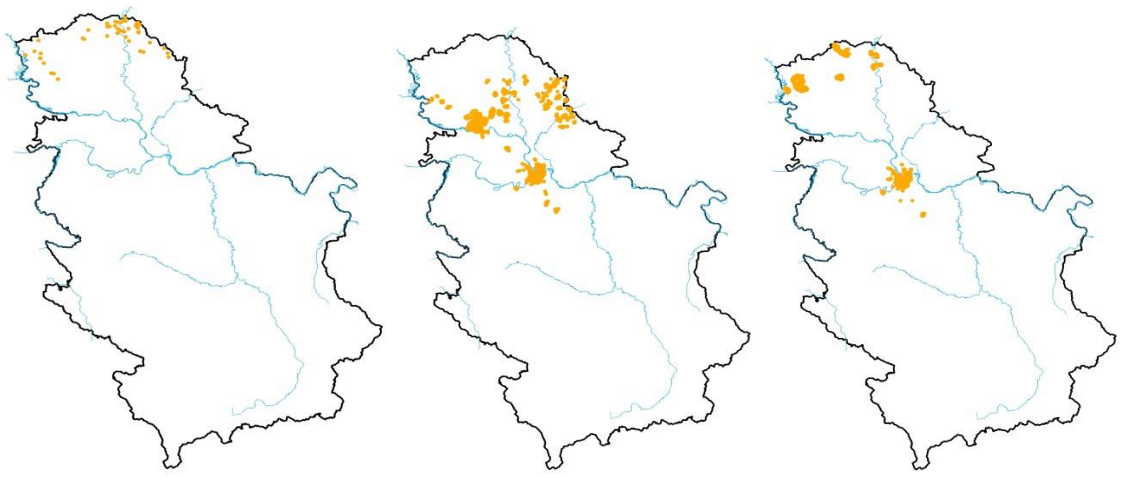


Fig. 1.1.9.1. Trend of ambrosia tretened areas



2012 2013 2014



2015 2017 2018

Map. 1.1.9.2. Distribution of the ambrosia treatment surface

During 2011, the suppression of ambrosia on the territory of the city of Belgrade was carried out on an area of 693,000 m2 (data for 2011 were taken from the Secretariat for Communal and Housing Affairs). In 2012, the suppression of the ambrosia was covered on an area of 580.955 m2. In 2013, the suppression of the ambrosia on the territory of the city of Belgrade was carried out on an area of 143,320 m2 (data for 2013 were taken from the Secretariat for Environmental Protection). During 2016, the Department of Biocides and Medical Ecology collected data from city municipalities and public municipal companies on the presence of ambrosia on certain areas for the period 2013-2016.
In 2017 and 2018, the Institute for Biocides and Medical Ecology carried out the program "Ambrosia as a health risk, monitoring and suppression of ambrosia from unregulated areas in the territory of Belgrade". During 2017 monitoring was carried out on 60 hectares, and the suppression with chemicals on 30 hectares. In 2018, monitoring areas were increased to 60 hectares and areas for treatment on 160 hectares.

On the territory of the Autonomous Province of Vojvodina, in 2012 and 2013, the Provincial Secretariat for Urban Planning and Environmental Protection carried out the suppression of ambrosia in the territory of five local municipalities (Sombor, Kikinda, Vrbas, Zrenjanin and Sremska Mitrovica), which were covered by the IPA project "Support of the environment without allergens "within the framework of the cross-border cooperation program Hungary - Republic of Serbia.

In 2012, the ambrosia was treated at 125 ha and in 2013 to 315 ha. In the framework of the project, the poles were also provided for measuring the pollen mounted at the mentioned sites. After the completion of the project, the Secretariat continues to measure the concentration of pollen and regularly publishes the results of the measurements in order to inform the population about the state of air pollution with pollen in a timely and adequate manner.In 2014 and 2015, in the territory of Vojvodina, from the funds of the budget of the APV - Provincial Secretariat for Urban Planning and Environmental Protection, action was carried out on the territory of ten local self-governments (Backa Palanka, Bac, Odzaci, Apatin, Sombor, Subotica, Kanjiža, Novi Kneževac, Čoka and Kikinda). In 2014, the ambrosia was suppressed on 350 ha, while in 2015 the action covered 250 ha. During the year 2017, from the budget of the APV - Provincial Secretariat for Urban Planning and Environmental Protection, funds were defined for the suppression of the ambrosia on 375 hectares carried out in the following local self-governments: Bečej, Novi Bečej, Nova Crnja, Žitište, Sečanj, Novi Sad, Temerin, Zabalj, Backi Petrovac, Odzaci, Indjija and Beocin. In 2018, the Provincial Secretariat for Urban Planning and Environmental Protection carried out the action of suppressing the ambrosia weed on 225 ha in 8 local self-governments (Apatin, Sombor, Subotica, Bačka Topola, Kanjiža, Senta, Novi Kneževac and Čoka).

During 2018, the Secretariat started the implementation of the IPA project "Nature protection from invasive plant species" within the framework of the cross-border cooperation program Hungary - Republic of Serbia. The project envisioned and suppressed the ambrosia in four protected natural assets in the border region of the north of Vojvodina: the Special Nature Reserve "Selevenjska pustara" and "Ludaško jezero", the area of exceptional features "Subotička peščara" and Nature Park "Palić". In the territory of these protected areas in 2018, the ambrosia has been suppressed on 85 ha, while in 2019 the plan is to suppress the ambrosia on the same area of 85 ha.

1.1.10. Indicator name: Trend of mosquito populations infected with WNV in Serbia

Author / Institution: dr Ivan Aleksic/ Institute for Biocides and Medical Ecology, Slaviša Popovic/ Environmental Protection Agency

Key message: The area of infected mosquitoes is growing, their number decreases

Assessment: 

Within the Project for the Ministry of Health, the Institute for Biocides and Medical Ecology is conducting search of the Western Nile virus in populations in the territory of Serbia. Sampling of mosquitoes in the field and testing for the presence of the virus is carried out during the season of mosquito activity (April-September) starting from 2013 to the present day. During 2013 and 2014 regular sampling of mosquitoes was conducted in 26 municipalities, and supplemental on epidemiological indications in another 20 municipalities. From 2015, sampling is carried out in the territories of 10 municipalities located in the Danube and Sava basins. Since the birds are carriers of the virus, the occurrence of viruses in mosquito populations varied from year to year. 2013 and 2018 are record years in terms of meteorological measurements. 2013 is one of the 5 hottest years in the past 100 years since the measurement started, and 2018 is the hottest in the history of meteorological measurements. Such conditions greatly affected the early and more frequent appearance of mosquito populations that were the carrier of the Western Nile virus. Out of the total number of cities covered by sampling and analysis of mosquitoes in the presence of VZN in 2013, 58% were positive, and in 2018, 73% of the cities surveyed. In the period from 2011 to 2017 The number of positive locations and cities for the presence of viruses in mosquitoes was significantly lower and ranged from 20% in 2014 to 50% 2015.

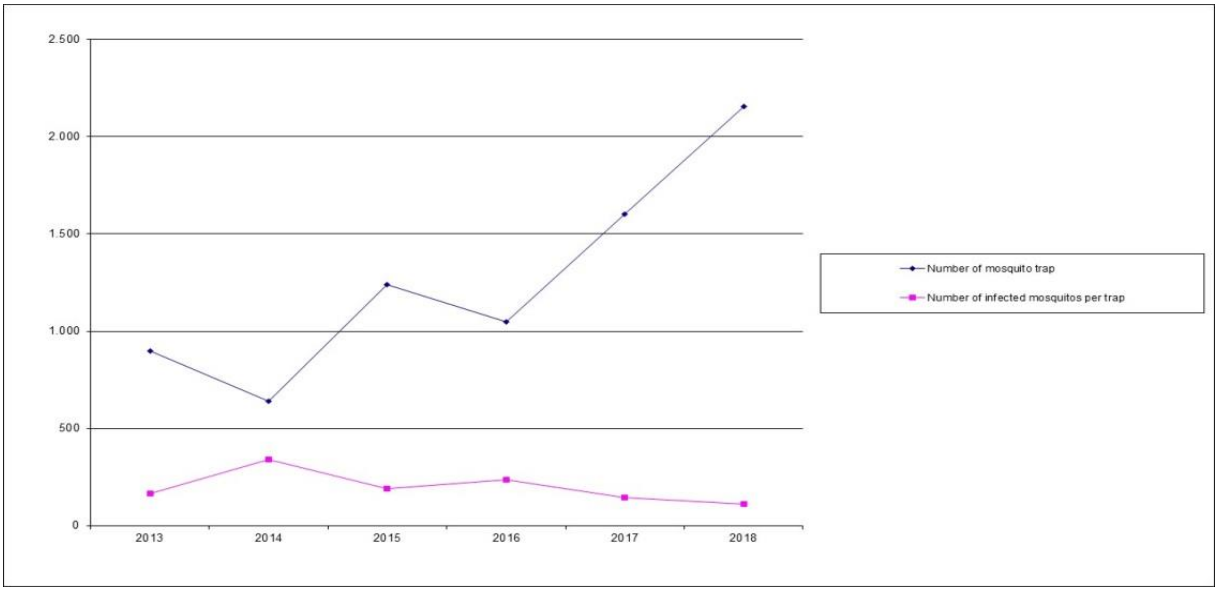
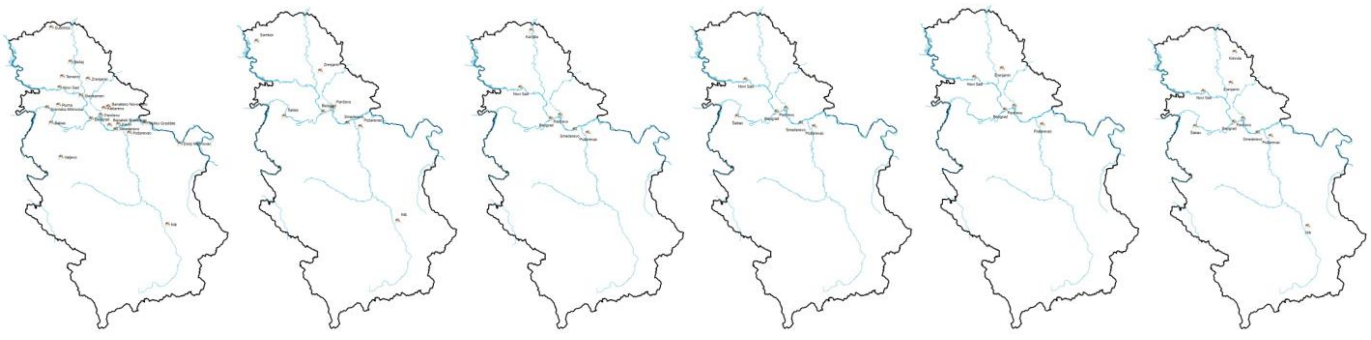


Fig. 1.1.10.1. Trend of mosquitos population infected by Western Nile virus.

Four studies conducted on the territory of the Republic of Serbia in the period from 2007 to 2012 pointed to the transmission of Western Nile virus in the population of mosquitoes, birds and horses. Taking into account these results and the circulation of the Western Nile virus in neighboring countries, Romania and Hungary, the Department for the Prevention and Control of Infectious Diseases Serbia implemented the control of Western Nile fever in the human population in 2012. From June 1 to November 15, on the entire territory of the Serbia control and passive control is being implemented intensively over the fever of the Western Nile. The first patients in the Republic of Serbia suspected of being infected with GZN were registered in the second half of July 2012. The highest number of patients was from the territory of the City of Belgrade (53 patients, 74.6%), the South Banat District (8.5%) and the Srem district (7%). The highest number of cases (86%) was registered in August and September 2012, which coincides with peak activity of mosquitoes.



Map. 1.1.10.2. Distribution mosquitos population infected by Western Nile virus.

Western Nile fever occurs worldwide. Epidemics of this disease are recorded in the human population, among birds and horses in America, Africa, Europe, Russia, the Middle East, India, parts of Asia, Australia and the Mediterranean. Circulation of the Western Nile virus has been present on the European continent since the 1960s, but the first epidemic among people was recorded in Bucharest, Romania, in 1996. Since then, cases of people and horses with the disease have been registered in the Czech Republic, France, Italy, Hungary, Romania, Spain and Portugal. During 2010, environmental factors in Central Europe and the Mediterranean countries favored the transmission of Western Nile virus to humans, so in the central part of Macedonia in the northern part of Greece the epidemic of this disease was first registered in the human population.

Local self-governments are authorized to conduct suppressing of mosquitos and they have done so,mostly with devices from the ground. Application of the biological compound based on *Bacillus thuringiensis* subsp. israĺlensis is an effective and environmentally friendly solution because they are selective to protect the environment from adverse effects, are biodegradable, it is not necessary to announce treatment to bee growers because biocides do not affect other organisms. The application of these insecticides is directed to the mosquito habitats of open water systems such as riverine surfaces and brief ponds as well as protected natural assets.

The chemical method involves the application of larvicidal biocides used in mosquito larva sources, or the use of conventional larvicides or insect growth regulators (IGRs) which influence the prevention of larval development of adult mosquitoes. Conventional larvicides are used only in sealed, isolated water systems without direct casting in river basins. IGR compounds can also be applied on leached surfaces, in canals, industrial and wastewater, with smaller water receivers, manholes, etc.

1.1.11. Indicator name: Trend of the mosquito population infected with Western Nile virus in Belgrade

Author / Institution: dr Ivan Aleksic/ Institute for Biocides and Medical Ecology, Slaviša Popovic/ Environmental Protection Agency

Key message: The largest number of infected with the West Nile virus was on the territory of the city of Belgrade

Assessment: 

Sampling of mosquitoes during the season of their activity is carried out on the whole territory of the City of Belgrade on about 200 locations. In the last six years, 2013 and 2018 stand out as the years with the greatest number of locations recorded with mosquitoes positive for the presence of the virus. On the territory of Belgrade in 2013, 48% and 2018, 52% of locations with mosquitoes positive for the presence of the virus. In the rest of the years, the number of positive locations in Belgrade varied widely, from 6% in 2016. to 29% in 2015. The number of mosquitoes at locations in Belgrade varied from season to season, but the number of mosquitoes is not correlated with their infectiousness with the western Nile virus (it is possible that the virus is present in many locations and in low numbers of mosquitoes). The Institute for Biocides and Medical Ecology has conducted mosquito control in the territory of 16 Belgrade municipalities (except Obrenovac) in cooperation with the Secretariat for the Protection of the Environment of Belgrade as part of its regular activities as well as on epidemiological indications (ie. registration of diseased people in Belgrade municipalities).

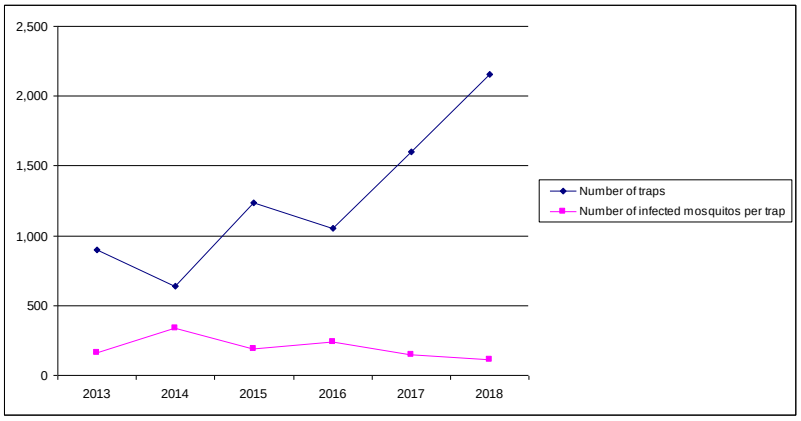
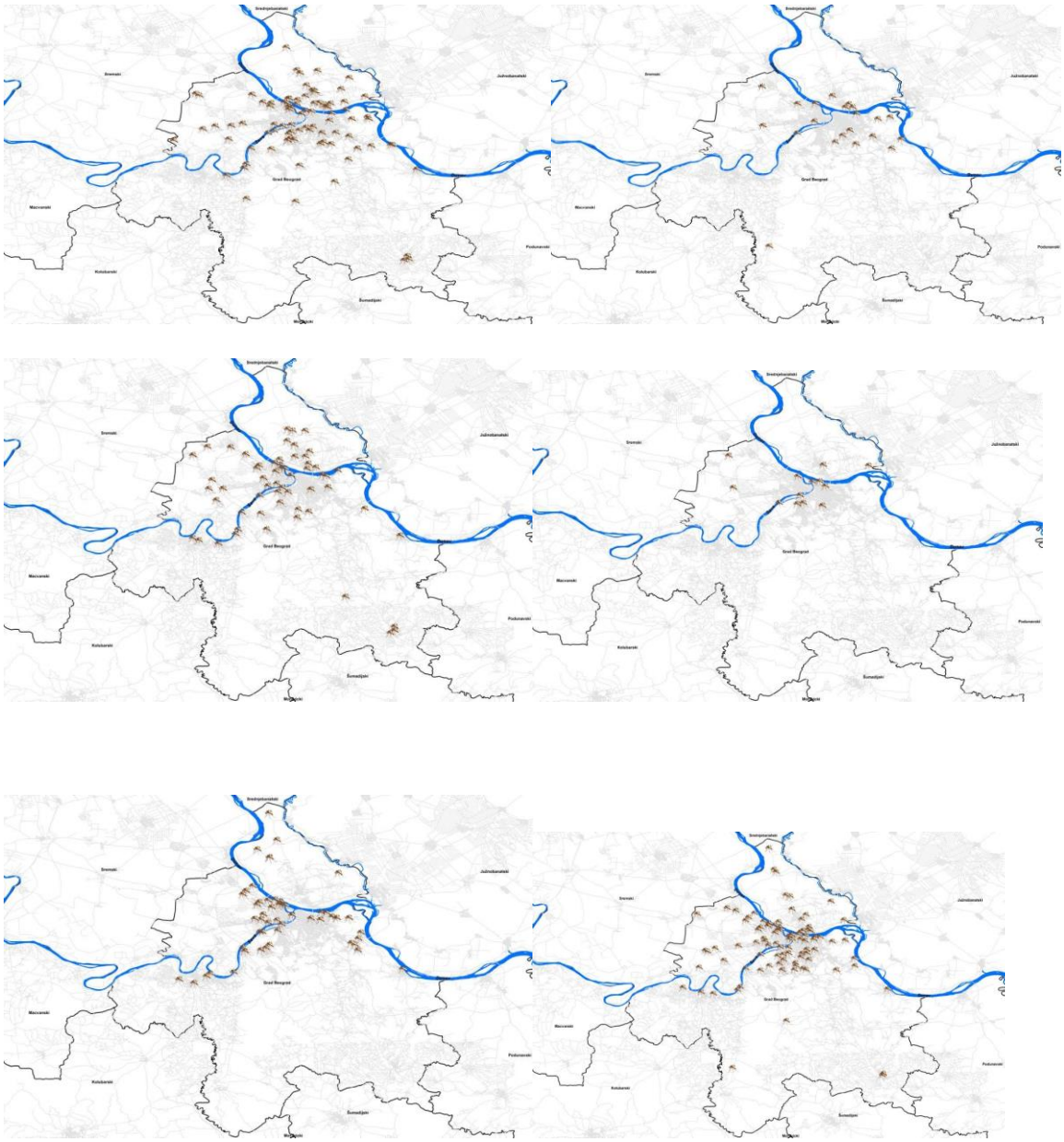


Fig. 1.1.11.1. Number of locations in Belgrade where where detected Western Nile virus infected mosquitos

Based on the data provided to the Institute for Public Health of Serbia "Dr. Milan Jovanović Batut" (in accordance with the Recommendations for the control of Western Nile fever in the human population in the seasons 2013, 2016, 2017 and 2018 of the Institute of Public Health of Serbia); Laboratory criteria (according to the recommendations of the European Center for Disease Prevention and Control), 415 cases of Western Nile fever have been registered on the territory of the Republic of Serbia, with 36 deaths that can be associated with fever from the Western Nile (Institute of Batut report for 2018 : http://www.batut.org.rs/index.php?content=1742), 49 (45 confirmed and four probable) cases of fever from the Western Nile with two deaths (Institute Institute Batut for 2017: http://www.batut.org.rs/index.php?content=1577), 41 confirmed case of fever from the Western Nile, including two deaths, a patient aged 81 years from the South Banat district and 74 year old from the territory of the City of Belgrade, which can be linked to fever from the Western Nile fever.



Map. 1.1.11.2. Distribucija komaraca zarazenih Western Nile virus in Belgrade 2013-2018

1.1.12. Indicator: Trend of population of infected ticks causing Lyme disease

Author / Institution: dr Ivan Aleksic/ Department of Biocides and Medical Ecology, Slaviša Popovic/ Environmental Protection Agency

Key message: The number of infected ticks is in decline

Assessment: 

During the realization of the project "Detecting the causative agent of Lyme disease, virus tropical encephalitis and human granulocytic anaplasmosis on the tick population and territorial distribution on the territory of the Republic of Serbia", the seasonal tick activity was monitored as well as the presence of Borrelia burgdorferi, tropic encephalitis virus and Anaplasma phagocytophilum in harvested ticks, from March to November. The activity ticks is conditioned by temperature and humidity, as well as the length of the day, and their number varies from year to year depending on the climatic conditions. During the harvesting of the ticks most commonly harvested species on the territory of the Republic of Serbia, were Ixodes ricinus, Dermacentor reticulatus, Rhipicephalus sanguineus.

Samples were collected from the surfaces of overgrown unregulated grass, shrubbery and woody vegetation. The areas where animals are frequent (domestic and wild) were selected. If the vegetation was wet, the collection was difficult, so the teams went out on the field when there was no strong rainfall and dew. Samples were collected from the surfaces of overgrown unregulated grass, shrubbery and woody vegetation. The areas where animals are frequent (domestic and wild) were selected. Samples were collected by the "flag / time" method, with white flannel flags measuring 1x1m. Flags are overlapped over vegetation at the specified locations, and collected ticks are removed from the flags and collected in containers. The duration of collection of ticks was approximately one hour per location.

The collected ticks are transported live in containers prepared for the transport of samples, to the Entomological Laboratory of the Institute for Biocides and Medical Ecology. The Laboratory of the Institute analyzed the collected specimens for the presence of Borrelia burgdorferi, Anaplasma phagocytophilum and tropic encephalitis virus. The presence of Borrelia burgdorferi was performed by microscopic examination of native specimen in the dark field with 400x magnification and PCR real time method. The presence of Anaplasma phagocytophilum and tropic encephalitis virus was determined by the PCR real time method.

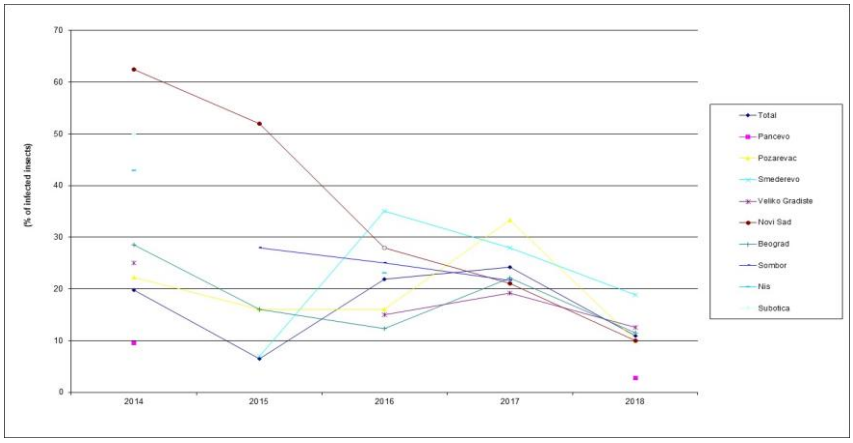
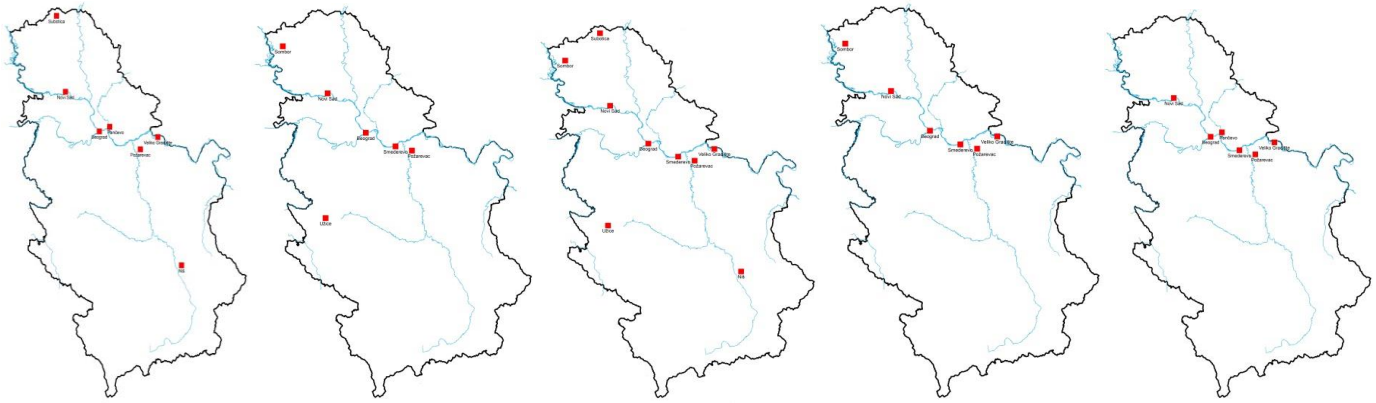


Fig. 1.1.12.1. Trend of population of infected ticks causing Lyme disease



2014 2015 2016 2017 2018

Map. 1.1.12.2. Distribution of infected specimen

SUPPRESSION OF TICKS ON THE TERRITORY OF Vojvodina

The Provincial Secretariat for Urban Planning and Environmental Protection is in charge od suppressing the ticks on the territory of Vojvodina. The ticks are beeing suppressed using the fonds from the budget of the APV since 2017.

Both deciduous and mixed forests with favorable ecological and microclimate conditions with the presence of hosts that are suitable for the development of all four stages of ticks represent an extremely suitable habitat for their development. During 2017, the tick-suppression was performed on a total of 600 hectares on the territory of the National Park Fruska Gora and on the territory of the municipality of Srpska Crnja. During the control, the active substance lambda-cyhalothrin was used. Ticks are predominantly suppressed on picnic areas, hiking trails, promenades and other surfaces suitable for their development and where people live.

1.1.13. Indicator: Trend of Morbus Lyme patients in Serbia

Author / Institution: Slavisa Popovic/Environmental Protection Agency

Key message: The number of patients with Lyme disease is in decline

Assessment: 

Lyme disease or Lyme borreliosis is a multisystemic disease of the subacute and chronic flow caused by Borrelia burgdorferi bacteria. It involves primarily the skin, then the heart, joints and central nervous system.

Carriers of these bacteria are ticks, rodents, deer, and others. Vectors of infection are hard ticks that transmit disease to man and domestic animals, and it occurs usually seasonally (from early spring to late autumn), mostly with people who often stay in nature.Lyme disease in the Republic of Serbia is the leading disease in the group of vector diseases, with participation in the structure of over 90%. Lyme disease is registered throughout the year, with the highest occurrence in June and July in the month when the tick population is the most numerous.

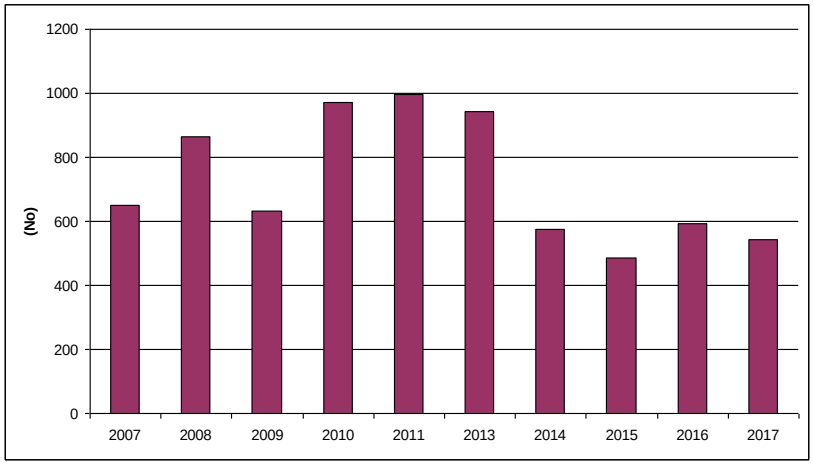


Fig. 1.1.13.1. Number of patients with Lyme disease in Serbia.

The number of patients suffering from Lyme disease ranges from about 500 (2015) to about 1000 (2011). Although the number of infected ticks decreases, the number of patients with Lyme disease has been constant over the last several years. Several reasons contributed to this. First of all, more and more people reside in nature, and more often, they are exposed to the possibility of picking up ticks. The increasingly warmer spring and summer months lead to an increase in the number of small rodents that are the bacteria carriers causing Lyme disease, and also contribute to faster bacterial multiplication.

The climatic trends and density of key hosts for adult ticks are the major factors in the spread of ticks and contribute to the spatial distribution of Lyme disease. The latest data show that ticks in Europe are spreading to the north latitudes, and also to higher altitudes.

Annual reports of Institute for Public Health:

http://www.batut.org.rs/download/izvestaji/Godisnji%20izvestaj%20zarazne%20bolesti%202017.pdf

http://www.batut.org.rs/download/izvestaji/zarazneBolestiGodisnjiIzvestaj2016.pdf

http://www.batut.org.rs/download/izvestaji/Zarazne%20bolesti%20godisnji%20izvestaj%202015.pdf

http://www.batut.org.rs/download/izvestaji/Izvestaj%20o%20zaraznim%20bolestima%202014.pdf

http://www.batut.org.rs/download/influenca/2013ZarazneBolesti2.pdf

http://www.batut.org.rs/index.php?content=387

http://www.batut.org.rs/index.php?content=299

BIODIVERSITY CHANGES AT SPECIES LEVEL

Species diversity of Serbia

According to official data 44,200 taxons were identified and classified in Serbia at the level of species and subspecies, which is not the final figure. According to real estimates, probably 60,000 taxon live in Serbia. The largest groups of organisms are insects with over 35,000 recorded species.

Although with 88,361 km2 the Republic of Serbia makes only 2.1% of Europe's land, the biological diversity of different groups of living organisms is high. In Serbia there are:

- ✓ 3662 species and subspecies of vascular flora (39% of Europe's vascular flora),
- ✓ 98 species of lampreys and fish (51% fish fauna of Europe),
- ✓ 45 species of amphibians and reptiles (49% of fauna of amphibians and reptiles of Europe),
- ✓ 360 species of birds (74% of bird fauna in Europe),
- ✓ 94 species of mammals (67% of European mammals).

Of particular importance for the evaluation of the species diversity of Serbia is the high percentage of endemism and relics that are particularly widespread in mountain and highland areas, in cliffs and canyons. The highest level of endemism in Serbia was established among insects and vascular plants.

The monitoring of population dynamics was focused on species that are important for ecosystem functioning (top predators, pollinators and decomposers). Top predators control stability of ecosystems by regulating number of individuals at different trophic levels.

Animals pollinate 87% of the world's flowering plant species. Many scientists are concerned that pollinators are in decline globally. Bees, flies (order Diptera), buterflies and moths (Lepidoptera) are the most important polinators among animals. Therefore, monitoring of pollinator species is essential in assessing function of ecosystems. Fungi are major decomposers in certain ecosystems and therefor they represent a key components of ecosystems that control the proces of matter cycling.

1.1.14. Indicator Name: Diversity of species-butterfly population trend

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Milan Djuric, Non-governmental organization "HabiProt", Belgrade

Key message: The population of the forest butterflies is in a slight increase and there is a slight decrease in the population of meadow butterflies

Assessment: 

The indicator shows trend of changes in population abundance of selected butterfly species from forest and meadow habitats. The change in the population of butterfly indicates the loss, but also changes in the structure of their habitats, due to fragmentation and isolation, as well as other changes in the environment that directly or indirectly affect the change in population structure. It is shown that population of butterflies in meadow habitats are more stable in the period from 2014 to 2017, while in forest habitats the oscillations in population dynamics are more evident.

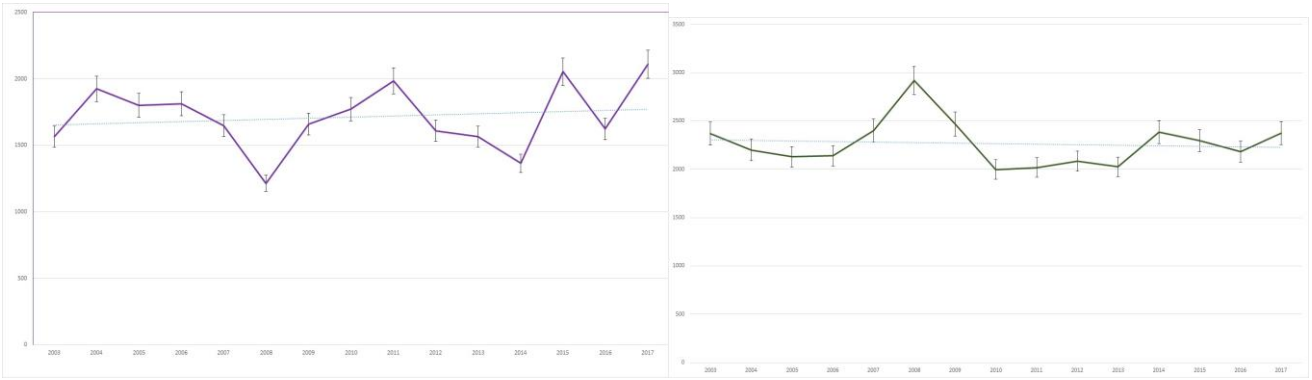


Fig. 1.1.14.1. Trend of forestland and grassland butterfly population.

In this assessment, data were used from 15 species of day butterflies for forests and the same for meadow habitats. The transect method was not used, but the method of relative representation of the finding in the base for insect mapping Alciphron for the period 201-2017. If we observe the territory of the Republic of Serbia in its entirety, deviations in the number of both forest and meadow species in this period are relatively small. According to these estimates, the trends of forest species are on a slight increase, with the maximum values in 2004, 2011, 2015, and 2017. Interestingly, in 2008, the largest increase in population was recorded in meadow species, while in forest species the greatest decrease was recorded. Likewise, the analysis shows a decrease in the number of population of species of meadow and forest habitats in the north of the country, while there is a significant increase in the number of population of butterflies in the south of the country.

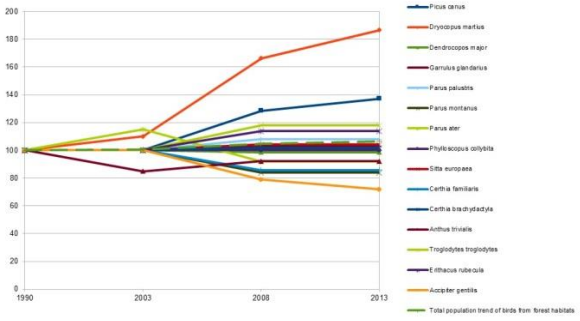
1.1.15. Indicator Name: Species diversity-birds population trend

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Milan Ruzic/ Society for the Study and Protection of Birds

Key message: The trend of the forest bird species is stable with a slight increase and a slight decrease of population in the meadow species

Assessment: 

The indicator shows trend of changes in the population abundance of selected bird species from forest and meadow habitats. The change in the population of birds explains the loss, and change in the structure of their habitats, due to fragmentation and isolation, as well as other changes in the environment that directly or indirectly affect the change in population structure. In the period from 2008 to 2013, trend in population dynamics of birds registered in meadow habitats are more or less stable, what is even more evident in forest habitats.



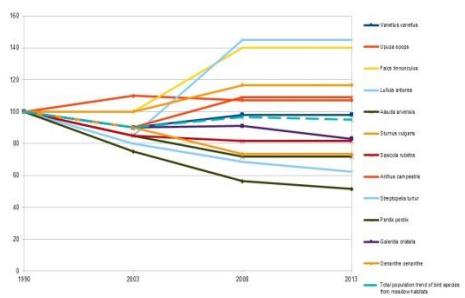


Fig. 1.1.15.1. Trend of forestland and grassland birds population.

Different patterns of the dynamics of bird populations indicate significant changes in forest and meadow ecosystems that specifically affect different species. The explanation for the increase in the number of forest habitat types is probably due to the increase in areas under forest and shrub vegetation, but may also be due to changes in the wider environment. However, in the forest habitats there is a significant, even number of species whose number is decreasing, which is probably due to the decrease in the quality of forest habitats (these are species specialized for life in old forests). Although a large number of species of meadow habitats show a downward trend, there is an increased number of species with a stable population. Improving the conditions in agricultural areas, as well as reducing the intensity of agriculture due to depopulation of the villages are the likely reasons for such a trend.

Among the forest species, there is more a species with a stable population, while the increase in populations of some species is obvious (eg *Dryocopus martius*). However, species with a markedly negative trend (eg, *Accipiter gentilis*) are noticeable. Among the meadow species, the most pronounced negative trend was observed in the *Perdix perdix, Oenanthe oenanthe* and *Streptopelia turtur* species.

1.1.15.1. Case study: The eastern imperial eagle (*Aquila heliaca*) – critically endangered species

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Milan Ruzic/ Society for the Study and Protection of Birds

Assessment: 

Twenty years ago Serbian sky was adorned with about ten pairs of the eastern imperial eagle, a bird that adorns Serbian coat of arms, and today it has fallen to one pair – Bora and Erzika, they live in the proximity of a small Serbian village Krstur. In the last two years the pair raised three young fledglings – two years ago Dusko and Lilika were born and last year Nada (Hope) came to the world, this name was given symbolically in the hope that the eagle would survive in Serbia.

The last remaining couple of this bird in Serbian Krstur is guarded by members of the Society for the Protection and Study of Birds within the international project ''Pannon Eagle Life'' which our country conducts in cooperation with the Czech Republic, Slovakia, Austria and Hungary.

Pic. 1.1.15.1.1. The eastern imperial eagle Bora and Erzika. Foto. M. Ruzic

The eastern imperial eagle is a Euroasian species, and today it is more present in the Mongolian and Kazakhstani steppe, while in Europe, unlike earlier times its number is drastically lower. For example, up to twenty years ago on Fruška Gora there were three pairs of eastern imperial eagle and Deliblatska pescara there were only seven or eight. Today they are no longer there, and the only remaining couple in our country has nested on Canadian Populus in the steppe near the village of Serbian Kostur, where this year it also has laid eggs.

The eastern imperial eagle was once a trophy bird for many hunters – beautiful and large with a span of wings two meters wide,yet accessible becouse it does not live in the mountains but in the steppe,this has also reduced their population. In addition to the lack of habitat the reasons behind this bird disappearing are the lack of tall and old trees which they usually choose for their nest, and the biggest problem for them is poisoning.

Good news come from Hungary. In 1995 they had only 30 pairs of the eagle left and since they have invested in projects, so today they have about 150 pairs. Since their eagle is recovering it is possible that some of them might come down to Serbia and form a pair with our young birds.

How did this eagle ended up on the Serbian coat of arms, and was this bird really an inspiration?

There are two stories, one says that it is the bird most seen in this region nesting on oak trees, a tree that our people consider sacred. The oak tree was considered a sacred place (shrine). Especially oaks over 100 years old which our people marked with a cross. The eastern imperial eagle (eagle of the cross in Serbian) likes old trees and this is why it got this folk name, because people saw a big eagle on a holy tree. It is logical that the bird which had symbolism in the people was an inspiration for the coat of arms.

The second story tells us that we are not the only one to have this eagle on our coat of arms and that we probably took it from others, becouse Roman emperors, Austrian Emperors, Napoleon Bonaparte, and even the Germans during the Second world war recognized this bird as a symbol and used it on their flags or seals.

1.1.16. Indictor name: Trend of Griffon vulture population restored

Author / Institution: Slaviša Popovic/Environmental Protection Agency, dr Sasa Marinkovic, Institute for biological researches "Sinisa Stankovic"

Key message: Increase in the population of the Griffon vulture

Assessment: 

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 rivers increased more than ten times. Permanent protection and improvement resulted in the population growth to 500 birds. 246 nesting couples and 125 juvenile were recorded.

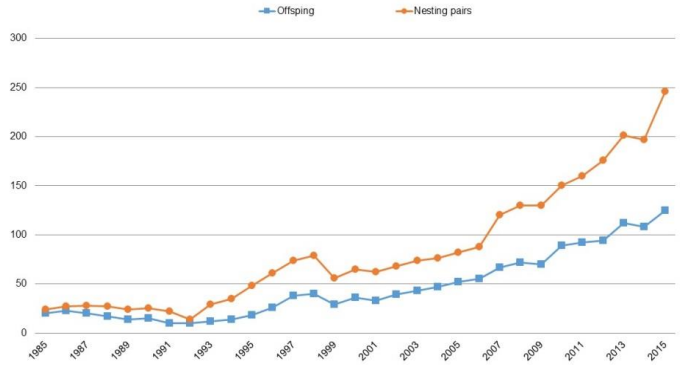


Fig. 1.1.16.1. Trend of population of Griffon vulture in Serbia.

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 pray 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).

1.1.17. Indicator name: Trend in the number of carnivorous mammal population

Author / Institution: Slaviša Popovic/Environmental Protection Agency

Key message: In Serbia, in the last 5 years there has been a slight increase in the wolf population

Assessment: 

The first action plans for the management of large carnivores (wolf, bear and lynx) were done in 2007, but they were never formally proclaimed. Then new management programs were prepared for bears and lynx in 2018, and in 2019 for the wolf. There are unharmonized data on the number of populations of large carnivores in Serbia. According to the data of the Forest Administration, the number of wolf population varies from 1600 to 2000. Bear population at 50-120 with a marked increase in number. The population of lynx on 20-21, and the population of beavers at 40-80 with a downward trend

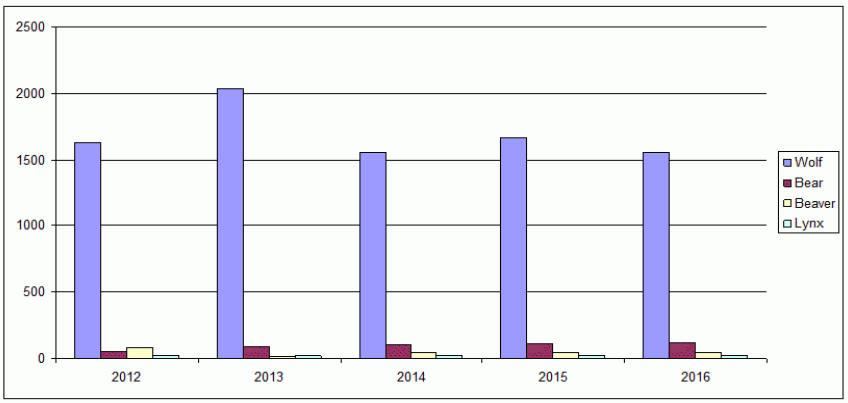


Fig. 1.1.17.1. Trend in number of wild animals (wolf, bear, beaver, lynx)

However, according to expert estimates, the number of wolf population in Serbia is 800-1200. The population is divided into two sub-populations, Dinara-Balkan and Carpathian and both populations have a stable and slightly upward trend. This estimate is based on a registered wolf catch in Serbia that has been in the range of 150-170 in the last 5 years, so if a five year catch is observed, the wolf population is estimated at about 1000 individuals, with a slight increase in the population.

1.1.17.1. Case study: Steppe Falcon (*Falco cherrug*)

Author/Institution: Nikola Stojnic, dr Slobodan Puzovic/ Provincial Institut for Nature Conservation, Novi Sad

Assesment: 

Protection of steppe falcon is extremely important, since according to the latest published estimates, 16-21 nesting pairs (32 to 42 adult individuals) in Serbia. In the last 19 years the population has decreased by 69%, which has been determined on the basis of permanent monitoring, reduction of the distribution of the species and potential level of exploitation - illegal killing. According to the census of 2006 and 2007, the number of nesting pairs was 50-60. Breeding and non-breeding population is estimated as critically endangered (CE) in Serbia according to the Red Book of Birds of Serbia, while the global status of the species according to the IUCN Red List is EN - endangered. Studies from 2019 show a smaller increase in the population in Serbia, estimated at 30-35 pairs, which is a possible consequence of protection measures.

Steppe Falcon (Falco cherrug) is a strictly protected species according to the Ordinance on the designation and protection of strictly protected and protected wild species of plants, animals and fungi ("Official Gazette of the Republic of Serbia" No. 5/2010, 47/2011,

32/2016 and 98 / 2016). Steppe Falcon is an endangered species at the European level and is listed in Annex I of the European Birds Directive and Annex II (strictly protected species) of the Berne Convention.

Active protection measures for steppe falcon

Care

Rescue, care and release is an important active measure of the protection of the steppe falcon, the species so rare that each preserved individual is very valuable. In the period 2017-2019 in this way is treated with four specimens of this rare species.

2017.

In March 2017, the joint action of the Provincial Inspection for Environmental Protection, Provincial Institute for Nature Conservation, BirdLife Serbia and the Police, executed the seizure of 4 steppe falcon from the person that they were illegally held in detention. Of these four individuals, two have been released in the vicinity of the National Park "Fruska gora".

2018.

The young male steppe falcon was returned to nature in August 2018, after almost a year of recovery. It is an individual who was ringed in the Czech Republic as a young in 2017 and was found in the same year in Serbia.

2019.

A young individual of the steppe falcon originating in Austria was successfully recovered and released during May 2019 in a team action led by the Institute for Nature Conservation of Serbia. This individual recovered for almost a year and was released near the place where it was found, in the vicinity of Paracin.

Platforms for nesting

Since these species can not build their own nest itself, and poor accessibility of the nests is recognized as a threatening factor, in Serbia in the second decade of the XXI century had a significant number of artificial wooden and aluminum structures in suitable locations. These platforms, although difficult, recognized by the steppe falcon and in which some couples successfully nest.

Pic. 1.1.17.1.1.Sttepe falcon artificial nest. Source: S. Puzovic

In the perspective, this type is necessary to help by the continuation of the implementation of these measures, but also by the isolation of risky low-voltage power lines that are subject to electrocution (shock due to electric shock), by suppressing poisoning,

capture and killing, and then increasing the number of prey, especially the ground squirrel, correctly planning wind farms and other measures.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Habitats of many known endangered species in RS are still not included in protected areas,
- Insufficient field conservation measures,
- Lack of field data and knowledge on species occurrence,
- Administratively and practically improperly implemented procedures issued to harmonize and minimize human impact on biodiversity.

1.2 Preservation of biological diversity at the genetic, species and ecosystem level

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target C13

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been effective 

Within active conservation measures, according to extent and duration most important are revitalization of wetlands in SNR "Obedska bara" and steppe grasslands on NP "Fruška gora", while this kind of measures are implemented in most of the protected areas in Vojvodina Province, as well as in some Pas in central Serbia, such as Protected Landscape "Veliko ratno ostrvo". Active conservation measures for species *in situ* are feeding places (Brown Bear *Ursus arctos*, Griffon Vulture *Gyps fulvus*, Eagles Accipitriformes), posture of artificial nests (Saker Falcon *Falco cherrug*, European Roller *Coracias garrulus*, Owls Strigiformes, Eagles Accipitriformes...), reintroduction (European Beaver *Castor fiber*, Red Deer *Cervus elaphus*, Chamois *Rupicapra rupicapra*), trans-locations (Amphibians Amphibia), nest-guarding (Imperial Eagle *Aquila heliaca*), bush-clearing (Banat Peony *Paeonia officinalis* subsp. *banatica*), water supplying (Maidenhair Fern *Adiantum capillus-veneris*) etc. Besides these *in situ* measures, additional measures are implemented as well, such as care of injured individuals, stopping of illegal activities, awareness raising etc.

Through analyses of genetical variability of population of certain species in RS, level of thier genetical diversity is determined, which can be used for conservation goals. So level of genetical variability is known for some species under expoatation regime, e.g. Nose-horned Viper (*Vipera ammodytes)*, Edible Frog (*Rana synklepton esculenta*), or game species such as Roe deer (*Capreolus capreolus), Brown Hare (Lepus europaeus) etc.* Research of genetical variability is done for some fish species, Brown Trout (*Salmo trutta)*, Grayling (*Thymallus thymallus),* Sterlet (*Acipenser ruthenus)*, and some *Barbus species.*

Genetical resources, in direct on indirect use by humans, are key component of agro-biodiversity of RS Agrobiodiversity encompasses species and habitats of cultivated fungi, plants and animals, as well as species and ecosystems important for food production (agro-ecosystems, pastures, meadows, forests, water ecosystems). Beside that, genetical resources are important for sustainable development of rural areas of RS, although role of local communities in this process is still not proper.

Based on the data contained in the Draft Programme of Rural Development (2008-2013), significant presence of more than 44 autochthonic and exotic races of domestic animals has been noted in Serbia (7 races of horse, 1 race of donkey, 8 races of cows, 3 races of goats, 5 races of sheep, 18 races of pigs and several races of poultry). Between 400 and 500 of agricultural husbandries and associations own endangered species. The FAO information system for domestic animals diversity (DAD-IS) contains information about the presence of more than 100 races and sorts of domestic animals on the territory of the Republic of Serbia.

The following autochthonic races of domestic animals in Serbia have survived: *podolac* cow; busha; domestic ox; domestic mountain horse; nonius, domestic Balkan donkey, *mangulica*, *moravka*, *resavka*, *pramenka* (*svrljiska, sjenicka, pirotska, karakacanski, krivovirski, bardoka, baljusa, vlaska vitoroga, lipska sheep*), cigaya (*cokanski* type), domestic Balkan goat, domestic chicken (Sombor *kaporka*, naked-neck chicken, Svrljig chicken, Eastern-Serbian chicken), domestic turkey, domestic guineafowl, domestic goose (status of Sombor goose, Novi Pazar goose and Podunvska goose is unknown), domestic duck. Autochthonic sort of bee, *Apis melifera carnica,* is also important with its varieties, which is one of most valuable sorts of honeybees in the world, according to its characteristics. Dogs that are used for protection of herds (Serbian Shepard dogs) or those used as working dogs for herd management (pulini) should be included into autochthonic animal races of Serbia.

Ex situ and *in situ* activities are applied with an aim to conserve these races and sorts, whereat basic emphasis is put to the so-called *on farm* conservation that includes active role of agricultural husbandries.

Other genetic resources

In addition to cultivated plant types, , overall agro-biodiversity of Serbia also includes wild plant species that represent important components of food production and agriculture (forage crops, medical and aromatic herbs, decorative plants, honey plants, wild fruit). Various agro-ecosystems (arable farms, orchards, vineyards, meadows, pastures, brink and ruderal habitats) and components thereof, including weed flora and vegetation also contribute to overall agro-biodiversity of Serbia.

The diversity of species that dwell in natural fields (meadows and pastures) has not been well studied or estimated, but number of species within the described 273 plant associations has been estimated at more than 1,000. Total number of medical and aromatic plant species in our flora is about 700, out of which 420 have been officially registered. 280 of these are traded as commodities. Honey plants are primarily found in meadow, forest and agro-ecosystems, and their number in our country has been estimated at approximately 1,800. In most general sense, flora agro-biodiversity includes weed and ruderal plants as agro-ecosystem components. The studies conducted to date on weed flora diversity in Serbia reveal that the number of weed species represents 28% of the total flora (more than 1,000 species).

Areas under forests in Serbia include combination of deciduous forest (beech and oak), in the percentage of about 60.7%, conifer forests, in the percentage of 4.7%, and mixed deciduous-conifer forests, which cover 33% of the area. With regard to autochthonic forest genetic resources, greatest value is seen in endemic and endemo-relict species (*Pinus peuce, P. heldreichii, Pinus nigra ssp. gocensis, Picea omorika, Taxus baccata, Prunus laurocerasus, Acer heldreichii, Fraxinus pallisae, Forsythia europaea, Corylus colurna, Daphne blagayana, D. mesereum* and others). Within forest genetic resources, in addition to the natural rarities, great importance is given to wild fruit species. Eighty-eight species of wild fruit have been identified within the natural forest associations of Serbia, 12 of which are endangered species.

Among genetic resources of medical and aromatic herbs, greatest importance is given to genetic diversity of commercially important species (chamomile, mint, sage, hypericum, yarrow, oregano, bearberry, valerian, plantain, primula, etc.), as well as to sorts of limited areals and to those that are for some reason endangered. Looking at the genetic resources of medical and aromatic herbs and the need for their conservation, coordinated monitoring activity, which would look into the status of their populations, has not been implemented for a long time, while general conservation strategy at national and international levels have not been developed yet. This is one of the main reasons for the recommendation related to establishment of ECPGR Working Group for Medical and Aromatic Herbs (1999).

The wild relatives are of particular importance as genetic resource in improving and selecting cultivated plants, especially at the level of resistance to various abiotic and biotic stressful external factors. More than a half of cultivated plants have direct relatives within forest and herbaceous plant associations. As far as it is known, there have been no attempts to develop inventory and perform characterization of these genetic resources in our country, except for wild relatives of fruit species.

Number and list of species and taxa of higher and lower ranges of fish in the rivers and lakes are monitored and vulnerability and protection of biodiversity of freshwater ecosystems have been described. There is also registered impact of allochthonous and invasive species to the auchthonous species.

According to the National Inventory of Forests in the Republic of Serbia, 49 tree species have been registered, 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. The picture shows number of forest species and shows trend of population of those species in forest's ecosystems (such as birds and butterflies).

Metodology for all forest related issues are in line with Forest Inventory and Forest Directorate of the Ministry of Agriculture.

AGROBIODIVERSITY

Based on the data contained in the Draft Programme of Rural Development (2008-2013), significant presence of more than 44 autochthonic and exotic races of domestic animals has been noted in Serbia (7 races of horse, 1 race of donkey, 8 races of cows, 3 races of goats, 5 races of sheep, 18 races of pigs and several races of poultry). Between 400 and 500 of agricultural husbandries and associations own endangered species. The FAO information system for domestic animals diversity (DAD-IS) contains information about the presence of more than 100 races and sorts of domestic animals on the territory of the Republic of Serbia.

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Ex situ and *in situ* activities are applied with an aim to conserve these races and sorts, whereat basic emphasis is put to the so-called *on farm* conservation that includes active role of agricultural husbandries.

For protection of cultivated plant varieties, in-situ and ex situ conservation measures are applied. In-situ protection measures primarily include the protection of indigenous and old varieties on their natural habitats through the so-called farm protection. Measures of ex situ conservation mainly include the conservation of varieties outside their natural habitats, in the banks of plant genes and national collections at various scientific institutions (Institute of Field and Vegetable Crops in Novi Sad, Krusevac Fodder Institute, Institute of true grasses in Kragujevac, Institute for vegetables in Smederevska Palanka, Potato Center in Guca, Faculty of Agriculture, University of Novi Sad and Belgrade. National collection of plant genes is located in the Institute of Maize in Zemun Polje and in the bank of the Plant Genes in Batajnica.)

1.2.1. Indicator Name: Population trends of autochthonous domestic species

Author / Institution: Slavisa Popovic/ Environmental Protection Agency

Key message: The trend of increasing the number of endangered indigenous domestic animals is on the rise

Assessment: 

The indicator is used to assess state of autochthonous breeds of domestic animals, in terms of their vulnerability and connected with stimulants received per category of breeds and individuals. This assessment serves to plan future stimulants in order to maintaine agrobiodiversity at a satisfactory level. The trend of the population of endangered autochthonous breeds of domestic animals is on the rise, as a result of incentives planed every year, under the Rulebook mentioned above. Increased number of animals recorder for example at cow busha and domestic mountain horses, can be explained by the fact that in these breeds there was no identification of animals on the ground. Additional monitoring in the field is needed. It is evident that from 2014 some of the domestic animals increast rapidly in number of animals, such as "mangulica" pig, due to increased interest for their growth for consumption as delicateous food (mostly in restaurants).

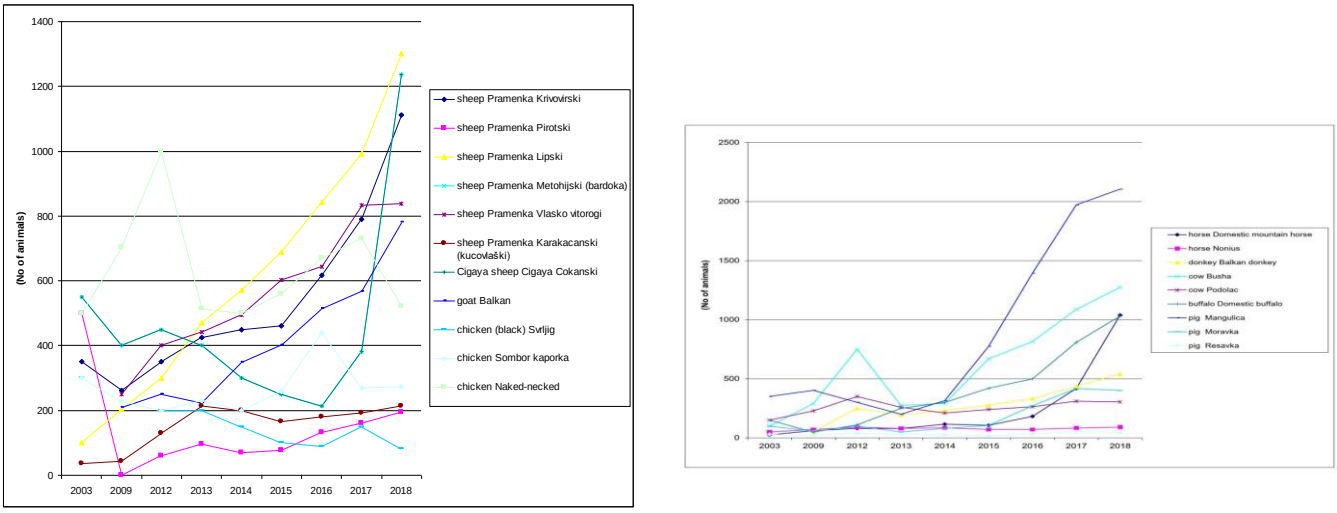


Fig. 1.2.1.1. Population trend of selected autohtonous domestic species

1.2.1.1. Case study: Seed Facilities in forestry as a basis for conservation and guided use of gene fond in Serbia

Author/Institution: Dejan Miletic, Public Enterprise Srbijasume

Assessment: 

The basis of forest ecosystem consists of different types of forest trees, whose genetic diversity is the basic unit of biodiversity. The modern man with his various activities constantly destroys and changes nature, which leads to irreversible loss of biological diversity through disappearance of a large number of organic species or the reduction of their populations to a critical limit.

Seed banks have significant role in conservation and directed use of forest genetic resources. Past activities on preservation of forest genetic resources in Serbia can be divided into two vasic groups : 1. In istu (on-site) conservation, which presrves forest genetic resources in natural populations (seed collectivity,group of trees or individual trees) and protected natural assets , and 2. Ex situ (out of place) is a form of conservation of forest genetic resources outside their natural habitat by establishment of seed banks, clonal archives, progeny tests, botanical gardens, arboretrums and living archives.

Seed collectivities are parts of a forest complex of suddicient uniformity, derived from the phenotypic characteristics of the trunks, whose primary purpose is the production of reproduction material. In order for seeds to serve their basic purpose it is necessary to carry out genetic improvements which include the selection of seed for trunks , spacing and other activities that increase productivity. Removal of phenotypic inferior trees frrom seed collectivity improves the quality of seeds and seedlings, but genetic diversity can be reduced in the following.

Plantages are isolated seedlings of selected specimens and each is indentified according to clone, family or provenance in which pollination from outside sources is reduced or avoided. They produce frequent and abundant yield of seed that is easily collected (OECD, 2014).They are used to produce genetically improved reproductive material and represent the link between refinement and restoration of forests.

According to the data from the Register of seed objects of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia – Forestry Management (2018), in Serbia there are 211 registeredfacilities for the production of selected and qualified reproductive material.

Of these, 192 are facilities for the production of selected reproductive material (51 coniferous and 141 deciduous), and 19 facilities are registered for the production of qualified reproductive material (1 coniferous and 18 deciduous)

The total area of seed objects is 2,190,8 ha (1.593,7 ha deciduous and 597,1 ha coniferous).These objects include 44 species of trees, of which 33 are deciduous and 11 coniferous species of trees.

According to the types of trees the following seed objects are most common: *Fagus sylvatica* L. (20 seed objects), *Quercus robur* L. (15), *Populus nigra* L. (14), *Quercus petraea* (Matt.) Liebl. (13), *Picea abies* Karst. (13), *Pinus nigra* Arn. (9), *Quercus frainetto* Ten (9), *Abies alba* Mill. (8), *Robinia pseudoacacia* L (8), *Acer pseudoplatanus* L. (7), *Juglans nigra* L. (6) etc.

1.2.1.2. Case study: Trend in conservation of Plant Genetic Resources for Food and Agriculture (PGRFA) - the number of accessions that are kept in the National Collection, Plant Gene Bank

Author/Institution: Milena Ivanov/ Ministry of agriculture, forestry and water management

Assessment: 

In a narrower sense the Serbian Herbitary Gene Bank is an object in which in strictly controlled conditions samples of plant genetic resources are stored: in the midrange term (on +4ºC to 20 years) and long term (-20ºC over 50 years). It is a necessary factor in the management of national and global conservation of plant genetic resources. The basic task of the herb gene bank is to preserve the identity and vitality of samples of seeds of plant genetic resources of Serbia. Preservation of plant genetic resources is priceless for the survival of humanity due to their resistance to stress, disease, pests and weeds. In a broader sense, the Bank of Herb Genes represents promoter, organizer and implementer of activities to conserve plant genetic resources for food and agriculture, as well as the national bearer of plant genetic resources management.

Plant genetic resources represent natural resources important for human and animal nutrition, as well as for providing raw materials for the industry. Plant genetic resources in agriculture comprise of: local population, genotypes, old and new varieties :grain, forage and industrial plants, vegetables, medicinal, aromatic and horticultural plants, fruit trees and vines, their wild relatives, as well as plant breeding material from real or potential value for agriculture.

In addition to keeping the national collection of cultivation seeds and horticultural plants, as well as the organization of preservation of planting material of fruits and vines, the bank og plant genes performesregistration of seed samples, their cleaning, drying, packaging, storage and maintenace; the organization of multiplication and regeneration of samples, and the exchange of samples

with other gene banks; maintaining a database on plant genetic resources; cooperation with scientific research institutions and other gene banks at the national, regional, European and world level.

It is vitally important that our country ensure a high level of preservation, protection and sustainable use of plant genetic resources, and determine the framework and method of access to plant genetic resources and the exchange of knowledge and technologies related to them.

Since BBG facilities were not completed and put into operation for many years, in order not to deteriorate the national collection of seeds, the Serbian governmemnt entrusted samples to the Maize institute ''Zemun Polje'' in the period 2000-2015 years. Since the establishment of all the necessary technical conditions, on April 1,2015, samples of NK were transferred and stored in the cold room of the Gene Bank Plant in Batajnica, the management for the National Reference Laboratories, Ministry of Agriculture, Forestry and Water Management.

This activated and started the work of BBG of Serbia, after 25 years since the complex for the needs of the BBG of Yugoslavia was built for this purpose. For many years, BBG has had an obvious lack of professional research staff, since it works under the auspices of state administration, which is not common in other countries.

The jurisdiction of the Gene Bank Plant: management and preservation of plant genetic resources for food and work with the equipment and samples in the Gene Bank Plant are carried out under two laws: the Law on Ministries and the Law on Food Safety. There are longterm evident problems with a lack of financial resources for the basic Gene Bank Plant activities.

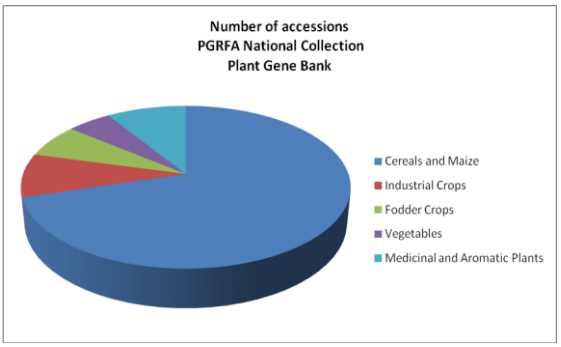


Fig. 1.2.1.2.1. The number of samples of plant genetic resources for food and agriculture in the collection of the National Bank of plant genes

At present, a total of 4,238 samples are kept in the collection of the National Bank of plant genes .

- Grain and maize 2.985 samples,
- Medicinal and aromatic herbs 387,
- Industrial plants 367,
- Fodder plants 284,
- Vegetables 215.

Fig. 1.2.1.2.2. It is particularly important to preserve traditional knowledge and skills related to the sustainable use of plant genetic resources owned by the farmers.

Given that the farmers have an active role in the ''in situ'' and ''on farm'' preservation of plant genetic resources, in the last few years, since 2013, the Ministry of Agriculture Forestry and Water management in accordance with its possibilities allocatescertain financial resources for subventions in preservation of BGRHP (Official Gazette of RS 85/13). The trend of allocating financial resources for these purposes in the last 7 years can be seen in Fig. below.

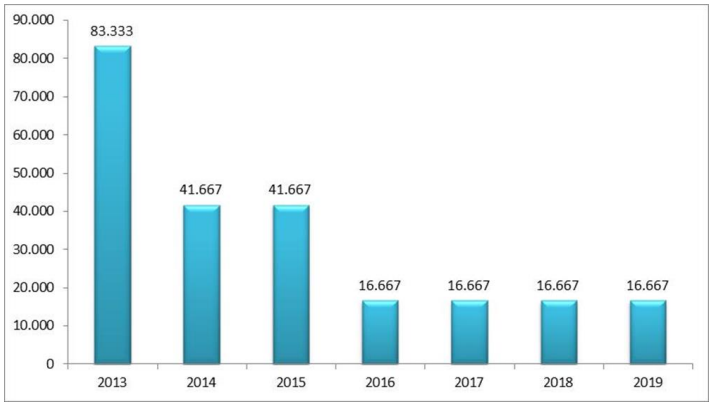


Fig. 1.2.1.2.3. Subvention fo preservation of BGRHP by years (EUR)

National policy on the preservation and sustainable use of agricultural plant genetic resources is presented in the new draft Law on Plant Genetic Resources Management and the draft of the National Plant Genetic Resources Conservation Program. It was concluded that at this time additional legislation on the management of plant genetic resources is necessary. The importance and transparency of the management and use of plant genetic resources for food and agriculture in our country depends on the new law in this area.

The approval of the Law on Plant Genetic Resources Management for Food and Agriculture and the approval of the National Plant Genetic Resources Conservation Program, from research institutes, faculties, private sector, other organizations and stakeholders, as well as farmers, are expected to take part in responsibility for the implementation of obligations in the field of conservation of plant genetic resources.

Strategic documents on agriculture and rural development, nature management, biodiversity, environment are very important and already approved. The Agriculture and Rural Development Strategy, as well as the Biodiversity Strategy, show that a large number of Biodiversity Policy commitments will be implemented, concentrating on relevant domestic and international aspects.

Serbia participates in all relevant international instruments for the conservation of plant genetic resources for food and agriculture and believesthat international obligations in terms of agriculture and biodiversity are mutually supportive.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Active field conservation measures for both habitats and species are financially and technically demanding,
- Lack of staff experienced to fulfill these measure
- There are administrative complications in implementing of active measures related to land use, e.g. on private land or on agricultural/forestry land
- Sectors policies are not in line with biodiversity conservation goals.
- Need for additional researches regarding genetical structures, in first priority for most endangered species,
- Need for support for sustainable development of rural areas of RS, with bigger role of local communities in management and conservation of agro-biodiversity.

1.3 Monitoring the impact of climate change on biodiversity and the impact of biodiversity on mitigating the effects of climate change

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target D15

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been ineffective 

Although Serbia did not have the obligation to reduce greenhouse gas emissions (GSB) between 2008 and 2012, it was necessary to prepare national and periodic UNFCCC reports in order to allow international cooperation in the field of climate change and systemic observation, as well as established knowledge transfer and clean technologies. Also, Serbia had to formulate and implement measures of mitigation, education, training and public information in order to increase the availability of information on the causes and consequences of climate change. During 2010, based on the UNFCCC requirements, the Ministry of Environment and Spatial Planning of the Republic of Serbia prepared the First National Communication (First Report), which contains information on the national context, the database and emission calculations GSB (1990-1998), under the UN Framework Convention on Climate Change (2010), assessment of the vulnerability and impact of climate change, as well as the necessary measures for adaptation and mitigation. It was developed in accordance with the "Guidelines for the Preparation of National Reports for parties not included in the Annex I Convention" (17 / SR.8), by the procedures of the Global Environment Fond (GEF), national regulations, documents and strategies. Taking into account the political, technological, financial and social aspect of the problem, this document also defines specific climate change scenarios (for the periods 2001-2030, 2071-2100), while the assessment of mitigation is related to several sectors - energy, industry, agriculture, forestry and waste management. The first national communication also provided data on research and systemic observations, but also gave recommendations and instructions for future education, training, capacity building and public awareness of global warming and GSB emissions.

The Republic of Serbia initiated the preparation of an institutional and legislative structure for the monitoring, reporting and verification of data and information of importance for climate change, with the financial and technical support of the EU. Preparation of the first national strategy for the fight against climate change, with the action plan, is in the initial phase and will provide a clear framework of activities in the fight against climate change in the period until 2020 and 2030.

This measure is implemented through certain projects, mainly through work on species with sensitive seasonal phases, such as migrating birds, early spring plants - Winter Aconite *Erantis hyemalis*) etc. Also, this monitoring is conducted on some sensitive habitats, such as Salt lake in SNR “Slano kopovo”. Effects of fires, floods, wind-breaks and drought are monitored within forest ecosystems. During spring 2014, when extremely big floods occurred in Serbia, brief survey on its effects on protected areas and protected species is conducted.

1.3.1. Indicator Name: Dead wood in forests and climate changes

Author / Institution: Slaviša Popovic/Environmental Protection Agency, dr Vladimir Djurdjevic, Institute for meteorology, University of Belgrade

Key message: Since 2007 number of dead trees increase 5 times

Assessment: 

The indicator shows connection between climate parameters and forest trees health condition (dead wood) registered by the Institute for Meteorology and ICP Forest Monitoring Network. Correlation between dried trees and strongly defoliated trees for 4 dominant

species (Beech, Hungarian oak, Turkish oak and Spruce) shown strong dependence of the temperature and precipitation anomalies during the summer season (June, July and August) - when extremely hot and dry summers were registered. 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. Increase of strongly defoliated trees was 4 times higher during the same period.

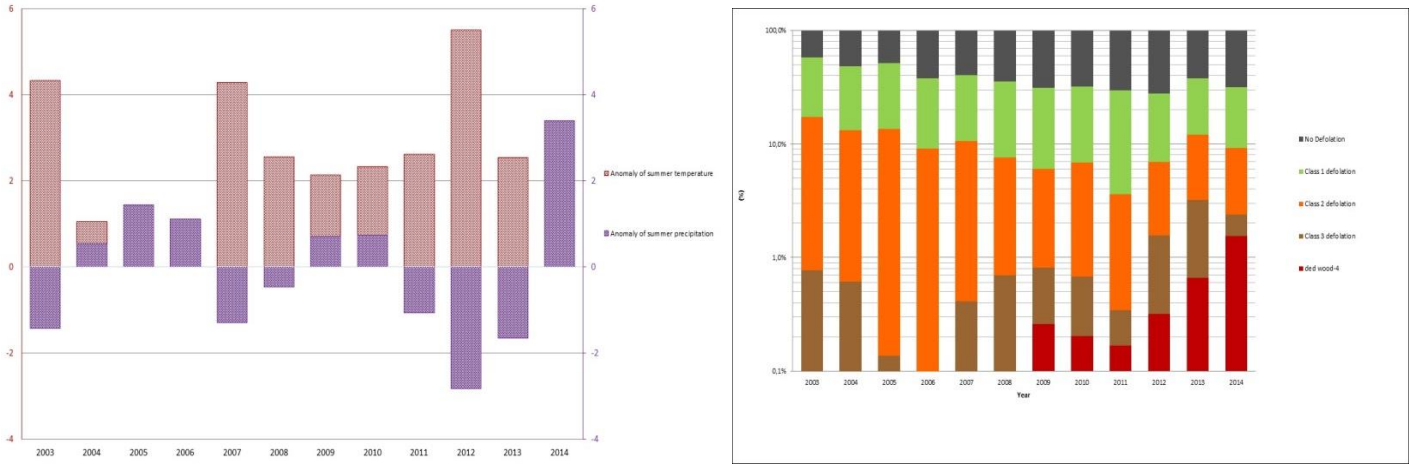


Fig. 1.3.1.1. Temperature and precipitation anomalies for summer season (June, July and August) (left)/ Defoliation of forest trees (right)

Correlation between dried trees strongly defoliated trees for 4 dominant species (Beech, Hungarian oak, Turkish oak and Spruce) have been observed. This was connected with temperature and precipitation anomalies during the summer season (June, July and August) when extremely hot and dry summers were registered. Percentage of "none", "slight", "average", "strong" and "dead wood" per years, in accordance with climate parameters: temperature and precipitations are presented. Calculation procedure has been done according to the criteria of ICP Forests monitoring.

1.3.2. Indicator Name: Forest damages

Author / Institution: Slaviša Popovic/Environmental Protection Agency

Key message: Increase in damge from natural disasters and insects

Assessment: 

The indicator show damage suffered by forests, broken down by selected biotic, abiotic and anthropogenic agents. The indicator is used to express level of damages and to compare which agent has the most expressive effect. In 2011 and 2012 man-made damage was the most expressed, while in recent year damage caused but natural disasters increased several times.

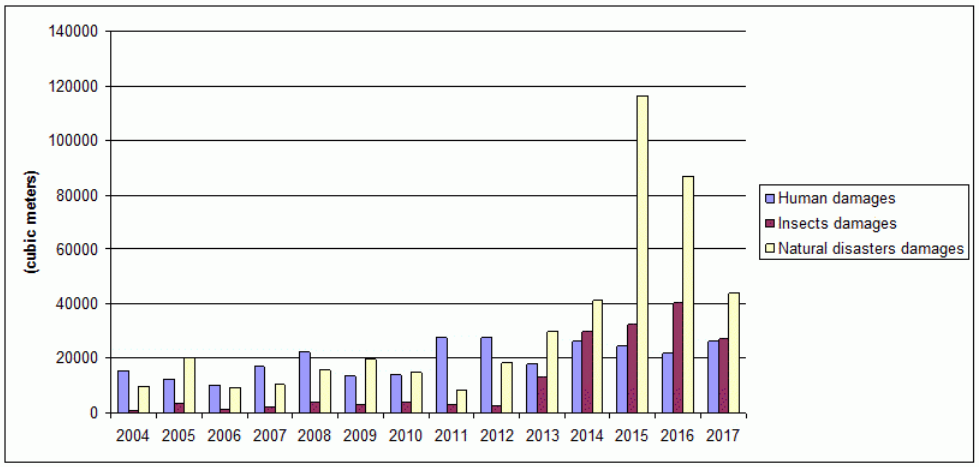


Fig. 1.3.2.1. Damage suffered by forests broken down by agents

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 2017 human damages in forest increased. Over 25 000 cubic meters of wood were illegally harvested, especially in the region of southern end eastern Serbia. дрвета је бесправно посечено из државних шума и то највише у региону јужне и источне Србије. Insects damages decreased for about 30 % and natural disaster damages decreased for about 5 %.

1.3.3. Indicator Name: Forest health conditions

Author / Institution: Slavisa Popovic/Environmental Protection Agency

Key message: Increase in the number of healthy trees

Assessment: 

The indicator is used to monitor forest health conditions through the trunk defoliation indicators in the frame of ICP Forests Monitoring Network. Monitoring of the health conditions of forests is based on the loss of leaves on trees in forests in each of defoliation classes: "none", "slight", "average", "strong" and "dead wood". There is also monitoring of health conditions according to changes in color of the leaves on the trees in the forests in each of decolorized classes: "none", "slight", "average", "strong" and "dead wood". Combined damage assessment of trees in classed: "none", "slight", "average", "strong" and "dead wood".

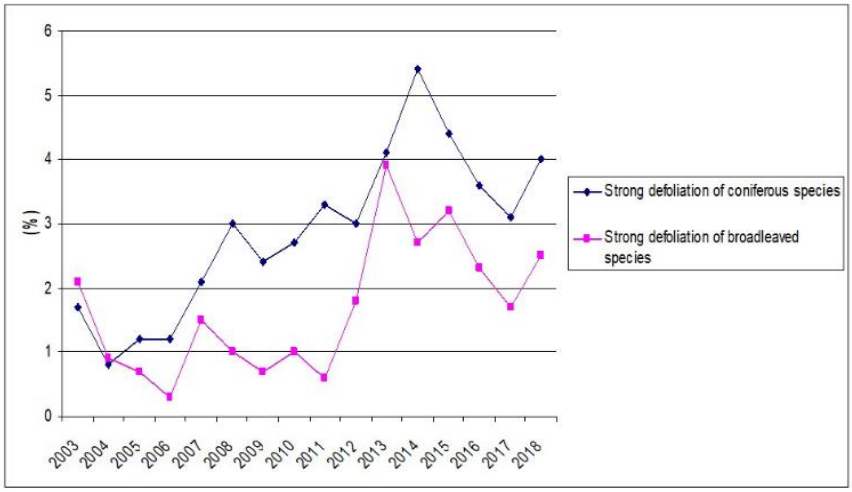


Fig. 1.3.3.1. Strong defoliation of coniferous and broadleaved species

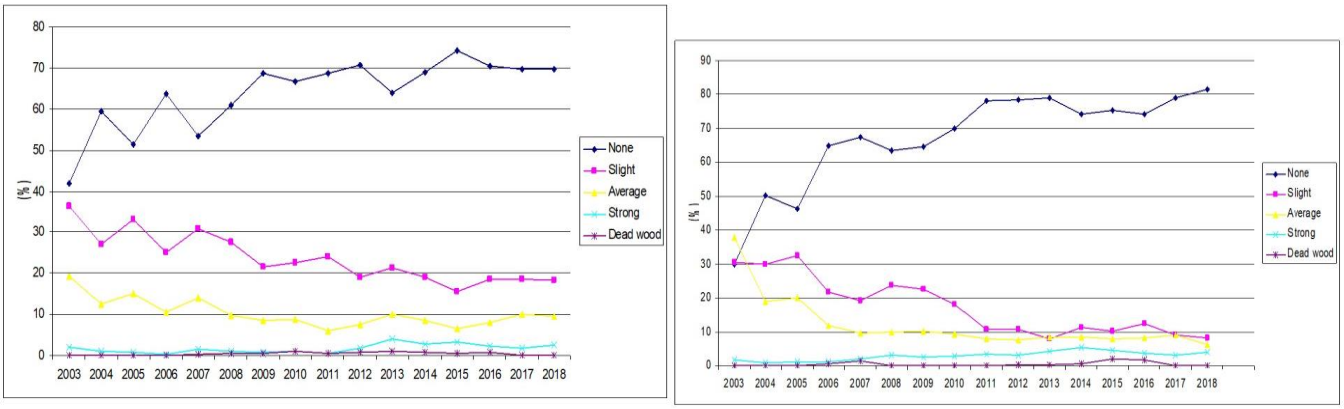
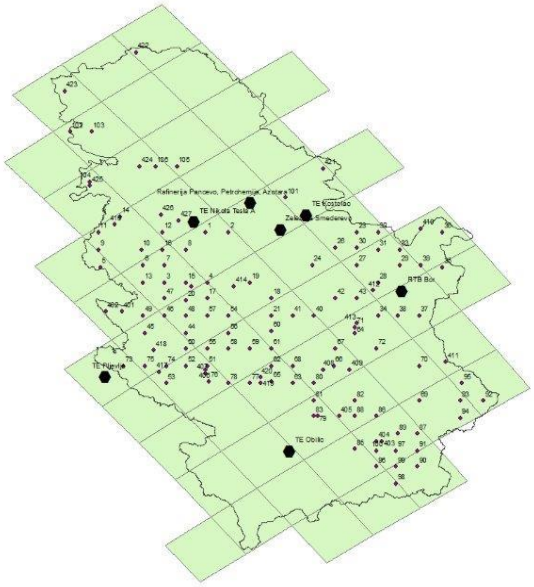


Fig. 1.3.3.2. Defoliation of coniferous (left) and broadleaved (right) tree species

When looking at healthy trees, about 90% of coniferous and deciduous trees did not have or had a weak defoliation. The defoliation was not registered on 92.4% of fir trees, 91.6% of spruce trees, 91% of white pine trees and about 40% of black pine trees. Moderate and strong defoliation involves about 43% of black pine trees.
Of the deciduous species, 85% of hornbeam trees, 81% of oak trees, 73.2% of beech trees, 71% of Austrian oak and 65.2% of sessile oak trees had no defoliation. The moderate and weak defoliation of the deciduous species was increased in relation to 2017.
In 2018 an assessment was made of the condition of forest species on 130 bioindication points, to a total of 2968 trees. During the year 2018, no drying of trees of coniferous species was recorded, while 0.1% deciduous trees were dried, but there was an increase in strong defoliation of coniferous species by around 30% and deciduous species by about 50% compared to 2017.



Map. 1.3.3.3. Plots for monitoring of forest health condition and main pollutant sites

1.3.4. Indicator Name: Forest fires

Author / Institution: Slavisa Popovis/Environmental Protection Agency

Key message: The greatest damage from forest fires was in 2003, 2012 and 2016

Assessment: 

Forest fires are monitored every year and data are expressed in cubic meters of timber volume or hectares of land destroyed. It is evidenced that some years were specific related to damage caused by forest fires. The most remarkable damages in cubic meters of timber were in 2012, 2003 and 2011. In 2007 even the amount of cubic meters of burned timber have not been large, damage in hectares on forest surface caused by fires have been very expressive.

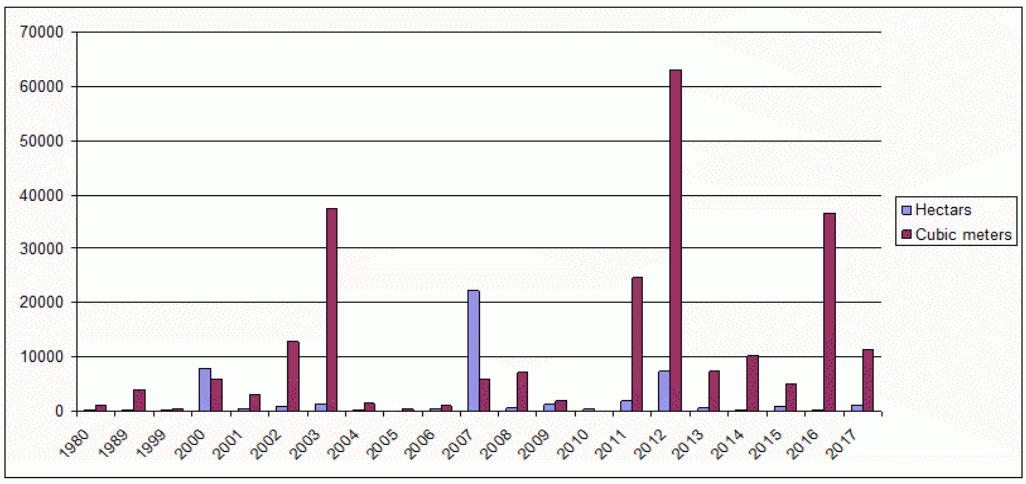


Fig. 1.3.4.1. Damage caused by forest fires

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. 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.).

1.3.5. Indicator Name: Number of fungal species in selected forest habitats

Author / Institution: dr Maja Karaman, MSc Milana Rakić/ Department of biology and ecology, Faculty of Sciences, University of Novi Sad

Key message: The number of mushroom species in the forests is reduced

Assessment: 

Macrofungal production is characterized by a high interannual variability which is closely linked to variations in weather conditions from one year to the next. Mushrooms generally flourish under warm and wet conditions. Source data are the fungal species collected from 2 permanent investigation plots (size of the plot: 1000m^2) within 2 different forest habitats on Mt. Vidlič, locality Vzganica, visited four times each year in the period 2009 – 2013. In the longterm study conducted on Mt. Vidlič (locality Vzganica) in the period 2009-2013, we observed that macrofungal speciess richness (number od detected species) was in correlation with several abiotic factors. Decline in annual precipitation, relative air humidity and soil moisture was followed by a decline in the recorded number of macrofungal species. On the contrary, increase in the value of above factors led to increase in the number of species. Therefore, it can be expected that the trend of climate change towards more arid conditions in Serbia would lead to the declining of macrofungal communities, as well as changes in species composition. This would inevitably lead to a change in the accompanying vegetation and cause a disturbance of natural processes in which macrofungi are involved.

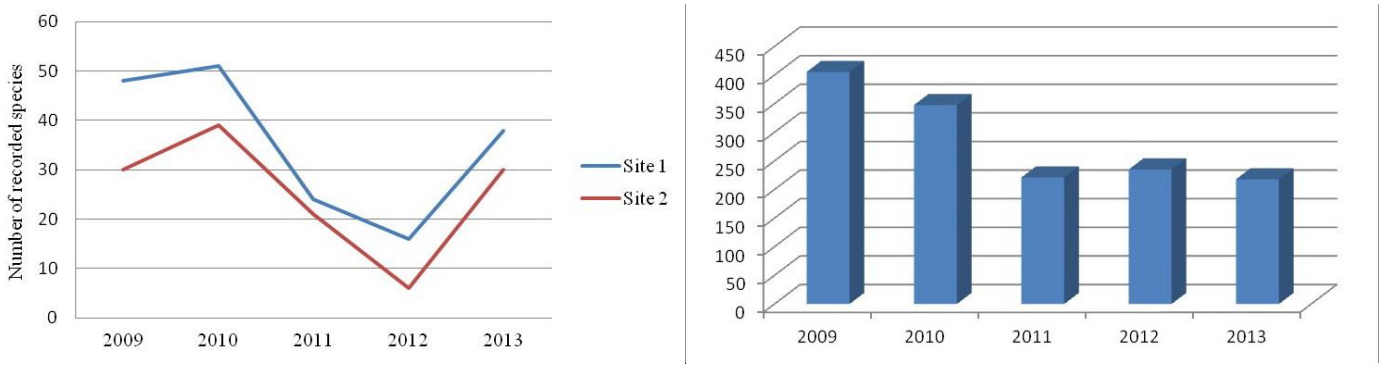
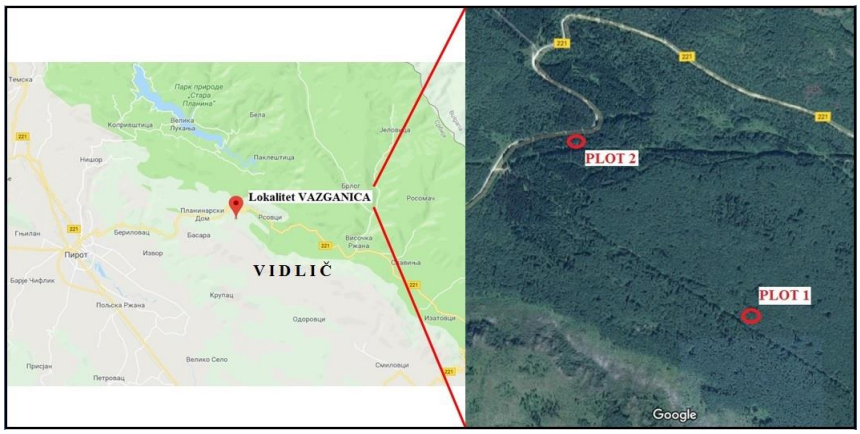


Fig. 1.3.5.1. Annual changes in the number of fungal species (left) and average annual precipitation (right)



Map. 1.3.5.2. Monitored localities

Pic. 1.3.5.3. - *Coprinus xanthotrix, Hymenopellis radicata, Phallus impudicus*, *Laccaria laccata, Spathularia flavida*

1.3.6. Indicator Name: Air pollution and forest defoliation in selected protected areas

Author / Institution: dr Jovana Dzoljic/College of applied professional studies, Vranje, Slavisa Popovic/ Environmental Protection Agency

Key message: Increased concentration of SO_x leads to greater defoliation

Assessment: 

The analysis of the most significant concentration of aero-pollutants (NO_x, NH_x i SO_x) in the air at the territory of protected area „Dolina Pcinje“ during the period 2012 – 2014 shows positive correlation between NO_x, and SO_x minimal detected concentration and defoliation intensity of broad-leaves species. Concentration of NH_x has not been changed, and therefore it cannot be directly linked to defoliation (Fig. below).

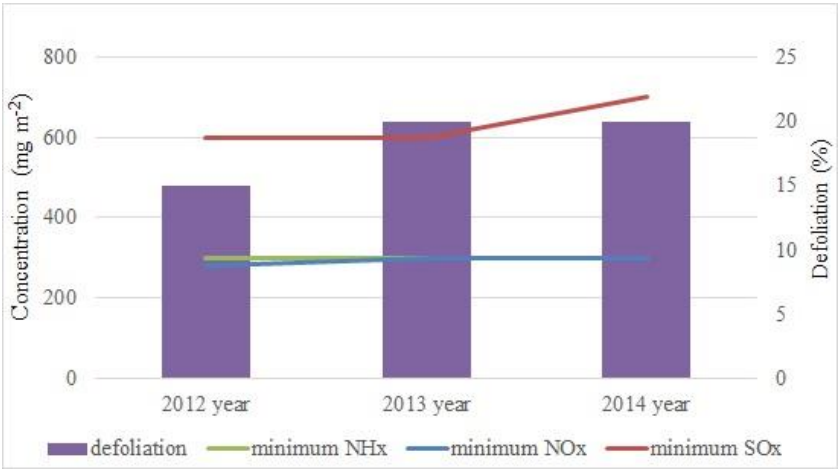


Fig. 1.3.6.1. Correlation between NH_x, NO_x and SO_x concentration in the air and defoliation intensity.

According to the the data of Republic Hydro-meteorological Service of Serbia over the last 20 years, noticeable change of climate parameters was registered, especially temperature and the amount of precipitation. Changes of climate conditions can indicate possible higher sensitivity of ecosystems, especially broad-leaves forests.

Regarding the fact that Coal Power plant "Kosovo" in Obilic, Kosovo and Metohija, has influence on the air quality of Southern Serbia, and based on the result of the analysis, it can be concluded that its influence is not significant at this protected area (Džoljić, 2017), mostly due to the topography of the terrain (Map below).

Map. 1.3.6.2. Location of Coal Power Plant "Obilic" and Protected Area "Dolina Pcinje".

1.3.7. Indicator name: Flowering of *Prunus laurocerasus* related to Climate Changes

Author / Institution: Dr Ana Vukovic/ Faculty of agriculture, University of Belgarde, Slavisa Popovic/ Environmental Protection Agency

Key message: Flowering of Prinus laurocerasus has been more frequent in recent years

Assessment: 

Flowering of Zeleniče (*Prunus laurocerasus*) has never been recorded in the older literature. For the first time it was observed and recorded in 1983. Years when flowering was observed and recorded are: 1983, 1998, 2008, 2012, 2017. For other years occurrence of flowering is unknown. Period during which flowering was observed is May-June.

Final set of criteria, which must agree with values derived from temperature data for the first half of the year, give as a result that during the period of 57 years flowering was possible in 17 years, from which 6 happened during the 1961-1990 and other 11 during the period of significantly warmer climate 1998-2017 when also was relatively frequent flowering of Zeleniče. Last three recorded flowering happened with 4-5 years interval. Did flowering occurred meanwhile - it is unknown.

One should have in mind there is high probability that Zeleniče at Ostrozub is currently under climate heat conditions that are still not optimal for every year flowering occurrence, but with future temperature increase flowering frequency can increase.

Analysis of climate conditions was done for the period 1961-2017 for the site where Zeleniče grows on mountain Ostrozub (latitude 42.88694; longitude 22.22361)

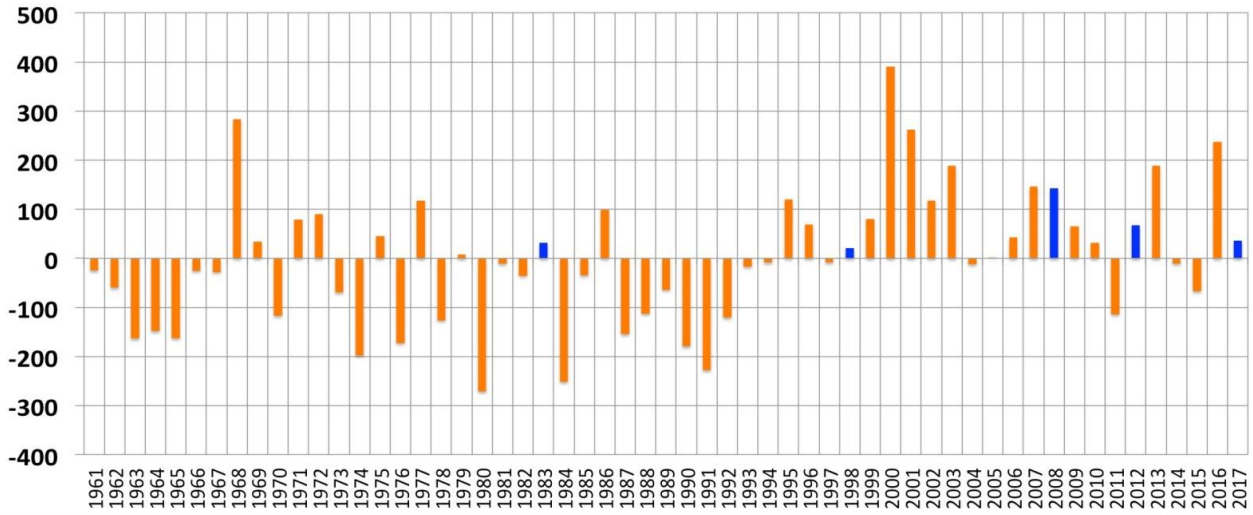


Fig. 1.3.7.1. Anomalies of a sum of active temperatures (growing degree days, GDD, in °C) for biological minimum of 10°C for the period January-June for each year with respect to 1961-2017 for locality of Zeleniče on Ostrozub; mean GDD for January-June for 1961-2017 is 829°C; in blue are marked years when flowering of Zeleniče was recorded.

Approach in finding the criteria, which indicate favorable heat conditions for flowering of Zeleniče that is possible to occur in the period May-June but depends on heat conditions before flowering occurrence as well, is based on setting the criteria using threshold values, which are defined using the values obtained for years for which was observed and recorded flowering. It was required that those years satisfy defined criteria for flowering and that defined criteria eliminate most of the other years as favorable for flowering (especially during the period of colder climate within period used for this analysis - on contrary flowering would have more frequent occurrence and would be recorded in older literature).

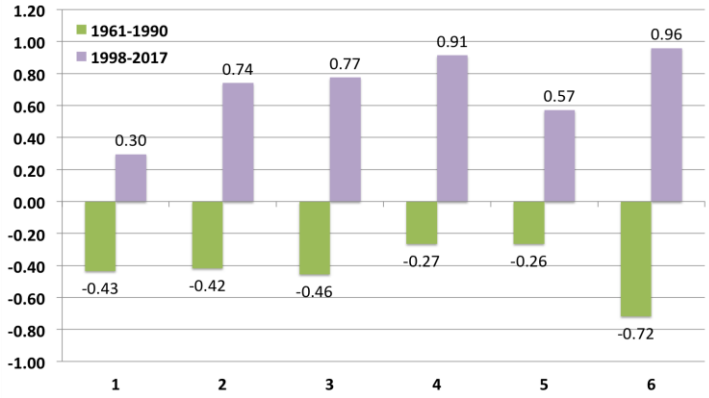


Fig.. 1.3.7.2. Anomalies of mean monthly temperatures for the periods 1961-1990 (green) and 1998-2017 (purple) in °C with respect to the 1961-2017 for locality of Zeleniče on Ostrozub.

1.3.8. Indicator name: Climate Changes and flowering phenology of winter aconite

Author/Institution: dr Ana Vukovic/ Faculty of Agriculture, Univerzity of Belgrade, dr Biljana Panjkovic/ Provincial Institute for Nature Conservation, Novi Sad, Slavisa Popovic/ Environmental Protection Agency

Key messege: Hellebore flowering became more earlier in the spring

Assesment: 

The average annual temperature increase in Serbia for the period 1996-2015 compared to the period 1961-1980 is 1.2 ° C, and for the winter and spring period by 1.3 ° C and 0.9 ° C, respectively (Vukovic et al., 2018) . However, the last 7 years (2012-2018) represent 7 the warmest years recorded, with a mean anomaly of about 2 ° C compared to the reference period (Djurdjevic et al., 2018). These changes in temperature caused favorable thermal conditions for the longer duration of the vegetation period, during the period 2008-2017 in the lowlands, even in about a month longer than in the middle of the 20th century. Observations of the start date of growing season show advancing toward earlier dates, and it is expected to advance more in the future (MEP, 2017).

The observation of the flowering of the winter aconite (*Eranthis hyemalis*) in the Bagremara forest near Backa Palanka city was carried out relatively regularly since 1996 (observations for the years 2000, 2001, 2002, 2004, 2011, 2012 are absent, while for 16 years there are data on the date of beginning of flowering). The data were analyzed for the period 1996-2017. The average date of flowering of winter aconite, obtained from all available data, is the 50th day from the beginning of the year (February 19th). For the period 1996-2006, the average day of flowering is the 68th day (March 9th), and for the period 2007-2017 is the 38th day (February 7th)

Pic. 1.3.8.1. Flowers of winter aconite. (Foto: B. Panjkovic)

Fig. below shows the anomalies of the beginning of flowering date of winter aconite for each year, with respect to the mean value for the entire period, together with the mean temperature anomalies for the period January-March compared to the mean for the period 1996-2017, but taking into account only the years in which there were monitoring of flowering (where data are not visible

means that they are close to zero, the years for which the flowering data is not observed are not marked in x-axis). The results show that positive anomalies in temperature correspond, in most of the years studied, to negative anomalies in the date of flowering. This means those warmer periods January-March correspond to the earlier date of flowering.

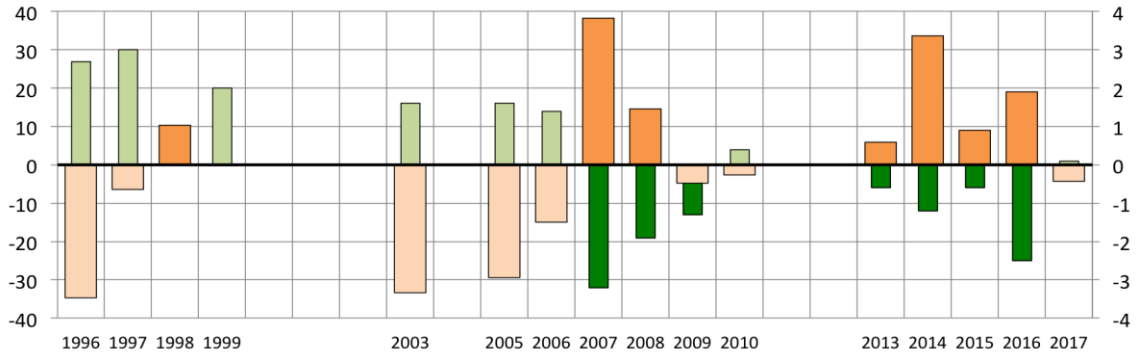


Fig. 1.3.8.2. Anomaly of the date of winter aconite flowering with respect to the mean value for the entire period (green color, left scale, anomalies in the number of days) and average temperature anomalies for January-March in the mean to the mean for the whole period (orange, right scale, in ° C); brighter colors indicate negative deviations anomalies in temperature and positive in flowering date, and darker to positive anomalies of temperature and negative in flowering date; The mean values for the entire period 1996-2017 are calculated from data for years when there are also observations of the flowering of maize

Minor deviations from this conclusion have caused the variability of different temperature conditions during the period January-March. Anomalies of mean monthly temperatures for each year relative to the mean for the entire period 1996-2017 are shown in Figure below.

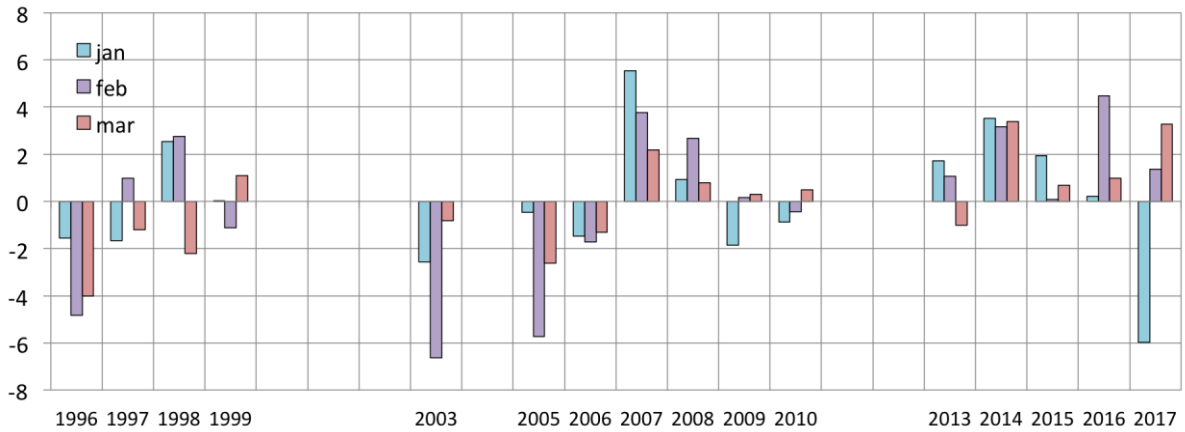


Fig. 1.3.8.3. Anomaly of average monthly air temperatures for January, February and March with respect to the average monthly values for the whole period; the mean values for the entire period 1996-2017 are calculated from data for years when there are also observations of the flowering of maize

Literature:

Djurdjevic, V., Vukovic, A., Vujadinovic, M., 2018: Osmotrene promene klime u Srbiji i projekcije buduće klime na osnovu različitih scenarija budućih emisija, Izveštaj, Program Ujedinjenih nacija za razvoj.

MEP, 2017: The Second National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Environmental Protection, Belgrade, 2017.

Vukovic, A. et al., 2018: Global warming impact on climate change in Serbia for the period 1961-2100, Thermal Science, vol. 22, pp. 2267-2280.

Panjković, B., Perić, R., Milenić, B (2019):Eranthis hyemalis (L.) Salisb. – indicator species of climate change. 13th Symposium on the Flora of Southeastern Serbia and Neighboring Regions. Stara planina Mt. 20 to 23 June 2019. Abstracts, 105-106.

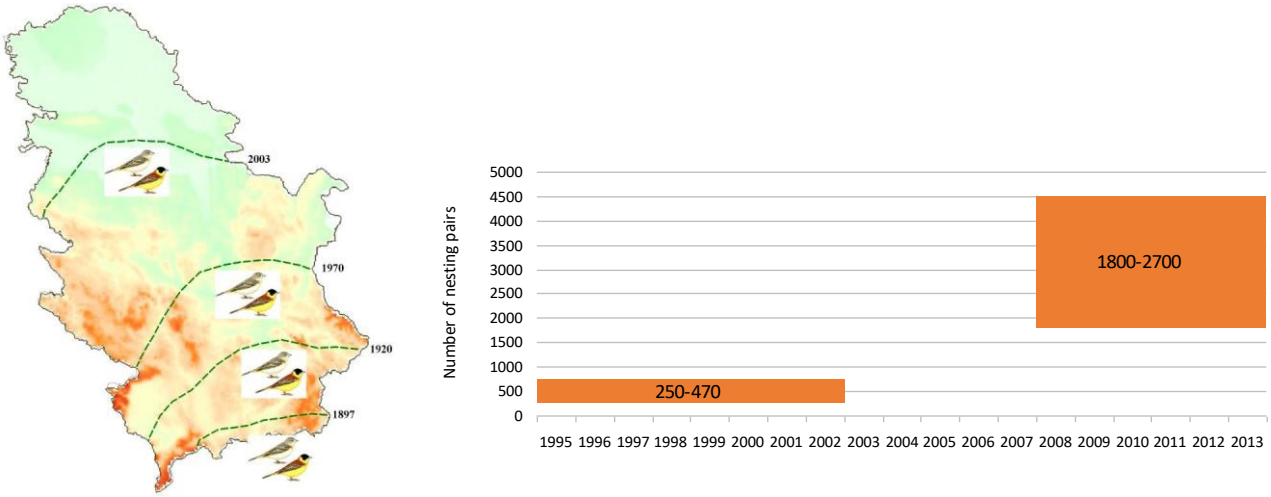
1.3.9. Indicator name: Climate Changes and Black-Headed Bunting areal and population size changes

Author/Institution: dr Ana Vukovic/ Faculty of Agriculture, Univerzity of Belgrade, Nikola Stojnic/ Provincial Institute for Nature Conservation, Novi Sad, Slavisa Popovic/ Environmental Protection Agency

Key messege: Areal and population size of Black-Headed Bunting increase within the Climate Change

Assesment: 

On the territory of Serbia observed the growth in number of Black-headed Bunting and increasing the areal distribution from south to north of Serbia. The first observed habitats in Serbia until the mid-20th century are in the area of southern Serbia (Vranje, Niš, Pirot, etc.), and it is also known that at the end of the XIX century it certainly did not nest north of Vranje. Since the middle of the 20th century in drought and warmer years begins to appear from time to time and to the north. Mostly areas of lower altitudes (up to about 400m) are inhabited, but their occurrences are examined in more rare cases at higher altitudes. During the year 2003, which was warm and dry during the period of settlement of this species, the Blackheaded Buntings were also seen on the slopes of Fruška Gora at an altitude of up to 200m. In addition to 2003, an important year after the settlement of this species on its way to warmer regions was 2000, which is also characterized by exceptionally warm and dry weather. Observed number of breeding pairs in two periods estimated for the territory of Serbia is: 250-470 for the period 1995-2002 and 1800-2700 for the period 2008-2013.

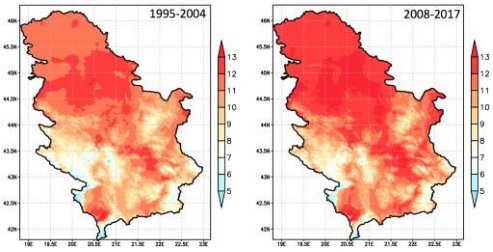


Map and fig1.3.9.1. Areal and population size change of Black-Headed Bunting

Parameters that are being tested for the analysis of favorable climatic conditions of the habitat of the Black-headed Buntingare:

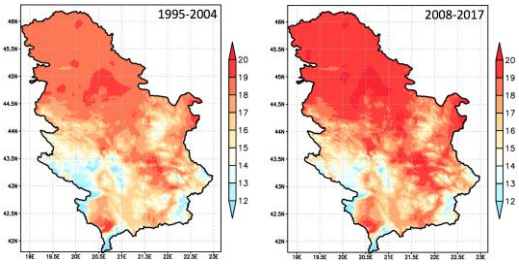
- mean annual temperature
- medium temperature for the period April-September

On maps below the spatial values of mean annual temperatures for 10-year periods are presented, which include the periods for which the data on the number of Black-headed Bunting counts were given: 1995-2004 and 2008-2017. From the results can be seen in the spatial distribution of temperature, which demonstrated a significant increase in temperature between the two periods.



Map. 1.3.9.2. Mean annual temperature in the territory of Serbia for the periods 1995-2004 (left panel) and 2008-2017 (right panel).

Particularly shown is the average temperature for the periods 1995-2004 and 2008-2017 for the Monts of April-September, as a period when the Black-Headed Bunting are been in Serbia (Map below). The increase in temperature for this period of the year between the two observed 10-year periods in some areas is significantly more pronounced than the change in the average annual temperature, as the observed heating, as already mentioned, is the highest during the summer season and is visible in this six-month period. Thus, the warming up of the period of the year when this species is retained in Serbia is more pronounced than the increase in the mean annual temperature, which indicates the likely spread of a favorable area for the settlement of this species.



Map. 1.3.9.3. Mean temperature for the period April-September in the territory of Serbia for the periods 1995-2004 and 2008-2017.

Observed habitats in Europe, Black-headed Bunting show that this type corresponds to warmer and drier weather in the period of their stay. Due to the impact of climate change in the thermal conditions in Serbia have become convenient for a stay of this species. The climate becomes similar to those in which their habitats are considered, south of Serbia - the area of south-eastern Europe, Italy, the Adriatic coast. This confirms that the movement of subtropical characteristics into the southern parts of Serbia and in the future further to the north, also affects migration of species. Due to the occasional reporting of extremely moist episodes in some years in Serbia in May and June, there may still be variations in their number, but the trend of change shows that favorable conditions are created in the territory of Serbia in the areas of southern, central and northern Serbia, such as predicted by Huntley et. al. 2004, but very likely faster than predicted, because temperature changes show faster warming than predicted.

Literature:

- Huntley, B. et. al., 2004: A Climatic Atlas of European Breeding Birds, Lynx Edicions;
- Puzović S. i Grubač B., 2003: Širenje areala rasprostranjenja crnoglave strnadice Emberiza melanocephala u Srbiji: prvo gnežđenje na Fruškoj gori i u Vojvodini, Glasnik društva za zaštitu i proučavanje ptica Vojvodine, vol. 12, Novi Sad, p. 180-183.
- Vukovic, A. et al., 2018: global warming impact on climate change in Serbia for the period 1961-2100, Thermal Science, vol. 22, pp. 2267-2280;)
- Djurdjevic, V., Vukovic, A., Vujadinovic, M., 2018: Osmotrene promene klime u Srbiji i projekcije buduće klime na osnovu različitih scenarija budućih emisija, Izveštaj, Program Ujedinjenih nacija za razvoj

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Lack of system for monitoring impact of climate changes on biodiversity,
- Lack of legal base for establishing of the monitoring system,
- Iinsufficient and irregular financing,
- Unharmonized goals of scientific and nature conservation sectors,

- Lack of trained staf,
- Lack of appropriate methodologies.

1.4 Establishment of an integral national information system for biodiversity with a database (INISB)

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target E19

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

This measure is directly connected to research, data collection and monitoring of biodiversity in RS, done by various subjects such as scientific institutions (institutes, faculties...), institutes for nature conservation, Natural History Museum, managers of protected areas, NGOs, even some private companies. First steps towards establishment of INISB are two biodiversity projects, one finished and one on-going, financed by MEP. Lead institution for this project is Biological Faculty Belgrade with main beneficiaries institutes for nature conservation. Besides that, there is very good database on biodiversity in Serbia – BIORAS – lead by civil sector. Another very important initiative for integration in this topic is led by German Development Agency, GIZ, within BIMR project (Biodiversity Information Management and Reporting) in cooperation with Serbian partners and for wider region.

The Ministry of Environmental Protection1 (MEP) is responsible for administration and policy development tasks in the field of environment including biodiversity and nature conservation. In close cooperation with the MEP there is a public administration authority, the Serbian Environmental Protection Agency (SEPA)**,** responsible for integrating data on environment and preparing reports on the state of environment in Serbia**.** Professional activities related to nature conservation and protected areas in Serbia are performed by the Institute of Nature Conservation of Serbia while for territory of Vojvodina Province these activities are delegated to the Institute of Nature Conservation of Vojvodina Province**.**

The most important operational state institutions in the BIMR framework are SEPA, Institute for Nature Conservation of Serbia and Institute for Nature Conservation of Vojvodina Province. A significant number of teams and individual scientists operate at the University of Belgrade, Novi Sad, Kragujevac and Niš and their cooperation in Centre for Biodiversity Informatics can be a good starting point for centralisation of providing scientifically verified biodiversity data in Serbia. The BioRaS portal, managed by group of non-governmental organizations (NGOs) and technically supported by Petnica Research Center, proved to be a robust platform for integrating civil society initiatives in biodiversity assessments and engaging general public in inventarisation and monitoring of biodiversity in Serbia. Based on the review of their legal responsibilities, recent activities and results, we enlisted stakeholders who are related to biodiversity, nature conservation or use of natural resources.

Institution/ organisations type Number

Governmental institution 6, Public institution 12, Public enterprise 12, Academic institution 18, NGO 24, International organisation 3, Religious institution 1and Company 14.

The most numerous stakeholders are from the NGO and academic community that are also recognized as the most important stakeholders for collecting and structuring biodiversity data. Although most academic institutions are located in Belgrade, there are significant scientific bases in Novi Sad, Kragujevac and Niš. With more than 20 relevant organizations the NGO community seems strong with numerous volunteer base. Unfortunately, this is not a case. Most of the organisations that collect and process biodiversity data are with only a few members initiated by graduates of biology who have no other opportunity for finding a job. Only a few organizations are working on the national level (Bird Protection and Study Society of Serbia, NGO Habiprot and Scientific research student association "Josif Pančić") and recruit a significant number of members that are collecting biodiversity data in the field. Others are local organisations with several volunteers that are frequently working in close cooperation with the local managers of the protected area.

Data used in the Studies of protection, collected by experts from the Institutes for Nature Conservation in Belgrade and Novi Sad;

- Data of monitoring of target species, collected by experts from the Institute for Nature Conservation of Vojvodina and Managers of protected areas;

- Data used for preparation of action plans for protection of large carnivores, collected and processed by experts from the Faculty of Biology in Belgrade, Institute for biological Research in Belgrade and Museum of Natural History in Belgrade;

- Data provided by the projects "Establishment of an ecological network in the Republic of Serbia" and "Development of the Red Book of Plants, Animals and Fungi in the Republic of Serbia", compiled and verified by experts from Faculty of Biology in Belgrade, Department for biology and ecology in Novi Sad and Birds Protection and Study Society from Novi Sad;

- Data of rapid ecological assessment of Serbian natural assets, collected by academic institutions and NGOs and provided to managers of PAs;

- Data collected by experts from Universities in Novi Sad, Belgrade, Kragujevac and Niš and Institute for Biological Research, in the framework of scientific projects supported by the Ministry of Education, Science and Technological Development;

- Data used for Fish stock management programmes, compiled by experts from Biological faculty in Belgrade, Institute for Multidisciplinary Research in Belgrade, Institute of Biology and Ecology in Kragujevac and Department for biology and ecology in Novi Sad;

- Data collected by support of local projects from the Rufford Small Projects Grants Scheme (or similar funders);

- Data collected by support of local/regional/national environmental authorities;
- Data used in EIA/SEA studies;
- Data published on the BioRaS portal;
- Data published into the Alciphron database;
- IPA project Natura 2000 Serbia / The project ceased operations due to administrative Reasons

1.4.1. Indicator: Number of biodiversity indicators in use

Author / Institution: Slavisa Popovic/Environmental Protection Agency

Key message: In the field of biodiversity, over 50 indicators have been developed

Assessment: 

Since the establishment of the Environmental Protection Agency in 2004 and the acceptance of the reporting structure according to the model: Actual factors - Pressure - Condition - Influence - Response, numerous indicators of environmental protection have been developed. In the field of biodiversity and nature protection, more than 50 indicators have been developed, in which the state of different parameters are being monitored in the yearly or perennial period.

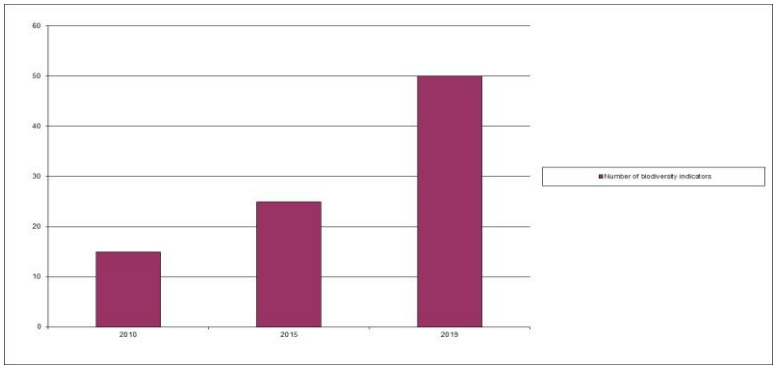


Fig. 1.4.1.1. Number of biodiversity indicators in use

The highest number of indicators monitors the status of species and habitats, as well as the parameters of protecting and conserving biodiversity and nature at different levels.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Legal base for establishing and work of INISB needs to be upgraded,
- Lack of synergy within nature conservation sector and with other data providing sectors,
- Technical demanding for establishing universal biodiversity data base system,
- Lack of regular financial source for systematic data collection.

1.5 Combating illegal killing, trapping and trade of wild species

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target E18

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been ineffective 

According to some assessments, this measure is implemented in Serbia on very satisfactory level, especially comparing to surrounding, even EU countries. Basement of this activity is good joint work of institutes for nature conservation and environmental inspectors with PA managers, Police, Prosecutors and Customs, and above all with NGOs and citizens. For previous ten years increasing trend of processing of cases of Combating illegal killing, trapping and trade of wild species.

Within its jurisdictions, hunting and fishing inspectors and guards also contribute. This measure, besides direct benefits through successful rehabilitation of individuals, additionally stops or inhibits negative subjects, and if followed by good media cover, works as prevention and affirmatively. Among cases highly covered by media is ceasure of more than 5000 wild bird eggs and processing of perpetrator in 2006.

1.5.1. Indicator name: Number and structure of animals in reception zoo garden

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Pavle Jovanovic/ Ministry for Environmental Protection, Kristijan Ovari/ Zoo garden Palic

Key message: The number of animals in the zoo shelter is increasing; the most endangered species are birds

Assessment: 

Zoo Palic was officially started cooperation with the competent institutions in the field of acceptance 19.10.2004. when the first individuals from the confiscation arrived at the reception, these are the three types of individuals living Green iguana (*Iguana iguana*) and one living individual species of Burmese python (*Python molurus*). To date, more than 3,500 yards have arrived in the reception, and the tendency of the arrival of individuals is increasing every year.

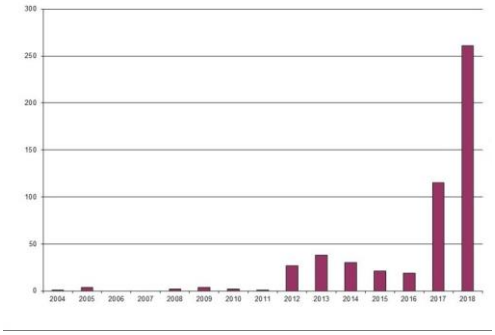


Fig. 1.5.1.1. Number of survived animals in reception zoo garden.

The structure of recepted animals shows that birds and reptils were the most numerous animals in Zoo, folowed with mamals. The largest seizure so far has been 400 parrots, which were stopped by the veterinary inspection without adequate veterinary sanitary

documentation, a bizarre was the seizure of 6 animals ape species Barbary Macaque (Macaca sylvanus) that were found in the trunk of a car bound and stacked in crates (http://www.rts.rs/page/stories/sr/story/135/hronika/1818471/majmuni-zaplenjeni-na-horgosu-zbrinuti-u-spaniji.html). But the garden had the opportunity on several occasions to places and dangerous animals like bears (https://www.telegraf.rs/vesti/srbija/2972856-meda-napa-stigao-u-svajcarsku-specijalnom-gondolom-zlostavljan-je-celog-zivota-u-srbobranu-a-sad-je-dobio-luksuzni-tretman-foto)

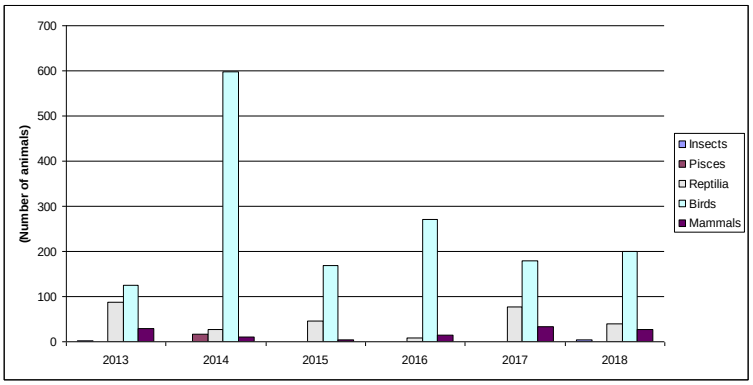


Fig. Taxonomic structure of survived animals in reception zoo garden.

About 50% of the individuals who arrive in the reception are brought by citizens, and about 50% of the number of individuals make the indigenous wild animal species that are under some regime of protection, and they are unable to care for themselves (the injured, the sick, fell out of the nest ...)

In cooperation with the Institute for the Protection of Nature every year about 30% of individuals successfully mark and back to nature, while the mortality rate of individuals of which approximately 30% as the percentage of animals which are due to the poor condition is not bad result. About 30% of individuals are retained each year in acceptance because they have a need for extended rehabilitation or a simple need to resolve legal status, and a court decision is pending.

Individuals who are members of the most exotic species through the seizures are due to the cooperation between customs, police, border police, environmental inspection, veterinary inspection and communal police, all under the supervision of the Ministry, with which a co-financing contract is attached each year, which is also the legal basis for the functioning of the care of animals.

The Zoo uses all its free capacities so that the injured animals are taken care of in separate compartments in the part of the garden that is not visible to visitors, but in cases where there are no other options, other capacities are also engaged, as in the case of the recently arrived iguanas and giant snakes, which the inspector has delivered in cooperation with the police, because the person who was trafficked by narcotics fugitives, or in case of confiscation of the bear from the circus.

http://mondo.rs/a689997/Info/Drustvo/Tri-meceta-odlaze-iz-Srbije-u-Rumuniju.html

Reception Center in Palic each year in cooperation with the Natural History Museum in Belgrade marks the day of the CITES Convention which presents the work of these institutions in the protection programiam. In the last two years, significant cooperation with the Provincial Institute for Nature Conservation has been achieved and over 40 windmills have been released in the framework of these programs (https://vojvodinainfo.rs/palic-vetruske-iz-zoo-vrta-vracene-u-prirodu/), as well as during the week of promotion of CITES, which was seen by over 200 children (http://zoopalic.com/obelezen-dan-divljih-vrsta-cites-konvencija/).

1.5.2. Indicator name: Wild bird poaching and poisoning

Author / Institution: Milan Ruzic/ Association for the protection and study of birds

Key message: Over the 200 wild bird species is endangered from poaching and poisoning

Assessment: 

Large birds of prey such as eagles, but also many other species are very threatened due to poisoning. Huge pressure onto bird from hunting, pigeon breeding and farming communities, more field work, more volunteers and members, large media campaigns, and better visibility of the issue. Critically endangered species such as Eastern Imperial Eagle are especially vulnerable. Almost 200 wild bird species are threatened due to poaching. Critically endangered species such as Eastern Imperial Eagle are especially vulnerable. Huge pressure onto bird from illegal and legal hunting, pigeon breeders, more field work, more volunteers and members, large media campaigns, and better visibility of the issue.

Intentional or accidental wild bird poisoning cases were also investigated. Pigeon fanciers whose main target are raptors generally commit intentional poisoning. Besides them, livestock breeders and game wardens often set poisoned baits for mammalian predators, which usually leads to raptor and crow poisoning. Accidental poisoning is generally the result of the inappropriate use of pesticides, which affects a wide variety of wild bird species. A total of 169 cases which involved 34 bird species were recorded, and of the 733 individuals that were poisoned, only 33 of these were rehabilitated. The vast majority of cases were registered in the northern intensive agricultural landscape, where poisoning cases are more likely to be found, and where most of BPSSS members and volunteers are active.

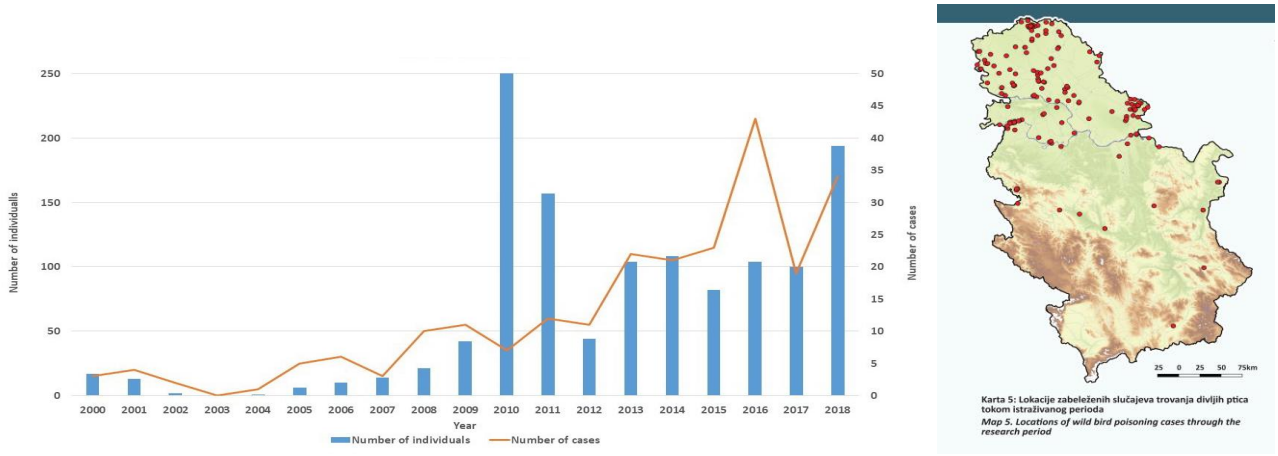


Fig. and Map.1.5.2.1. Trend of wild bird poisoning cases and number of individual birds affected by poisoning (left) and map of localities (right)

Illegal wild bird shooting includes the killing and wounding of protected and strictly protected species, and cases of gamebird poaching. Within poaching cases of hunting with illegal methods and means, the use of live decoys, electronic calling devices and semiautomatic shotguns were also included. As many as 840 cases of illegal shooting were registered, which involved a total of 89 bird species. A total of 4,088 birds were affected by this illegal activity. The majority of cases were linked to Common Quail poaching incidents, whereby the use of electronic calling devices is a widespread phenomenon. Besides Common Quail, other common issues include the poaching of waterfowl and the shooting of birds of prey. These can be lucrative crimes, and the chance of making money is one of the main drivers. The other is sport shooting. Additionally, a truck containing a shocking number of dead birds (120,702) was confiscated in 2001 during the "Balkan birds" case; all of these birds had been killed in Serbia.

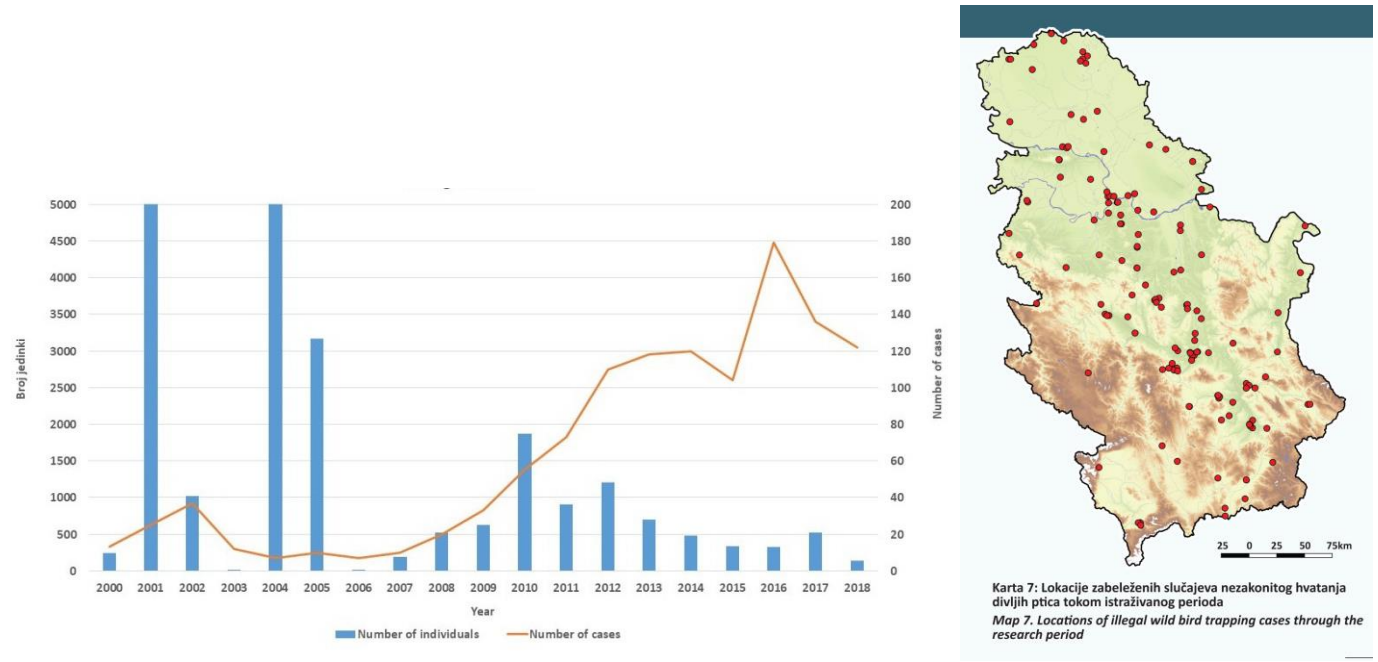


Fig. and Map. 1.5.2.2. Trend of wild bird poaching cases and number of individual birds affected by poisoning (left) and map of localities

http://pticesrbije.rs/wp-content/uploads/2017/10/Serbia-bird-crime-report.pdf?fbclid=IwAR1IQfmmmJksGVhcim9SL15vZ2IYDt1kceOCDcZZY0wuMNgEHVQrWeGDyVY

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Inefficient and slow court procedures,
- Not satisfied level of punishments,
- Lack of skills for field controls,
- Low motivation and empowered of staff,
- Problems with poisoning cases.

Protection biodiversity indicators system

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
1.1. Stopping the trend of vulnerability and loss of biodiversity	1.1.1. Main pollutants concentration and deposition trend	N			
	1.1.2. Biomonitoring of air-pollution	N		C12	
	1.1.3. Air quality in the selected protected areas	L			
	1.1.4. Aquatic macrophytes water pollution biomonitoring (AQMWB)	N			
	1.1.5. Red algae population trend	L			1.1.5.1. Case study: Invasive cyanobacteria *Cylindrospermopsis raciborskii* in the waters of Serbia 
					1.1.5.2. Case study: Contaminated sites in the Republic of Serbia – potential risk to ecosystems and natural resources 

					1.1.5.3. Case study: Specific activity of ^{137}Cs in soil in southern Serbia 
	1.1.6. Invasive insect species	N			
	1.1.7. Monitoring and gradation of gipsy moth (*Limantria dispar*) in the forests of Serbia	N			
	1.1.8. Trend of concentration of allergenic pollen of ambrosia (*Ambrosia artemisifolia*) in Serbia	N			
	1.1.9. The trend of the areas where the ambrosia has been threatened				
	1.1.10. Trend of mosquito populations infected with WNV in Serbia 1.1.11. Trend of the mosquito population infected with Western Nile virus in Belgrade	N L	 		
	1.1.12. Trend of population of infected ticks causing Lyme disease	N			

	1.1.13. Trend of Morbus Lyme patients in Serbia	N			
	1.1.14. Diversity of species-butterfly population trend	N			
	1.1.15. Species diversity-birds population trend	N			1.1.15.1. Case study: The eastern imperial eagle (Aquila heliaca) – critically endangered species 
	1.1.16. Trend of Griffon vulture population restored	N			
	1.1.17. Trend in the number of carnivorous mammal population	N			1.1.17.1. Case study: Steppe Falcon (Falco cherrug) 
1.2. Preservation of biological diversity at the genetic, species and ecosystem level	1.2.1. Population trends of autochthonous domestic species	N		C13	1.2.1.1. Case study: Seed Facilities in forestry as a basis for conservation and guided use of gene fond in Serbia  1.2.1.2. Case study: Trend in conservation of Plant Genetic Resources for Food and Agriculture (PGRFA) - the number of accessions that are kept in the National Collection, Plant Gene

					Bank 
1.3. Monitoring the impact of climate change on biodiversity and the impact of biodiversity on mitigating the effects of climate change	1.3.1. Dead wood in forests and climate changes	N		D15	
	1.3.2. Forest damages	N			
	1.3.3. Forest health conditions	N			
	1.3.4. Forest fires	N			
	1.3.5. Number of fungal species in selected forest habitats	L			
	1.3.6. Air pollution and forest defoliation in selected protected areas	L			
	1.3.7. Flowering of *Prunus laurocerasus* related to Climate Changes	L			
	1.3.8. Climate Changes and flowering phenology of winter aconite				
	1.3.9. Climate Changes and Black-Headed Bunting areal and population size changes				

1.4. Establishment of an integral national information system for biodiversity with a database (INISB)	1.4.1.Number of biodiversity indicators in use	N		E19	
1.5 Combating illegal killing, trapping and trade of wild species	1.5.1. Number and structure of animals in reception zoo garden	N		E18	
	1.5.2. Wild bird poaching and poisoning	N			

National Target 1

Protection of Biodiversity

Rate of progresses toward the implementation of the selected target

- On track to achieve target 

Priority Area	Priority actions	Aichi target	Progress Assessment	National Progress Assessment
Priority Area 1. Protection of Biodiversity	Priority action 1.1.	C12		
	Priority action 1.2.	C13		
	Priority action 1.3.	D15		
	Priority action 1.4.	E19		
	Priority action 1.5.	E18		

The causes that lead to the reduction of biodiversity include disappearing, fragmentation and degradation of habitats, illegal hunting, fishing and collecting, illegal and inadequate forest cutting, inadequate preservation of genetic diversity of autochthonous populations of plant and animal species, introduction of invasive and allochthons species and genetically modified organisms. In order to preserve biodiversity in Serbia it is necessary to establish mechanisms for economic valuation of biodiversity, areas and ecosystem services and integrate these values into national policies, plans, budgets and strategies in relevant sectors. At present, there is a developed system of compensation for the use of natural resources in Serbia, which includes fees for the use of resources in protected areas, which was established on the basis of various legal acts.

Climate change and biodiversity are interconnected. Preserving natural ecosystems and restoring degraded ecosystems (including their genetic diversity and species diversity) is essential for the overall objectives of the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change, as ecosystems play a key role in the global carbon cycle and adapt to climate change while at the same time providing a wide range of ecosystem services that are essential for human well-being and development. Thus, the preservation of biodiversity can greatly contribute to mitigating the negative effects of climate change.

The functional information system for biodiversity is a prerequisite for achieving efficient nature protection. At the national level, it is necessary to introduce an organized collection of biodiversity data as well as a monitoring system in order to determine the status and monitor the trends of the biodiversity state at the national level. Certain databases that exist in public and scientific institutions need to be networked and granted access rights.

The main anthropogenic factors that adversely affect biodiversity involve:

- degradation of natural ecosystems to cultivated agroecosystems, sylvicultures or (sub)urban area,
- fragmentation of habitats
- overexploitation of genetic and biological resources
- introduction of allien species from remote areas
- contamination of air, water and soil by toxic pollutants
- increased level of ionizing and nonionizing radiation
- induced climate changes

Priority Actions toward National Target 1

1.1 Stopping the trend of vulnerability and loss of biodiversity

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target C12

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

Due to effect of numerous negative anthropogenic factors, in recent period the trend of vulnerability and loss of biodiversity is registered worldwide and in Serbia as well. Most important cause of this is destroying or disturbance of habitats, followed by various direct threats from invasive species and over-exploitation to intent killing, harming, disturbing and fatal incidents caused by traffic, infrastructure, pollution etc. Official administrative measures in Republic of Serbia (RS) towards stopping the trend of vulnerability and loss of biodiversity are signing and ratification of relevant conventions, especially Convention on Biodiversity, as well as Bern, CMS, CITES and other, and within national system, through Law on Nature Conservation and following laws and bylaws.

Most prominent aspect of the trend of vulnerability and loss of biodiversity is extinction of species, with most obvious examples from RS since middle XX century European Mink *Mustela lutreola*, Little Bustard *Tetrax tetrax*, Egyptian Vulture *Neophron percnopterus*, Bearded vulture (*Gypaetus barbatus*), White-headed Duck *Oxyura leucocephala* and Nodding Sage *Salvia nutans*. Some plant species are lost not only for Serbia, but Globaly, since they were endemic. These species are Kragujevac Marshmallow (*Althaea kragujevacensis*), Vranje Marshmallow (*Althaea vranjensis*) and Morava Water Chestnut (*Trapa annosa*). Additionally, many species in RS are recently very rare and endangered, such as Balkan Lynx *Lynx lynx martinoi*, European Souslik *Spermophilus citellus*, Great Bustard *Otis tarda*, Lanner Falcon *Falco biarmicus*, Meadow Viper *Vipera ursinii,* Blck Salamander *Salamandra atra,* Huchen *Hucho hucho*, European Sturgeon *Huso huso*, Tench *Tinca tinca,* Goldfish *Carassius auratus*, Pančić's Grasshopper P*yrgomorphella serbica*, Edelweiss *Leontopodium alpinum*, Banat Peony *Paeonia officinalis* subsp. *banatica*, Yarrow of King Alexander (*Achilleaalexandri-regis)* with decreasing trend of population, area or ecological status. For these species, and other with similar status, measures are taken in order to stop the trend of vulnerability and loss of biodiversity. These measures, although clearly orientated, certainly didn't fully stop this negative process. Among most important measures is its strict protection, according to Regulation on proclamation and protection of strictly protected and protected wild species of plants, animals and fungi (Official gazette of Serbia; br. 5/10) to with 1769 strictly protected and 853 protected species. Additionally, establishing of protected area is mainly orientated towards biodiversity conservation. Protected areas established with main cause of conservation of certain species, named after species, such as Strict Nature Reserve "Zeleničje" and Special nature Reserve "Pastures of Great Bustard" are especially interesting cases. Officially, within protected areas and in nature areas in general, all human activities are harmonized to minimize or exclude damage to biodiversity, mainly through conditions within licenses issued by INCS and INCVP. Besides these measures, some active conservation measures of habitats and species are taken.

In Sebia, there is a system for monitoring of some birds and butterfly species for several years. There are data collected regardnig the trend of changes in population abundance of selected butterfly and bird species from forest and meadow habitats. The change in the population of butterfly indicates the loss, but also changes in the structure of their habitats, due to fragmentation and isolation, as well as other changes in the environment that directly or indirectly affect the change in population structure. This measure is monitored throught indicator which relates to the number of population of selected butterfly species and population growth through the time and by habitats. Changes of the most important types of habits is presented according to CORINE Land Cover and EUNIS.

AIR QUALITY: The most prominent air pollutants include: sulfur dioxide, nitrogen oxides, tropospheric ozone, suspended particles, persistent organic pollutants and haevy metals. Direct exposure to these polutants may result with acute and chronic physiological disorders of organisms, irrespective on their taxonomic status. Besides the direct harmful effects, sulphur and nitrogen oxides indirectly degrade ecosystems by the acidification process, or process of forming strong mineral acids from precursors (sulphur and nitrogen oxides).

1.1.1. Indicator name: Main pollutants concentration and deposition trend

Author / Institution: Lidija Marić/ Environmental Protection Agency

Key message: The trend of air pollution In Serbia has deteriorated

Assessment: 

The deposition of pollutants from the air is one of the main exogenous ones factors that affect health the state of forests and vegetation, as well as the quality of forests land influencing the stability of the ecosystem. Also, like the deposition result also results in a reduction in forest resistance to drought, but also on attacks of insects and fungi.

Methodology used to determine the deposition of air pollutants is defined by the criteria of *European Monitoring and Evaluation Programme*- EMEP.

(https://www.emep.int/)

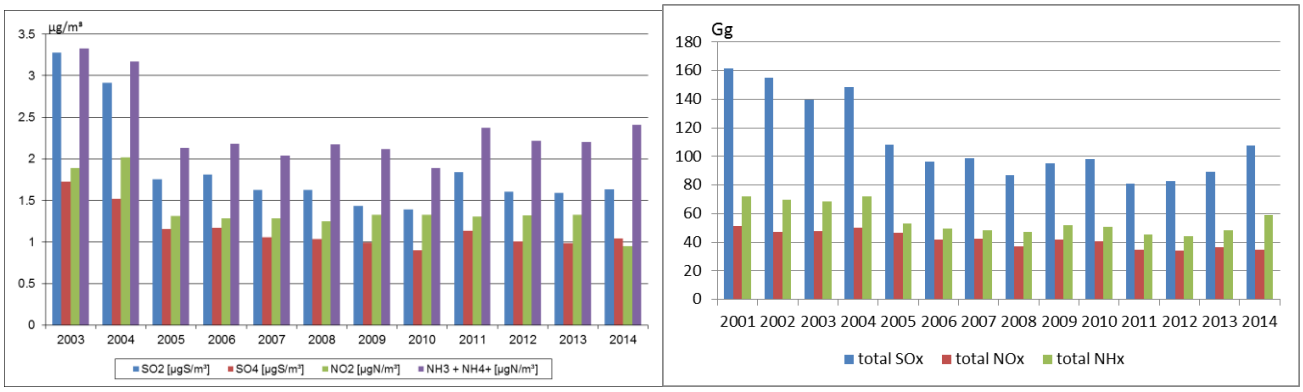


Fig. 1.1.1.1. Concentration and deposition of main pollutants trend.

Based on the results, it can be concluded that there has been a significant reduction in the concentration of the air pollution deposition since 2001.

1.1.2. Indicator name: Biomonitoring of air-pollution

Author / Institution: dr. Mira Anicic-Urosevis/ Institute for Physics, University of Belgrade

Key message: In Serbia there is a declining trend of air pollution with potentially toxic elements

Assessment: 

The bio-indicator species of moss *Hypnum cupressiforme* are used in Serbia for the research of air quality in out-of-town / rural areas (so-called passive bio-monitoring). In Serbia, from 2000 to 2015, there is a declining trend of air pollution with potentially toxic elements (a potential cause: the cessation of the operation of numerous industrial plants)

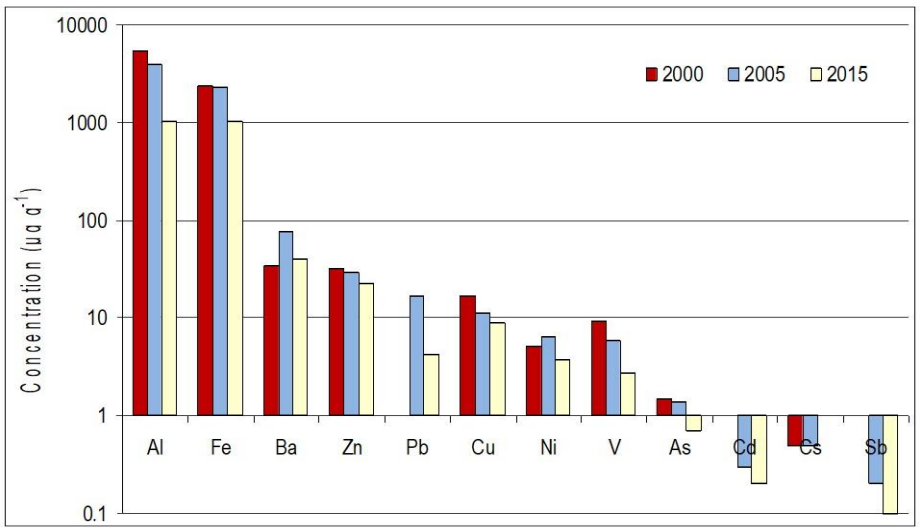
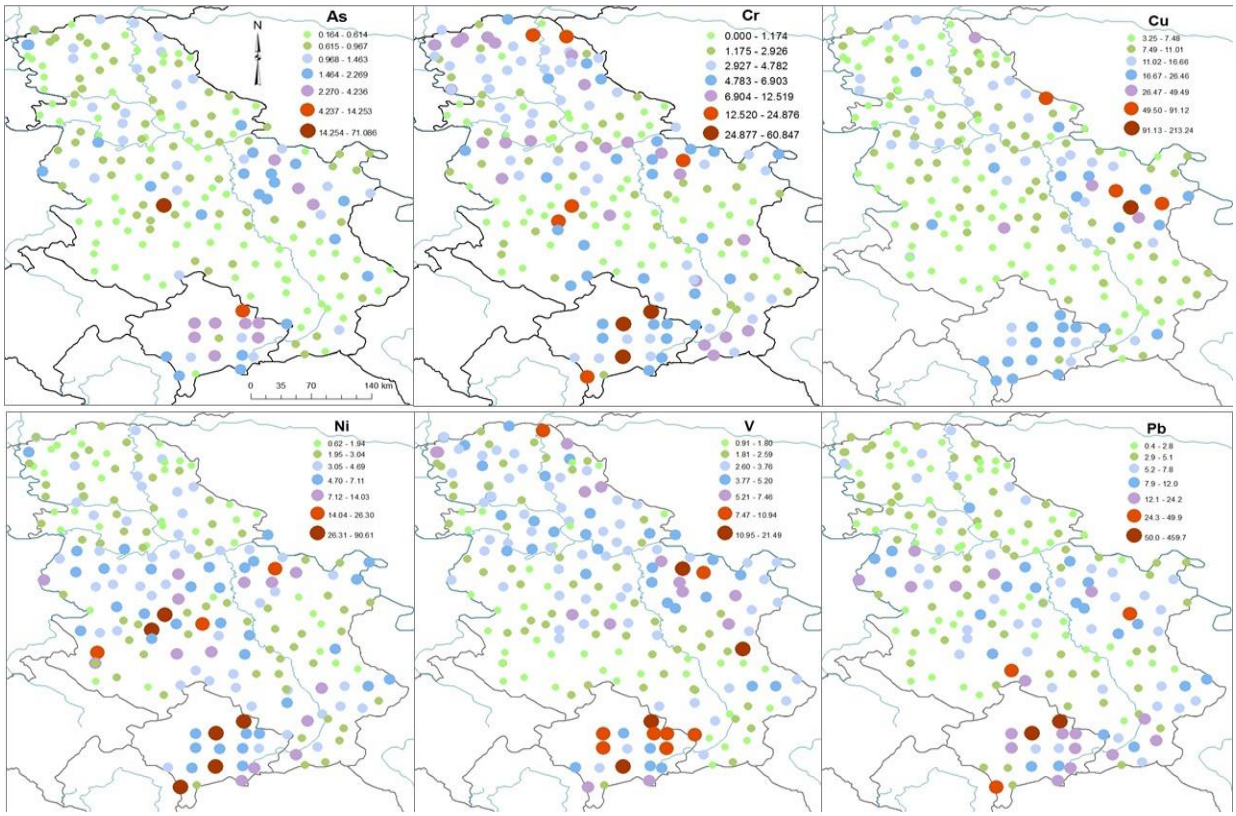


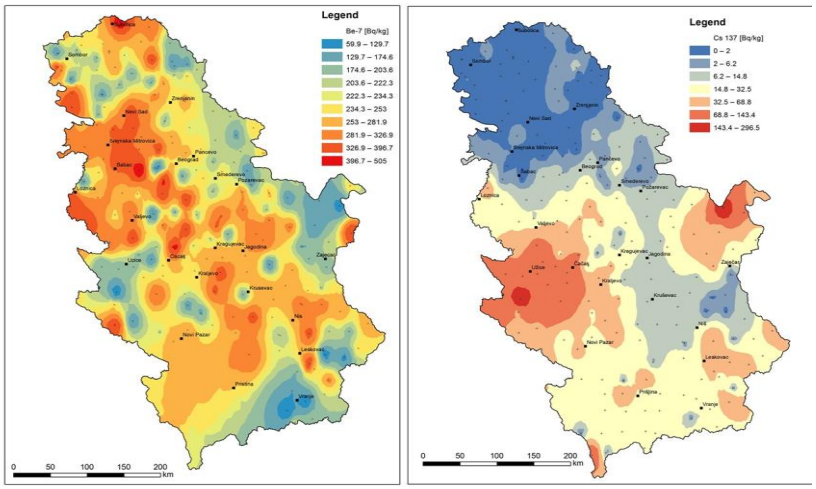
Fig.1.1.2.1. Concentration of heavy metals in mosses as indicators of air pollution

Spatial distribution of the element concentrations in the moss across Serbia in 2015 highlighted the southern part of the country (Kosovo and Metohija) as the most loaded with the elements, especially As, Cd, Cr, Ni, Pb, Sb, V and Zn. This area is characterised by complex geological settings, followed by the mining, and the other accompanied activities. Besides, the highest concentrations of Cu found in the region of the copper-mining basin in the north-eastern part of Serbia.



Map. 1.1.2.2.Distribution of heavy metals in Serbia

Spatial distribution of natural radionuclides and ^{137}Cs were assessed in the moss samples collected in 2015. Particular interest was on the spatial distribution of ^{7}Be, cosmogenic radionuclide, produced by cosmic radiation in lower stratosphere and upper troposphere. This radionuclide can be used as natural radiotracer in estimation of atmospheric transport paths. Higher concentrations of ^{137}Cs were found in the moss growing in forests of mountain regions than in agricultural areas. Spatial distribution of ^{7}Be was non-uniform across Serbia, and varied even for the order of magnitude.



Map. 1.1.2.3. Distribution of Cs and Be in Serbia.

1.1.3. Indicator Name: Air quality in the selected protected areas

Author / Institution: Lidija Maric/ Environmental Protection Agency

Key message: Since 2010, there have not been exceedences of limit values for air quality parameters SO_2, NO_2 and PM10 in protected areas. Only in the summer period there were exceedences of target value for ground level ozone.

Assessment: 

The indicator shows the exceedences of annually limit values for air quality parameters SO_2, NO_2, PM_{10}, and O_3 in the protected areas.The indicator describes the state of the environment in terms of air quality pollution The indicator is calculated based on the data of the national and local networks for monitoring of air quality from daily SO_2, NO_2, PM_{10} concentrations and max eight-hour values for O_3 concentration.

Since 2010, there have not been exceedences of limit values for air quality parameters SO_2, NO_2 and PM_{10} in protected areas. Only in the summer period there were exceedences of target value for ground level ozone.

Protected areas are only part of the territory of the Republic of Serbia where operational air quality monitoring is carried out. Parameters that are measured because they have negative effects on people, plant and animal world are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO, suspended particles smaller than 10 micrometers (PM_{10}) and diameters smaller than 2.5 micrometers ($PM_{2.5}$) and ground-level ozone (O_3). The graphs show the concentrations of the mentioned parameters in protected areas over the limit values of concentrations are not recorded for any parameter exept the target value of ground-level ozone for protection of vegetation of TV AOT40, Kopaonik, Kamenicki Vis and Obedska Bara.The graph below shows trend of a slight increase concentrations SO_2 and trend of reducing concentrations NO_2 in the selected protected areas since 2014.

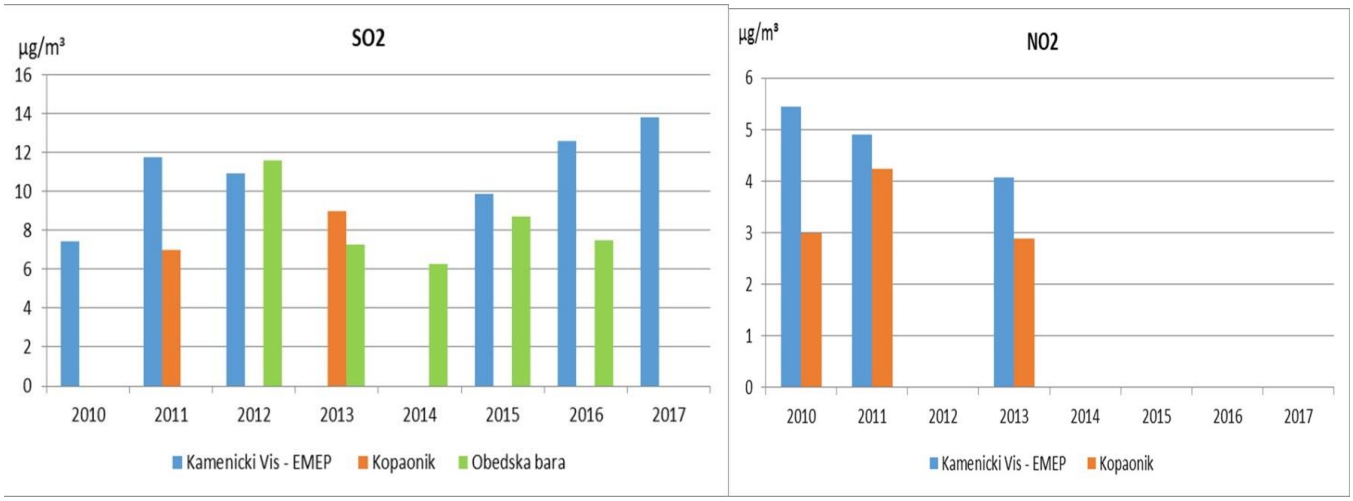


Fig. 1.1.3.1. Trend of SO_2 and NO_2 in the selected protected areas

The graph below (left) shows trend of reducing concentrations PM_{10} at the location Kamenicki Vis since 2012. The graph below (right) shows trend of concentrations ground-level ozone for protection of vegetation (AOT40), on four locations: Kopaonik, Kamenicki Vis, Obedska Bara and Deliblatska pescara. Ground-level ozone had the biggest negative impact on vegetation in 2012 in the selected protected areas.

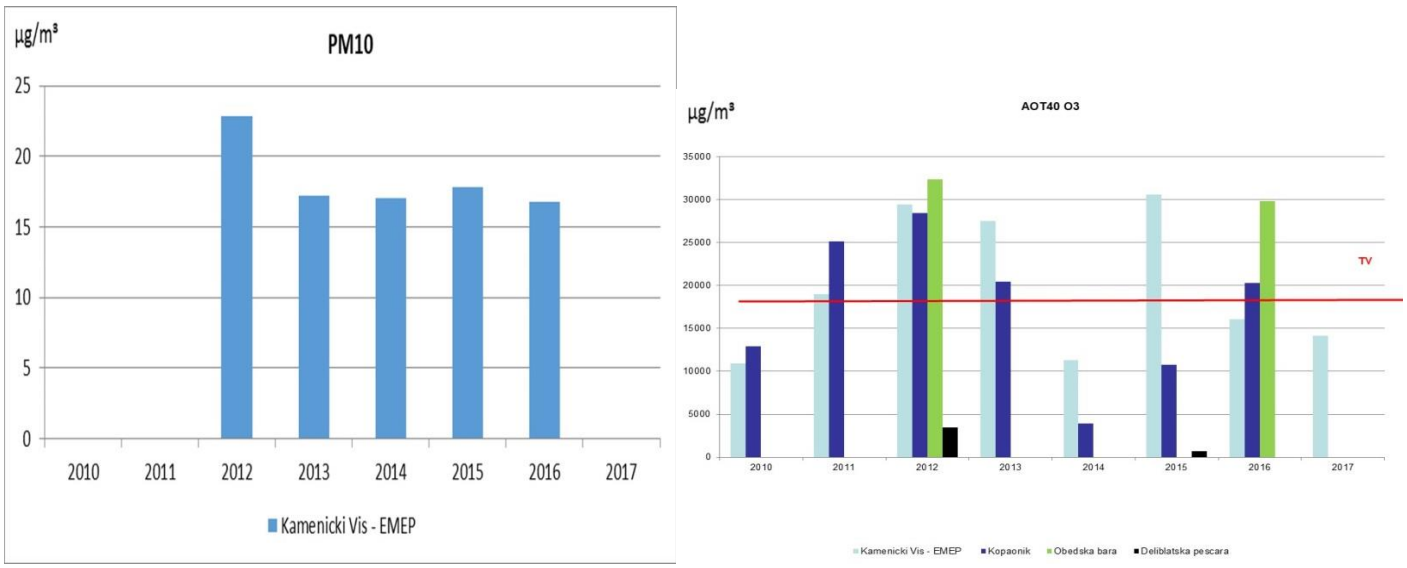


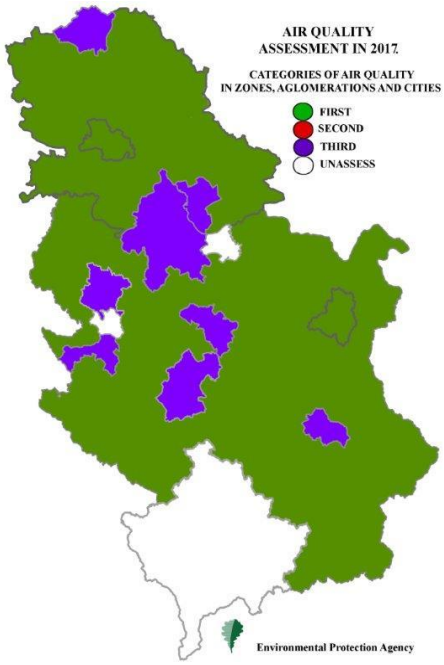
Fig. 1.1.3.2. Trend of PM_{10} (left) and ground level ozone (right) in the selected protected areas

Additional information and comments

The Environmental Protection Agency carries out operational monitoring of air quality in the national network for air quality monitoring in the Republic of Serbia. In accordance with the Law on Air Protection, the national network has been established for the purpose of measuring air quality in settlements, industrial and non-urban areas, in areas affected by traffic, protected natural areas and for the purpose of measuring transboundary atmospheric transport of pollutants in the air.

The assessment of the quality of air is carried out on the basis of exceeding the limit and tolerance values of the average annual concentrations for SO_2, NO_2, PM_{10}, CO, and O_3 pollutants and the only legally defined and binding assessment of the degree of pollution in the Republic of Serbia. There are three categories of air quality: category I, i.e. clean or slightly polluted air, category II,

i.e. polluted air, category III, i.e. over-polluted air. The assessment of the air quality in the Republic of Serbia in 2017, by zones, agglomerations and cities is shown on the map.



		CATEGORIES OF AIR QUALITY							
		2010	2011	2012	2013	2014	2015	2016	2017
ZONE	SRBIJA	II	I	I	I	I	I	I	I
	City Kragujevac					II	III	III	III
	City Kraljevo								III
	City Valjevo			III	III	III	III	III	III
	VOJVODINA	II	I	I	I	I	I	I	I
	City Sremska Mitrovica					II	III	III	I
	City Subotica							III	III
AGLOMERATION	Novi Sad	III	III	I	I	I	II	I	I
	Beograd	III	III	III	III	II	III	III	III
	Pančevo		III	III	I	I	III	I	III
	Smederevo		III	III	III	III			
	Bor	III	III	III	III	III	III	I	I
	Kosjerić		III	III	II	I			
	Užice		II	II	III	III	III	III	III
	Niš	III	III	II	I	I		I	III

Map. and Tab. 1.1.3.3. The change in air quality by categories of air quality in agglomerations in the period from 2011 to 2017

Over time, the percentage of agglomerations with heavily polluted air has changed so that in 2011 over 80% of agglomerations had heavily polluted air, which was the largest share, while in 2012 and 2016 it was the smallest with about 20% of the total number of agglomerations. The number of agglomerations with excessively polluted air increased in 2017, while the number of agglomerations for which categorization could not be maintained remained unchanged. The largest number of agglomerations had clean air in 2014 and 2016.

WATER POLLUTION: Water enrichment and overloading with nitrate and phosphorus initiate the eutrophication process. Eutrophication is the result of synergistic effects of multiple factors. Inorganic phosphorus and nitrogen are the major limiting compounds for aquatic photoautotrophs (cyanobacteria, micro- and macroalgae, as well as angiosperms). High input of these compounds to waters may provoke a rapid phytoplankton production. Algal blooms (overgrowth of algal populations) may disturb the structure and functions of aquatic ecosystems. Freshwater cyanobacteria produce several bioactive secondary metabolites with diverse chemical structure, which may achieve high concentrations in the water, when cyanobacterial blooms occur. Some of the compounds released by cyanobacteria have allelopathic properties, influencing the biological processes of other phytoplankton or aquatic plants. Allelopathy can influence the competition between different photoautotrophs for resources and change the structure of phytoplankton communities. Allelochemical compounds produced by dominant species eliminate weak competitors, reducing biodiversity of phytoplankton communities. Gross described allelopathic mechanisms of cyanotoxins. Excessive growth of *Cyanobacteria* (previously misclassified as blue-green algae or Cyanophyta) can produce cyanotoxins in such concentrations that they are poisonous to fish, cattle, and humans. When dead phytoplankton sink to the bottom, their decomposition may reduce the oxygen concentration in the water to levels too low to support fish and benthic invertebrates. Enhanced biological production and other associated effects of eutrophication usually occur in lakes, reservoirs, coastal areas, and large, slowly flowing rivers.

1.1.4. Indicator Name: Aquatic macrophytes water pollution biomonitoring

Author / Institution: dr Snežana Branković/ Institute of biology and ecology, Faculty of Science, Kragujevac

Key message: Increase in heavy metals concentration in aquatic ecosystems

Assessment: 

The aquatic macrophytes were investigated in the period 1996 - 2018. Research results show a general trend in increasing the concentration of investigated metals in aquatic ecosystems.

The monitoring of accumulation of 8 metals (Fe, Mn, Zn, Cu, Ni, Pb, Cd, Cr) in aquatic macrophytes covered the period of 1996-2018. On the basis of literature data and research, data were used for 11 years (1996, 1998, 2002, 2003, 2004, 2006, 2010, 2013, 2014, 2015, 2018). Samples of water plants were taken from the sites with the greatest multitude and cover on several locations in different part of Serbia; up to 200- 1000 g of fresh aquatic species in each subsample; scientists and support staff should collect the aquatic macrophytes.

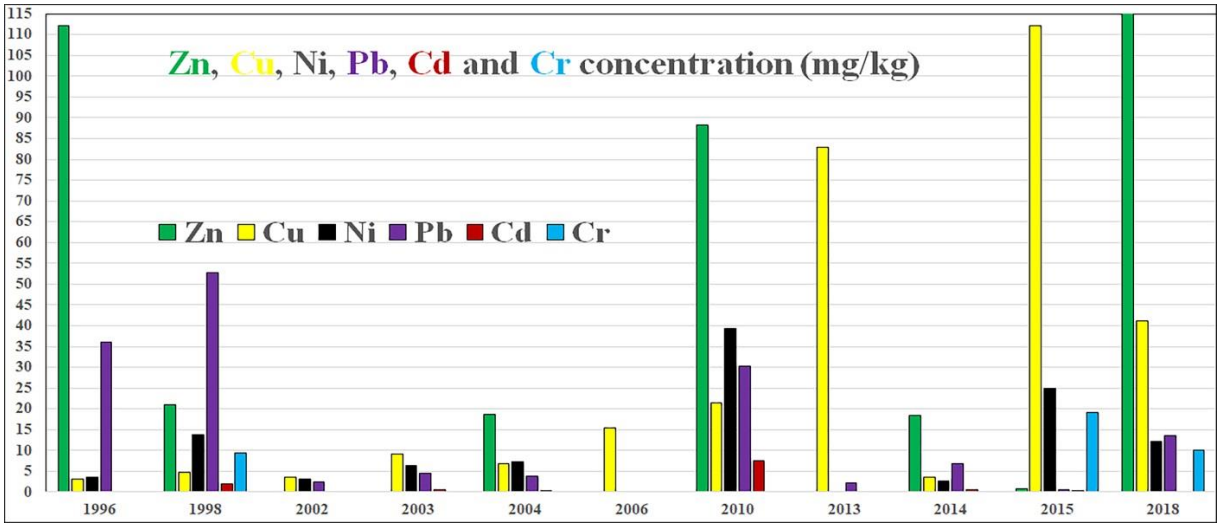


Fig. 1.1.4.1. Concentration of heavy metals in water bodies in Serbia.

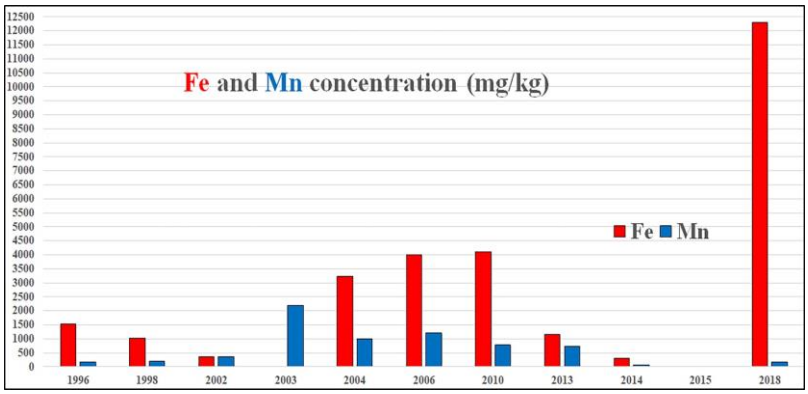


Fig. 1.1.4.2. Concentration of Fe and Mn in water bodies in Serbia.

On the base of published works and researches in the indicator passport: "WATER MACROPHYTES - WATER POLUTION MONITORING", the results of metals accumulation monitoring in water macrophytes are presented. The time period for monitoring of the accumulation of 8 metals (Fe, Mn, Zn, Cu, Ni, Pb, Cd, Cr) encompassed the period from 1996 to 2018. During processing of literature data and results of researches, data were used for 11 years (1996, 1998, 2002, 2003, 2004, 2006, 2010, 2013, 2014, 2015, 2018). Results of metal accumulation for 31 species of aquatic macrophytes at 65 sites throughout the Republic of Serbia were presented. The obtained results for the water macrophytes application show a tendency to increase of the concentration of the tested metals in water plants in the period of 11 years of the rivers, reservoirs and lakes monitoring.

1.1.5. Indicator Name: Red algae population trend

Author / Institution: Aleksandar Mitrović, dr Snežana Simić/ Institute of biology and ecology, Faculty of Science, Kragujevac

Key message: It is recorded increment of population cover of red algae

Assessment: 

The indicator shows trend of the percent cover (%) changes of red algae population in aquatic ecosystems. The change in the percent cover (%) of red algae population indicates changes in environmental conditions in the habitat, which influences the composition of the benthic algae community in general, including red algae.

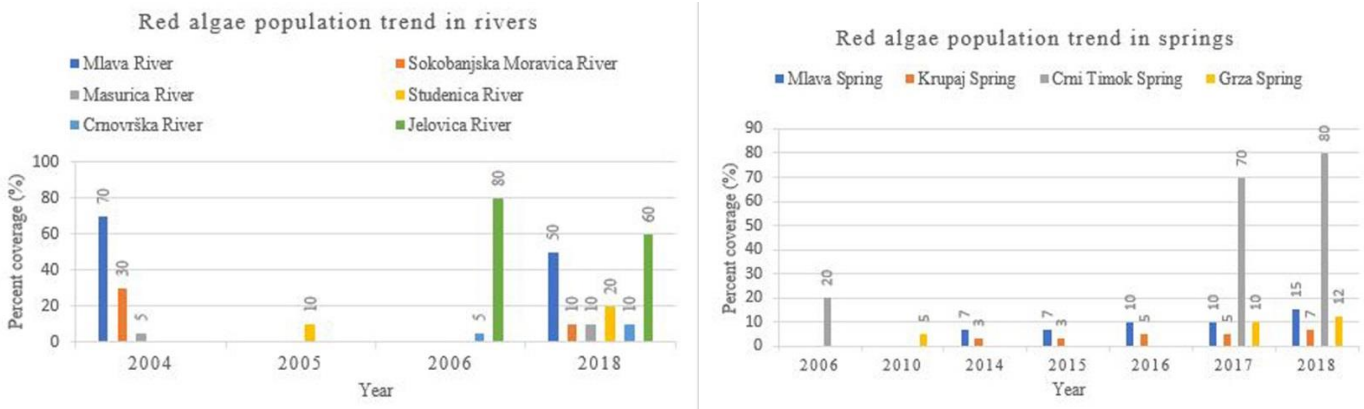


Fig. 1.1.5.1. Red algae population cover trend

One part of the data used for the production of indicators (data from 2004, 2005, 2006 and 2010) was taken from the published work (Simic & Djordjevic, 2017), while data from other years (2014, 2015, 2016, 2017 and 2018) obtained by research for the needs of final work and doctoral dissertation. The indicator was built on the basis of data on the diffusion percentage of red algae in four springs and six rivers. Based on the available data on the coverage of red algae in four sources (the Mlava well, the Krupa well, the Grze well, the spring of the Black Timok) of Serbia, we conclude that the trend of the population in all sources is on the rise.
The well of Mlava, Krupa and Grze are protected natural assets (Monuments of nature), so an increase in the population of these algae can indicate efficiency in the management of protected areas. Further monitoring of the trend is expected to increase the population, if the well is not exposed to a negative anthropogenic factor. The Black Timok spring is protected from all potential threats, so in the future it predicts a stagnation or further increase in the population of this group of algae
The increase in the red algae population was also observed at the locations of Studenica, Crnovrska reka and Masurička Reka. The Masurička Reka site is protected from all potentially negative impact factors (it is over 10 km away from the first inhabited place, and the water catchment area of this river is at least 5 km downstream of the sites where the red algae was found), so in further monitoring The trend is expected to increase the red algae population. It is assumed that a slight increase in their population is a consequence of the fact that the site is in full shade of deciduous vegetation, and the red algae recorded at this site prefer sunny habitats. In the Studenica and Crnovrška rivers the population trend is on the rise. However, as the construction of derivative mini hydropower plants is ongoing in these rivers, further downsizing of the trend is expected to reduce the red algae populations, and ultimately their complete disappearance from the mentioned ecosystems. On the sites of Moravica of Sokobanja, Mlava and Jelovica rivers, there is a trend of decrease of red algae populations cover.
Negative impacts were not noticed on the Jelovička River site, except for the possible impact of tourism, so that a further reduction in the red algae population is not expected in further monitoring of the trend. On the Moravica of Sokobanja and Mlava, the derivative mini hydropower plants have been built, so the downward trend in the population is expected. Further monitoring of the trend should predict further reduction of the red algae population, and ultimately their complete disappearance from the mentioned ecosystems.

Literature:

Simić S., Đorđević N. (2017): Morphology, distribution and ecology of the freshwater red algae Paralemanea (Batrachospermaceae, Batrachospermales, Rhodophyta) in Serbia. Archives of Biological Sciences, 69 (1): 167-174. DOI:10.2298/ABS160211093S. ISSN 0354-4664.

1.1.5.1. Case study: Invasive cyanobacteria *Cylindrospermopsis raciborskii* in the waters of Serbia

Author / Institution: *Aleksandra Mitrović* / Institute of Biology and Ecology, Faculty of Natural Sciences and Mathematics, University of Kragujevac

Assessment: 

In the conditions of climate change and increasingly frequent burden of nutrients, the phenomenon of cyanobacterial flowering is increasingly present in the waters, which can be accopmanied by the production of toxins dangerous to all aquatic organisms.
Cyanobacteria is characterized by strong tolerance to different environmental conditions,which is why they successfully populate a wide range of habitats. Toxins of cyanobacteria are very poisonous substances and when released into the water pose a threat to both aquatic and terrestrial organisms (Sedmak & Sirčev), 2011). Cyanotoxins can accumulate in different fish and other hydrobiotic organs, and their consumption poses a potential risk to human health.

In Serbia, a mass accidental death of fish is also caused by blooming of cyanobacteria. Thus, the massive fish die-off in the Aleksandrovac lake near Vranje in 2012 coincided with the blooming of the invasive cyanobacteria *Cylindrospermopsis raciborskii* (Woloszyńska) Seenayya et Subba Raju.

This thread like invasive cyanobacteria commonly inhabits tropical and subtropical ecosystems around the world (Karadžić, 2011). However, in the last thirty years the species has significantly expanded its area on moderate terrain of all continents.The species has a high level of adaptation to different environmental factors. In Serbia, it was recorded for the first time in a salt marsh near the Tamiš river (Cvijan & Fužinato), while its first flowering was recorded in the river Ponjavica (Karadžić et al., 2013), and then in Aleksandrovac lake (Đorđević & Simić, 2014 Đorđević et al., 2015).A significant presence of this type was also recorded in the lake Srebreno jezero ,a reservoir dedicated to tourism and recreation (Simić et al., 2018). Data on the presence of this pecies in a growing number of waters indicate the expansion of its area, and its expansion is predicted in the future. The fact that the species is growing more and more in the waters of Serbia is significant given the fact that the species is known as the producer of toxic substances, primarily hepatoxic cylindrospermopsin. Đorđević et al. (2015) were the first to detect a cylindrospermopsin toxin in Serbia, after a massive fish die-off in the Aleksadrovac lake. It is believed that the effect of various factors, but above all the presence of toxins and

the lack of oxygen caused by the flowering of C.raciborskii, led to this alarming situation when 3 t of cyprinid fish died-off (Đorđević et al., 2015).

Pic and Map. 1.1.5.1.1. Invasive cyanobacteria *Cylindrospermopsis raciborskii* in the waters of Serbia

SOIL QUALITY: The great heterogeneity of the geological base in Serbia, its climate, vegetation and pedo-fauna contributed to the formation of extremely heterogenic soils in Serbia. There are nine edaphic climatic regions on Serbian territory. In each of the regions, several soil types are represented and their combinations reflect the general characteristics of these units. According to the Serbian soil map the most extensive groups are Cambisols (27.99%), Chernozems (17.68%), Leptosols (15.9%) and Vertisols (8.32%).

Agricultural areas dominate in Serbia and spread over 55% of the country's total area, while about 27% is occupied by arable land, 12% by complex cultivation and 12% by principally agricultural land with areas of natural vegetation. The share of agricultural and arable land in the total area of the Republic of Serbia is primarily the consequence of geomorphological and pedogenetic factors. These factors have had influence not only on the total areas under these land uses, but also on their distribution within the country. The largest areas subject to the above land uses are in the northern part of the country, the Autonomous Province of Vojvodina, as well as in the valleys of the large rivers in central Serbia. The share of agricultural land in the total area of AP Vojvodina is significantly higher, at the level of 71.3%, while the arable land is at the level of 65.8%. The average rate of soil organic carbon in the top 30 cm of the agricultural soils is 1.98 %, which can be considered as low.

The occurrence and progress of soil erosion is one of the major soil degradation processes and a cause of deteriorated soil quality. It is estimated that soil erosion (of various degrees) affects about 80% of agricultural soil. In the central and hilly-mountainous regions water erosion is predominant, while in the Vojvodina province in the north of Serbia, eolic erosion prevails, affecting approximately 85% of the agricultural soil with an annual loss of over 0.9 ton of soil per ha. A number of measures have been defined in agriculture related law aiming at the protection of agricultural land against the harmful effects of erosion.

Soil quality in the Republic of Serbia is also affected by uncontrolled and inadequate dumping of waste and by contamination stemming from industrial complexes. The largest number of registered sources of local soil pollution is related to municipal waste disposal and industrial and commercial activities. The risk from chemical pollution of soil in urban areas was monitored on 170 sites (2015) and 240 samples were analysed in the territory of the eight towns. The highest percentage of exceeded limit values was recorded for Cd, Cu, Zn, Ni and Co on the locations of frequent traffic, in the vicinity of business commercial zone and on agricultural land (Vidojevic et al., 2017).

1.1.5.2. Case study: Spatial distribution of soil organic carbon stocks in Serbia

Author/Institution: dr Dragana Vidojevic/ Environmental Protection Agency

Spatial distribution of soil organic carbon (SOC) were investigated in the soils of the Republic of Serbia (Vidojević et al., 2017). The database included a total of 1,140 soil profiles which corresponded to 4,335 soil horizons. To establish the relationship between organic carbon content and soil type, a soil map of Serbia was adapted to the WRB classification and divided into 15,437 polygons (map units). We calculated the SOC stock values for each reference soil group based on mean values of SOC at 0-30 and 0-100 cm and their areas. The largest SOC stocks for the soil layers 0-30 cm were found in Cambisol 194.76 x 10^{12} g and Leptosol 186.43 x 10^{12} g, and for the soil layers 0-100 cm in Cambisol 274.87 x 10^{12} g and Chermozem 230.43 x 10^{12} g. Based on the size of the reference groups, total area of Republic of Serbia, and the mean SOC values for each reference group, we calculated the total SOC stocks. The obtained values for the soil layers 0-30 cm and 0-100 cm amounted to 705.84 x 10^{12} g and 1,159.55 x 10^{12} g, respectively. The spatial distribution of organic carbon stocks and its variability is caused by various factors, such as clay content, land use pattern, altitude, and climate. In general, the distribution of the content of organic carbon at 0-30 cm showed higher values in Central Serbia, where forestland occupied a larger area than agricultural land. This study is the first comprehensive assessment of organic carbon stocks in the soils layers 0-30 cm and 0-100 cm done in the Republic of Serbia. The compilation of data on organic carbon stocks and its distribution in the different soil reference groups is the first step in the evaluation and monitoring of changes of organic carbon stocks in the soils of Serbia.

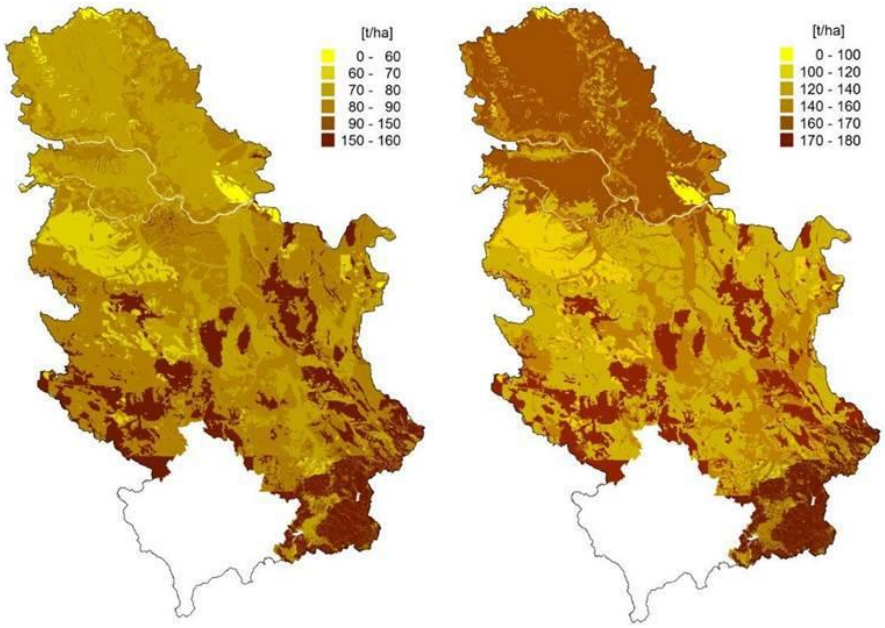


Fig. 1.1.5.2.1. SOC stocks distribution by soil type, to the depths of a) 0-30 cm and b) 0-100 cm

References:

Vidojević, D., Manojlović, M., Đorđević, A., Nešić, Lj. and Dimić, B. 2015. Organic Carbon Stocks in the Soils of Serbia. Carpathian Journal of Earth and Environmental Sciences, November 2015, Vol. 10, No 4, p. 75 - 83

Vidojević, D., edt. 2016. Agriculture and environment in the Republic of Serbia – Indicators based report, Ministry of Agriculture and Environmental Protection – Environmental protection Agency, Poljoprivreda i životna sredina u Republici Srbiji – Indikatorski prikaz. Ministarstvo poljoprivrede i zaštite životne sredine, Agencija za zaštitu životne sredine. ISBN 978-86-87159-11-2 (online) http://www.sepa.gov.rs/download/publikacije/Poljoprivreda_2016.pdf

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Vidojević, D., Manojlović, M., Đorđević, A., Nešić, Lj., Dimić, B. 2017. Spatial distribution of soil organic carbon stocks in Serbia. FAO 2017. Proceedings of the Global Symposium on Soil Organic Carbon 2017. Food and Agriculture Organization of the United Nations. Rome, Italy, p. 195-198

1.1.5.3. Case study: Contaminated sites in the Republic of Serbia – potential risk to ecosystems and natural resources

Author/Institution: dr Dragana Vidojevic/ Environmental Protection Agency

Assessment: 

Serbian Environmental Protection Agency (SEPA) is responsible for establishment and management of a national Cadaster of contaminated sites which is an integral part of the information system for environmental protection in the Republic of Serbia.

Already upon its establishment in 2006, SEPA started with data collecting and systematization of information on potentially contaminated and contaminated sites for the Cadaster. According to the Law on Soil Protection, the Cadaster of contaminated sites *is a set of relevant data on vulnerable, contaminated and degraded soils*. The collected data includes sites where processes of degradation and destruction are manifested. The main purpose of the Cadastre is to provide systematic data on sources of pollution, such as type, quantities, method and location of discharges of pollutants into the soil, in order to implement prevention and remediation measures.

The latest update of the Cadastre database shows that on the territory of the Republic of Serbia, 709 potentially contaminated and contaminated sites were identified and recorded, of which 557 sites are registered and 152 are estimated. Out of 709 sites, 478 are in need of investigation or still to be investigated and 103 are currently under investigation. Rehabilitation and remediation (re-cultivation) are completed on 52 sites where after-care measures are currently being applied (Figure 1,2). Sites such as former military locations, petrol and filling stations, dry cleaners, wastewater treatment installations and pipelines for the transport of dangerous substances are not included in Cadaster.

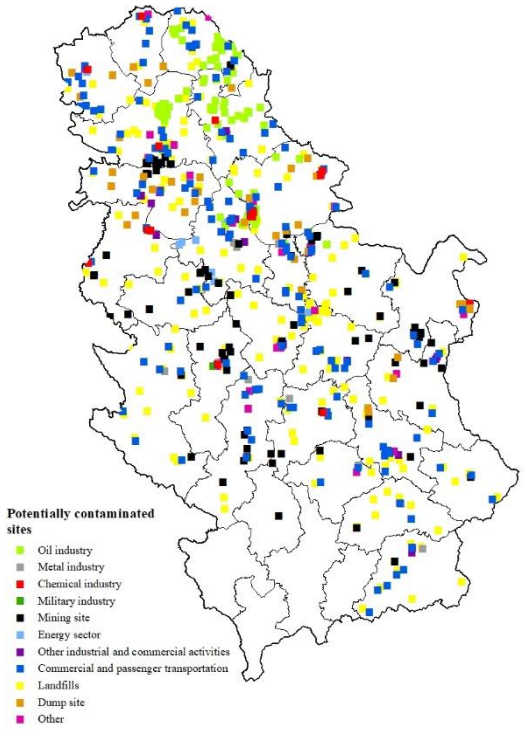
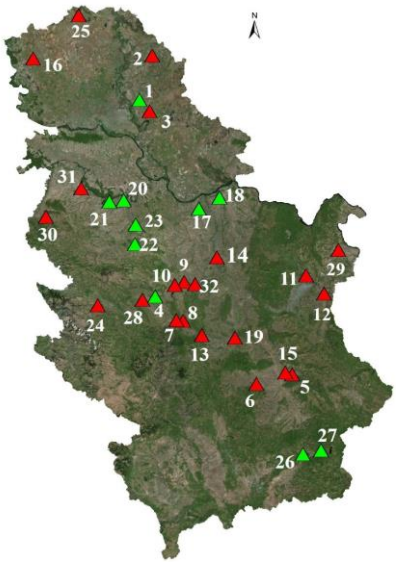


Fig. 1.1.5.3.1. Map of potentially contaminated sites in the Republic of Serbia

Identified sites	
Potentially contaminated sites in need of investigation	478
Contaminated sites under investigation	103
Sites where main sites investigation have been completed	76
Remediated sites	52
Total number	709

Tab. 1.1.5.3.2.Current status in Cadaster of contaminated sites of the Republic of Serbia

The UN Environment/GEF project "*Enhanced Cross-sectoral Land Management through Land Use Pressure Reduction and Planning*" funded by the Global Environment Facility (GEF), started in October 2015 and is executed by UN Environment Europe Office – Vienna Programme Office. The main objective of this project is to develop instruments and mechanisms for integrated land use management, remediation, and capacities to reduce pressures on land as a natural resource from competing land uses in the wider landscape, while supporting reversal of land degradation. To date, project has supported development of a legal framework for soil protection, a Contaminated Sites module and application for data submission for the Cadaster, in addition to preliminary investigation applied at 32 industrial sites across the country (Figure above).



▲ Localities with exceeded remediation values of analyzed parameters	
2	Zn
3	PCB
5	Pb
6	Cr, Cu, Ni, Zn, C10-C40
7	Cu, Pb, Ni, As
8	As, Ni, Cu,
9	As, Cu, Ni, Zn
10	Cu
11	As, Cu
12	Cr, As, Pb
13	As, Cu, Ni, Cd, Zn
14	Ni
15	Cu, Zn, Pb, Ni, As, Cr
16	Pb, C10-C40
19	Hg, Cr, Cu, Ni, Zn, Pb, As, Cd
24	Cu, Zn, Ni
25	As, Cu, Zn
28	Ni
29	As
30	As,Cd, Cu, Ni, Pb, Zn
31	As, Cd, Cr, Cu, Ni, Pb, Zn DDE/DDD/DDT, PAH
32	Cr, Cu, Ni, Zn

Map. and Fig. 1.1.5.3.3.Investigated industrial contaminated sites in the period 2015-2018

1.1.5.4. Case study: Specific activity of ^{137}Cs in soil in southern Serbia

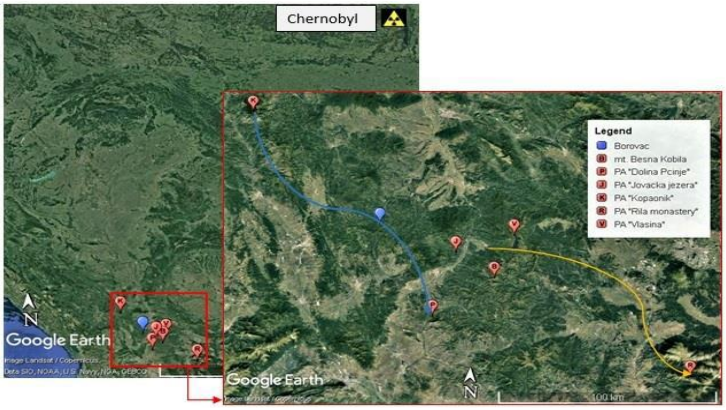
Author/Institution: dr Jovana Dzoljic, College of applied professional studies, Vranje

Assessment: 

The total amount of ^{137}Cs has reached the environment after nuclear tests in the post-war period from 1945 to 1980, and after the incident in Chernobyl in 1986. Based on data from the Agency for the Registration of Toxic Substances and Diseases(ATSDR,2004),the radiological effect of ^{137}Cs was released on the teritoryof Europe during the Chernobyl disaster was high.

Authors Bossew et al. (2001) state that Austria is one of the countries whose territory was significantly contaminated by the ^{137}Cs after the Chernobyl disaster. The same authors also state that higher values of contamination can only be foundin Ukraine, Belarus, Russia as well as in some parts of Scandinavia.
On the territory of Serbia distribution of ^{137}Cs is heterogeneus. Authors Jankovic-Mandic et al. (2014) point out that the variability of the specific activities of ^{137}Cs in samples of non-cultivated soil from the territory of Belgrade (3 – 87 Bq kg^{-1}) is due to topographical differences and non homogeneous surface contamination of the soil after the Chernobyl accident.

The specific activity of ^{137}Cs in the soil of central and southern Serbia is different, however, two regularities can be noticed.
According to the detected values, two curves of distribution can be separated, western and eastern (Map below).



Map.1.1.5.4.1. Locations for soil sampling

On graph below maximum value of the specific activity follow the western curve and increase further from the Kopaonik National Park (NP) (Džoljić et al.,2017) to the area of exceptional qualities (PIO) “Dolina Pčinja” (average value 101 Bq kg^{-1} (Petrović et al., 2016; Džoljić, 2017)).

In the countries of the region a similar specific activity of ^{137}Cs was also detected west of the the sites covered by the study.Authors Antovic,Vukotic, Svrkota i Andrukovich (2012) indicate that in the soil of Montenegro the average specific activity is 81.1 Bq Kg^{-1}. Also the same authors point out that ^{137}Cs detected in the soil of Montenegro was mainly due to the Chernobyl accident.

The specific activitiy of ^{137}Cs at sites that follow the eastern curve show lower detected values than the wetern curve. The highest value was measured on the eastmost site, the Natural Park (PP) “Rilski Monastery” in Bulgaria (49 Bq kg^{-1}), (Džojić, 2017). In the south,for example in Northern Macedonia, aspecific activity of ^{137}Cs was recorded in uncultivated soil by authors Todorovik et al. (2015) ranges from 6.63 to 14.94 Bq kg^{-1}. Values in Norther Macedonia are similar to the values at sites PIO “Vlasina” the monument of nature (SP) “Jovačka jezera” and the mountain “Besna Kobila”.

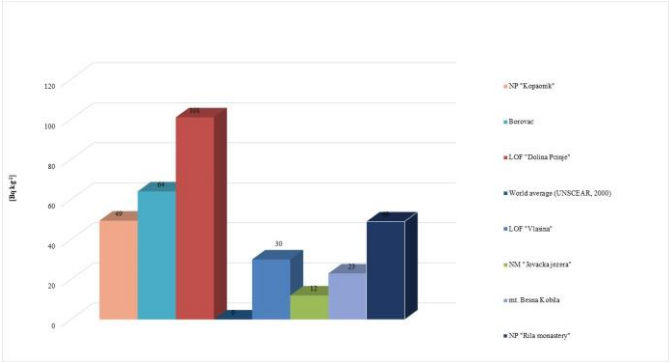


Fig. 1.1.5.4.2. Detected specific ativity of ^{137}Cs in the soil

By inspecting the literature data it can be concluded that the specific ativity of ^{137}Cs in the soil is significantly higher in countries that were exposed to the radioactive clloud from Chernobyl, icluding Bulgaria, R. Srpska, Serbia, Montenegro, North Macedonia, etc. Compared to other countries where the specific activity of ^{137}Cs is the result of nuclear testing.

The importance of determining the distribution of specific activities of this radionuclide in the soil is primarily due to the development of traditional forms of agriculture, as well as local and organic products of this region, in order to improve the living standards of people living in this area.

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INVASIVE ALIAN SPECIES (IAS) AND PESTS OUTBREAKS

The first preliminary national list of invasive plant species for the territory of the Republic of Serbia date from 2012, while at that time a list of invasive species of plants and animals on the territory of the Autonomous Province of Vojvodina was already existed. The first mentioned above for the territory od Serbia was printed under the paper "Preliminary List of Invasive Species in the Republic of Serbia with General Measures of Control and Suppression in Support of Future Legislative Acts". In 2018, a comparative Table of invasive plant species of the Republic of Serbia and countries in the region was prepared, but general problem faced on was that criteria for proposing invasive species differamong WB countries. The results was published under the internship research paper (2018): "Revision of the preliminary national list of invasive plant species with proposed measures on control and suppression." Considering that the species is invasive on the territory of a country if it is listed on the "official" list of invasive species of that country, a total of 165 species of invasive plants have been recorded for the Republic of Serbia and eight countries in the WB region.

According to the last inventory of the invasive species of plants and animals for the Republic of Serbia, which was made in 2016 under the ESENIAS (regional portal for information on invasive alien species in the countries of eastern and south-eastern Europe - http://www.esenias.org), There are a total of 346 invasive species on the territory of our country. In addition to the species of plants that are invasive to there are 11 other invasive species in Serbia (Amaranthus blitum L., Bromus catharticus Vahl, Catalpa bignonioides Walter, Centaurea biebersteinii DC, Helianthus annuus L., Helianthus scaberrimus Elliott, Impatiens balsamina L., Oenothera villosa Thunb, Portulaca grandiflora Hooker, Symphyotrichum novae-angliea (L.) GL Nesom and Tragopogon porrifolius L. subsp. Australis (Jordan) Nr. -Bl.), which should also be taken into consideration when drafting a national inventory of invasive species and determining their status.

1.1.6. Indicator name: Invasive insect species

Author / Institution: Bojana Nadazdin/ Non-governmental organization “HabiProt”, Belgrade

Key message: The number of invasive species of insects in Serbia is on the rise

Assessment: 

By reviewing the entry into the online insect database of Serbia "Alciphron", the total number of invasive insect species at the moment is 30. When we look at the earlier data, we will see that the number in 2009 was only 10 insect species, in the following years the number varies and is mainly increasing. Exceptions are 2012 and 2016 when the number dropped compared to the previous one, but it is most likely a consequence of overseeing the factual state, and not the actual disappearance of one species from the territory of Serbia, due to the lack of targeted research into invasive insect species and possibly a small number of individuals of the given species.

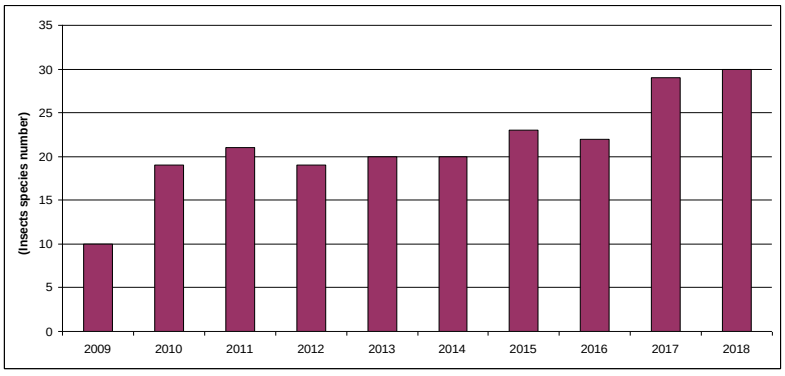


Fig. 1.1.6.1. Trend of invazive insects species number.

It is very difficult and rare that the invasive species disappears from the habitat by itself. This data shows clearly that the number of invasive insect species in Serbia is on the rise and suggests that it is necessary to compile a list of priority invasive species, as well as develop a strategy for controlling the influx of invasive species, preventing their spread and defining measures for the protection of autochthonous biodiversity.

Halyomorpha halys is a type of bug-insect from the *Pentatomidae* family, which is native to the area of East Asia. The species is invasive and is first seen outside its natural area in the US. The first published data on the findings in the area of Europe are from 2004, although it is assumed that it was previously present in Europe. H.halis is considered a pest of agricultural crops and uses a large number of plant species in its diet.

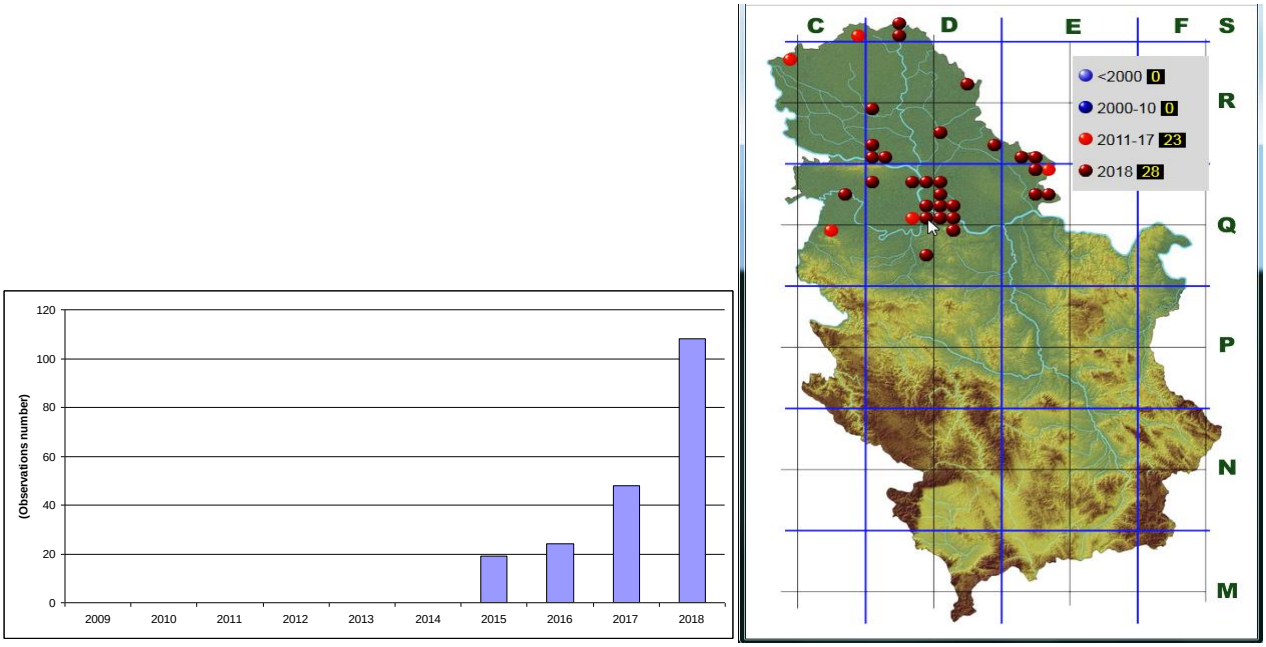


Fig. 1.1.6.2. Trend of *Halyomorpha halys* findings per year and distribution map.

The "Alciphron" database of insect propagation of Serbia is an excellent tool for assessing the status and distribution of this invasive species. Data analysis shows that Halyomorpha halys is first recorded in Serbia in 2015 (Graph 1). In 2016, a slight increase in the findings is observed, and in 2017 this number is doubled. Analysis of the data from 2018 shows us clearly that the species is in the process of spreading its area, the number of findings is more than twice as high as in the previous year. Map 1 shows UTM fields (10x10km) in which an invasive species is recorded per year (period up to 2000, 2000-2010, 2011-2017 and 2018). On the map, we notice that the growth of "infected" UTM fields is not great, but it is evident that it is growing. By analyzing all the data from the database, it is clear that the number of encounters with the species is steadily growing, and for now, the species is localized in Vojvodina, precisely because of the development of agriculture, as well as the climate that favors this invasive species. What is expected in the following period is the spread of the H.halys at the southern region of Serbia, as well as at higher altitudes due to the invasive character of the species and climate change (milder and shorter winter periods). This is a species that must be taken into account in the processes of planning biodiversity protection measures against invasive species, given the current data, the growing number of recorded species findings in Serbia, as well as the significant detrimental economic consequences that it leaves.

The species *Cydalima perspectalis* (Box tree moth) is a butterfly from the *Crambidae* family, which is native to the region of East Asia. The diet is related to plant species of the genus Buxus, which grow in the form of bush and are often used in horticulture. The first species was recorded in Europe in 2006, followed by the spread of its area.It is assumed that it has been introduced into Europe through the transport of plant species. Larvae of this kind of butterfly feed on leaves of the genus *Buxus* and they can almost completely lead to defoliation of the bushes for a short period of time. As there are autochthonous species of the genus Buxus in Europe, it is clear that the butterfly represents a threat to native plant species. The analysis of data from the "Alciphron" database shows that the type of *Cydalima perspectalis* was first recorded in Serbia in 2014 with just a few finds. As of next year, there is an increase in the findings (even 10 times higher in 2015 than in 2014). In the following period, the number of findings were growing and falling slightly over the years. Map 1 shows UTM fields (10x10km) in which an invasive species is recorded per year (period up to 2000, 2000-2010, 2011-2017 and 2018).

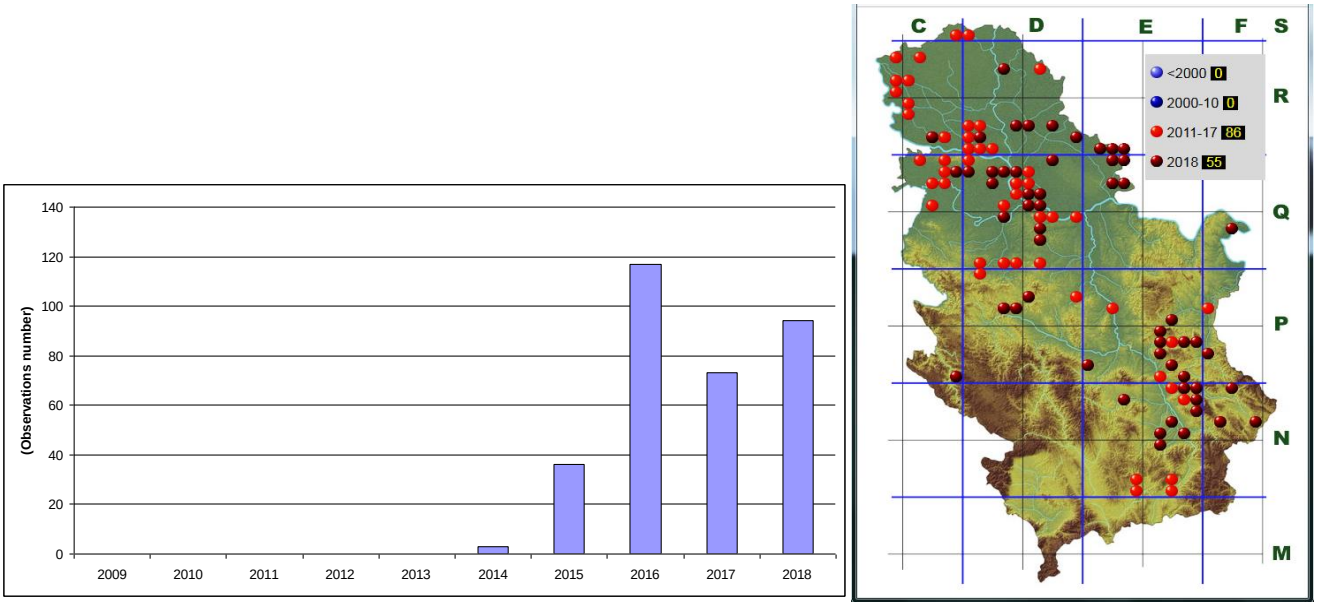


Fig. 1.1.6.3. Trend of *Cydalima perspectalis* finding per year and distribution map.

In addition to harmful economic effects (destruction of plantings in parks, gardens, etc.), the most serious consequence is the destruction of native species of the genus *Buxus* (in the territory of Europe, these are *Buxus sempervirens* and *B. balearica*). We can say that the situation is not alarming, but it is definitely that the invading species of *Cydalima perspectalis* has space for expansion and that it will most likely come in the upcoming period if appropriate control and protection measures are not taken, and this can have undoubtedly serious consequences.

1.1.7. Indicator Name: Monitoring and gradation of gipsy moth (*Limantria dispar*) in the forests of Serbia

Author / Institution: Dejan Miletic/ Public Enterprise Srbijasume

Key message: More frequent gradation period and decrease of latency

Assessment: 

Insect gypsy moth (*Lymantria dispar* L.) is the largest pest of the deciduous forests in Serbia, and also is a significant pest in fruit growing. Its overpopulation (gradation) often has the character of a natural disaster requiring significant engagement of labor and financial resources for the purpose of suppression. In the forests defoliation of gypsy moth leads to a decrease in the growth and weakening of the vitality of trees, and if this damage is in a chain reaction it can also lead to the occurrence of drying of forests.

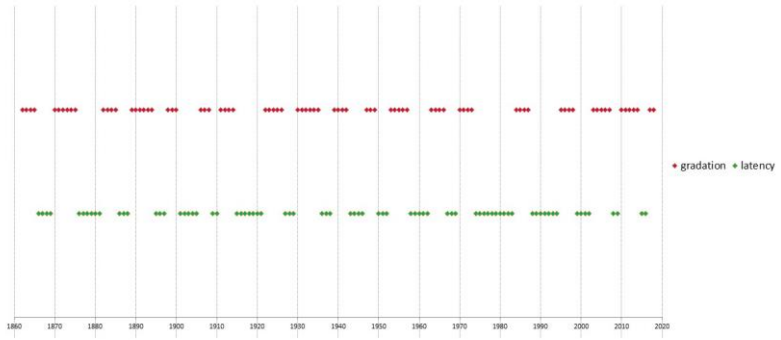


Fig. 1.1.7.1. Gradation of gypsy moth in the forests of Serbia.

Overpopulation of gypsy moth usually lasts from 3 to 6 years. In the period from 1862, since the time when it is being monitored in the territory of our country, to date 18 gradations have been registered, and the new (19th) gradation of the gypsy moth is underway in 2017, with the increased presence of gypsy moth nests, on relatively small surfaces, so that the gypsy moth came out of the latency and entered the first phase of gradation - progradation. During 2018, the trend of increasing its number and expanding territory under attack, which is mainly of low intensity.

Science has not yet established the reason for the occurrence of gradations, however, the analysis of the appearance of gypsy moth in Serbia in the period from 1862-2019 clearly shows the trend of increasing the frequency of gradations during the past 20 years. It is clearly visible that the duration of the latency period is reduced, which is only two years after the last three gradations.

There are some scientific researches that presuppose that the frequency of occurrence of gradations can be dramatically increased by the increase in temperature, change of precipitation regime and climate change.

Literature:
Predviđanje prenamnoženja gubara (*Limantria dispar* L.) u svetlu klimatskih promena - Dejan Stojanović, Milena Kresoja, Milan Drekić, Leopold Poljaković-Pajnik,Nataša Krklec-Jerinkić, Nataša Krejić, Saša Orlović
https://scindeks-clanci.ceon.rs/data/pdf/0563-9034/2016/0563-90341698015S.pdf

BIODIVERSITY AND HUMAN HEALTH

Health is often considered as a basic human right, and is defined by the World Health Organization (WHO) as not simply being free from illness, but in a state of complete physical, mental and social well-being. Biodiversity can be considered as the foundation for human health as it underpins the functioning of the ecosystems on which we depend for our food and fresh water; aids in regulating climate, floods and disease; provides recreational benefits and offers aesthetic and spiritual enrichment. Biodiversity also contributes to local livelihoods, to both traditional and modern medicines and to economic development.

All human health ultimately depends on ecosystem services that are made possible by biodiversity and the products derived from them. While the inter-linkages between biodiversity, ecosystem services and human health are inherently complex, inter-disciplinary research is aiming to develop a more thorough understanding of these essential relationships

1.1.8. Indicator name: Trend of concentration of allergenic pollen of ambrosia (*Ambrosia artemisifolia*) in Serbia

Author / Institution: Ana Ljubicic/ Environmental Protection Agency

Key message: Increase in the concentration of allergenic pollen of ambrosia from north to south of Serbia

Assessment: 

The indicator shows the spatial distribution of the total amount of pollen grains of the ambrosia on the territory of the Republic of Serbia and is presented through data from three stations, from north to south. The data presented includes a period of seven years. This indicator was monitored on three stations from the network: Subotica, Belgrade (Zeleno Brdo, ZB) and Vranje. The total quantities of pollen grains of the ambrosia were taken into account throughout the entire period of pollination.

The analysis of this indicator on these three stations in the period from 2012 to 2018 has shown that the concentration of allergenic pollen of ambrosia is increasing in recent years. At the same time, geographic inequality of distribution is perceived as the total amount of this strongest allergen decreases from north to south. However, it must be taken into account that the quantity of pollen depends on several factors. It depends primarily on the plant-geographic characteristics of the area. Quantities can be significantly modified primarily by meteorological and anthropogenic factors. Also, the amount of pollen depends on the agricultural region, which Vojvodina is distinguished with more than the south of the country. The factor that should not be neglected is the mowing and the influence of the wind that carries the pollen at long distances. Subotica is on the border with Hungary in which Ambrosia is extremely represented, despite numerous campaigns of suppression.

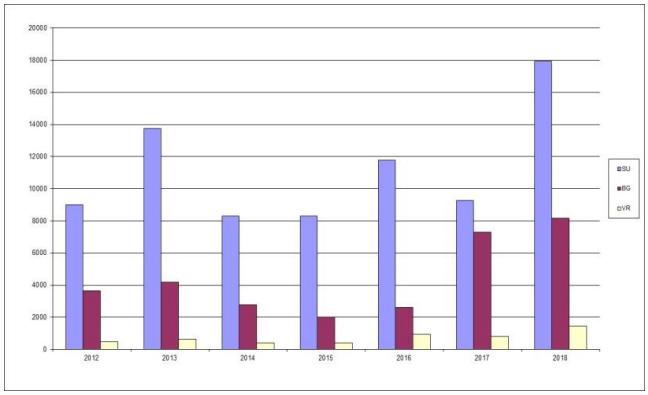
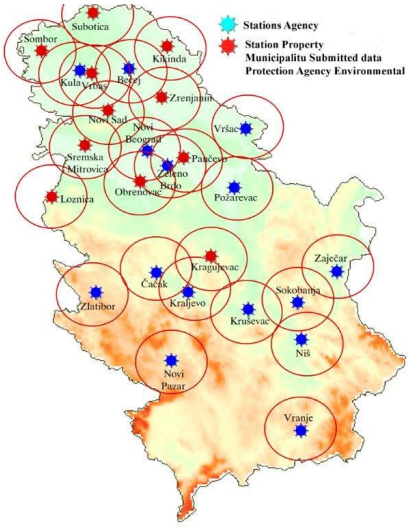


Fig. 1.1.8.1. Trend of ambrosia pollen air concentration change

Ambrosia artemisiifolia is the largest weed allergen. It originates in North America, whilst it is widespread in Central and South Europe. It was brought to Europe in the mid-nineteenth century with the clover seed.

In southeastern Europe, this species is recorded by Hungarian botanist Javorka in 1908, in the vicinity of Orsava, in the Romanian Danube area in 1910. The first data in our country appeared in 1953, in Sremski Karlovci, Petrovaradin and Novi Sad.

It is believed that these it was brought to this area from Romania, most likely transported by the ships operating on the Danube. Later, these sites became centers from which *Ambrosia artemisiifolia* spread very aggressively throughout Vojvodina towards the south. It was also established in the vicinity of Belgrade in 1994 and further spread south to Paracin and Nis, and as a rare plant was also found in the Sićevačka gorge in 1999. It is widespread and expanding thanks to the great power of flexibility.



Map. 1.1.8.2. Distribution of stations for ambrosia pollen detection.

1.1.9. Indicator name: The trend of the areas where the ambrosia has been threatened

Author / Institution: Slaviša Popović / Environmental Protectin Agency, Danica Popin / Provincial Secretariat for Urban Planning and Environmental Protection, dr Ivan Aleksic/ Institute for Biocides and Medical Ecology

Key message: The area of ambrosia suppression is increasing

Assessment: 

In the last 20 years significant population increase of this plant has been documented on the territory of Serbia and the city of Belgrade. Long-term presence of ambrosia in this area and high reproductive potential created substantial seed reserves in the soil, resulting in its presence on cultivated and non-cultivated land on the territory of Vojvodina province and Belgrade area representing a long lasting problem. All social entities that can contribute to the issue within their competencies must be included in the resolution of the problem. In the system of measures that need to be implemented (preventive, physical, chemical, biological, agro-technical, administrative) in order to combat ambrosia, it is important to constantly educate and raise awareness of the need for timely preventive health measures in order to protect and improve their own health and preservation of the environment.

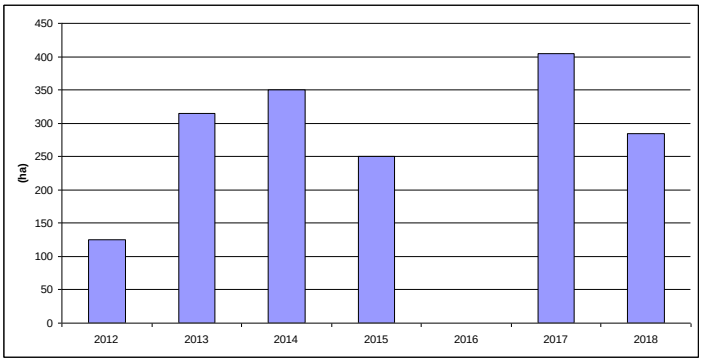
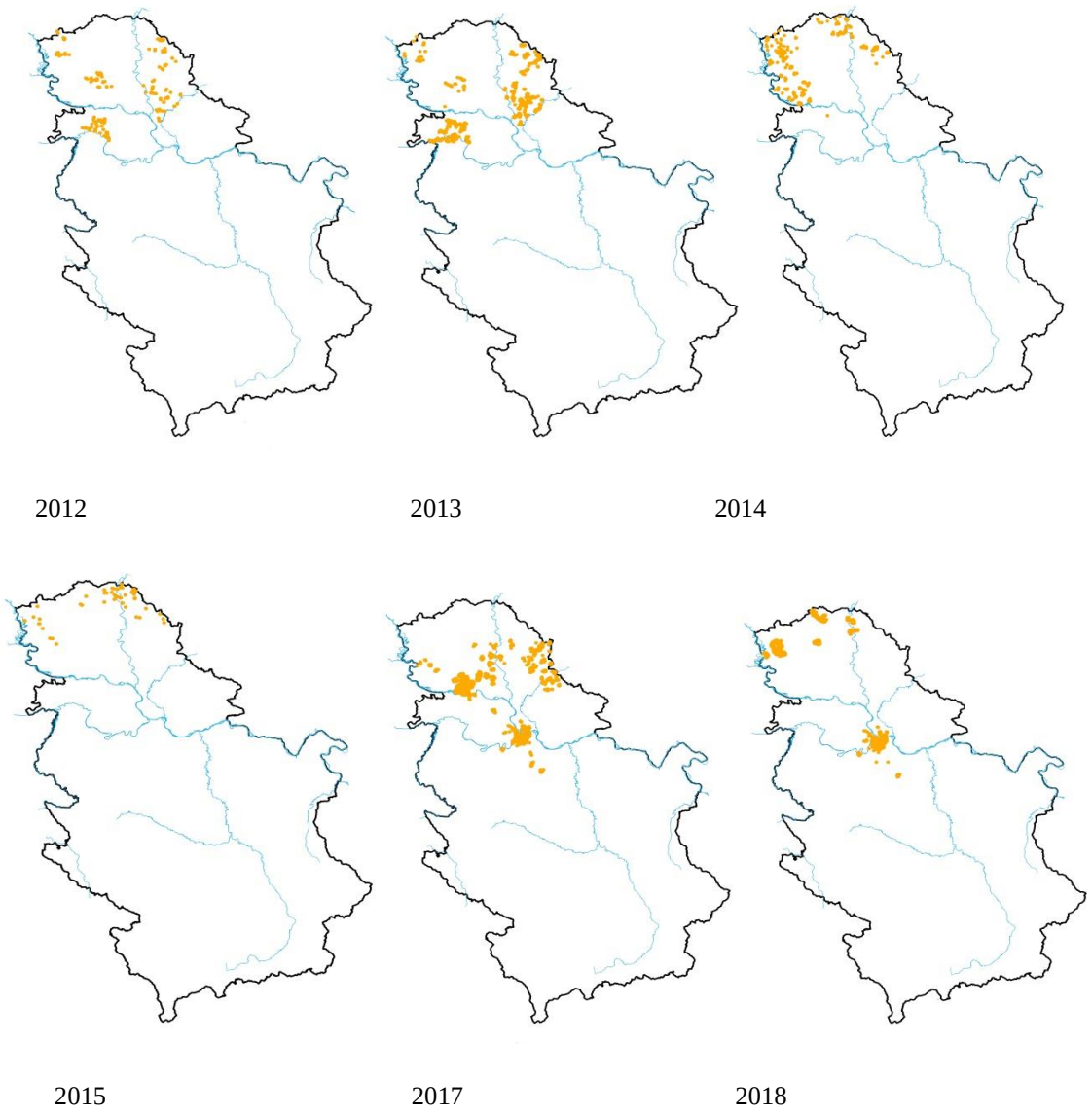


Fig. 1.1.9.1. Trend of ambrosia tretened areas



Map. 1.1.9.2. Distribution of the ambrosia treatment surface

During 2011, the suppression of ambrosia on the territory of the city of Belgrade was carried out on an area of 693,000 m2 (data for 2011 were taken from the Secretariat for Communal and Housing Affairs). In 2012, the suppression of the ambrosia was covered on an area of 580.955 m2. In 2013, the suppression of the ambrosia on the territory of the city of Belgrade was carried out on an area of 143,320 m2 (data for 2013 were taken from the Secretariat for Environmental Protection). During 2016, the Department of Biocides and Medical Ecology collected data from city municipalities and public municipal companies on the presence of ambrosia on certain areas for the period 2013-2016.
In 2017 and 2018, the Institute for Biocides and Medical Ecology carried out the program "Ambrosia as a health risk, monitoring and suppression of ambrosia from unregulated areas in the territory of Belgrade". During 2017 monitoring was carried out on 60 hectares, and the suppression with chemicals on 30 hectares. In 2018, monitoring areas were increased to 60 hectares and areas for treatment on 160 hectares.

On the territory of the Autonomous Province of Vojvodina, in 2012 and 2013, the Provincial Secretariat for Urban Planning and Environmental Protection carried out the suppression of ambrosia in the territory of five local municipalities (Sombor, Kikinda, Vrbas, Zrenjanin and Sremska Mitrovica), which were covered by the IPA project "Support of the environment without allergens "within the framework of the cross-border cooperation program Hungary - Republic of Serbia.
In 2012, the ambrosia was treated at 125 ha and in 2013 to 315 ha. In the framework of the project, the poles were also provided for measuring the pollen mounted at the mentioned sites. After the completion of the project, the Secretariat continues to measure the concentration of pollen and regularly publishes the results of the measurements in order to inform the population about the state of air pollution with pollen in a timely and adequate manner.In 2014 and 2015, in the territory of Vojvodina, from the funds of the budget of the APV - Provincial Secretariat for Urban Planning and Environmental Protection, action was carried out on the territory of ten local self-governments (Backa Palanka, Bac, Odzaci, Apatin, Sombor, Subotica, Kanjiža, Novi Kneževac, Čoka and Kikinda). In 2014, the ambrosia was suppressed on 350 ha, while in 2015 the action covered 250 ha. During the year 2017, from the budget of the APV - Provincial Secretariat for Urban Planning and Environmental Protection, funds were defined for the suppression of the ambrosia on 375 hectares carried out in the following local self-governments: Bečej, Novi Bečej, Nova Crnja, Žitište, Sečanj, Novi Sad, Temerin, Zabalj, Backi Petrovac, Odzaci, Indjija and Beocin. In 2018, the Provincial Secretariat for Urban Planning and Environmental Protection carried out the action of suppressing the ambrosia weed on 225 ha in 8 local self-governments (Apatin, Sombor, Subotica, Bačka Topola, Kanjiža, Senta, Novi Kneževac and Čoka).

During 2018, the Secretariat started the implementation of the IPA project "Nature protection from invasive plant species" within the framework of the cross-border cooperation program Hungary - Republic of Serbia. The project envisioned and suppressed the ambrosia in four protected natural assets in the border region of the north of Vojvodina: the Special Nature Reserve "Selevenjska pustara" and "Ludaško jezero", the area of exceptional features "Subotička peščara" and Nature Park "Palić". In the territory of these protected areas in 2018, the ambrosia has been suppressed on 85 ha, while in 2019 the plan is to suppress the ambrosia on the same area of 85 ha.

1.1.10. Indicator name: Trend of mosquito populations infected with WNV in Serbia

Author / Institution: dr Ivan Aleksic/ Institute for Biocides and Medical Ecology, Slaviša Popovic/ Environmental Protection Agency

Key message: The area of infected mosquitoes is growing, their number decreases

Assessment: 

Within the Project for the Ministry of Health, the Institute for Biocides and Medical Ecology is conducting search of the Western Nile virus in populations in the territory of Serbia. Sampling of mosquitoes in the field and testing for the presence of the virus is carried out during the season of mosquito activity (April-September) starting from 2013 to the present day. During 2013 and 2014 regular sampling of mosquitoes was conducted in 26 municipalities, and supplemental on epidemiological indications in another 20 municipalities. From 2015, sampling is carried out in the territories of 10 municipalities located in the Danube and Sava basins. Since the birds are carriers of the virus, the occurrence of viruses in mosquito populations varied from year to year. 2013 and 2018 are

record years in terms of meteorological measurements. 2013 is one of the 5 hottest years in the past 100 years since the measurement started, and 2018 is the hottest in the history of meteorological measurements. Such conditions greatly affected the early and more frequent appearance of mosquito populations that were the carrier of the Western Nile virus. Out of the total number of cities covered by sampling and analysis of mosquitoes in the presence of VZN in 2013, 58% were positive, and in 2018, 73% of the cities surveyed. In the period from 2011 to 2017 The number of positive locations and cities for the presence of viruses in mosquitoes was significantly lower and ranged from 20% in 2014 to 50% 2015.

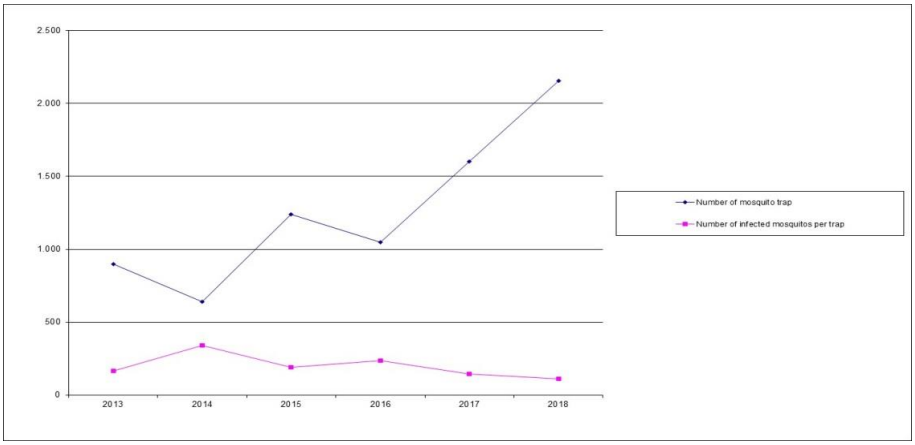
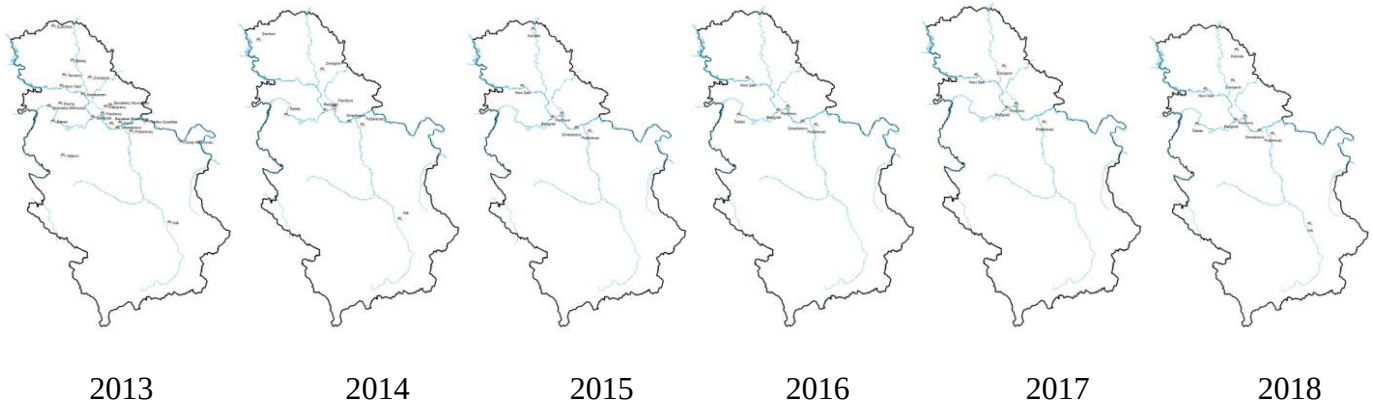


Fig. 1.1.10.1. Trend of mosquitos population infected by Western Nile virus.

Four studies conducted on the territory of the Republic of Serbia in the period from 2007 to 2012 pointed to the transmission of Western Nile virus in the population of mosquitoes, birds and horses. Taking into account these results and the circulation of the Western Nile virus in neighboring countries, Romania and Hungary, the Department for the Prevention and Control of Infectious Diseases Serbia implemented the control of Western Nile fever in the human population in 2012. From June 1 to November 15, on the entire territory of the Serbia control and passive control is being implemented intensively over the fever of the Western Nile. The first patients in the Republic of Serbia suspected of being infected with GZN were registered in the second half of July 2012. The highest number of patients was from the territory of the City of Belgrade (53 patients, 74.6%), the South Banat District (8.5%) and the Srem district (7%). The highest number of cases (86%) was registered in August and September 2012, which coincides with peak activity of mosquitoes.



Map. 1.1.10.2. Distribution mosquitos population infected by Western Nile virus.

Western Nile fever occurs worldwide. Epidemics of this disease are recorded in the human population, among birds and horses in America, Africa, Europe, Russia, the Middle East, India, parts of Asia, Australia and the Mediterranean. Circulation of the Western Nile virus has been present on the European continent since the 1960s, but the first epidemic among people was recorded in Bucharest, Romania, in 1996. Since then, cases of people and horses with the disease have been registered in the Czech Republic, France, Italy, Hungary, Romania, Spain and Portugal. During 2010, environmental factors in Central Europe and the Mediterranean countries favored the transmission of Western Nile virus to humans, so in the central part of Macedonia in the northern part of Greece the epidemic of this disease was first registered in the human population.

Local self-governments are authorized to conduct suppressing of mosquitos and they have done so,mostly with devices from the ground. Application of the biological compound based on *Bacillus thuringiensis* subsp. israĺlensis is an effective and environmentally friendly solution because they are selective to protect the environment from adverse effects, are biodegradable, it is not necessary to announce treatment to bee growers because biocides do not affect other organisms. The application of these insecticides is directed to the mosquito habitats of open water systems such as riverine surfaces and brief ponds as well as protected natural assets.

The chemical method involves the application of larvicidal biocides used in mosquito larva sources, or the use of conventional larvicides or insect growth regulators (IGRs) which influence the prevention of larval development of adult mosquitoes. Conventional larvicides are used only in sealed, isolated water systems without direct casting in river basins. IGR compounds can also be applied on leached surfaces, in canals, industrial and wastewater, with smaller water receivers, manholes, etc.

1.1.11. Indicator name: Trend of the mosquito population infected with Western Nile virus in Belgrade

Author / Institution: dr Ivan Aleksic/ Institute for Biocides and Medical Ecology, Slaviša Popovic/ Environmental Protection Agency

Key message: The largest number of infected with the West Nile virus was on the territory of the city of Belgrade

Assessment: 

Sampling of mosquitoes during the season of their activity is carried out on the whole territory of the City of Belgrade on about 200 locations. In the last six years, 2013 and 2018 stand out as the years with the greatest number of locations recorded with mosquitoes positive for the presence of the virus. On the territory of Belgrade in 2013, 48% and 2018, 52% of locations with mosquitoes positive for the presence of the virus. In the rest of the years, the number of positive locations in Belgrade varied widely, from 6% in 2016. to 29% in 2015. The number of mosquitoes at locations in Belgrade varied from season to season, but the number of mosquitoes is not correlated with their infectiousness with the western Nile virus (it is possible that the virus is present in many locations and in low numbers of mosquitoes). The Institute for Biocides and Medical Ecology has conducted mosquito control in the territory of 16 Belgrade municipalities (except Obrenovac) in cooperation with the Secretariat for the Protection of the Environment of Belgrade as part of its regular activities as well as on epidemiological indications (ie. registration of diseased people in Belgrade municipalities).

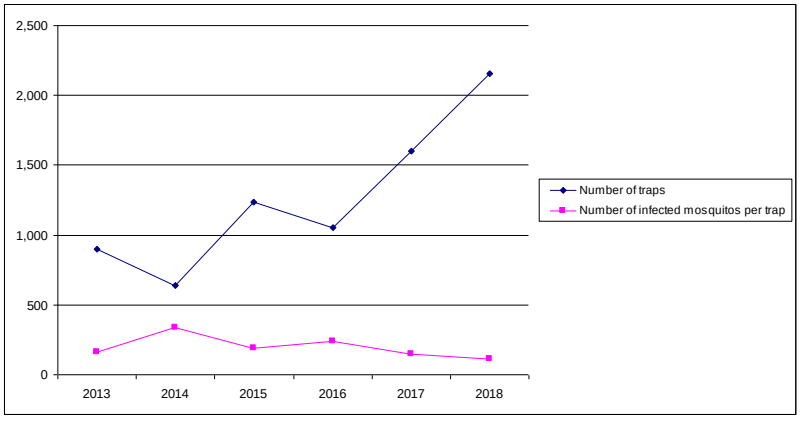
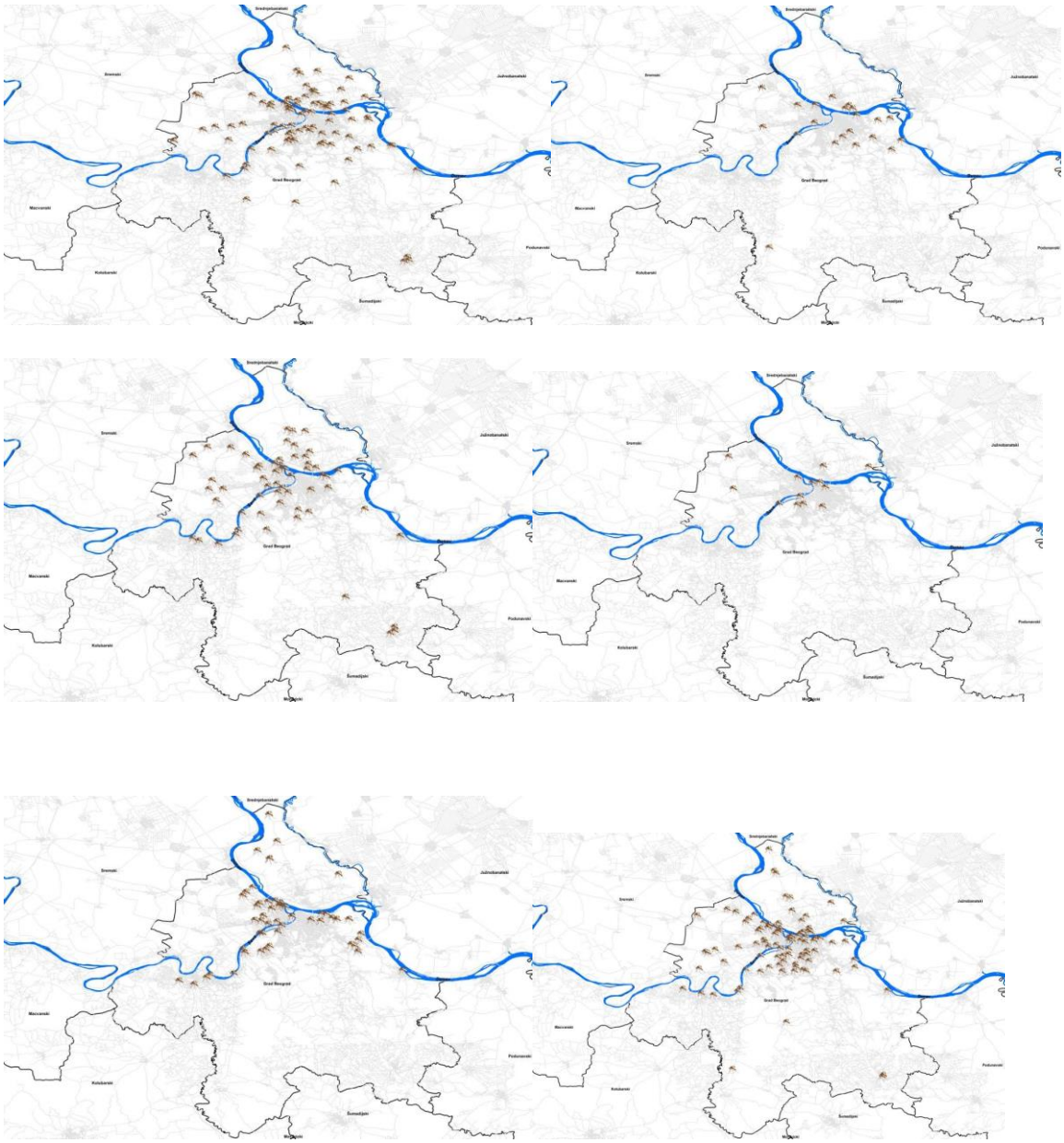


Fig. 1.1.11.1. Number of locations in Belgrade where where detected Western Nile virus infected mosquitos

Based on the data provided to the Institute for Public Health of Serbia "Dr. Milan Jovanović Batut" (in accordance with the Recommendations for the control of Western Nile fever in the human population in the seasons 2013, 2016, 2017 and 2018 of the Institute of Public Health of Serbia); Laboratory criteria (according to the recommendations of the European Center for Disease Prevention and Control), 415 cases of Western Nile fever have been registered on the territory of the Republic of Serbia, with 36 deaths that can be associated with fever from the Western Nile (Institute of Batut report for 2018 : http://www.batut.org.rs/index.php?content=1742), 49 (45 confirmed and four probable) cases of fever from the Western Nile with two deaths (Institute Institute Batut for 2017: http://www.batut.org.rs/index.php?content=1577), 41 confirmed case of fever from the

Western Nile, including two deaths, a patient aged 81 years from the South Banat district and 74 year old from the territory of the City of Belgrade, which can be linked to fever from the Western Nile fever.



Map. 1.1.11.2. Distribucija komaraca zarazenih Western Nile virus in Belgrade 2013-2018

1.1.12. Indicator: Trend of population of infected ticks causing Lyme disease

Author / Institution: dr Ivan Aleksic/ Department of Biocides and Medical Ecology, Slaviša Popovic/ Environmental Protection Agency

Key message: The number of infected ticks is in decline

Assessment: 

During the realization of the project "Detecting the causative agent of Lyme disease, virus tropical encephalitis and human granulocytic anaplasmosis on the tick population and territorial distribution on the territory of the Republic of Serbia", the seasonal tick activity was monitored as well as the presence of Borrelia burgdorferi, tropic encephalitis virus and Anaplasma phagocytophilum in harvested ticks, from March to November. The activity ticks is conditioned by temperature and humidity, as well as the length of the day, and their number varies from year to year depending on the climatic conditions. During the harvesting of the ticks most commonly harvested species on the territory of the Republic of Serbia, were Ixodes ricinus, Dermacentor reticulatus, Rhipicephalus sanguineus.

Samples were collected from the surfaces of overgrown unregulated grass, shrubbery and woody vegetation. The areas where animals are frequent (domestic and wild) were selected. If the vegetation was wet, the collection was difficult, so the teams went out on the field when there was no strong rainfall and dew. Samples were collected from the surfaces of overgrown unregulated grass, shrubbery and woody vegetation. The areas where animals are frequent (domestic and wild) were selected. Samples were collected by the "flag / time" method, with white flannel flags measuring 1x1m. Flags are overlapped over vegetation at the specified locations, and collected ticks are removed from the flags and collected in containers. The duration of collection of ticks was approximately one hour per location.

The collected ticks are transported live in containers prepared for the transport of samples, to the Entomological Laboratory of the Institute for Biocides and Medical Ecology. The Laboratory of the Institute analyzed the collected specimens for the presence of Borrelia burgdorferi, Anaplasma phagocytophilum and tropic encephalitis virus. The presence of Borrelia burgdorferi was performed by microscopic examination of native specimen in the dark field with 400x magnification and PCR real time method. The presence of Anaplasma phagocytophilum and tropic encephalitis virus was determined by the PCR real time method.

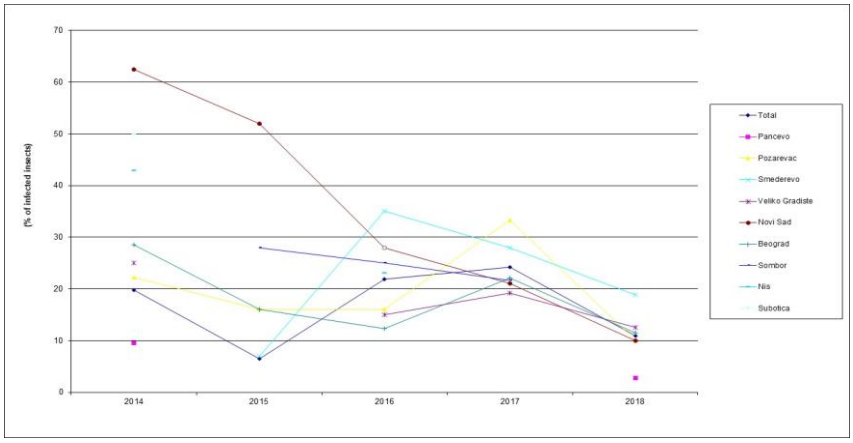
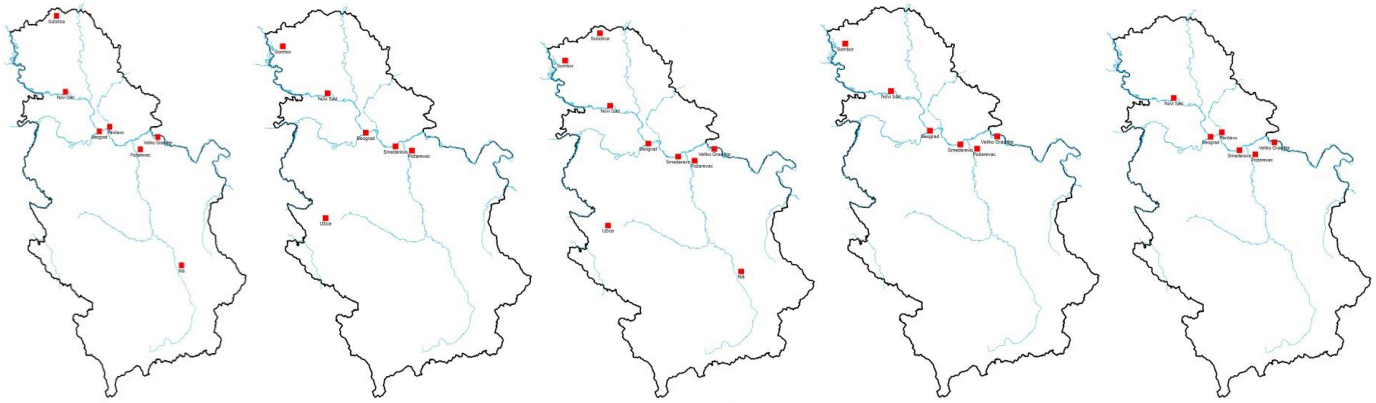


Fig. 1.1.12.1. Trend of population of infected ticks causing Lyme disease



2014 2015 2016 2017 2018

Map. 1.1.12.2. Distribution of infected specimen

SUPPRESSION OF TICKS ON THE TERRITORY OF Vojvodina

The Provincial Secretariat for Urban Planning and Environmental Protection is in charge od suppressing the ticks on the territory of Vojvodina. The ticks are beeing suppressed using the fonds from the budget of the APV since 2017.

Both deciduous and mixed forests with favorable ecological and microclimate conditions with the presence of hosts that are suitable for the development of all four stages of ticks represent an extremely suitable habitat for their development.During 2017, the tick-suppression was performed on a total of 600 hectares on the territory of the National Park Fruska Gora and on the territory of the municipality of Srpska Crnja. During the control, the active substance lambda-cyhalothrin was used. Ticks are predominantly suppressed on picnic areas, hiking trails, promenades and other surfaces suitable for their development and where people live.

1.1.13. Indicator: Trend of Morbus Lyme patients in Serbia

Author / Institution: Slavisa Popovic/Environmental Protection Agency

Key message: The number of patients with Lyme disease is in decline

Assessment: 

Lyme disease or Lyme borreliosis is a multisystemic disease of the subacute and chronic flow caused by Borrelia burgdorferi bacteria. It involves primarily the skin, then the heart, joints and central nervous system.
Carriers of these bacteria are ticks, rodents, deer, and others. Vectors of infection are hard ticks that transmit disease to man and domestic animals, and it occurs usually seasonally (from early spring to late autumn), mostly with people who often stay in nature.Lyme disease in the Republic of Serbia is the leading disease in the group of vector diseases, with participation in the structure of over 90%. Lyme disease is registered throughout the year, with the highest occurrence in June and July in the month when the tick population is the most numerous.

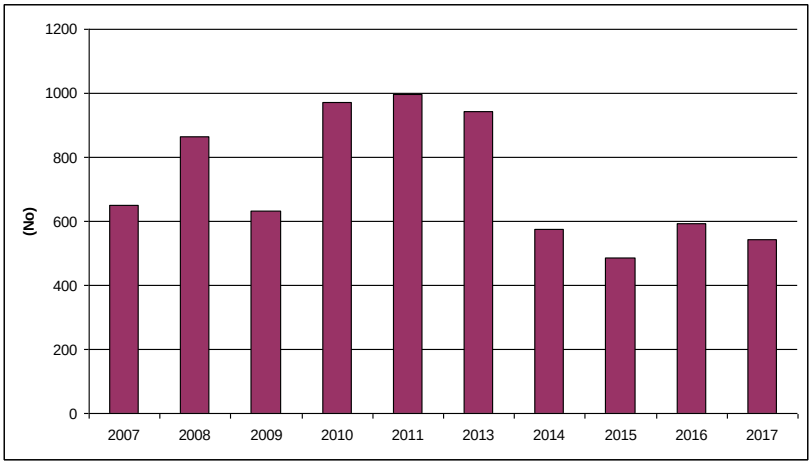


Fig. 1.1.13.1. Number of patients with Lyme disease in Serbia.

The number of patients suffering from Lyme disease ranges from about 500 (2015) to about 1000 (2011). Although the number of infected ticks decreases, the number of patients with Lyme disease has been constant over the last several years. Several reasons contributed to this. First of all, more and more people reside in nature, and more often, they are exposed to the possibility of picking up ticks. The increasingly warmer spring and summer months lead to an increase in the number of small rodents that are the bacteria carriers causing Lyme disease, and also contribute to faster bacterial multiplication.

The climatic trends and density of key hosts for adult ticks are the major factors in the spread of ticks and contribute to the spatial distribution of Lyme disease. The latest data show that ticks in Europe are spreading to the north latitudes, and also to higher altitudes.

Annual reports of Institute for Public Health:

http://www.batut.org.rs/download/izvestaji/Godisnji%20izvestaj%20zarazne%20bolesti%202017.pdf

http://www.batut.org.rs/download/izvestaji/zarazneBolestiGodisnjiIzvestaj2016.pdf

http://www.batut.org.rs/download/izvestaji/Zarazne%20bolesti%20godisnji%20izvestaj%202015.pdf

http://www.batut.org.rs/download/izvestaji/Izvestaj%20o%20zaraznim%20bolestima%202014.pdf

http://www.batut.org.rs/download/influenca/2013ZarazneBolesti2.pdf

http://www.batut.org.rs/index.php?content=387

http://www.batut.org.rs/index.php?content=299

BIODIVERSITY CHANGES AT SPECIES LEVEL

Species diversity of Serbia

According to official data 44,200 taxons were identified and classified in Serbia at the level of species and subspecies, which is not the final figure. According to real estimates, probably 60,000 taxon live in Serbia. The largest groups of organisms are insects with over 35,000 recorded species.

Although with 88,361 km2 the Republic of Serbia makes only 2.1% of Europe's land, the biological diversity of different groups of living organisms is high. In Serbia there are:

- ✓ 3662 species and subspecies of vascular flora (39% of Europe's vascular flora),
- ✓ 98 species of lampreys and fish (51% fish fauna of Europe),
- ✓ 45 species of amphibians and reptiles (49% of fauna of amphibians and reptiles of Europe),
- ✓ 360 species of birds (74% of bird fauna in Europe),
- ✓ 94 species of mammals (67% of European mammals).

Of particular importance for the evaluation of the species diversity of Serbia is the high percentage of endemism and relics that are particularly widespread in mountain and highland areas, in cliffs and canyons. The highest level of endemism in Serbia was established among insects and vascular plants.

The monitoring of population dynamics was focused on species that are important for ecosystem functioning (top predators, pollinators and decomposers). Top predators control stability of ecosystems by regulating number of individuals at different trophic levels.
Animals pollinate 87% of the world's flowering plant species. Many scientists are concerned that pollinators are in decline globally. Bees, flies (order Diptera), buterflies and moths (Lepidoptera) are the most important polinators among animals. Therefore, monitoring of pollinator species is essential in assessing function of ecosystems. Fungi are major decomposers in certain ecosystems and therefor they represent a key components of ecosystems that control the proces of matter cycling.

1.1.14. Indicator Name: Diversity of species-butterfly population trend

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Milan Djuric, Non-governmental organization "HabiProt", Belgrade

Key message: The population of the forest butterflies is in a slight increase and there is a slight decrease in the population of meadow butterflies

Assessment: 

The indicator shows trend of changes in population abundance of selected butterfly species from forest and meadow habitats. The change in the population of butterfly indicates the loss, but also changes in the structure of their habitats, due to fragmentation and isolation, as well as other changes in the environment that directly or indirectly affect the change in population structure. It is shown that population of butterflies in meadow habitats are more stable in the period from 2014 to 2017, while in forest habitats the oscillations in population dynamics are more evident.

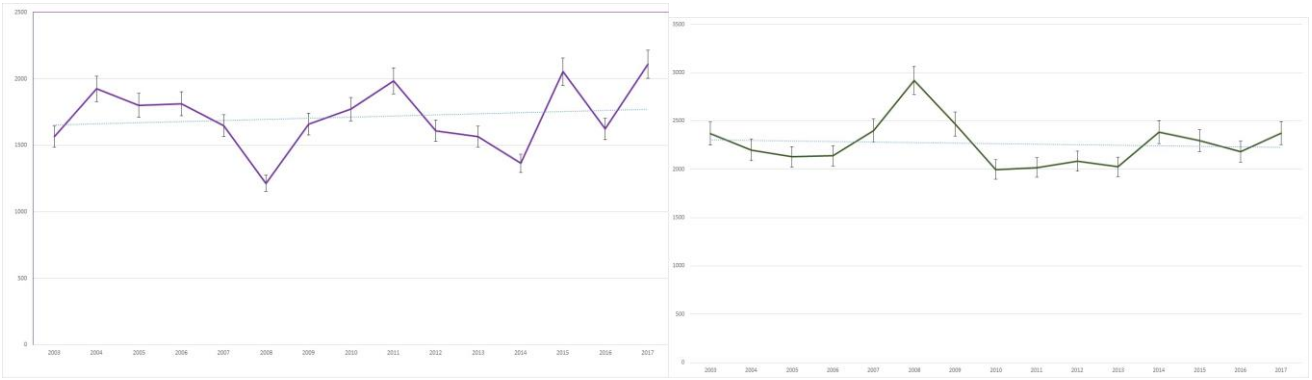


Fig. 1.1.14.1. Trend of forestland and grassland butterfly population.

In this assessment, data were used from 15 species of day butterflies for forests and the same for meadow habitats. The transect method was not used, but the method of relative representation of the finding in the base for insect mapping Alciphron for the period 201-2017. If we observe the territory of the Republic of Serbia in its entirety, deviations in the number of both forest and meadow species in this period are relatively small. According to these estimates, the trends of forest species are on a slight increase, with the maximum values in 2004, 2011, 2015, and 2017. Interestingly, in 2008, the largest increase in population was recorded in meadow species, while in forest species the greatest decrease was recorded. Likewise, the analysis shows a decrease in the number of population of species of meadow and forest habitats in the north of the country, while there is a significant increase in the number of population of butterflies in the south of the country.

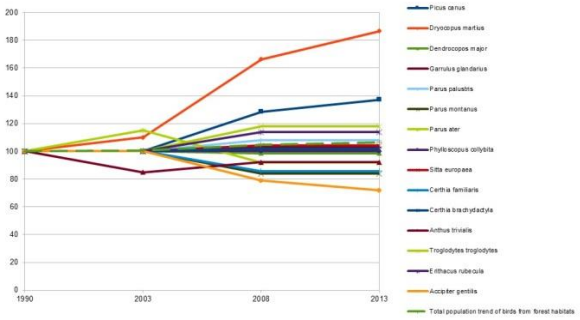
1.1.15. Indicator Name: Species diversity-birds population trend

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Milan Ruzic/ Society for the Study and Protection of Birds

Key message: The trend of the forest bird species is stable with a slight increase and a slight decrease of population in the meadow species

Assessment: 

The indicator shows trend of changes in the population abundance of selected bird species from forest and meadow habitats. The change in the population of birds explains the loss, and change in the structure of their habitats, due to fragmentation and isolation, as well as other changes in the environment that directly or indirectly affect the change in population structure. In the period from 2008 to 2013, trend in population dynamics of birds registered in meadow habitats are more or less stable, what is even more evident in forest habitats.



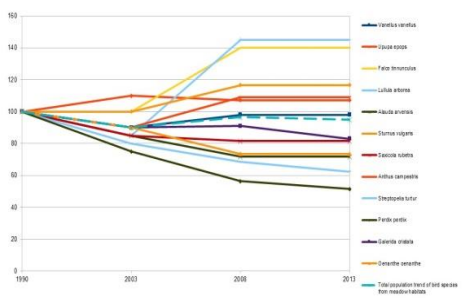


Fig. 1.1.15.1. Trend of forestland and grassland birds population.

Different patterns of the dynamics of bird populations indicate significant changes in forest and meadow ecosystems that specifically affect different species. The explanation for the increase in the number of forest habitat types is probably due to the increase in areas under forest and shrub vegetation, but may also be due to changes in the wider environment. However, in the forest habitats there is a significant, even number of species whose number is decreasing, which is probably due to the decrease in the quality of forest habitats (these are species specialized for life in old forests). Although a large number of species of meadow habitats show a downward trend, there is an increased number of species with a stable population. Improving the conditions in agricultural areas, as well as reducing the intensity of agriculture due to depopulation of the villages are the likely reasons for such a trend.

Among the forest species, there is more a species with a stable population, while the increase in populations of some species is obvious (eg *Dryocopus martius*). However, species with a markedly negative trend (eg, *Accipiter gentilis*) are noticeable. Among the meadow species, the most pronounced negative trend was observed in the *Perdix perdix, Oenanthe oenanthe* and *Streptopelia turtur* species.

1.1.15.1. Case study: The eastern imperial eagle (*Aquila heliaca*) – critically endangered species

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Milan Ruzic/ Society for the Study and Protection of Birds

Assessment: 

Twenty years ago Serbian sky was adorned with about ten pairs of the eastern imperial eagle, a bird that adorns Serbian coat of arms, and today it has fallen to one pair – Bora and Erzika, they live in the proximity of a small Serbian village Krstur. In the last two years the pair raised three young fledglings – two years ago Dusko and Lilika were born and last year Nada (Hope) came to the world, this name was given symbolically in the hope that the eagle would survive in Serbia.

The last remaining couple of this bird in Serbian Krstur is guarded by members of the Society for the Protection and Study of Birds within the international project "Pannon Eagle Life" which our country conducts in cooperation with the Czech Republic, Slovakia, Austria and Hungary.

Pic. 1.1.15.1.1. The eastern imperial eagle Bora and Erzika. Foto. M. Ruzic

The eastern imperial eagle is a Euroasian species, and today it is more present in the Mongolian and Kazakhstani steppe, while in Europe, unlike earlier times its number is drastically lower. For example, up to twenty years ago on Fruška Gora there were three pairs of eastern imperial eagle and Deliblatska pescara there were only seven or eight. Today they are no longer there, and the only remaining couple in our country has nested on Canadian Populus in the steppe near the village of Serbian Kostur, where this year it also has laid eggs.

The eastern imperial eagle was once a trophy bird for many hunters – beautiful and large with a span of wings two meters wide,yet accessible becouse it does not live in the mountains but in the steppe,this has also reduced their population. In addition to the lack of

habitat the reasons behind this bird disappearing are the lack of tall and old trees which they usually choose for their nest, and the biggest problem for them is poisoning.

Good news come from Hungary. In 1995 they had only 30 pairs of the eagle left and since they have invested in projects, so today they have about 150 pairs. Since their eagle is recovering it is possible that some of them might come down to Serbia and form a pair with our young birds.

How did this eagle ended up on the Serbian coat of arms, and was this bird really an inspiration?

There are two stories, one says that it is the bird most seen in this region nesting on oak trees, a tree that our people consider sacred. The oak tree was considered a sacred place (shrine). Especially oaks over 100 years old which our people marked with a cross. The eastern imperial eagle (eagle of the cross in Serbian) likes old trees and this is why it got this folk name, because people saw a big eagle on a holy tree. It is logical that the bird which had symbolism in the people was an inspiration for the coat of arms.

The second story tells us that we are not the only one to have this eagle on our coat of arms and that we probably took it from others, becouse Roman emperors, Austrian Emperors, Napoleon Bonaparte, and even the Germans during the Second world war recognized this bird as a symbol and used it on their flags or seals.

1.1.16. Indictor name: Trend of Griffon vulture population restored

Author / Institution: Slaviša Popovic/Environmental Protection Agency, dr Sasa Marinkovic, Institute for biological researches “Sinisa Stankovic”

Key message: Increase in the population of the Griffon vulture

Assessment: 

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 rivers increased more than ten times. Permanent protection and improvement resulted in the population growth to 500 birds. 246 nesting couples and 125 juvenile were recorded.

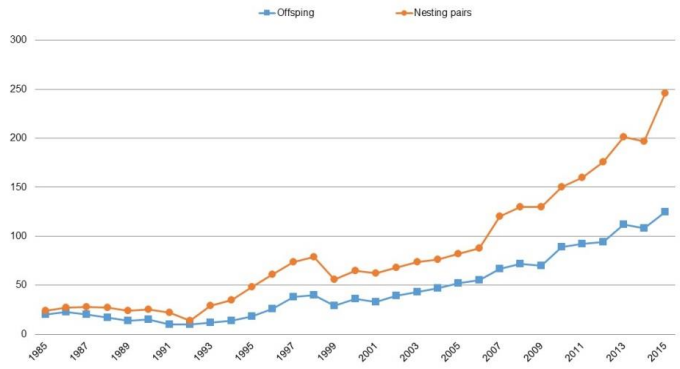


Fig. 1.1.16.1. Trend of population of Griffon vulture in Serbia.

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 pray 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).

1.1.17. Indicator name: Trend in the number of carnivorous mammal population

Author / Institution: Slaviša Popovic/Environmental Protection Agency

Key message: In Serbia, in the last 5 years there has been a slight increase in the wolf population

Assessment: 

The first action plans for the management of large carnivores (wolf, bear and lynx) were done in 2007, but they were never formally proclaimed. Then new management programs were prepared for bears and lynx in 2018, and in 2019 for the wolf. There are unharmonized data on the number of populations of large carnivores in Serbia. According to the data of the Forest Administration, the number of wolf population varies from 1600 to 2000. Bear population at 50-120 with a marked increase in number. The population of lynx on 20-21, and the population of beavers at 40-80 with a downward trend

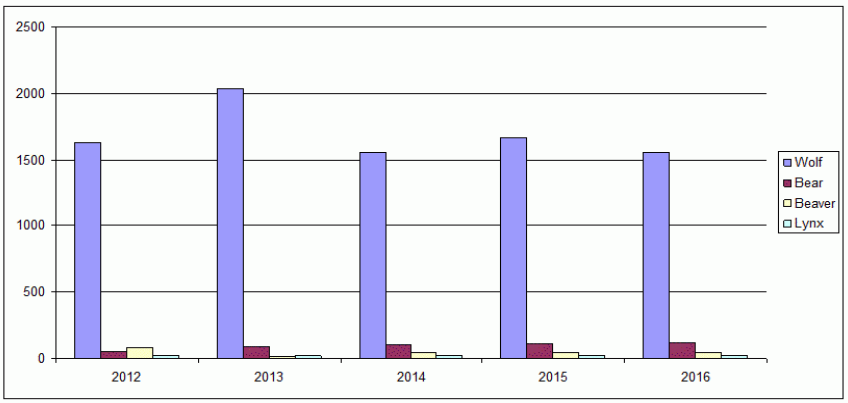


Fig. 1.1.17.1. Trend in number of wild animals (wolf, bear, beaver, lynx)

However, according to expert estimates, the number of wolf population in Serbia is 800-1200. The population is divided into two sub-populations, Dinara-Balkan and Carpathian and both populations have a stable and slightly upward trend. This estimate is based on a registered wolf catch in Serbia that has been in the range of 150-170 in the last 5 years, so if a five year catch is observed, the wolf population is estimated at about 1000 individuals, with a slight increase in the population.

1.1.17.1. Case study: Steppe Falcon (*Falco cherrug*)

Author/Institution: Nikola Stojnic, dr Slobodan Puzovic/ Provincial Institut for Nature Conservation, Novi Sad

Assesment: 

Protection of steppe falcon is extremely important, since according to the latest published estimates, 16-21 nesting pairs (32 to 42 adult individuals) in Serbia. In the last 19 years the population has decreased by 69%, which has been determined on the basis of permanent monitoring, reduction of the distribution of the species and potential level of exploitation - illegal killing. According to the census of 2006 and 2007, the number of nesting pairs was 50-60. Breeding and non-breeding population is estimated as critically endangered (CE) in Serbia according to the Red Book of Birds of Serbia, while the global status of the species according to the IUCN Red List is EN - endangered. Studies from 2019 show a smaller increase in the population in Serbia, estimated at 30-35 pairs, which is a possible consequence of protection measures.

Steppe Falcon (Falco cherrug) is a strictly protected species according to the Ordinance on the designation and protection of strictly protected and protected wild species of plants, animals and fungi ("Official Gazette of the Republic of Serbia" No. 5/2010, 47/2011, 32/2016 and 98 / 2016). Steppe Falcon is an endangered species at the European level and is listed in Annex I of the European Birds Directive and Annex II (strictly protected species) of the Berne Convention.

Active protection measures for steppe falcon

Care

Rescue, care and release is an important active measure of the protection of the steppe falcon, the species so rare that each preserved individual is very valuable. In the period 2017-2019 in this way is treated with four specimens of this rare species.

2017.

In March 2017, the joint action of the Provincial Inspection for Environmental Protection, Provincial Institute for Nature Conservation, BirdLife Serbia and the Police, executed the seizure of 4 steppe falcon from the person that they were illegally held in detention. Of these four individuals, two have been released in the vicinity of the National Park "Fruska gora".

2018.

The young male steppe falcon was returned to nature in August 2018, after almost a year of recovery. It is an individual who was ringed in the Czech Republic as a young in 2017 and was found in the same year in Serbia.

2019.
A young individual of the steppe falcon originating in Austria was successfully recovered and released during May 2019 in a team action led by the Institute for Nature Conservation of Serbia. This individual recovered for almost a year and was released near the place where it was found, in the vicinity of Paracin.

Platforms for nesting

Since these species can not build their own nest itself, and poor accessibility of the nests is recognized as a threatening factor, in Serbia in the second decade of the XXI century had a significant number of artificial wooden and aluminum structures in suitable locations. These platforms, although difficult, recognized by the steppe falcon and in which some couples successfully nest.

Pic. 1.1.17.1.1.Sttepe falcon artificial nest. Source: S. Puzovic

In the perspective, this type is necessary to help by the continuation of the implementation of these measures, but also by the isolation of risky low-voltage power lines that are subject to electrocution (shock due to electric shock), by suppressing poisoning, capture and killing, and then increasing the number of prey, especially the ground squirrel, correctly planning wind farms and other measures.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Habitats of many known endangered species in RS are still not included in protected areas,
- Insufficient field conservation measures,
- Lack of field data and knowledge on species occurrence,
- Administratively and practically improperly implemented procedures issued to harmonize and minimize human impact on biodiversity.

1.2 Preservation of biological diversity at the genetic, species and ecosystem level

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target C13

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been effective 

Within active conservation measures, according to extent and duration most important are revitalization of wetlands in SNR "Obedska bara" and steppe grasslands on NP "Fruška gora", while this kind of measures are implemented in most of the protected areas in Vojvodina Province, as well as in some Pas in central Serbia, such as Protected Landscape "Veliko ratno ostrvo". Active conservation measures for species *in situ* are feeding places (Brown Bear *Ursus arctos*, Griffon Vulture *Gyps fulvus*, Eagles Accipitriformes), posture of artificial nests (Saker Falcon *Falco cherrug*, European Roller *Coracias garrulus*, Owls Strigiformes, Eagles Accipitriformes...), reintroduction (European Beaver *Castor fiber*, Red Deer *Cervus elaphus*, Chamois *Rupicapra rupicapra*), translocations (Amphibians Amphibia), nest-guarding (Imperial Eagle *Aquila heliaca*), bush-clearing (Banat Peony *Paeonia officinalis* subsp. *banatica*), water supplying (Maidenhair Fern *Adiantum capillus-veneris*) etc. Besides these *in situ* measures, additional measures are implemented as well, such as care of injured individuals, stopping of illegal activities, awareness raising etc.

Through analyses of genetical variability of population of certain species in RS, level of thier genetical diversity is determined, which can be used for conservation goals. So level of genetical variability is known for some species under expoatation regime, e.g. Nose-horned Viper (*Vipera ammodytes)*, Edible Frog (*Rana synklepton esculenta*), or game species such as Roe deer (*Capreolus capreolus), Brown Hare (Lepus europaeus) etc.* Research of genetical variability is done for some fish species, Brown Trout (*Salmo trutta)*, Grayling (*Thymallus thymallus)*, Sterlet (*Acipenser ruthenus)*, and some *Barbus species.*

Genetical resources, in direct on indirect use by humans, are key component of agro-biodiversity of RS Agrobiodiversity encompasses species and habitats of cultivated fungi, plants and animals, as well as species and ecosystems important for food production (agro-ecosystems, pastures, meadows, forests, water ecosystems). Beside that, genetical resources are important for sustainable development of rural areas of RS, although role of local communities in this process is still not proper.

Based on the data contained in the Draft Programme of Rural Development (2008-2013), significant presence of more than 44 autochthonic and exotic races of domestic animals has been noted in Serbia (7 races of horse, 1 race of donkey, 8 races of cows, 3 races of goats, 5 races of sheep, 18 races of pigs and several races of poultry). Between 400 and 500 of agricultural husbandries and associations own endangered species. The FAO information system for domestic animals diversity (DAD-IS) contains information about the presence of more than 100 races and sorts of domestic animals on the territory of the Republic of Serbia.

The following autochthonic races of domestic animals in Serbia have survived: *podolac* cow; busha; domestic ox; domestic mountain horse; nonius, domestic Balkan donkey, *mangulica, moravka, resavka, pramenka* (*svrljiska, sjenicka, pirotska, karakacanski, krivovirski, bardoka, baljusa, vlaska vitoroga, lipska sheep*), cigaya (*cokanski* type), domestic Balkan goat, domestic chicken (Sombor *kaporka*, naked-neck chicken, Svrljig chicken, Eastern-Serbian chicken), domestic turkey, domestic guineafowl, domestic goose (status of Sombor goose, Novi Pazar goose and Podunvska goose is unknown), domestic duck. Autochthonic sort of bee, *Apis melifera carnica*, is also important with its varieties, which is one of most valuable sorts of honeybees in the world, according to its characteristics. Dogs that are used for protection of herds (Serbian Shepard dogs) or those used as working dogs for herd management (pulini) should be included into autochthonic animal races of Serbia.

Ex situ and *in situ* activities are applied with an aim to conserve these races and sorts, whereat basic emphasis is put to the so-called *on farm* conservation that includes active role of agricultural husbandries.

Other genetic resources

In addition to cultivated plant types, , overall agro-biodiversity of Serbia also includes wild plant species that represent important components of food production and agriculture (forage crops, medical and aromatic herbs, decorative plants, honey plants, wild fruit).

Various agro-ecosystems (arable farms, orchards, vineyards, meadows, pastures, brink and ruderal habitats) and components thereof, including weed flora and vegetation also contribute to overall agro-biodiversity of Serbia.

The diversity of species that dwell in natural fields (meadows and pastures) has not been well studied or estimated, but number of species within the described 273 plant associations has been estimated at more than 1,000. Total number of medical and aromatic plant species in our flora is about 700, out of which 420 have been officially registered. 280 of these are traded as commodities. Honey plants are primarily found in meadow, forest and agro-ecosystems, and their number in our country has been estimated at approximately 1,800. In most general sense, flora agro-biodiversity includes weed and ruderal plants as agro-ecosystem components. The studies conducted to date on weed flora diversity in Serbia reveal that the number of weed species represents 28% of the total flora (more than 1,000 species).

Areas under forests in Serbia include combination of deciduous forest (beech and oak), in the percentage of about 60.7%, conifer forests, in the percentage of 4.7%, and mixed deciduous-conifer forests, which cover 33% of the area. With regard to autochthonic forest genetic resources, greatest value is seen in endemic and endemo-relict species (*Pinus peuce, P. heldreichii, Pinus nigra ssp. gocensis, Picea omorika, Taxus baccata, Prunus laurocerasus, Acer heldreichii, Fraxinus pallisae, Forsythia europaea, Corylus colurna, Daphne blagayana, D. mesereum* and others). Within forest genetic resources, in addition to the natural rarities, great importance is given to wild fruit species. Eighty-eight species of wild fruit have been identified within the natural forest associations of Serbia, 12 of which are endangered species.

Among genetic resources of medical and aromatic herbs, greatest importance is given to genetic diversity of commercially important species (chamomile, mint, sage, hypericum, yarrow, oregano, bearberry, valerian, plantain, primula, etc.), as well as to sorts of limited areals and to those that are for some reason endangered. Looking at the genetic resources of medical and aromatic herbs and the need for their conservation, coordinated monitoring activity, which would look into the status of their populations, has not been implemented for a long time, while general conservation strategy at national and international levels have not been developed yet. This is one of the main reasons for the recommendation related to establishment of ECPGR Working Group for Medical and Aromatic Herbs (1999).

The wild relatives are of particular importance as genetic resource in improving and selecting cultivated plants, especially at the level of resistance to various abiotic and biotic stressful external factors. More than a half of cultivated plants have direct relatives within forest and herbaceous plant associations. As far as it is known, there have been no attempts to develop inventory and perform characterization of these genetic resources in our country, except for wild relatives of fruit species.

Number and list of species and taxa of higher and lower ranges of fish in the rivers and lakes are monitored and vulnerability and protection of biodiversity of freshwater ecosystems have been described. There is also registered impact of allochthonous and invasive species to the auchthonous species.

According to the National Inventory of Forests in the Republic of Serbia, 49 tree species have been registered, 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. The picture shows number of forest species and shows trend of population of those species in forest's ecosystems (such as birds and butterflies).

Metodology for all forest related issues are in line with Forest Inventory and Forest Directorate of the Ministry of Agriculture.

AGROBIODIVERSITY

Based on the data contained in the Draft Programme of Rural Development (2008-2013), significant presence of more than 44 autochthonic and exotic races of domestic animals has been noted in Serbia (7 races of horse, 1 race of donkey, 8 races of cows, 3 races of goats, 5 races of sheep, 18 races of pigs and several races of poultry). Between 400 and 500 of agricultural husbandries and associations own endangered species. The FAO information system for domestic animals diversity (DAD-IS) contains information about the presence of more than 100 races and sorts of domestic animals on the territory of the Republic of Serbia.

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Ex situ and *in situ* activities are applied with an aim to conserve these races and sorts, whereat basic emphasis is put to the so-called *on farm* conservation that includes active role of agricultural husbandries.

For protection of cultivated plant varieties, in-situ and ex situ conservation measures are applied. In-situ protection measures primarily include the protection of indigenous and old varieties on their natural habitats through the so-called farm protection. Measures of ex situ conservation mainly include the conservation of varieties outside their natural habitats, in the banks of plant genes and national collections at various scientific institutions (Institute of Field and Vegetable Crops in Novi Sad, Krusevac Fodder Institute, Institute of true grasses in Kragujevac, Institute for vegetables in Smederevska Palanka, Potato Center in Guca, Faculty of Agriculture, University of Novi Sad and Belgrade. National collection of plant genes is located in the Institute of Maize in Zemun Polje and in the bank of the Plant Genes in Batajnica.)

1.2.1. Indicator Name: Population trends of autochthonous domestic species

Author / Institution: Slavisa Popovic/ Environmental Protection Agency

Key message: The trend of increasing the number of endangered indigenous domestic animals is on the rise

Assessment: 

The indicator is used to assess state of autochthonous breeds of domestic animals, in terms of their vulnerability and connected with stimulants received per category of breeds and individuals. This assessment serves to plan future stimulants in order to maintaine agrobiodiversity at a satisfactory level. The trend of the population of endangered autochthonous breeds of domestic animals is on the rise, as a result of incentives planed every year, under the Rulebook mentioned above. Increased number of animals recorder for example at cow busha and domestic mountain horses, can be explained by the fact that in these breeds there was no identification of animals on the ground. Additional monitoring in the field is needed. It is evident that from 2014 some of the domestic animals increast rapidly in number of animals, such as "mangulica" pig, due to increased interest for their growth for consumption as delicateous food (mostly in restaurants).

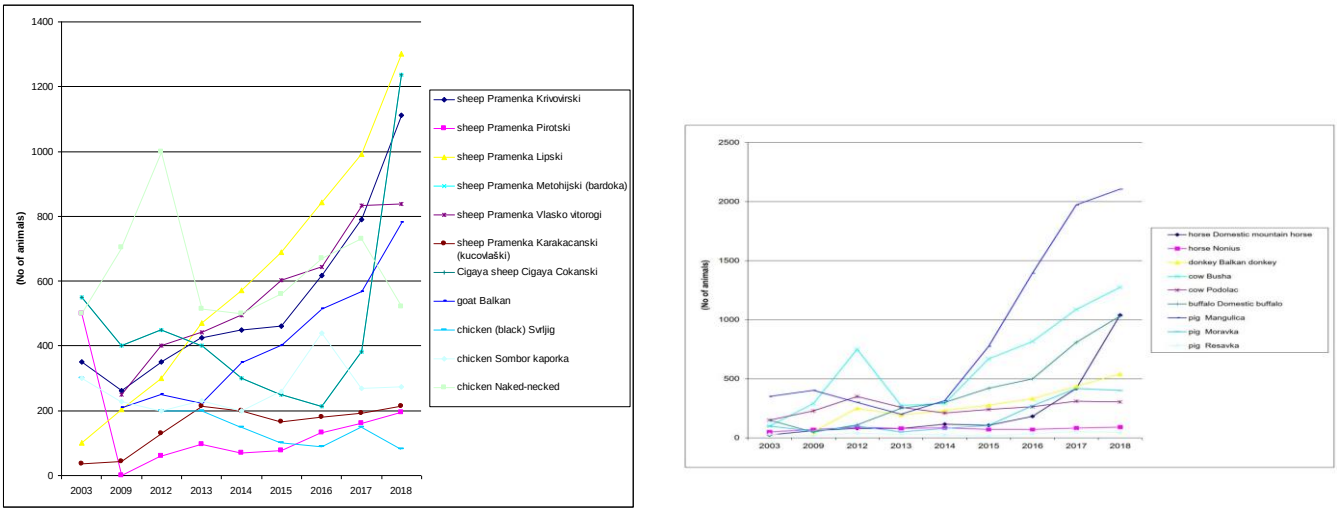


Fig. 1.2.1.1. Population trend of selected autohtonous domestic species

1.2.1.1. Case study: Seed Facilities in forestry as a basis for conservation and guided use of gene fond in Serbia

Author/Institution: Dejan Miletic, Public Enterprise Srbijasume

Assessment: 

The basis of forest ecosystem consists of different types of forest trees, whose genetic diversity is the basic unit of biodiversity. The modern man with his various activities constantly destroys and changes nature, which leads to irreversible loss of biological diversity through disappearance of a large number of organic species or the reduction of their populations to a critical limit.

Seed banks have significant role in conservation and directed use of forest genetic resources. Past activities on preservation of forest genetic resources in Serbia can be divided into two vasic groups : 1. In istu (on-site) conservation, which presrves forest genetic resources in natural populations (seed collectivity,group of trees or individual trees) and protected natural assets , and 2. Ex situ (out of place) is a form of conservation of forest genetic resources outside their natural habitat by establishment of seed banks, clonal archives, progeny tests, botanical gardens, arboretrums and living archives.

Seed collectivities are parts of a forest complex of suddicient uniformity, derived from the phenotypic characteristics of the trunks, whose primary purpose is the production of reproduction material. In order for seeds to serve their basic purpose it is necessary to carry out genetic improvements which include the selection of seed for trunks , spacing and other activities that increase productivity. Removal of phenotypic inferior trees frrom seed collectivity improves the quality of seeds and seedlings, but genetic diversity can be reduced in the following.

Plantages are isolated seedlings of selected specimens and each is indentified according to clone, family or provenance in which pollination from outside sources is reduced or avoided. They produce frequent and abundant yield of seed that is easily collected (OECD, 2014).They are used to produce genetically improved reproductive material and represent the link between refinement and restoration of forests.

According to the data from the Register of seed objects of the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia – Forestry Management (2018), in Serbia there are 211 registeredfacilities for the production of selected and qualified reproductive material.

Of these, 192 are facilities for the production of selected reproductive material (51 coniferous and 141 deciduous), and 19 facilities are registered for the production of qualified reproductive material (1 coniferous and 18 deciduous)
The total area of seed objects is 2,190,8 ha (1.593,7 ha deciduous and 597,1 ha coniferous).These objects include 44 species of trees, of which 33 are deciduous and 11 coniferous species of trees.

According to the types of trees the following seed objects are most common: *Fagus sylvatica* L. (20 seed objects), *Quercus robur* L. (15), *Populus nigra* L. (14), *Quercus petraea* (Matt.) Liebl. (13), *Picea abies* Karst. (13), *Pinus nigra* Arn. (9), *Quercus frainetto* Ten (9), *Abies alba* Mill. (8), *Robinia pseudoacacia* L (8), *Acer pseudoplatanus* L. (7), *Juglans nigra* L. (6) etc.

1.2.1.2. Case study: Trend in conservation of Plant Genetic Resources for Food and Agriculture (PGRFA) - the number of accessions that are kept in the National Collection, Plant Gene Bank

Author/Institution: Milena Ivanov/ Ministry of agriculture, forestry and water management

Assessment: 

In a narrower sense the Serbian Herbitary Gene Bank is an object in which in strictly controlled conditions samples of plant genetic resources are stored: in the midrange term (on +4ºC to 20 years) and long term (-20ºC over 50 years). It is a necessary factor in the management of national and global conservation of plant genetic resources. The basic task of the herb gene bank is to preserve the identity and vitality of samples of seeds of plant genetic resources of Serbia. Preservation of plant genetic resources is priceless for the survival of humanity due to their resistance to stress, disease, pests and weeds. In a broader sense, the Bank of Herb Genes represents promoter, organizer and implementer of activities to conserve plant genetic resources for food and agriculture, as well as the national bearer of plant genetic resources management.

Plant genetic resources represent natural resources important for human and animal nutrition, as well as for providing raw materials for the industry. Plant genetic resources in agriculture comprise of: local population, genotypes, old and new varieties :grain, forage and industrial plants, vegetables, medicinal, aromatic and horticultural plants, fruit trees and vines, their wild relatives, as well as plant breeding material from real or potential value for agriculture.

In addition to keeping the national collection of cultivation seeds and horticultural plants, as well as the organization of preservation of planting material of fruits and vines, the bank og plant genes performesregistration of seed samples, their cleaning, drying, packaging, storage and maintenace; the organization of multiplication and regeneration of samples, and the exchange of samples with other gene banks; maintaining a database on plant genetic resources; cooperation with scientific research institutions and other gene banks at the national, regional, European and world level.

It is vitally important that our country ensure a high level of preservation, protection and sustainable use of plant genetic resources, and determine the framework and method of access to plant genetic resources and the exchange of knowledge and technologies related to them.

Since BBG facilities were not completed and put into operation for many years, in order not to deteriorate the national collection of seeds, the Serbian governmemnt entrusted samples to the Maize institute "Zemun Polje" in the period 2000-2015 years. Since the establishment of all the necessary technical conditions, on April 1,2015, samples of NK were transferred and stored in the cold room of the Gene Bank Plant in Batajnica, the management for the National Reference Laboratories, Ministry of Agriculture, Forestry and Water Management.

This activated and started the work of BBG of Serbia, after 25 years since the complex for the needs of the BBG of Yugoslavia was built for this purpose. For many years, BBG has had an obvious lack of professional research staff, since it works under the auspices of state administration, which is not common in other countries.

The jurisdiction of the Gene Bank Plant: management and preservation of plant genetic resources for food and work with the equipment and samples in the Gene Bank Plant are carried out under two laws: the Law on Ministries and the Law on Food Safety. There are longterm evident problems with a lack of financial resources for the basic Gene Bank Plant activities.

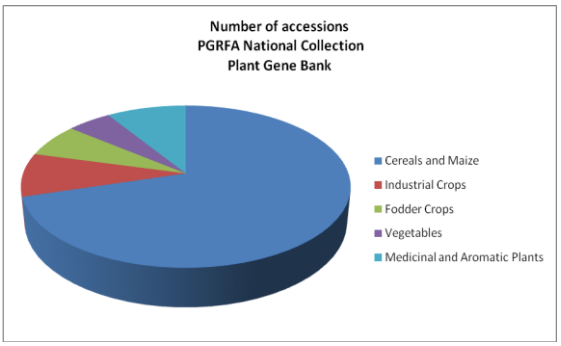


Fig. 1.2.1.2.1. The number of samples of plant genetic resources for food and agriculture in the collection of the National Bank of plant genes

At present, a total of 4,238 samples are kept in the collection of the National Bank of plant genes .

- Grain and maize 2.985 samples,
- Medicinal and aromatic herbs 387,
- Industrial plants 367,
- Fodder plants 284,
- Vegetables 215.

Fig. 1.2.1.2.2. It is particularly important to preserve traditional knowledge and skills related to the sustainable use of plant genetic resources owned by the farmers.

Given that the farmers have an active role in the "in situ" and "on farm" preservation of plant genetic resources, in the last few years, since 2013, the Ministry of Agriculture Forestry and Water management in accordance with its possibilities allocatescertain financial resources for subventions in preservation of BGRHP (Official Gazette of RS 85/13). The trend of allocating financial resources for these purposes in the last 7 years can be seen in Fig. below.

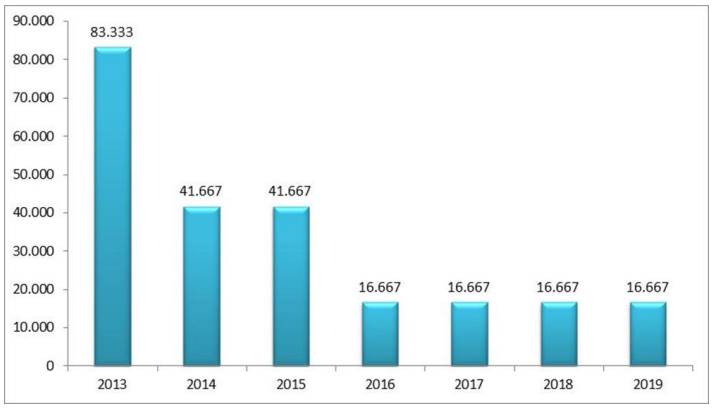


Fig. 1.2.1.2.3. Subvention fo preservation of BGRHP by years (EUR)

National policy on the preservation and sustainable use of agricultural plant genetic resources is presented in the new draft Law on Plant Genetic Resources Management and the draft of the National Plant Genetic Resources Conservation Program. It was concluded that at this time additional legislation on the management of plant genetic resources is necessary. The importance and transparency of the management and use of plant genetic resources for food and agriculture in our country depends on the new law in this area.

The approval of the Law on Plant Genetic Resources Management for Food and Agriculture and the approval of the National Plant Genetic Resources Conservation Program, from research institutes, faculties, private sector, other organizations and stakeholders, as well as farmers, are expected to take part in responsibility for the implementation of obligations in the field of conservation of plant genetic resources.

Strategic documents on agriculture and rural development, nature management, biodiversity, environment are very important and already approved. The Agriculture and Rural Development Strategy, as well as the Biodiversity Strategy, show that a large number of Biodiversity Policy commitments will be implemented, concentrating on relevant domestic and international aspects.

Serbia participates in all relevant international instruments for the conservation of plant genetic resources for food and agriculture and believesthat international obligations in terms of agriculture and biodiversity are mutually supportive.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Active field conservation measures for both habitats and species are financially and technically demanding,
- Lack of staff experienced to fulfill these measure
- There are administrative complications in implementing of active measures related to land use, e.g. on private land or on agricultural/forestry land
- Sectors policies are not in line with biodiversity conservation goals.
- Need for additional researches regarding genetical structures, in first priority for most endangered species,
- Need for support for sustainable development of rural areas of RS, with bigger role of local communities in management and conservation of agro-biodiversity.

1.3 Monitoring the impact of climate change on biodiversity and the impact of biodiversity on mitigating the effects of climate change

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target D15

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been ineffective 

Although Serbia did not have the obligation to reduce greenhouse gas emissions (GSB) between 2008 and 2012, it was necessary to prepare national and periodic UNFCCC reports in order to allow international cooperation in the field of climate change and systemic observation, as well as established knowledge transfer and clean technologies. Also, Serbia had to formulate and implement measures of mitigation, education, training and public information in order to increase the availability of information on the causes and consequences of climate change. During 2010, based on the UNFCCC requirements, the Ministry of Environment and Spatial Planning of the Republic of Serbia prepared the First National Communication (First Report), which contains information on the national context, the database and emission calculations GSB (1990-1998), under the UN Framework Convention on Climate Change (2010), assessment of the vulnerability and impact of climate change, as well as the necessary measures for adaptation and mitigation. It was developed in accordance with the "Guidelines for the Preparation of National Reports for parties not included in the Annex I Convention" (17 / SR.8), by the procedures of the Global Environment Fond (GEF), national regulations, documents and strategies. Taking into account the political, technological, financial and social aspect of the problem, this document also defines specific climate change scenarios (for the periods 2001-2030, 2071-2100), while the assessment of mitigation is related to several sectors - energy, industry, agriculture, forestry and waste management. The first national communication also provided data on research and systemic observations, but also gave recommendations and instructions for future education, training, capacity building and public awareness of global warming and GSB emissions.

The Republic of Serbia initiated the preparation of an institutional and legislative structure for the monitoring, reporting and verification of data and information of importance for climate change, with the financial and technical support of the EU. Preparation of the first national strategy for the fight against climate change, with the action plan, is in the initial phase and will provide a clear framework of activities in the fight against climate change in the period until 2020 and 2030.

This measure is implemented through certain projects, mainly through work on species with sensitive seasonal phases, such as migrating birds, early spring plants - Winter Aconite *Erantis hyemalis*) etc. Also, this monitoring is conducted on some sensitive habitats, such as Salt lake in SNR “Slano kopovo”. Effects of fires, floods, wind-breaks and drought are monitored within forest ecosystems. During spring 2014, when extremely big floods occurred in Serbia, brief survey on its effects on protected areas and protected species is conducted.

1.3.1. Indicator Name: Dead wood in forests and climate changes

Author / Institution: Slaviša Popovic/Environmental Protection Agency, dr Vladimir Djurdjevic, Institute for meteorology, University of Belgrade

Key message: Since 2007 number of dead trees increase 5 times

Assessment: 

The indicator shows connection between climate parameters and forest trees health condition (dead wood) registered by the Institute for Meteorology and ICP Forest Monitoring Network. Correlation between dried trees and strongly defoliated trees for 4 dominant

species (Beech, Hungarian oak, Turkish oak and Spruce) shown strong dependence of the temperature and precipitation anomalies during the summer season (June, July and August) - when extremely hot and dry summers were registered. 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. Increase of strongly defoliated trees was 4 times higher during the same period.

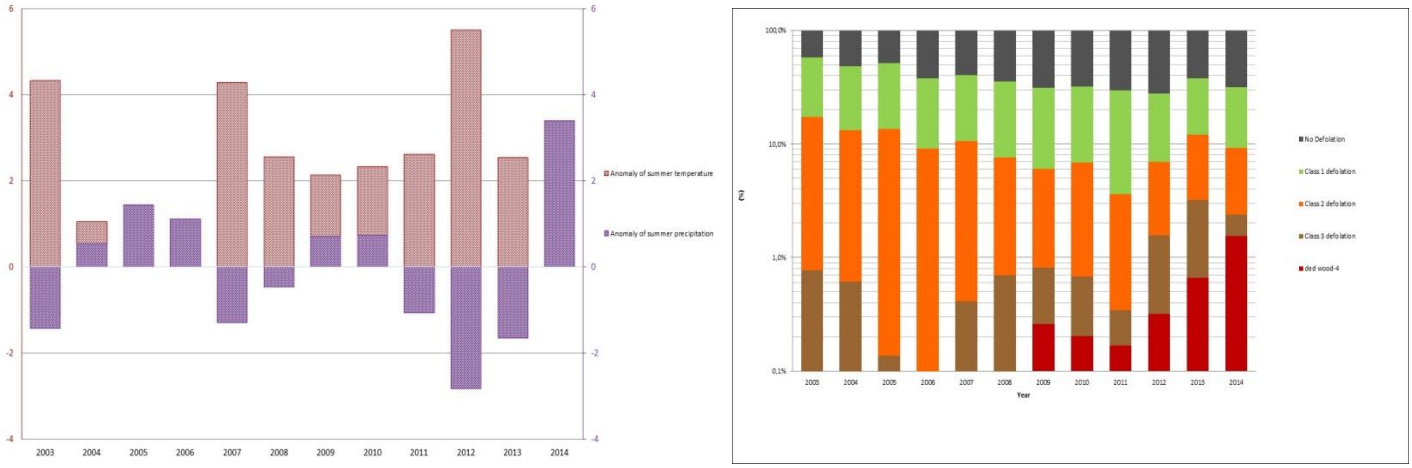


Fig. 1.3.1.1. Temperature and precipitation anomalies for summer season (June, July and August) (left)/ Defoliation of forest trees (right)

Correlation between dried trees strongly defoliated trees for 4 dominant species (Beech, Hungarian oak, Turkish oak and Spruce) have been observed. This was connected with temperature and precipitation anomalies during the summer season (June, July and August) when extremely hot and dry summers were registered. Percentage of "none", "slight", "average", "strong" and "dead wood" per years, in accordance with climate parameters: temperature and precipitations are presented. Calculation procedure has been done according to the criteria of ICP Forests monitoring.

1.3.2. Indicator Name: Forest damages

Author / Institution: Slaviša Popovic/Environmental Protection Agency

Key message: Increase in damge from natural disasters and insects

Assessment: 

The indicator show damage suffered by forests, broken down by selected biotic, abiotic and anthropogenic agents. The indicator is used to express level of damages and to compare which agent has the most expressive effect. In 2011 and 2012 man-made damage was the most expressed, while in recent year damage caused but natural disasters increased several times.

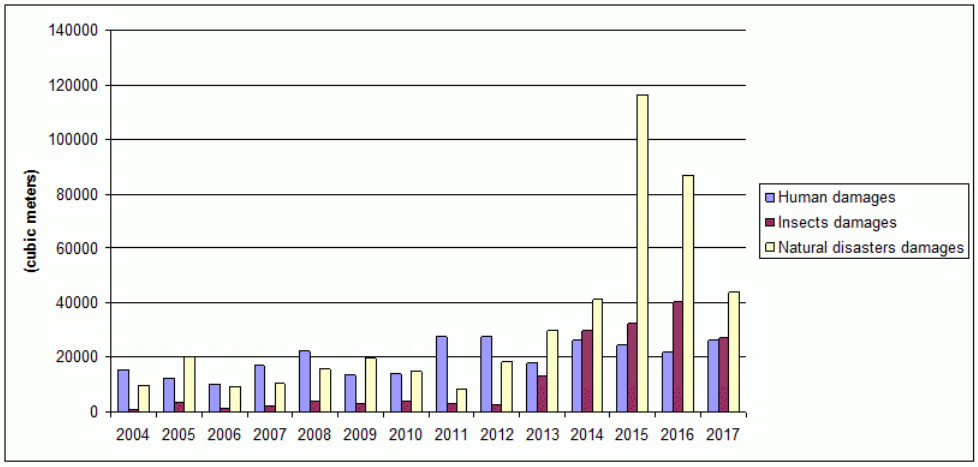


Fig. 1.3.2.1. Damage suffered by forests broken down by agents

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 2017 human damages in forest increased. Over 25 000 cubic meters of wood were illegally harvested, especially in the region of southern end eastern Serbia. дрвета је бесправно посечено из државних шума и то највише у региону јужне и источне Србије. Insects damages decreased for about 30 % and natural disaster damages decreased for about 5 %.

1.3.3. Indicator Name: Forest health conditions

Author / Institution: Slavisa Popovic/Environmental Protection Agency

Key message: Increase in the number of healthy trees

Assessment: 

The indicator is used to monitor forest health conditions through the trunk defoliation indicators in the frame of ICP Forests Monitoring Network. Monitoring of the health conditions of forests is based on the loss of leaves on trees in forests in each of defoliation classes: "none", "slight", "average", "strong" and "dead wood". There is also monitoring of health conditions according to changes in color of the leaves on the trees in the forests in each of decolorized classes: "none", "slight", "average", "strong" and "dead wood". Combined damage assessment of trees in classed: "none", "slight", "average", "strong" and "dead wood".

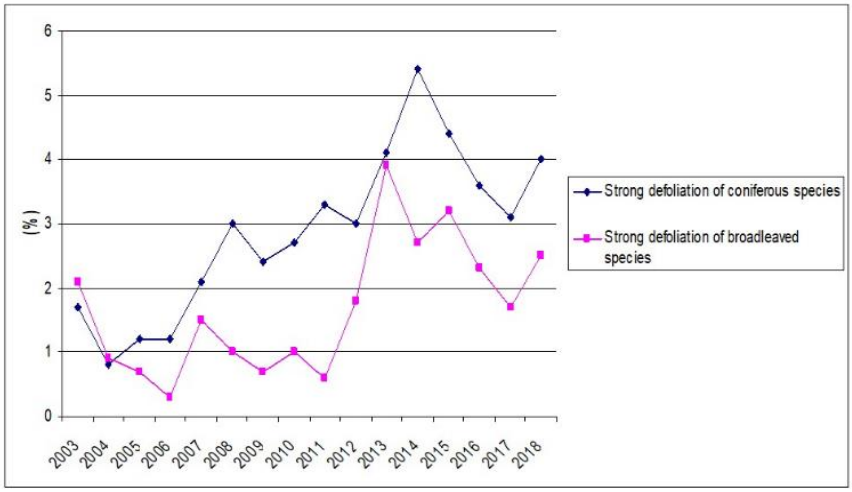


Fig. 1.3.3.1. Strong defoliation of coniferous and broadleaved species

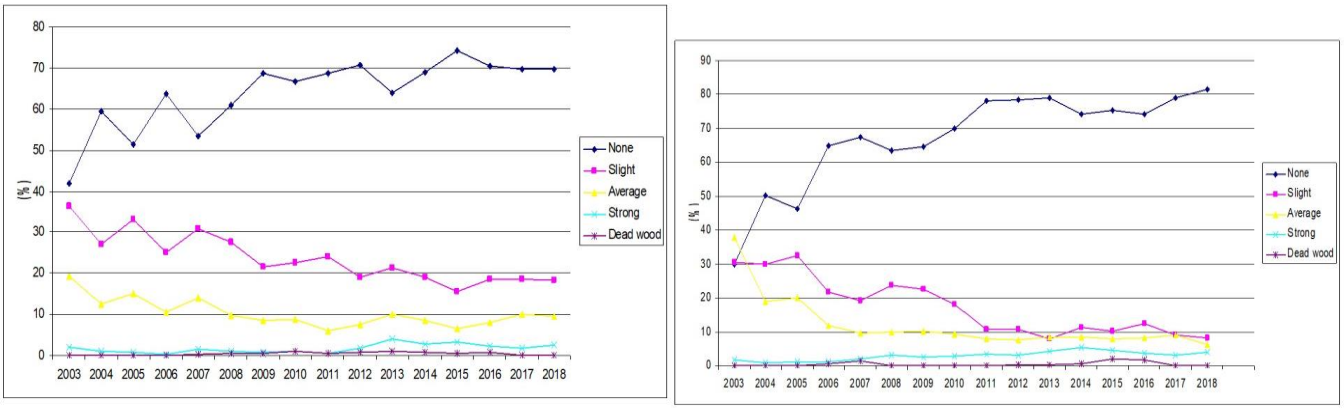
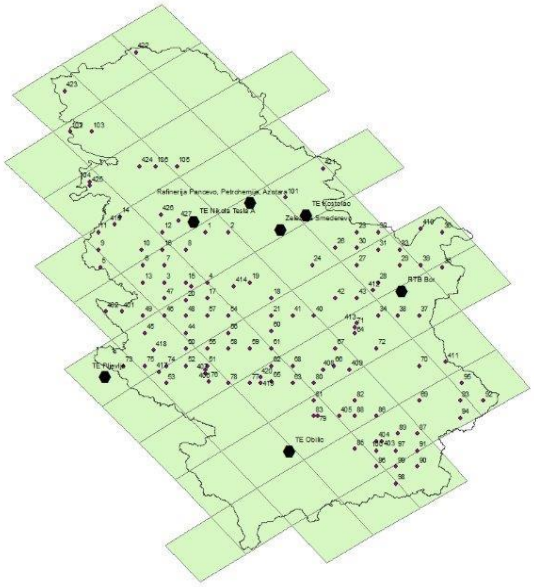


Fig. 1.3.3.2. Defoliation of coniferous (left) and broadleaved (right) tree species

When looking at healthy trees, about 90% of coniferous and deciduous trees did not have or had a weak defoliation. The defoliation was not registered on 92.4% of fir trees, 91.6% of spruce trees, 91% of white pine trees and about 40% of black pine trees. Moderate and strong defoliation involves about 43% of black pine trees.
Of the deciduous species, 85% of hornbeam trees, 81% of oak trees, 73.2% of beech trees, 71% of Austrian oak and 65.2% of sessile oak trees had no defoliation. The moderate and weak defoliation of the deciduous species was increased in relation to 2017.
In 2018 an assessment was made of the condition of forest species on 130 bioindication points, to a total of 2968 trees. During the year 2018, no drying of trees of coniferous species was recorded, while 0.1% deciduous trees were dried, but there was an increase in strong defoliation of coniferous species by around 30% and deciduous species by about 50% compared to 2017.



Map. 1.3.3.3. Plots for monitoring of forest health condition and main pollutant sites

1.3.4. Indicator Name: Forest fires

Author / Institution: Slavisa Popovis/Environmental Protection Agency

Key message: The greatest damage from forest fires was in 2003, 2012 and 2016

Assessment: 

Forest fires are monitored every year and data are expressed in cubic meters of timber volume or hectares of land destroyed. It is evidenced that some years were specific related to damage caused by forest fires. The most remarkable damages in cubic meters of timber were in 2012, 2003 and 2011. In 2007 even the amount of cubic meters of burned timber have not been large, damage in hectares on forest surface caused by fires have been very expressive.

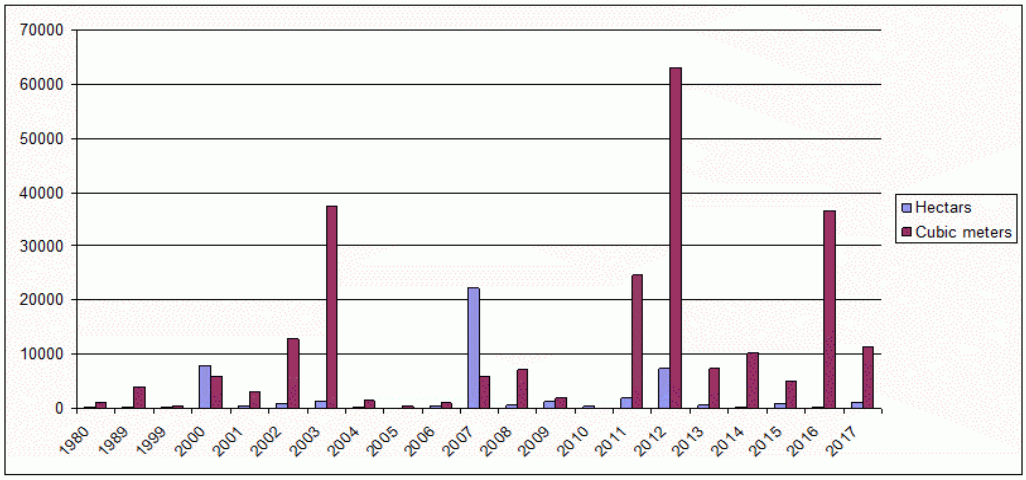


Fig. 1.3.4.1. Damage caused by forest fires

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. 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.).

1.3.5. Indicator Name: Number of fungal species in selected forest habitats

Author / Institution: dr Maja Karaman, MSc Milana Rakić/ Department of biology and ecology, Faculty of Sciences, University of Novi Sad

Key message: The number of mushroom species in the forests is reduced

Assessment: 

Macrofungal production is characterized by a high interannual variability which is closely linked to variations in weather conditions from one year to the next. Mushrooms generally flourish under warm and wet conditions. Source data are the fungal species collected from 2 permanent investigation plots (size of the plot: 1000m^2) within 2 different forest habitats on Mt. Vidlič, locality Vzganica, visited four times each year in the period 2009 – 2013. In the longterm study conducted on Mt. Vidlič (locality Vzganica) in the period 2009-2013, we observed that macrofungal speciess richness (number od detected species) was in correlation with several abiotic factors. Decline in annual precipitation, relative air humidity and soil moisture was followed by a decline in the recorded number of macrofungal species. On the contrary, increase in the value of above factors led to increase in the number of species. Therefore, it can be expected that the trend of climate change towards more arid conditions in Serbia would lead to the declining of macrofungal communities, as well as changes in species composition. This would inevitably lead to a change in the accompanying vegetation and cause a disturbance of natural processes in which macrofungi are involved.

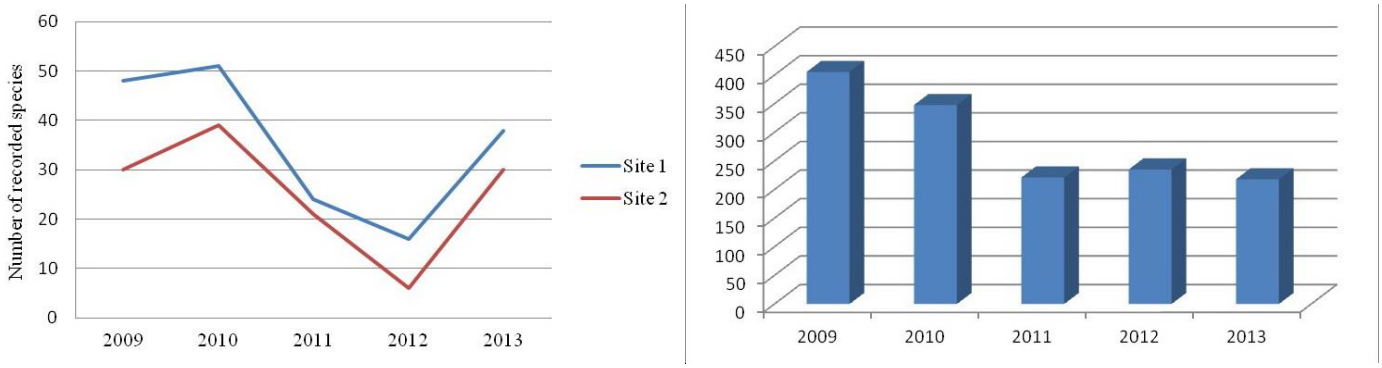
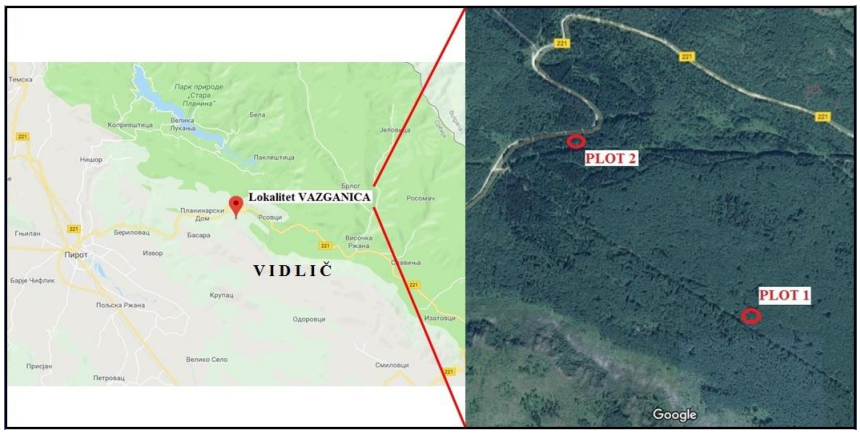


Fig. 1.3.5.1. Annual changes in the number of fungal species (left) and average annual precipitation (right)



Map. 1.3.5.2. Monitored localities

Pic. 1.3.5.3. - *Coprinus xanthotrix, Hymenopellis radicata, Phallus impudicus*, *Laccaria laccata, Spathularia flavida*

1.3.6. Indicator Name: Air pollution and forest defoliation in selected protected areas

Author / Institution: dr Jovana Dzoljic/College of applied professional studies, Vranje, Slavisa Popovic/ Environmental Protection Agency

Key message: Increased concentration of SO_x leads to greater defoliation

Assessment: 

The analysis of the most significant concentration of aero-pollutants (NO_x, NH_x i SO_x) in the air at the territory of protected area „Dolina Pcinje“ during the period 2012 – 2014 shows positive correlation between NO_x, and SO_x minimal detected concentration and defoliation intensity of broad-leaves species. Concentration of NH_x has not been changed, and therefore it cannot be directly linked to defoliation (Fig. below).

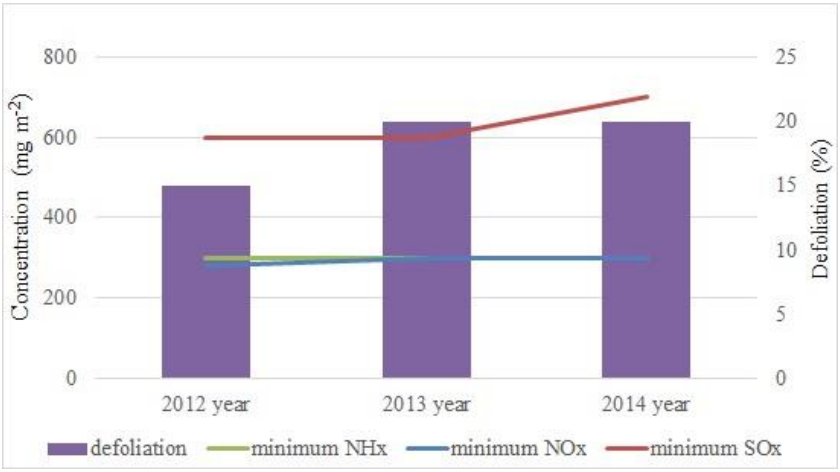


Fig. 1.3.6.1. Correlation between NH_x, NO_x and SO_x concentration in the air and defoliation intensity.

According to the the data of Republic Hydro-meteorological Service of Serbia over the last 20 years, noticeable change of climate parameters was registered, especially temperature and the amount of precipitation. Changes of climate conditions can indicate possible higher sensitivity of ecosystems, especially broad-leaves forests.

Regarding the fact that Coal Power plant "Kosovo" in Obilic, Kosovo and Metohija, has influence on the air quality of Southern Serbia, and based on the result of the analysis, it can be concluded that its influence is not significant at this protected area (Džoljić, 2017), mostly due to the topography of the terrain (Map below).

Map. 1.3.6.2. Location of Coal Power Plant "Obilic" and Protected Area "Dolina Pcinje".

1.3.7. Indicator name: Flowering of *Prunus laurocerasus* related to Climate Changes

Author / Institution: Dr Ana Vukovic/ Faculty of agriculture, University of Belgarde, Slavisa Popovic/ Environmental Protection Agency

Key message: Flowering of Prinus laurocerasus has been more frequent in recent years

Assessment: 

Flowering of Zeleniče (*Prunus laurocerasus*) has never been recorded in the older literature. For the first time it was observed and recorded in 1983. Years when flowering was observed and recorded are: 1983, 1998, 2008, 2012, 2017. For other years occurrence of flowering is unknown. Period during which flowering was observed is May-June.

Final set of criteria, which must agree with values derived from temperature data for the first half of the year, give as a result that during the period of 57 years flowering was possible in 17 years, from which 6 happened during the 1961-1990 and other 11 during the period of significantly warmer climate 1998-2017 when also was relatively frequent flowering of Zeleniče. Last three recorded flowering happened with 4-5 years interval. Did flowering occurred meanwhile - it is unknown.

One should have in mind there is high probability that Zeleniče at Ostrozub is currently under climate heat conditions that are still not optimal for every year flowering occurrence, but with future temperature increase flowering frequency can increase.

Analysis of climate conditions was done for the period 1961-2017 for the site where Zeleniče grows on mountain Ostrozub (latitude 42.88694; longitude 22.22361)

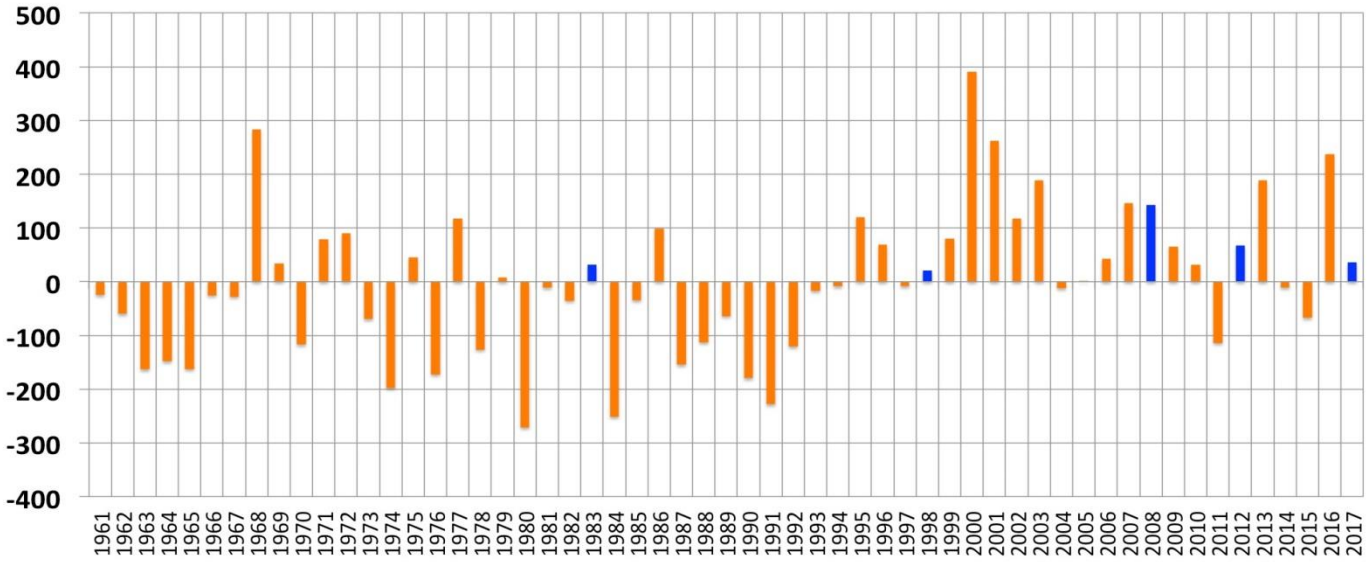


Fig. 1.3.7.1. Anomalies of a sum of active temperatures (growing degree days, GDD, in °C) for biological minimum of 10°C for the period January-June for each year with respect to 1961-2017 for locality of Zeleniče on Ostrozub; mean GDD for January-June for 1961-2017 is 829°C; in blue are marked years when flowering of Zeleniče was recorded.

Approach in finding the criteria, which indicate favorable heat conditions for flowering of Zeleniče that is possible to occur in the period May-June but depends on heat conditions before flowering occurrence as well, is based on setting the criteria using threshold values, which are defined using the values obtained for years for which was observed and recorded flowering. It was required that those years satisfy defined criteria for flowering and that defined criteria eliminate most of the other years as favorable for flowering (especially during the period of colder climate within period used for this analysis - on contrary flowering would have more frequent occurrence and would be recorded in older literature).

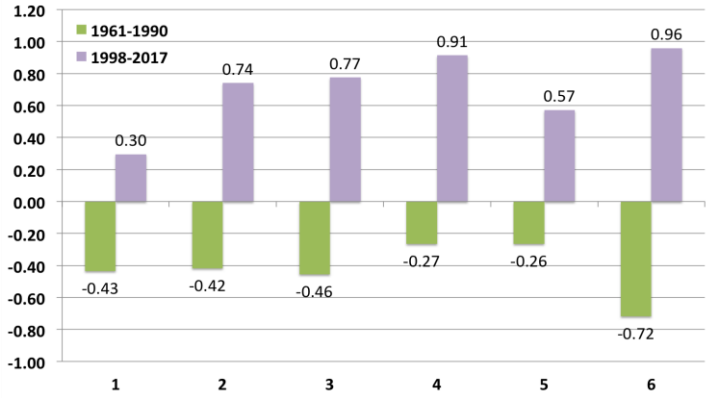


Fig.. 1.3.7.2. Anomalies of mean monthly temperatures for the periods 1961-1990 (green) and 1998-2017 (purple) in °C with respect to the 1961-2017 for locality of Zeleniče on Ostrozub.

1.3.8. Indicator name: Climate Changes and flowering phenology of winter aconite

Author/Institution: dr Ana Vukovic/ Faculty of Agriculture, Univerzity of Belgrade, dr Biljana Panjkovic/ Provincial Institute for Nature Conservation, Novi Sad, Slavisa Popovic/ Environmental Protection Agency

Key messege: Hellebore flowering became more earlier in the spring

Assesment: 

The average annual temperature increase in Serbia for the period 1996-2015 compared to the period 1961-1980 is 1.2 ° C, and for the winter and spring period by 1.3 ° C and 0.9 ° C, respectively (Vukovic et al., 2018) . However, the last 7 years (2012-2018) represent 7 the warmest years recorded, with a mean anomaly of about 2 ° C compared to the reference period (Djurdjevic et al., 2018). These changes in temperature caused favorable thermal conditions for the longer duration of the vegetation period, during the period 2008-2017 in the lowlands, even in about a month longer than in the middle of the 20th century. Observations of the start date of growing season show advancing toward earlier dates, and it is expected to advance more in the future (MEP, 2017).

The observation of the flowering of the winter aconite (*Eranthis hyemalis*) in the Bagremara forest near Backa Palanka city was carried out relatively regularly since 1996 (observations for the years 2000, 2001, 2002, 2004, 2011, 2012 are absent, while for 16 years there are data on the date of beginning of flowering). The data were analyzed for the period 1996-2017. The average date of flowering of winter aconite, obtained from all available data, is the 50th day from the beginning of the year (February 19th). For the period 1996-2006, the average day of flowering is the 68th day (March 9th), and for the period 2007-2017 is the 38th day (February 7th)

Pic. 1.3.8.1. Flowers of winter aconite. (Foto: B. Panjkovic)

Fig. below shows the anomalies of the beginning of flowering date of winter aconite for each year, with respect to the mean value for the entire period, together with the mean temperature anomalies for the period January-March compared to the mean for the period

1996-2017, but taking into account only the years in which there were monitoring of flowering (where data are not visible means that they are close to zero, the years for which the flowering data is not observed are not marked in x-axis). The results show that positive anomalies in temperature correspond, in most of the years studied, to negative anomalies in the date of flowering. This means those warmer periods January-March correspond to the earlier date of flowering.

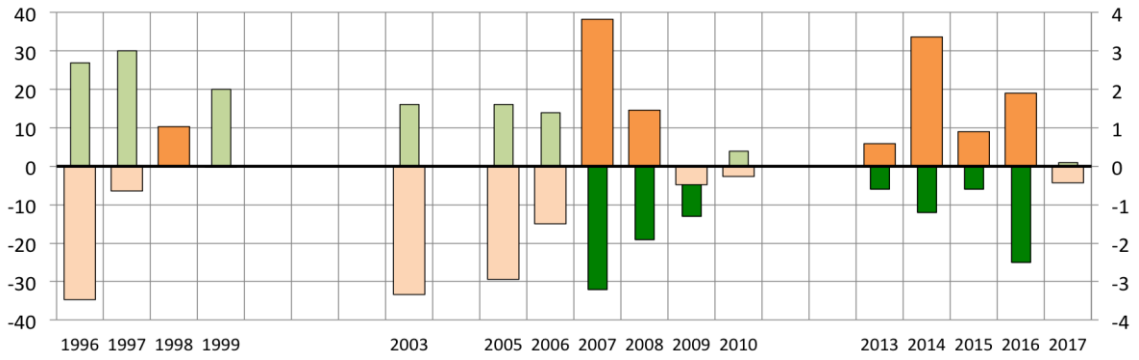


Fig. 1.3.8.2. Anomaly of the date of winter aconite flowering with respect to the mean value for the entire period (green color, left scale, anomalies in the number of days) and average temperature anomalies for January-March in the mean to the mean for the whole period (orange, right scale, in ° C); brighter colors indicate negative deviations anomalies in temperature and positive in flowering date, and darker to positive anomalies of temperature and negative in flowering date; The mean values for the entire period 1996-2017 are calculated from data for years when there are also observations of the flowering of maize

Minor deviations from this conclusion have caused the variability of different temperature conditions during the period January-March. Anomalies of mean monthly temperatures for each year relative to the mean for the entire period 1996-2017 are shown in Figure below.

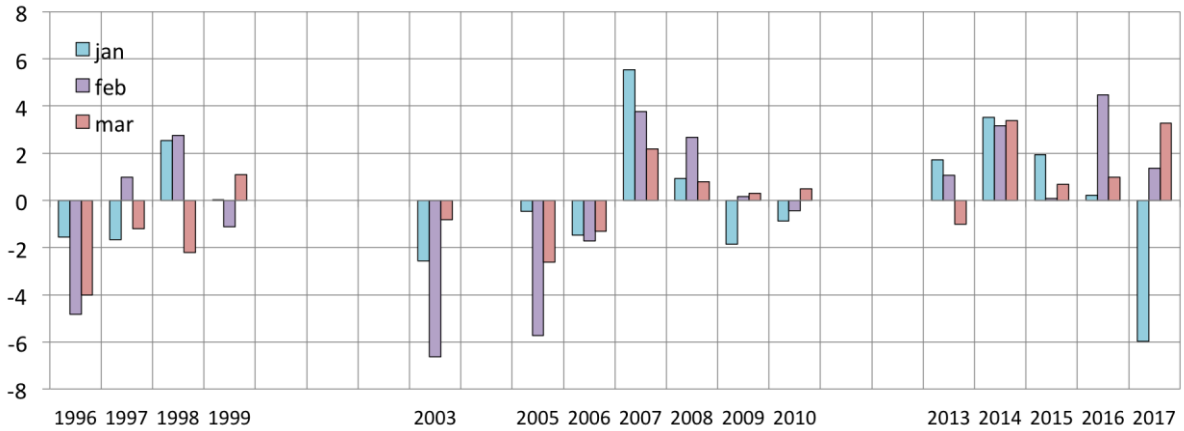


Fig. 1.3.8.3. Anomaly of average monthly air temperatures for January, February and March with respect to the average monthly values for the whole period; the mean values for the entire period 1996-2017 are calculated from data for years when there are also observations of the flowering of maize

Literature:

Djurdjevic, V., Vukovic, A., Vujadinovic, M., 2018: Osmotrene promene klime u Srbiji i projekcije buduće klime na osnovu različitih scenarija budućih emisija, Izveštaj, Program Ujedinjenih nacija za razvoj.

MEP, 2017: The Second National Communication on Climate Change under the United Nations Framework Convention on Climate Change, Ministry of Environmental Protection, Belgrade, 2017.

Vukovic, A. et al., 2018: Global warming impact on climate change in Serbia for the period 1961-2100, Thermal Science, vol. 22, pp. 2267-2280.

Panjković, B., Perić, R., Milenić, B (2019):Eranthis hyemalis (L.) Salisb. – indicator species of climate change. 13th Symposium on the Flora of Southeastern Serbia and Neighboring Regions. Stara planina Mt. 20 to 23 June 2019. Abstracts, 105-106.

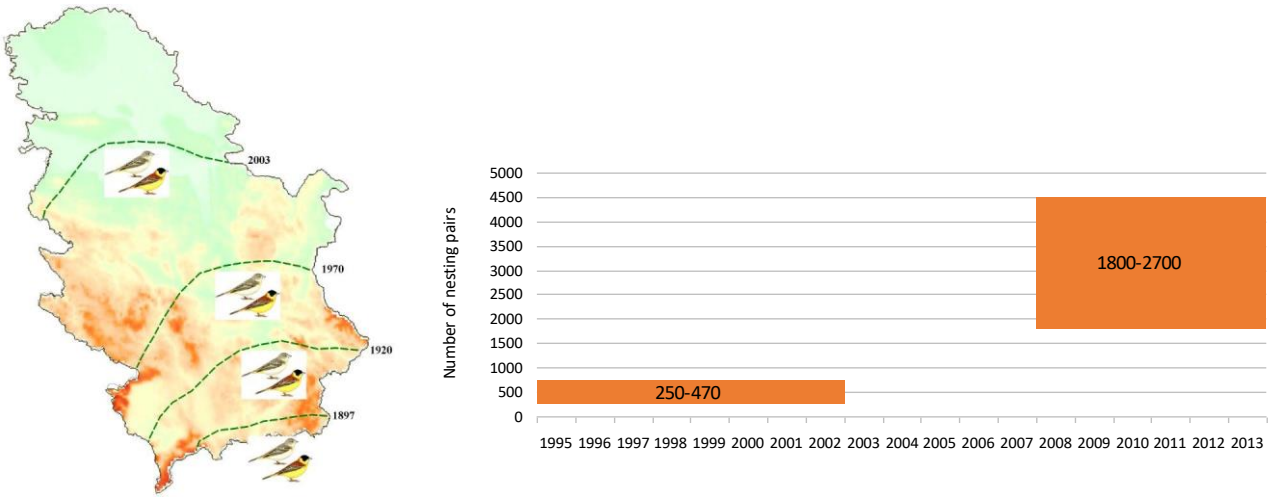
1.3.9. Indicator name: Climate Changes and Black-Headed Bunting areal and population size changes

Author/Institution: dr Ana Vukovic/ Faculty of Agriculture, Univerzity of Belgrade, Nikola Stojnic/ Provincial Institute for Nature Conservation, Novi Sad, Slavisa Popovic/ Environmental Protection Agency

Key messege: Areal and population size of Black-Headed Bunting increase within the Climate Change

Assesment: 

On the territory of Serbia observed the growth in number of Black-headed Bunting and increasing the areal distribution from south to north of Serbia. The first observed habitats in Serbia until the mid-20th century are in the area of southern Serbia (Vranje, Niš, Pirot, etc.), and it is also known that at the end of the XIX century it certainly did not nest north of Vranje. Since the middle of the 20th century in drought and warmer years begins to appear from time to time and to the north. Mostly areas of lower altitudes (up to about 400m) are inhabited, but their occurrences are examined in more rare cases at higher altitudes. During the year 2003, which was warm and dry during the period of settlement of this species, the Blackheaded Buntings were also seen on the slopes of Fruška Gora at an altitude of up to 200m. In addition to 2003, an important year after the settlement of this species on its way to warmer regions was 2000, which is also characterized by exceptionally warm and dry weather. Observed number of breeding pairs in two periods estimated for the territory of Serbia is: 250-470 for the period 1995-2002 and 1800-2700 for the period 2008-2013.

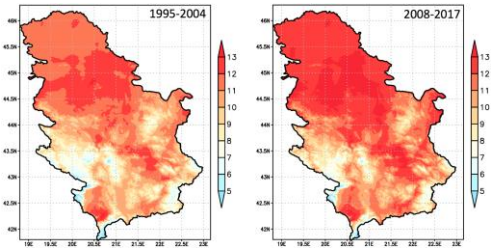


Map and fig1.3.9.1. Areal and population size change of Black-Headed Bunting

Parameters that are being tested for the analysis of favorable climatic conditions of the habitat of the Black-headed Buntingare:

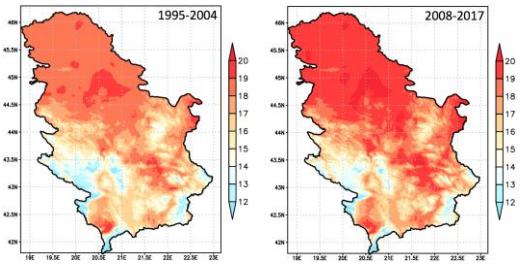
- mean annual temperature
- medium temperature for the period April-September

On maps below the spatial values of mean annual temperatures for 10-year periods are presented, which include the periods for which the data on the number of Black-headed Bunting counts were given: 1995-2004 and 2008-2017. From the results can be seen in the spatial distribution of temperature, which demonstrated a significant increase in temperature between the two periods.



Map. 1.3.9.2. Mean annual temperature in the territory of Serbia for the periods 1995-2004 (left panel) and 2008-2017 (right panel).

Particularly shown is the average temperature for the periods 1995-2004 and 2008-2017 for the Monts of April-September, as a period when the Black-Headed Bunting are been in Serbia (Map below). The increase in temperature for this period of the year between the two observed 10-year periods in some areas is significantly more pronounced than the change in the average annual temperature, as the observed heating, as already mentioned, is the highest during the summer season and is visible in this six-month period. Thus, the warming up of the period of the year when this species is retained in Serbia is more pronounced than the increase in the mean annual temperature, which indicates the likely spread of a favorable area for the settlement of this species.



Map. 1.3.9.3. Mean temperature for the period April-September in the territory of Serbia for the periods 1995-2004 and 2008-2017.

Observed habitats in Europe, Black-headed Bunting show that this type corresponds to warmer and drier weather in the period of their stay. Due to the impact of climate change in the thermal conditions in Serbia have become convenient for a stay of this species. The climate becomes similar to those in which their habitats are considered, south of Serbia - the area of south-eastern Europe, Italy, the Adriatic coast. This confirms that the movement of subtropical characteristics into the southern parts of Serbia and in the future further to the north, also affects migration of species. Due to the occasional reporting of extremely moist episodes in some years in Serbia in May and June, there may still be variations in their number, but the trend of change shows that favorable conditions are created in the territory of Serbia in the areas of southern, central and northern Serbia, such as predicted by Huntley et. al. 2004, but very likely faster than predicted, because temperature changes show faster warming than predicted.

Literature:

- Huntley, B. et. al., 2004: A Climatic Atlas of European Breeding Birds, Lynx Edicions;
- Puzović S. i Grubač B., 2003: Širenje areala rasprostranjenja crnoglave strnadice Emberiza melanocephala u Srbiji: prvo gnežđenje na Fruškoj gori i u Vojvodini, Glasnik društva za zaštitu i proučavanje ptica Vojvodine, vol. 12, Novi Sad, p. 180-183.
- Vukovic, A. et al., 2018: global warming impact on climate change in Serbia for the period 1961-2100, Thermal Science, vol. 22, pp. 2267-2280;)
- Djurdjevic, V., Vukovic, A., Vujadinovic, M., 2018: Osmotrene promene klime u Srbiji i projekcije buduće klime na osnovu različitih scenarija budućih emisija, Izveštaj, Program Ujedinjenih nacija za razvoj

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Lack of system for monitoring impact of climate changes on biodiversity,
- Lack of legal base for establishing of the monitoring system,
- Iinsufficient and irregular financing,
- Unharmonized goals of scientific and nature conservation sectors,
- Lack of trained staf,
- Lack of appropriate methodologies.

1.4 Establishment of an integral national information system for biodiversity with a database (INISB)

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target E19

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

This measure is directly connected to research, data collection and monitoring of biodiversity in RS, done by various subjects such as scientific institutions (institutes, faculties...), institutes for nature conservation, Natural History Museum, managers of protected areas, NGOs, even some private companies. First steps towards establishment of INISB are two biodiversity projects, one finished and one on-going, financed by MEP. Lead institution for this project is Biological Faculty Belgrade with main beneficiaries institutes for nature conservation. Besides that, there is very good database on biodiversity in Serbia – BIORAS – lead by civil sector. Another very important initiative for integration in this topic is led by German Development Agency, GIZ, within BIMR project (Biodiversity Information Management and Reporting) in cooperation with Serbian partners and for wider region.

The Ministry of Environmental Protection1 (MEP) is responsible for administration and policy development tasks in the field of environment including biodiversity and nature conservation. In close cooperation with the MEP there is a public administration authority, the Serbian Environmental Protection Agency (SEPA)**,** responsible for integrating data on environment and preparing reports on the state of environment in Serbia**.** Professional activities related to nature conservation and protected areas in Serbia are performed by the Institute of Nature Conservation of Serbia while for territory of Vojvodina Province these activities are delegated to the Institute of Nature Conservation of Vojvodina Province**.**

The most important operational state institutions in the BIMR framework are SEPA, Institute for Nature Conservation of Serbia and Institute for Nature Conservation of Vojvodina Province. A significant number of teams and individual scientists operate at the University of Belgrade, Novi Sad, Kragujevac and Niš and their cooperation in Centre for Biodiversity Informatics can be a good starting point for centralisation of providing scientifically verified biodiversity data in Serbia. The BioRaS portal, managed by group of non-governmental organizations (NGOs) and technically supported by Petnica Research Center, proved to be a robust platform for integrating civil society initiatives in biodiversity assessments and engaging general public in inventarisation and monitoring of biodiversity in Serbia. Based on the review of their legal responsibilities, recent activities and results, we enlisted stakeholders who are related to biodiversity, nature conservation or use of natural resources.

Institution/ organisations type Number

Governmental institution 6, Public institution 12, Public enterprise 12, Academic institution 18, NGO 24, International organisation 3, Religious institution 1and Company 14.

The most numerous stakeholders are from the NGO and academic community that are also recognized as the most important stakeholders for collecting and structuring biodiversity data. Although most academic institutions are located in Belgrade, there are significant scientific bases in Novi Sad, Kragujevac and Niš. With more than 20 relevant organizations the NGO community seems strong with numerous volunteer base. Unfortunately, this is not a case. Most of the organisations that collect and process biodiversity data are with only a few members initiated by graduates of biology who have no other opportunity for finding a job. Only a few organizations are working on the national level (Bird Protection and Study Society of Serbia, NGO Habiprot and Scientific research student association "Josif Pančić") and recruit a significant number of members that are collecting biodiversity data in the field. Others are local organisations with several volunteers that are frequently working in close cooperation with the local managers of the protected area.

Data used in the Studies of protection, collected by experts from the Institutes for Nature Conservation in Belgrade and Novi Sad;

- Data of monitoring of target species, collected by experts from the Institute for Nature Conservation of Vojvodina and Managers of protected areas;

- Data used for preparation of action plans for protection of large carnivores, collected and processed by experts from the Faculty of Biology in Belgrade, Institute for biological Research in Belgrade and Museum of Natural History in Belgrade;

- Data provided by the projects "Establishment of an ecological network in the Republic of Serbia" and "Development of the Red Book of Plants, Animals and Fungi in the Republic of Serbia", compiled and verified by experts from Faculty of Biology in Belgrade, Department for biology and ecology in Novi Sad and Birds Protection and Study Society from Novi Sad;

- Data of rapid ecological assessment of Serbian natural assets, collected by academic institutions and NGOs and provided to managers of PAs;

- Data collected by experts from Universities in Novi Sad, Belgrade, Kragujevac and Niš and Institute for Biological Research, in the framework of scientific projects supported by the Ministry of Education, Science and Technological Development;

- Data used for Fish stock management programmes, compiled by experts from Biological faculty in Belgrade, Institute for Multidisciplinary Research in Belgrade, Institute of Biology and Ecology in Kragujevac and Department for biology and ecology in Novi Sad;

- Data collected by support of local projects from the Rufford Small Projects Grants Scheme (or similar funders);

- Data collected by support of local/regional/national environmental authorities;
- Data used in EIA/SEA studies;
- Data published on the BioRaS portal;
- Data published into the Alciphron database;
- IPA project Natura 2000 Serbia / The project ceased operations due to administrative Reasons

1.4.1. Indicator: Number of biodiversity indicators in use

Author / Institution: Slavisa Popovic/Environmental Protection Agency

Key message: In the field of biodiversity, over 50 indicators have been developed

Assessment: 

Since the establishment of the Environmental Protection Agency in 2004 and the acceptance of the reporting structure according to the model: Actual factors - Pressure - Condition - Influence - Response, numerous indicators of environmental protection have been developed. In the field of biodiversity and nature protection, more than 50 indicators have been developed, in which the state of different parameters are being monitored in the yearly or perennial period.

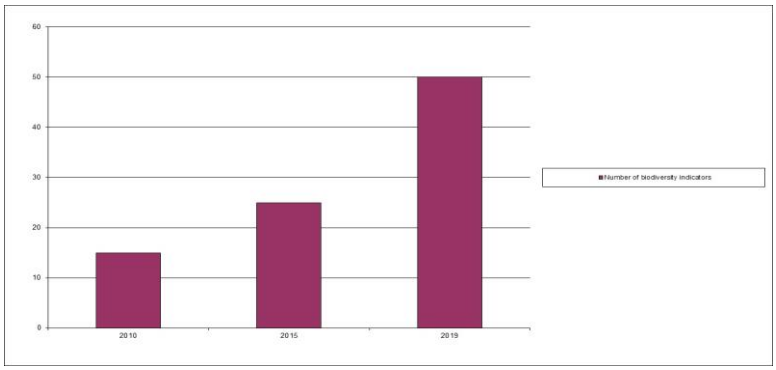


Fig. 1.4.1.1. Number of biodiversity indicators in use

The highest number of indicators monitors the status of species and habitats, as well as the parameters of protecting and conserving biodiversity and nature at different levels.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Legal base for establishing and work of INISB needs to be upgraded,
- Lack of synergy within nature conservation sector and with other data providing sectors,
- Technical demanding for establishing universal biodiversity data base system,
- Lack of regular financial source for systematic data collection.

1.5 Combating illegal killing, trapping and trade of wild species

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 1

Aichi target E18

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been ineffective 

According to some assessments, this measure is implemented in Serbia on very satisfactory level, especially comparing to surrounding, even EU countries. Basement of this activity is good joint work of institutes for nature conservation and environmental inspectors with PA managers, Police, Prosecutors and Customs, and above all with NGOs and citizens. For previous ten years increasing trend of processing of cases of Combating illegal killing, trapping and trade of wild species.

Within its jurisdictions, hunting and fishing inspectors and guards also contribute. This measure, besides direct benefits through successful rehabilitation of individuals, additionally stops or inhibits negative subjects, and if followed by good media cover, works as prevention and affirmatively. Among cases highly covered by media is ceasure of more than 5000 wild bird eggs and processing of perpetrator in 2006.

1.5.1. Indicator name: Number and structure of animals in reception zoo garden

Author / Institution: Slavisa Popovic/Environmental Protection Agency, Pavle Jovanovic/ Ministry for Environmental Protection, Kristijan Ovari/ Zoo garden Palic

Key message: The number of animals in the zoo shelter is increasing; the most endangered species are birds

Assessment: 

Zoo Palic was officially started cooperation with the competent institutions in the field of acceptance 19.10.2004. when the first individuals from the confiscation arrived at the reception, these are the three types of individuals living Green iguana (*Iguana iguana*) and one living individual species of Burmese python (*Python molurus*). To date, more than 3,500 yards have arrived in the reception, and the tendency of the arrival of individuals is increasing every year.

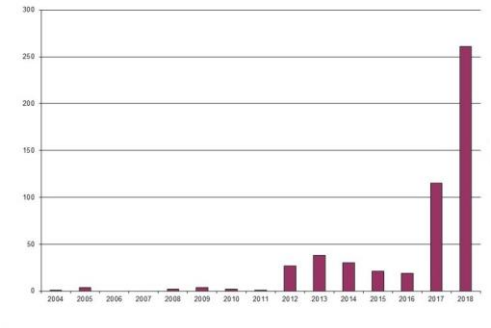


Fig. 1.5.1.1. Number of survived animals in reception zoo garden.

The structure of recepted animals shows that birds and reptils were the most numerous animals in Zoo, folowed with mamals. The largest seizure so far has been 400 parrots, which were stopped by the veterinary inspection without adequate veterinary sanitary documentation, a bizarre was the seizure of 6 animals ape species Barbary Macaque (Macaca sylvanus) that were found in the trunk of a car bound and stacked in crates (http://www.rts.rs/page/stories/sr/story/135/hronika/1818471/majmuni-zaplenjeni-na-horgosu-zbrinuti-u-spaniji.html). But the garden had the opportunity on several occasions to places and dangerous animals like bears (https://www.telegraf.rs/vesti/srbija/2972856-meda-napa-stigao-u-svajcarsku-specijalnom-gondolom-zlostavljan-je-celog-zivota-u-srbobranu-a-sad-je-dobio-luksuzni-tretman-foto)

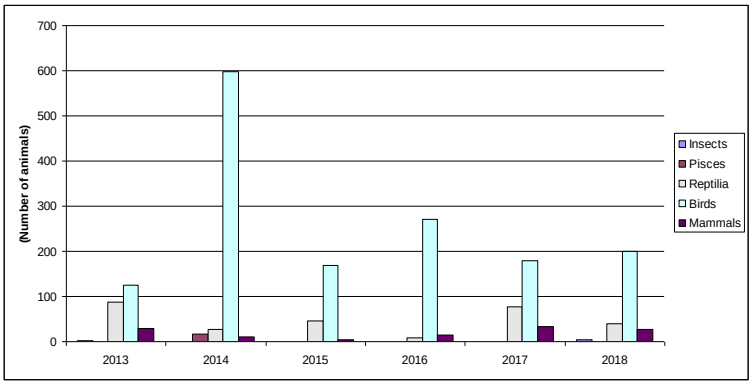


Fig. Taxonomic structure of survived animals in reception zoo garden.

About 50% of the individuals who arrive in the reception are brought by citizens, and about 50% of the number of individuals make the indigenous wild animal species that are under some regime of protection, and they are unable to care for themselves (the injured, the sick, fell out of the nest ...)

In cooperation with the Institute for the Protection of Nature every year about 30% of individuals successfully mark and back to nature, while the mortality rate of individuals of which approximately 30% as the percentage of animals which are due to the poor condition is not bad result. About 30% of individuals are retained each year in acceptance because they have a need for extended rehabilitation or a simple need to resolve legal status, and a court decision is pending.

Individuals who are members of the most exotic species through the seizures are due to the cooperation between customs, police, border police, environmental inspection, veterinary inspection and communal police, all under the supervision of the Ministry, with which a co-financing contract is attached each year, which is also the legal basis for the functioning of the care of animals.

The Zoo uses all its free capacities so that the injured animals are taken care of in separate compartments in the part of the garden that is not visible to visitors, but in cases where there are no other options, other capacities are also engaged, as in the case of the recently arrived iguanas and giant snakes, which the inspector has delivered in cooperation with the police, because the person who was trafficked by narcotics fugitives, or in case of confiscation of the bear from the circus.

http://mondo.rs/a689997/Info/Drustvo/Tri-meceta-odlaze-iz-Srbije-u-Rumuniju.html

Reception Center in Palic each year in cooperation with the Natural History Museum in Belgrade marks the day of the CITES Convention which presents the work of these institutions in the protection programiam. In the last two years, significant cooperation with the Provincial Institute for Nature Conservation has been achieved and over 40 windmills have been released in the framework of these programs (https://vojvodinainfo.rs/palic-vetruske-iz-zoo-vrta-vracene-u-prirodu/), as well as during the week of promotion of CITES, which was seen by over 200 children (http://zoopalic.com/obelezen-dan-divljih-vrsta-cites-konvencija/).

1.5.2. Indicator name: Wild bird poaching and poisoning

Author / Institution: Milan Ruzic/ Association for the protection and study of birds

Key message: Over the 200 wild bird species is endangered from poaching and poisoning

Assessment: 

Large birds of prey such as eagles, but also many other species are very threatened due to poisoning. Huge pressure onto bird from hunting, pigeon breeding and farming communities, more field work, more volunteers and members, large media campaigns, and better visibility of the issue. Critically endangered species such as Eastern Imperial Eagle are especially vulnerable. Almost 200 wild bird species are threatened due to poaching. Critically endangered species such as Eastern Imperial Eagle are especially vulnerable. Huge pressure onto bird from illegal and legal hunting, pigeon breeders, more field work, more volunteers and members, large media campaigns, and better visibility of the issue.

Intentional or accidental wild bird poisoning cases were also investigated. Pigeon fanciers whose main target are raptors generally commit intentional poisoning. Besides them, livestock breeders and game wardens often set poisoned baits for mammalian predators, which usually leads to raptor and crow poisoning. Accidental poisoning is generally the result of the inappropriate use of pesticides, which affects a wide variety of wild bird species. A total of 169 cases which involved 34 bird species were recorded, and of the 733 individuals that were poisoned, only 33 of these were rehabilitated. The vast majority of cases were registered in the northern intensive agricultural landscape, where poisoning cases are more likely to be found, and where most of BPSSS members and volunteers are active.

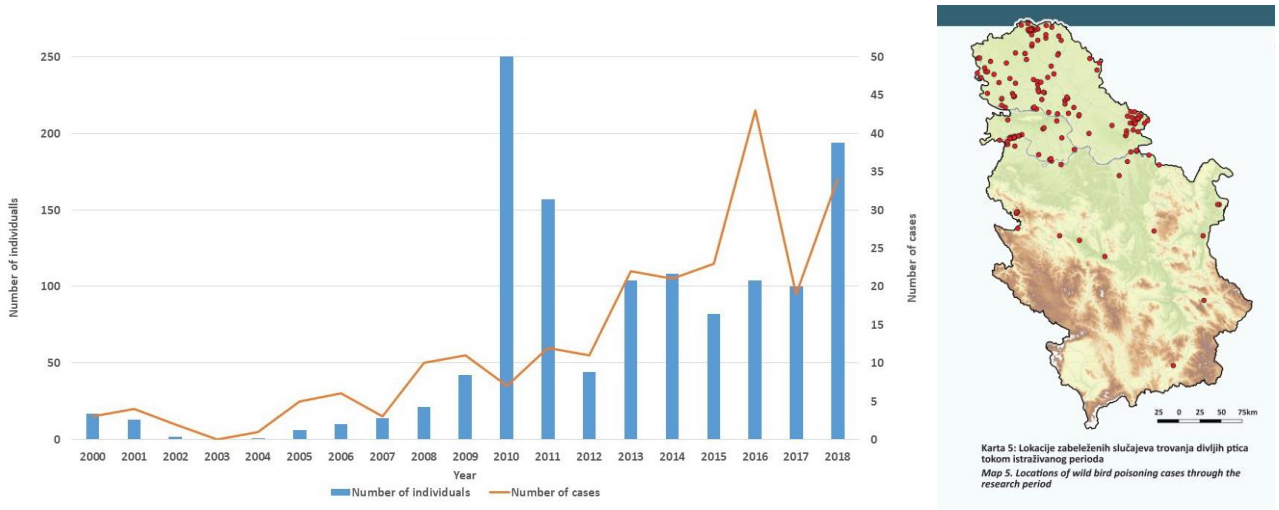


Fig. and Map.1.5.2.1. Trend of wild bird poisoning cases and number of individual birds affected by poisoning (left) and map of localities (right)

Illegal wild bird shooting includes the killing and wounding of protected and strictly protected species, and cases of gamebird poaching. Within poaching cases of hunting with illegal methods and means, the use of live decoys, electronic calling devices and semiautomatic shotguns were also included. As many as 840 cases of illegal shooting were registered, which involved a total of 89 bird species. A total of 4,088 birds were affected by this illegal activity. The majority of cases were linked to Common Quail poaching incidents, whereby the use of electronic calling devices is a widespread phenomenon. Besides Common Quail, other common issues include the poaching of waterfowl and the shooting of birds of prey. These can be lucrative crimes, and the chance of making money is one of the main drivers. The other is sport shooting. Additionally, a truck containing a shocking number of dead birds (120,702) was confiscated in 2001 during the “Balkan birds” case; all of these birds had been killed in Serbia.

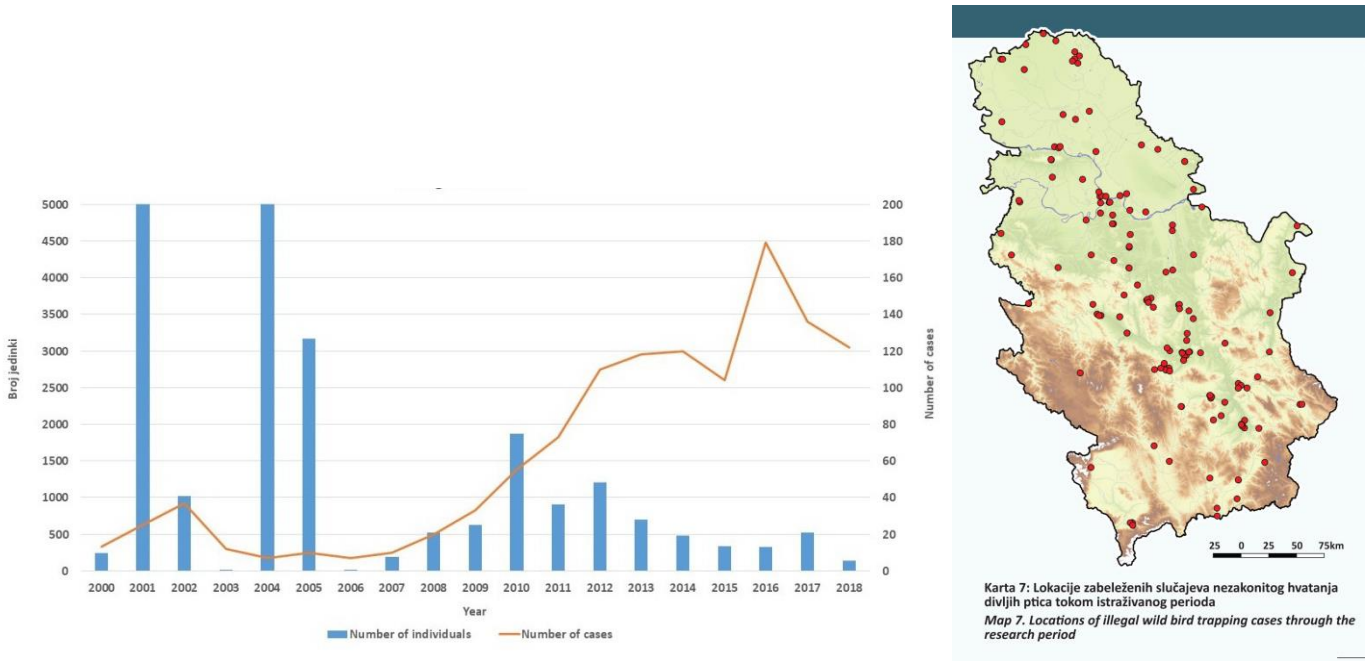


Fig. and Map. 1.5.2.2. Trend of wild bird poaching cases and number of individual birds affected by poisoning (left) and map of localities

http://pticesrbije.rs/wp-content/uploads/2017/10/Serbia-bird-crime-report.pdf?fbclid=IwAR1IQfmmmJksGVhcim9SL15vZ2IYDt1kceOCDcZZY0wuMNgEHVQrWeGDyVY

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Inefficient and slow court procedures,
- Not satisfied level of punishments,
- Lack of skills for field controls,
- Low motivation and empowered of staff,
- Problems with poisoning cases.

Protection biodiversity indicators system

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
1.1. Stopping the trend of vulnerability and loss of biodiversity	1.1.1. Main pollutants concentration and deposition trend	N			
	1.1.2. Biomonitoring of air-pollution	N		C12	
	1.1.3. Air quality in the selected protected areas	L			
	1.1.4. Aquatic macrophytes water pollution biomonitoring (AQMWB)	N			
	1.1.5. Red algae population trend	L			1.1.5.1. Case study: Invasive cyanobacteria *Cylindrospermopsis raciborskii* in the waters of Serbia 
					1.1.5.2. Case study: Contaminated sites in the Republic of Serbia – potential risk to ecosystems and natural resources 
					1.1.5.3. Case study: Specific activity of ^{137}Cs in soil in southern Serbia 
	1.1.6. Invasive insect species	N			
	1.1.7. Monitoring and gradation of gipsy moth (*Limantria dispar*) in the forests of Serbia	N			
	1.1.8. Trend of concentration of allergenic pollen of	N			

	ambrosia (*Ambrosia artemisifolia*) in Serbia				
	1.1.9. The trend of the areas where the ambrosia has been threatened				
	1.1.10. Trend of mosquito populations infected with WNV in Serbia 1.1.11. Trend of the mosquito population infected with Western Nile virus in Belgrade	N L	 		
	1.1.12. Trend of population of infected ticks causing Lyme disease	N			
	1.1.13. Trend of Morbus Lyme patients in Serbia	N			
	1.1.14. Diversity of species-butterfly population trend	N			
	1.1.15. Species diversity-birds population trend	N			1.1.15.1. Case study: The eastern imperial eagle (Aquila heliaca) – critically endangered species 
	1.1.16. Trend of Griffon vulture population restored	N			
	1.1.17. Trend in the number of carnivorous mammal population	N			1.1.17.1. Case study: Steppe Falcon (Falco cherrug) 
1.2. Preservation of biological diversity at the genetic, species and ecosystem level	1.2.1. Population trends of autochthonous domestic species	N		C13	1.2.1.1. Case study: Seed Facilities in forestry as a basis for conservation and guided use of gene fond in Serbia 

					1.2.1.2. Case study: Trend in conservation of Plant Genetic Resources for Food and Agriculture (PGRFA) - the number of accessions that are kept in the National Collection, Plant Gene Bank 
1.3. Monitoring the impact of climate change on biodiversity and the impact of biodiversity on mitigating the effects of climate change	1.3.1. Dead wood in forests and climate changes	N		D15	
	1.3.2. Forest damages	N			
	1.3.3. Forest health conditions	N			
	1.3.4. Forest fires	N			
	1.3.5. Number of fungal species in selected forest habitats	L			
	1.3.6. Air pollution and forest defoliation in selected protected areas	L			
	1.3.7. Flowering of *Prunus laurocerasus* related to Climate Changes	L			
	1.3.8. Climate Changes and flowering phenology of winter aconite				
	1.3.9. Climate Changes and Black-Headed Bunting areal and population size changes				
1.4. Establishment of an integral	1.4.1.Number of biodiversity indicators in use	N		E19	

national information system for biodiversity with a database (INISB)					
1.5 Combating illegal killing, trapping and trade of wild species	1.5.1. Number and structure of animals in reception zoo garden	N		E18	
	1.5.2. Wild bird poaching and poisoning	N			

National Target 2

Improvement of the system of protected areas and ecological networks

Rate of progresses toward the implementation of the selected target

- On track to achieve target 

Priority Area	Priority actions	Aichi target	Progress Assessment	National Progress Assessment
Priority Area 2. Improvement of the system of protected areas and ecological networks	Priority action 2.1.	**C11**		
	Priority action 2.2.	**B5, D14**		
	Priority action 2.3.	**C11**		

Recognized problems in the previous system of protected area management relate, in addition to the unfavorable financial situation, to the insufficient capacity of the managers. For the efficient functioning of protected areas, it is necessary to improve the financial system, to introduce continuous monitoring and reporting, to establish functional networks of protected area managers.

Biodiversity in Serbia is protected by implementing measures for protection and improvement of species, their populations, natural habitats and ecosystems(The Law on Environmental protection, “The Official Gazette of the Republic of Serbia“, No. 36/2009, 88/2010 and 91/2010-correction). This includes the system of protected natural goods: protected areas, protected species and protected natural documents. Protected areas of general interest are areas with specific geological, biological, ecosystem and/or landscape diversity and are important as habitats of birds and other migratory species in compliance with international regulations. The categories of protected areas are: a strict nature reserve, special nature reserve, national park, natural monument, protected habitat, landscape of exceptional characteristics and nature park. The ecological network as a functional and spatially connected whole is established in order to preserve habitat types of special importance for the protection, rehabilitation and / or improvement of disturbed habitats and for the conservation of wildlife habitats. The basis for the establishment of an ecological network in Serbia is given in the Law on Nature Protection ("Official Gazette of the Republic of Serbia" No. 36/2009, 88/2010, 91/2010, and 14/2016) and the Regulation on the ecological network ("Official Gazette of the Republic of Serbia "No. 102/2010).In order to establish an efficient ecological network in Serbia, it is necessary to improve the legal regulations, to define precise criteria for establishing and defining the target species and types of ecological network habitat.

When it comes to protecting the landscape diversity, it is provided with defined principles of protection, such as the issuance of the Nature Protection Requirements. In accordance with the Nature Protection Law, identification of the landscapes includes the definition of precursor types as the basis for the protection, management and planning of the area, while the application of the European Convention on the landscapes also involves the assessment of the area. The typology of the landscapes in Serbia has not been incorporated in the legislation yet, and the by-laws related to the protection of the area are also missing. The geodiversity of Serbia, as the basic component of nature and the environment, is exposed to various anthropogenic pressures that lead to its permanent degradation. Given that the set of elements of geodiversity forms an integral part of natural habitats, ecosystems and landscapes, their damage or permanent destruction is a factor that indirectly contributes to the loss of biodiversity and landscape diversity. Destruction of objects of geodiversity can be prevented primarily by meaningful planning through sustainable development, and by constantly emphasizing the significance of geodiversity. In addition, certain concrete measures of protection of certain facilities are also necessary.

Priority Actions toward National Target 1

2.1 Increasing the area of protected areas and management effectiveness

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 2

Aichi target C11

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been effective 

The total protected surface is changed and Institute for Nature Protection of the Republic of Serbia, as well as Institut for Nature Protection of the Vojvodina Provence are responsible to manage data base related to protected areas and keep records on total protected surface and number of protected areas. According to the Spatial plan of the Republic of Serbia an increase of up to 12% of the total territory has been envisaged until 2021.

Acts on proclamation of a protected area and a management plan for the protected serve to support system of protection, management, usage and improvement of protected areas, in the period of ten years. The management plan represents document which determine implementation of protection, usage and management of the protected area, directions and priorities for conservation of natural values of the protected area, as well as guidelines for further development, including the needs of the local population.

The manager of the protected area is determined by the Law on Environmental Protection and can be a legal entity, an entrepreneur and/or a natural person that fulfils certain professional, human and organizational conditions. In case of need for management of one or more protected areas, a public enterprise, public institution or a company can be established. The Ministry, or the authority which is competent for the environmental protection operations in the autonomous province, i.e. the authority which is competent for the environmental protection operations of a local self-government unit, determine obligation that manager of protected area have to fulfill, in the process of the preparation of the proposal of the proclamation act.

Financing of protected areas is provided from: the budget funds of the Republic of Serbia, autonomous province, i.e. unit of local self-government; a fee for the utilization of the protected area, income from the activities and management of the protected areas; the funds obtained for the realization of programmes, plans and projects in the area of nature conservation; donations, gifts and aid; other sources according to the law (pursuant to the Law on Environmental Protection and pursuant to the Law on termination of the Environmental Protection Fund – "The Official Gazette of the Republic of Serbia", No. 93/2012).

In previous period, increasing the area of protected area is done through setting laws, bylaws and decisions for establishing of new and enlarging of existing PAs.

Table. 2.1.1. Legal structure of protected are establishment in RS

Legal base	Type of protected area	Institution
Law in National parks	National park	National Assembly of RS
Bylaws	Special nature reserve, Protected landscape, Nature park...	Government of RS
Provincial Assembly Decisions	Protected landscape, Nature park...	Assembly of Autonomous Province of Vojvodina
Decision	Protected landscape, Nature park, Protected habitat...	Local government

2.1.1. Indicator Name: Trend of Protected areas changes

Author / Institution: Slaviša Popovic/Environmental Protection Agency

Key message: Protected area increase in Serbia

Assessment: 

For measuring progress in line with biodiversity protection issues. The establishment of protected areas is a direct response of the society to the threat to nature, and aims to conserve biodiversity (species, habitats and ecosystems), according to national criteria and objectives. The indicator shows total number, structure and surface of protected areas in hectares (ha) and percentage (%) of the surface of protected areas compared to total surface of the Republic of Serbia. Categories of protected areas with number and surface are presented in table below.
The total protected surface is 669310 hectares, which represents 7.57 % of the total area of Serbia. The current statistics for the territories with a defined protection regime is presented in graph below. Total of 459 protected areas and well are under protection. During 2018 protected area increase for 6.416 ha or about 1 %.

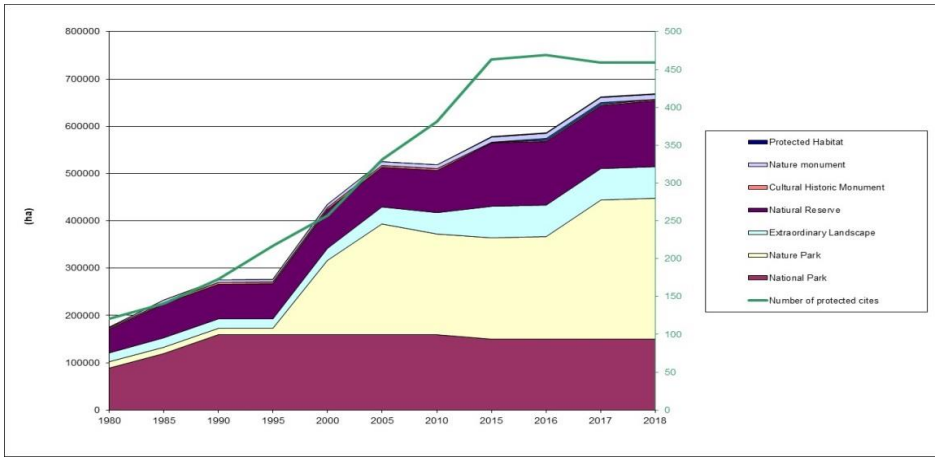


Fig. 2.1.1.1. Protected areas changes per categories and number of sites

Total surface of protected areas that belong to the one of IUCN categories (I-VI) is 410.798 ha. In 2018 compared to 2010, percentage of areas under category IV decreased from 37% to 25%. Other categories more or less increased, or has retained the same proportion.

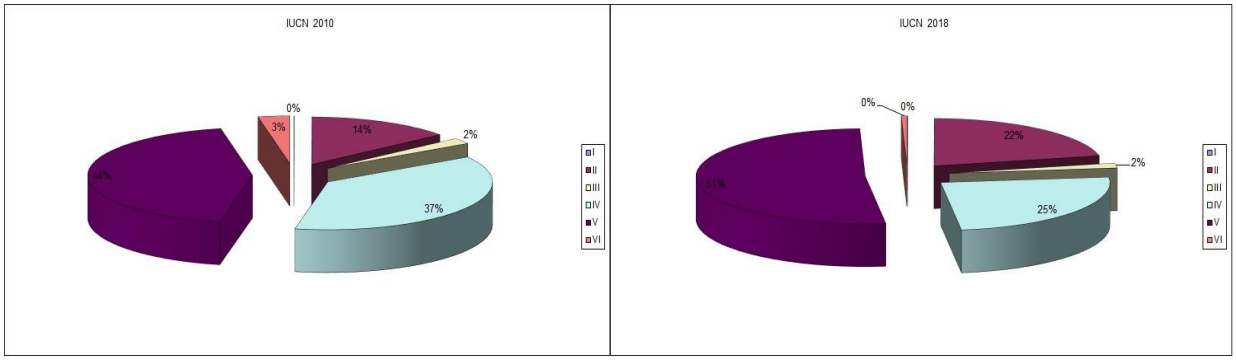
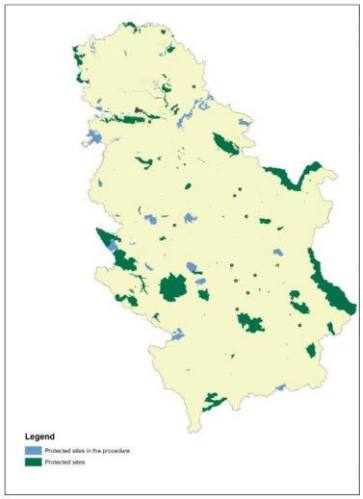


Fig. 2.1.1.2. Trend in change of areas belonging to different IUCN categories

Institute for nature conservation of Serbia and Provincial institute for nature protection prepared studies of protection and revision for 89 more protected areas, total surface 110.030 ha. So we can concider total protected area represents 8,82% of total terrytory of the Republic of Serbia. According to national legislation, areas with finalized studies of protection, even they are not designated, are considered as protected areas.



Map. 2.1.1.3. Map of oficialy protected sites and sites prepared for protetion

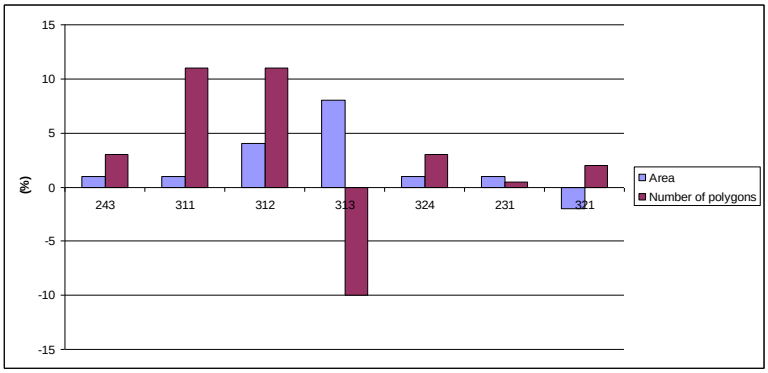
2.1.2. Indicator name: CLC habitat changes in Protected Area in Serbia

Author/Institution: Slavisa Popovic, Nemanja Jevtic/ Environmental Protection Agency

Key messege: Afforestation process inside protected areas increase

Assesment: 

Habitat changes inside protected areas show increase of forests (classes 311, 312 and 313) and semi-forested areas (243 and 324). All type of forests has increase, especially coniferous and mixed forests. At the same time increase of polygons number is registered, except for mixed forests. Although forested areas increase inside the protected areas at the same time fragmentation of forests increase, except for mixed forest. The pastures and natural grasslands (classes 231 and 321) have different changes. Increase of pastures area altogether with decrease of fragmentation is registered. Also decrease of natural grasslands altogether with increase of fragmentation is registered.



CORINE Land Cover classes:
243 Land principally occupied by agriculture, with significant areas of natural vegetation
311 Broad-leaved forest
312 Coniferous forest
313 Mixed forest
324 Transitional woodland-shrub
231 Pastures
321 Natural grasslands

Fig. 2.1.2.1. The trend of natural areas and number of polygons changes according to CORINE Land Cover.

The main increase (80 %) is registered in the class 142, sport and leisure facilities. Class of fruit trees and berry plantations also has significant increase (36 %). Other agricultural landscape does not show significant changes, except the decrease of complex cultivation patterns (13 %) altogether with decrease of fragmentation. Significant result is registered inside the class of bare rocks (class 332) with 23 % decrease altogether with 20 % decrease of fragmentation, and inside class of sparsely vegetated area (class 333) with 23 % of area and 20 % of polygons increase.

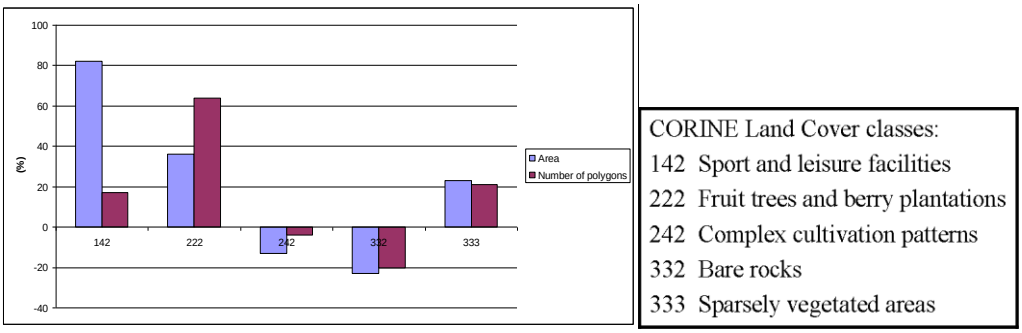


Fig. 2.1.2.2. The trend of agricultural, sport and bare areas and number of polygons changes according to CORINE Land Cover.

As a conclusion it could be said that increase of forested areas and decrease of non-forested areas is registered inside protected areas in the period 2012-2018.

2.1.2.1. Case study: Ecosystem status of Pannonia open sand in Serbia

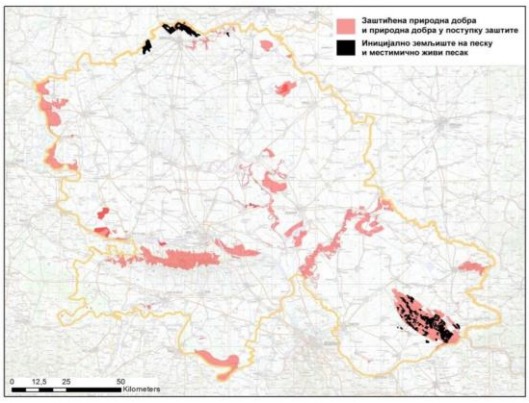
Author/Institution: Nikola Stojnic/ Provincial Institute for Nature Conservation, Novi Sad

Assessment: 

Starting from the EU regionalization for the purpose of establishing Natura 2000,AP Vojvodina belongs to the Pannonian biogeographical region, within which the Pannonian inland dunes have been separated as a priority type of habitat for protection (code *6120 - Xeric and calcareous grasslands and *2340 - Pannonic inland dunes) which indicates their vulnerability in international proportions. The adjective "priority" refers to natural habitat types at risk of extinction present on the territory for which the EU has a special responsibility for the proportions of their natural distribution within the boundaries of the member states (Council Directive 92/43/EEC, Annex I).

The current state and representation of habitat types in Vojvodina province is a consequence of a development strategy aimed at increasing the intensity of agricultural production, regardless of local ecological conditions. Natural vegetation is preserved in the form of more or less fragmented remains on soil types that are in terms of their convenience for cultivation poorer in quality (sand, salt marshes)

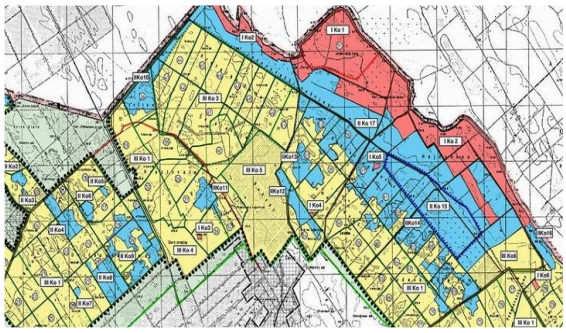
Pannonian inland dunes appear as a habitat type in Vojvodina on initial land,on the sand and sporadically on the live sand as a pedological surface.This type of land occupies 14,141.64 ha of land in the APV. By overlapping the pedological map of Vojvodina and maps of protected areas it was found that 89.1% of this type of surface is located within the protected areas: Special nature reservation „Deliblatska peščara“,area off exceptional qualities „ Subotička peščara“ and special nature reservation „Selevenjske pustare“.This indicates that the inland dune habitats are almost completely covered by spatial protection.



Map: 2.1.2.1.1. Map of area on which inland dune vegetation can be expected in Vojvodina (Author: D. Čalakić – based on Živanović, 1972)

Subotica inland dune is the same as Deliblatska inland dune and Selevenjska moor they are listed on the list of internationaly significant plant habitats – IPA area. They are also listed for ecologically important areas called Subotica lakes and moors, and Deliblatska inland dune within the national ecological network („Official Gazette of RS“, 102/2010).

Pannonian inland dunes as a type of habitat on which inland dune vegetation was developed are well kept on significantly smaler surfaces than the total area of protected natural resources. For the sake of planning and implemetation of protection of natural resources of grate importance are spatial distribution, surfaces and structure of habitat types, and especially type of habitat for protection that has priority. On the Deliblatska and Subotica inland dunes dominate monocultures of allochten woody species of acacia and black pine,while the remains of autochthonous inland dune and steppe habitats are preserved on forest clearings, meadow and pasture areas. Inland dune habitats are preserved on forest clearings, and on the meadow and pasture surfaces the steppe vegetation of sandy soil is preserved. Individual micro-habitats under inland dune vegetation often do not exceed the size of 0.01 ha. This is noticed in protected areas where natural habitats are under the I and II degree of protection and are mosaically distributed in the area (Szabados i Panjković, 2009).



Map. 2.1.2.1.2. Inland dune habitats protected by the II degree protection, have survived as isolated islands within forest monocultures (Protection regime III degree) (Author: D. Čalakić)

Authors:

1. Butorac, B.& Panjković, B. (2013): Peđčarska vegetacija u Vojvodini. Str.102-103.Pokrajinski zavod za zaštitu prirode,Novi Sad. 159.

2. Sabadoš K. (2009): Zaštita i monitoring populacije peščarskog karanfila (*Dianthus serotinus*). Str. 44-47. *In* Panjković, B., ur. : Monitoring osetljivih ekosistema ugroženih biljnih i životinjskih vrsta na području Autonomne Pokrajine Vojvodine. Izveštaj za 2008. Tema 4: Monitoring populacija retkih i ugroženih biljnih vrsta na području Vojvodine: banatski božur (*Paeonia officinallis* subsp. *banatica),* kukurjak *(Eranthis hyemalis),* testerica *(Stratiotes aloides*), peščarski karanfil *(Dianthus serotinus), Monotropa hypopitiys* L. 1753 subs*p. hypopitys, Ononis pusilla* L. 1759*, Peucedanum carvifolia* (L.) Vill. 1779*, Globularia punctata* Lapeyr. 1813. i *Ophrys scolopax* Cav. 1793 subsp. *cornuta* (Steven) Camus 1908. Zavod za zaštitu prirode Srbije: 34-64, Novi Sad.

2.1.2.2. Case study: Change of open-sand habitats in Deliblatski pesak region since XIX century

Author/Institution Nikola Stojnic/ Institute for nature Conservation of Vojvodina Province

Assessment: 

Deliblato sands is the biggest continental sand area in Europe. Regarding the history of human activities in the Deliblato Sands area, forestry was one of the basic activities. Primarily it was cultivation of alochtonous species of trees of Black locust (*Robinia pseudoaccacia*), Scots pine (*Pinus silvestris*) and Black Pine (*Pinus nigra*) on natural grassland and sandy habitats since XIX century. These species, mainly Black locust, besides plantating, later on spreaded spontaneously. Therefore, large proportion of Deliblato Sands, former area of valuable grassland and sandy habitats turned into plantation. Most visible area of this process is shown on the map in this case study. According to recognizable places (e.g. Grebenac village), toponyms and through comparison of maps, it is calculated that area of 1648 ha is from open sand habitats changed to mosaic of grasslands, bush and forest habitats between 1819-1869 and 1869-1887, and since then until today, they are almost completely changed to forest plantation dominated by Black Locust (*Robinia pseudoaccacia*).
Possible reasons for upward or downward trends are afforestation, invasive species, grazing abandonment. Specific measures of opening sandy habitats are needed, whixch are mainly prescribed but not implemented in the field.

According to recognizable places (e.g. Grebenac village), toponyms and through comparison of maps, in GoogleEarth is calculated that area of 1648 ha is from open sand habitats changed to mosaic of grasslands, bush and forest habitats between 1819-1869 and 1869-1887, and until today, they are almost completely changed to forest plantation dominated by Black Locust (*Robinia pseudoaccacia*).

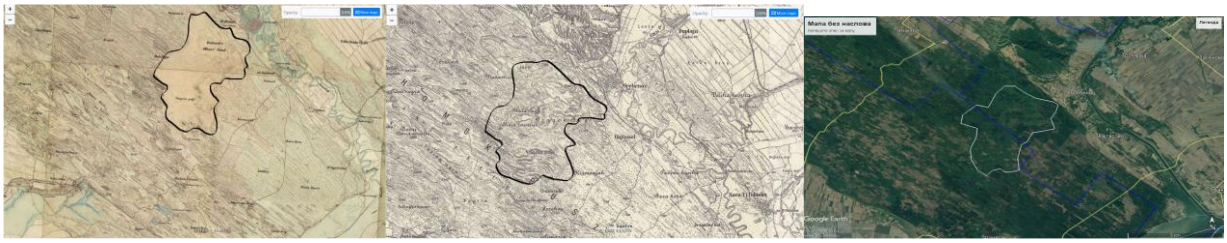


Fig. 2.1.2.2.1. Deliblato sand in 1819-1869 (left) with open sand area shown (black line), in 1869-1887 (center) with former open sand area changed into mosaic habitat shown (black line) and in 2018 with former open sand area changed into forested plantations, shown (white line).

2.1.3. Indicator Name: Monitoring and improving the status of protected areas

Author/Institution: Dejan Miletic/ Public Enterprise Srbijasume

Key messege: In the last 5 years there has been an increase in the number of activities of Public enterprise Srbijasume in monitoring and improving the state of the protected area

Assesment: 

All activities on monitoring and improving the status of protected areas are planned by the Plans and Programs of Protected Area Management. The realization of the planned activities on monitoring and improvement of the state of protected areas depends directly on the provided financial resources from the budget through the Ministry of Environmental Protection, in other words means of compensation for the use of the ZP or own funds of the manager.

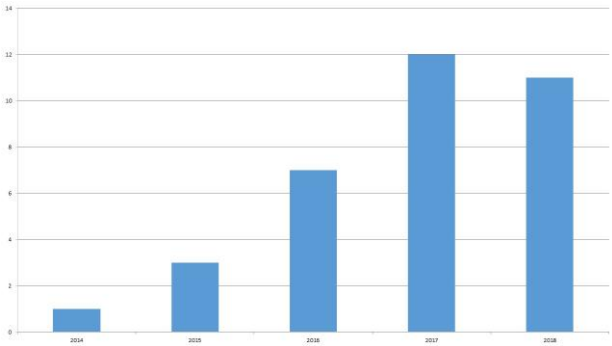


Fig. 2.1.3.1.Number of projects and biodiversity monitorings in protected areas

Over the past 5 years clearly visible is the trend of increasing the number of activities of Public enterprise Srbijašume on monitoring and improving the state of protected areas through the realization of various projects, monitoring and research of biodiversity in the protected areas in which the manager is.

Activities are carried out by various relevant scientific, educational and research institutions, as well as various associations (Institute of Nature Protection of Serbia, Faculty of Forestry, Faculty of Biology, Association for Protection and Study of Birds, Habiprot, Royal Society of Nature, etc.). Activities were carried out to monitor the status of night butterflies, entomofauna, birds, amphibians and reptiles, bears, lampenflora, inventories and mapping of habitat types, conservation and targeted use of genofunds of rare and endangered species of forest trees and bushes, the most significant endemic and relict flora representatives, medicinal herbs , drying of forests, etc.

2.1.4. Indicator Name: Change in the amount of funds allocated from the Budget to Protected Areas

Author/Institution: Dejan Miletic/ Public Enterprise Srbijasume

Key messege: From 2011-2019. There is a trend of increasing the determined budget funds of Serbia

Assesment: 

Every year the Government of the Republic of Serbia issues a Decree on the allocation and use of funds for subventions of protected natural assets of national interest.

The Regulation stipulates the schedule, conditions and manner of using funds for subventions of protected natural assets of national interest, which are determined by the Law on the Budget of the Republic of Serbia. Subventions relate to the financing of works and other costs, including salaries of employees of the manager on jobs defined by the Nature Protection Act and this Regulation, as well as the value of their own resources and assets used.

The right to use subventions have managers of national parks and protected areas of national interest declared by the act of the Government of the Republic of Serbia. Subventions are granted to managers on the basis of a program of management of a protected area where the Ministry of Environmental Protection has given consent in accordance with the law.

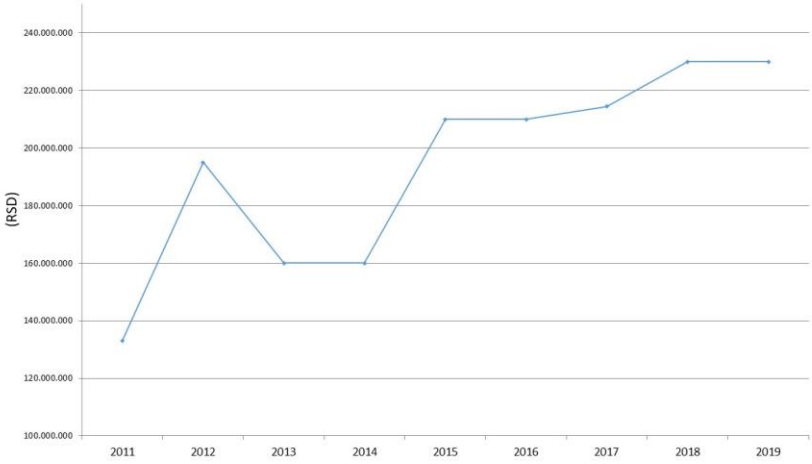


Fig. 2.1.4.1. Pregled Review of funds under the Regulation on co-financing of protected areas of national interest

The allocation of subventions shall be made on the request for allocation of subventions for protected natural assets of national interest, submitted by managers, not later than within 20 days from the date of going into effect of this Regulation, and based on the notification from the Ministry of Environmental Protection. Since 2011, when 133,000,000 RSD has been defined from the RS Budget to this day, when a total of 230,000,000 dinars has been set for 2019, it is clear that the increase in the total amount of funds defined in the RS Budget is evident. The functions that the state supports up to 80 percent of the values are the preservation, maintenance and presentation of protected areas, visitor management, monitoring and improvement of protected areas, as well as spatial planning and sustainable use of natural resources

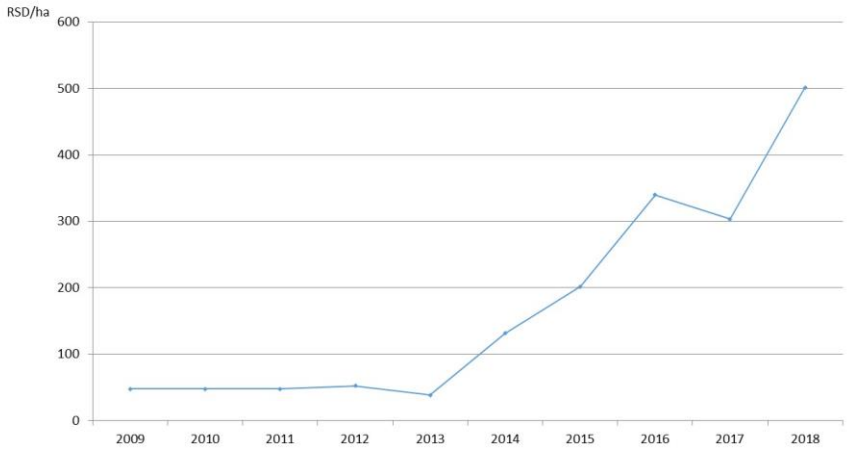
2.1.5. Indicator Name: Change in the amount of funds allocated from the compensation for Protected Areas

Author/Institution: Dejan Miletić/ Public Enterprise Srbijasume

Key messege: In 2018 there is an increase in revenues in the name of compensation for the use of protected areas in comparison with the previous period

Assesment: 

Funds from fees for the use of the protection area are used by the management for the protection, development and implementation of the protection plan, and they relate to the implementation of the management plan and program, so that it is based on nature protection. The taxpayer is a user of a protected area, that is, an individual, an entrepreneur, a business company and another legal entity that carries out business or is in possession of immovable property and other things in the protected area, visits the protected area for rest, sport, recreation and similar needs, and otherwise uses protected area and its benefits. The management determines the amount of compensation, the tax base and determines the amount of compensation for the use of the protected area, depending on the type of use of the area and its benefits



Fig, 2.1.5.1. Trend in the amount of collected funds for the use of protected areas

Depending on the activity of the management and the ability to identify users of the protected area as well as to collect the payment, the amount of compensation funds can be increased or decreased. Specifically, JP "Srbijašume", which represents the largest manager of protected areas in Serbia, clearly shows the trend of increasing revenues in the name of fees for the use of protected areas in relation to the total surface of protected areas of national interest where the management is.

2.1.6. Indicator name: Sources of financing of national parks in Serbia

Author/Institution: Goran Sekulic, WWF Adria, Slavisa Popovic/ Environmental Protection Agency

Key messege: Financial support from the budget is about 10% of the total budget of national parks

Assesment: 

The indicator shows from which sources are national parks of Serbia are financed. It shows the proportion of annual budgets coming form different sources of income. Sources of income are divided in 8 categories:

1. Incomes from forestry activities,
2. Incomes from hunting tourism,
3. Incomes from taxes on the use of a protected area,
4. Incomes from the state budget (Ministry of Environment)
5. Incomes from the state budget (Ministry of Agriculture, Forestry and Water Management),
6. Incomes from projects (international or national),
7. Other incomes.

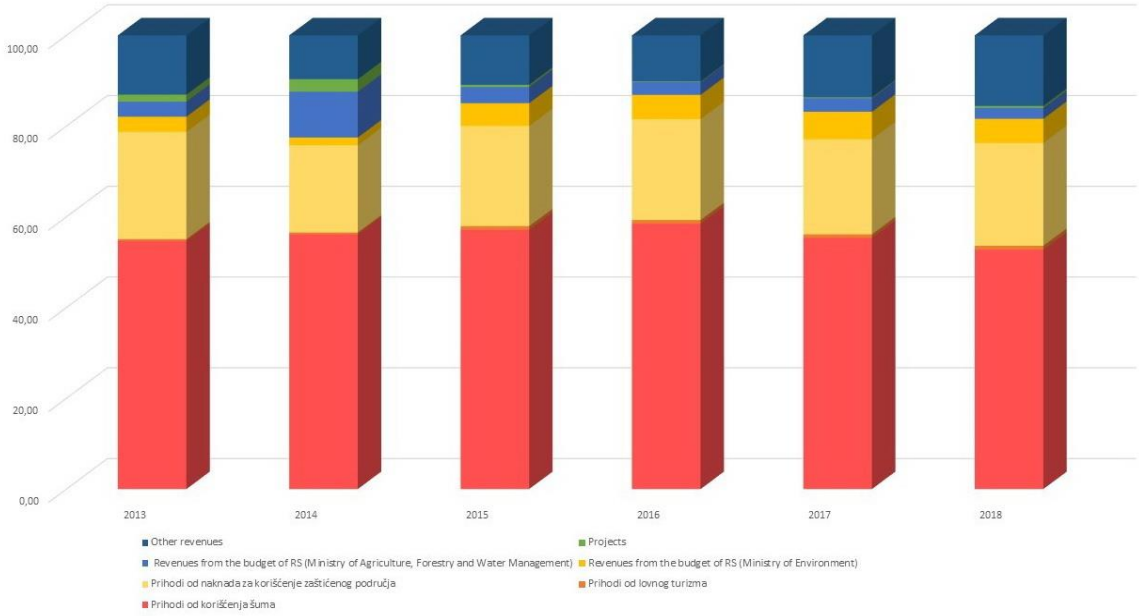


Fig. 2.1.6.1. Sources of income for National Parks

Budget structure provides an information on the general management of a national park and state commitments (support) to management of national parks. Currently, support from the state budget is low (in average less then 10% of the total budget. The biggest proportion of budget is coming from the direct use of natural resources (primarily wood) and in average it makes over 50% of the total budget of a national park. Such management practice, where the financing is based on forestry activities, is not in line with the modern concept of protected areas and not sustainable.

This indicator can be used to track developments in management practice of national parks. Supposedly, improved and sustainable practice will lead to less incomes from forestry and more incomes other sustainable sources. As well, increasing of incomes coming from the use of natural resources can indicate that the state of natural values/biodiversity is worsen (i.e. intensive or overexploitation of forests cause decline of certain species/habitats).

2.1.7. Indicator Name: Change in the amount of funds invested in the protected areas in Vojvodina

Author/Institution: Lorand Vigh, Olivia Tešić, Tamara Stojanović/ Provincial Secretariat for Urban Planning and Environmental Protection

Key messege: The amount of invested funds in protected areas is in decline

Assesment: 

Provincial Secretariat for Urban Planning and Environmental Protection financially supported the protected area managers in Autonomous Province of Vojvodina during period of 2002-2018. The annual amount of financial support were depend on the adopted financial plan by the Provincial Assembly prepared by the Provincial Secretariat for urban planning and Environmental Protection for each year according to the overall budget for the Autonomous Province of Vojvodina. The funds were awarded within the framework of a call for proposals hat was announced each year for protected area managers and to which managers were applied with their project proposals. For the preparation of this indicator, data on the amount of funds spent on activities from the first and second groups were taken into account. It is important to notice that in the period from 2010-2011 funds were additional provided through the Environmental Protection Fund of the Republic of Serbia.

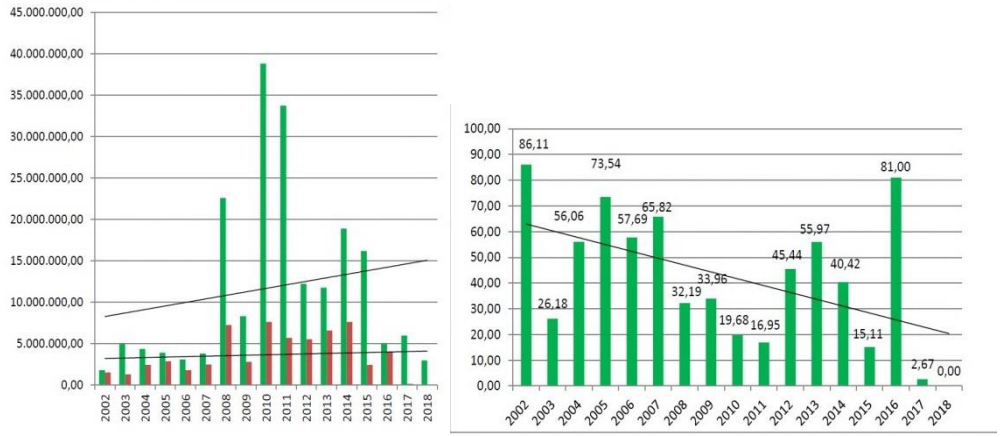


Fig. 2.1.7.1. The relation beteween amount overal funds for protected area managers and funds for biodiversity protection projects (left) and the percentage ratio beteween overall funds and funds for biodiversity conservation projects (right)

The results show that the funds varied from year to year but reached the highest level during the period 2010-2011 due to additional financial sources. Due to trend line on Chart 1. it is evident upward trend of the total funds per year, but only slight increasing of funds for biodiversity conservation activities. The reason for this may be the increase in the number of projects, or managers who applied for the funds during the investigated period. Thus, during the first few years, between 2002 and 2007, the number of applicants was between 11-14, in the following period 2008-2016 the number was gradually increased and ranged from 18-26. In practical terms, this means that the "new" applied managers are mainly applied with the projects on development of tourist infrastructure and only later on the activities of biodiversity conservation. These changes are shown more clearly on the Chart 2. which presents the percentage ratio of total funds and funds spent on biodiversity conservation projects by downward trend.

2.1.8. Indicator Name: Protected Area Management Effectivness

Author/Institution: dr Jovana Dzoljic/ College of applied professional studies, Vranje

Key messege: The efficiency of management of the area of exceptional qualities "Dolina Pčinja" in 2017 amounts to 72%

Assesment: 

In order to assess the effectiveness of protected area management in Serbia, official methods have not been determined by the authorities in jurisdiction. However, worldwide, the World Bank, the World Wildlife Fund (WWF) and the Global Environmental Facility (GEF) propose the application of an appropriate methodology that would allow monitoring of the management in these areas in order to direct priority conservation and protection activities. The indicator provides the possibility, in addition to the assessment of effectiveness, to make an assessment of the managerial, sociological and environmental conditions of the protected area. The indicator can help to identify strengths, constraints and weaknesses in the management of natural resources, to analyze the intensity of activities and the distribution of threats and pressures, then to identify areas of high environmental and social importance and vulnerability, as well as to point out the priorities in the protection of individual protected areas.

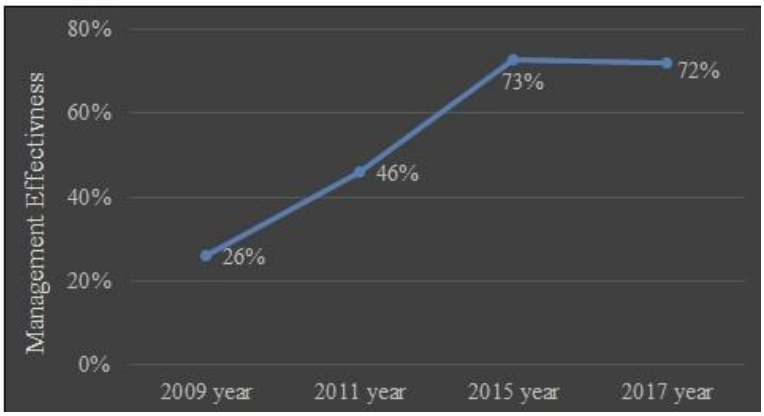


Fig. 2.1.8.1. The management effciency of the protected area „Dolina Pčinje“

The difference in the effectiveness of management in the four conducted studies (2009 - 2017) in the area of exceptional qualities (PIO) „Dolina Pčinje“ was noticed. The last survey was conducted for only one area, the area of exceptional characteristics "Dolina Pčinja" (Džoljić, 2017).
The large differences in the results of the research for PIO "Dolina Pcinja" in the initial research period can be attributed to the lack of objectivity and the participation of different respondents (Graph 1). The first three surveys were conducted within the project "Ensuring Financial Sustainability of the Protected Area System of Serbia", which included 21 pilot areas (Williams, 2016).
According to the latest research, in the PIO "Dolina Pčinja" management, as a large number of threats, marks of those with medium or even poor influence on the degradation of the value of the area. First of all, there are settlements and houses, livestock and grazing, energy production, including hydropower dams, also the overall impact on the biological resources of the area and climate change and weather, etc.

Literatura:

Džoljić, J. (2017). *Savremene metode praćenja radionuklida i ostalih parametara stanja životne sredine u funkciji optimalnog upravljanja zaštićenim područjima Pčinjskog okruga. Doktorska disertacija*. Fakultet za ekologiju i zaštitu životne sredine, Univerzitet „Union-Nikola Tesla”, Beograd, Srbija. Dostupno na: Retrieved from http://nardus.mpn.gov.rs/handle/123456789/9121

Williams, S. (2016). Ensuring Financial Sustainability of the Protected Area System of Serbia, PIMS 4281, Terminal Evaluation Vol. 1. Retrieved from http://www.rs.undp.org/content/dam/serbia/docs/Our Projects/UNDP_SRB_PA.pdf

2.1.9. Indicator Name: Habitat changes in selected protected areas

Author/Institution: dr Jovana Dzoljic/ College of applied professional studies, Vranje, Slavisa Popovic/ Environmental Protection Agency

Key messege: The area of broadleaved forests is reduced; the area of coniferous forest and transitional shrubs-forest vegetation is increased

Assesment: 

Protected Area „Vlasina“

Considering the fact that no significant anthropogenic pressure was exerted in the area in means of construction of new artificial structures in the protected area "Vlasina" since 2006, the changes in habitat types in the protected area "Vlasina" are a result of natural regeneration of vegetation. The most significant result is the state of natural grassland systems in the mountains, which are considered as one of the ecosystems with the largest number of species. Since 2006, the size and number of surfaces of natural grasslands in this area did not change significantly. After 2006, this type of habitat shows a tendency to expand its surface, which can be seen as a recovery of highland grass surfaces.
It should be noted that in 2000, the development of a discontinuous urban area (0.28%) was observed, which is concentrated on the north coast of the lake. Since 2000, there has been stagnation in the development of artificial surfaces, most likely due to the worsening economic situation in the south of Serbia, and the anthropogenic pressure in the following period has remained the same.

The results of the analysis of habitat types in the territory of protected area "Vlasina" in the period from 1990 to 2018 are shown in Fig. and Tab. below.

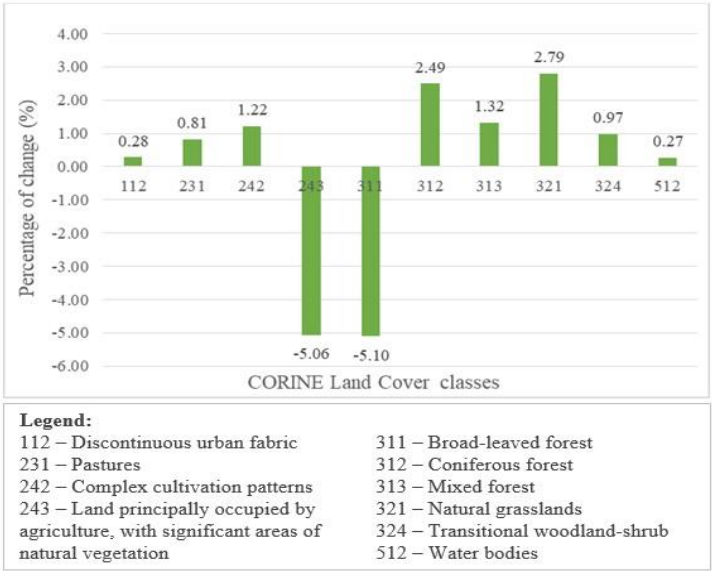


Fig. 2.1.9.1. Habitat types change on the territory of protected area „Vlasina“ in the period from 1990 – 2018.

Tab. 2.1.9.2. Fragmentation of habitat types in protected area „Vlasina“ in the period 1990-2018.

CORINE habitat type	1990	2000	2006	2012	2018
112	0	1	1	1	1
231	10	10	10	10	10
242	0	0	2	2	2

243	12	12	4	4	4
311	4	6	4	4	5
312	1	3	4	4	5
313	2	5	5	5	5
321	11	13	20	20	20
324	12	15	21	22	24
512	1	1	1	1	1

The total area of forest ecosystems is largely unchanged, which is in line with the claims of the authors Popović and Džoljić (2016). However, a significant decrease in surfaces under broad-leaved forests, together with increased fragmentation, was recorded. Also, the higher sensitivity of deciduous forests is the result of a change in climate parameters or the exploitation of forest resources. In connection with this, an increase in the transitional area of the forest landscape - shrub (0.97%) was also recorded. Unlike deciduous forests, the areas under coniferous and mixed forests in the mentioned period have increased its surface.

The class of agricultural area with significant amount of natural vegetation is noticed decrement (5.06%) of territory but also in habitats number in 2006. Partially decrement in this class can be explained more intensive agricultural activity e.g. increment of complexes of arable land (1,2%). On the other hand, lower anthropogenic pressure provided suitable conditions for natural succession and also for increment number of natural grassland (2.79). In the analyzed period regeneration of high mountain natural grassland has occurred.

Protected Area „Dolina Pcinje“

In the territory of protected area "Dolina Pčinja" in 2000, the phenomenon of pasture class (0.12%), whose area slightly increased in 2012, was recorded. (0.13%), and in 2018 the class of pasture was not recorded. Possible reasons for this may be either the abandonment of the village, as a result of which these areas are subject to natural succession, or their conversion to agricultural land, or changes in local climatic conditions. Negative demographic data indicate a decrease in the number of inhabitants in the villages or even the extintion of villages in this area, but the pressure on resources and biodiversity is not decreasing. The analysis of the data showed the trend of increasing the area under the class of predominantly agricultural land with a significant area under natural vegetation (0.18%), followed by a minimal increase in the number of these territories in 2000.

The change of habitat types in the territory of the region of exceptional characteristics " Dolina Pčinja" in the period from 1990 to 2018 is shown in Graph 2 and in Table 2. It is interesting to note that all changes detected in this area can be related to anthropogenic pressures.

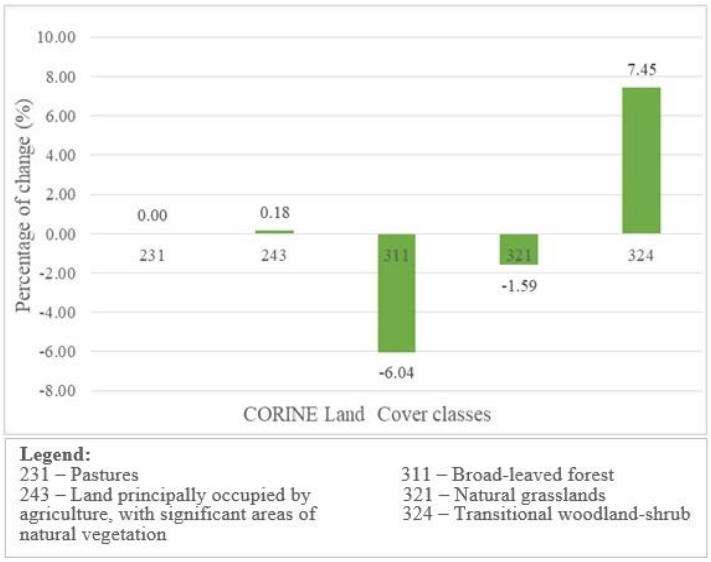


Fig. 2.1.9.3. Habitat type change on the territory of PIO „Dolina Pčinje“ in the period of 1990 – 2018.

Tab. 2.1.9.4. Fragmentation of habitat types in protected area „Dolina Pčinje“ in the period 1990-2000.

CORINE habitats type	1990	2000	2006	2012	2018
231	0	1	1	1	0
243	3	4	4	4	4
311	2	1	1	3	3
321	4	2	3	3	6
324	5	5	6	6	6

In the analyzed period, a significant decrease in areas under deciduous forests was recorded by 6.04%, mainly on the account of the transition forest area / shrubs, which increased by as much as 7.45%. Changes in the area of deciduous forests can be associated with increased anthropogenic pressure, accompanied by higher fragmentation of forests. The south of Serbia represents an economically underdeveloped area, which is why there is an increased negative effect of man on biodiversity. In particular, this refers to forest ecosystems because the dominant way of heating homes in this area is heating on wood during the winter period.
The beech forests, which dominate this area, are particularly vulnerable. As an additional pressure, the change of climatic parameters of the last two decades can also be highlighted, which undoubtedly influence the increase in the sensitivity of forest ecosystems. It should be added that in the period of 2012-2014 the upward trend of defoliation of deciduous trees on the territory of protected area "Dolina Pčinja" was observed from weak to moderate.
The area of natural grasslands has been reduced by 1.59%, which can be partly explained by their conversion into agricultural land. The largest decrease in the area with greater fragmentation of the habitat was recorded in 2018.
The area of protected area "Dolina Pčinja" shows the clear consequences of negative anthropogenic activities, which can be monitored as an increase in the number of classes while simultaneously reducing the area of different types of habitat. Forest ecosystems in this area are additionally endangered, since they also represent a potential target of forest theft.

2.1.9.1. Case study: Restoration of steppe habitats on Fruška gora and Deliblato Sands in XXI century

Author/Institution: Nikola Stojnic, Pokrajinski zavod za zastitu prirode

Assesment: 

Steppe habitats on Fruška gora slopes, until 2015 outside of borders of protected area were deteriorated due partial abandoning of pasturing and therefore overgrowing of invasive bush, mainly Hawthorn (*Crataegus monogyna*). Through activities financed by Provincial Secretariat relevant for Nature Conservation, revitalization is done through Hawthorn removals. It is done on localities Neradinski do (24ha), Krušedolski pašnjak (31ha) and Remetski do (40ha). These localities are important as habitats of animals such as European Souslik (*Spermophillus citellus*), Imperial Eagle (*Aquila heliaca*) and plants such as Pheasanat's Eye (*Adonis vernalis*), *Sternbergia colchiciflora*... Altogether **95 ha** on Fruška gora in period 2012-2015 are revitalized, with grazing that is following for maintain purpose. New Law on National Parks in Serbia followed these activities and enlarged borders of National park Fruška gora through including these project areas.
Steppe habitats in Special Nature Reserve Deliblato Sands, were deteriorated due complete abandoning of pasturing and therefore overgrowing of invasive bush, mainly Hawthorn (*Crataegus monogyna*). Through activities financed by Provincial Secretariat relevant for Nature Conservation, revitalization is done through Hawthorn removals. It is done on locality Korn in period 2002-2015 on **150ha** with new establishing of grazing of sheep and cattle that is following for maintain purpose. This locality is important as habitat of animals such as European Souslik (*Spermophillus citellus*), European Mole Rat (*Nannonspalax leucodon*) and plants such as *Paeonia tenuifolia, Crocus variegatus...*

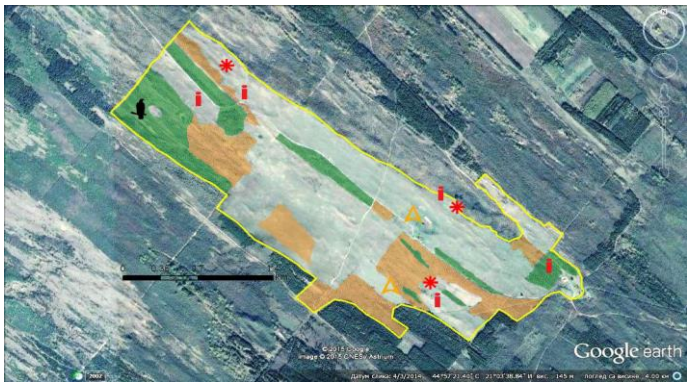


Fig. 2.1.9.1.1. Altogether, on these two protected areas, steppe habitats are revitalized on 245 ha.

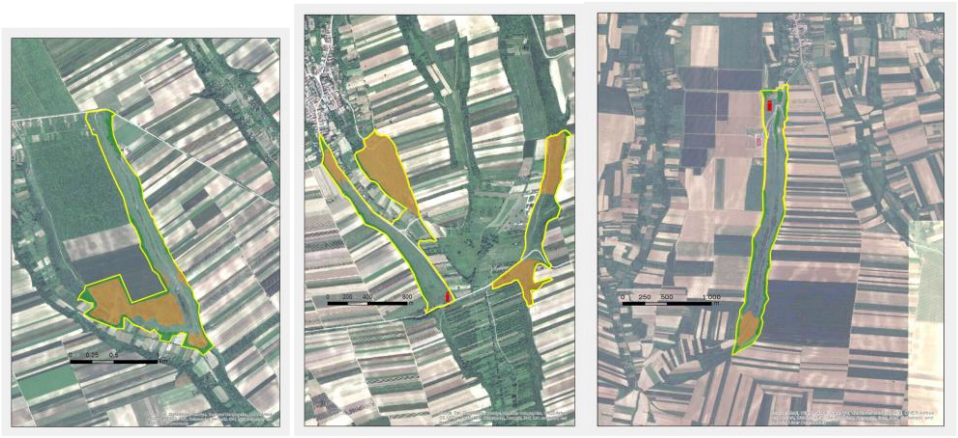


Fig. 2.1.9.1.2.Krusedolski pasnjak Neradinski deo Remetski deo

Legend:

Yellow line: border of protected locality

Unmarked zone: area where revitalization activities took place

Orange area: Localities/area for further revitalization

Green area: Localities/area which are not planned for revitalization

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Slow trend of establishing of protected area,
- Lack of inter-sect oral harmonization,
- Lack of trained staff of institutes for nature conservation skilled to prepare of Expert elaborates for PA establishment or enlargement.

2.2 Establishment and development of the ecological network of the Republic of Serbia

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 2

Aichi targets B5 and D14

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been effective 

The ecological network of Serbia comprises of protected areas have been established by the Law on Nature Conservation, as well as areas of international importance, with a primary goal of conservation of biodiversity. Ecological network is defined by the Decree on ecological network ("The Official Gazette of the Republic of Serbia", No. 102/10), as well as more detailed manner of management and financing of the ecological network, with the aim of conservation of biological and landscape diversity. It represents an assembly of functionally connected or spatially closes ecologically significant areas, which through their biogeography presence and representativeness significantly contribute to the conservation of biodiversity and sustainable utilization of resources, including the ecologically significant areas.

A legislative system for the protection of natural resources is governed by a number of international conventions, directives and resolutions, including bilateral and multilateral treaties (the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat 1971; The Convention on Biological Diversity 1992, the Bern Convention on the Conservation of European Wildlife and Natural Habitats, 1979 etc). According to this legislative basis, the conservation networks of world culture and nature heritage in Europe involve

- wetlands of international importance,
- UNESCO biosphere reserves, specified under MAB (Man and Biosphere) project,
- important bird areas,
- important plant areas,
- herpetologically important areas,
- prime butterfly areas,
- pan-European ecological network,
- EMERALD ecological network,
- European network of biogenetic reserves

Beside above legislative framework, the biodiversity conservation policy in the European Union is based on the Birds Directive (Directive 2009/147/EC of the European Parliament) and the Habitats Directive (Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora). According to these two directives, the EU member states are obliged to establish Special Protection Areas (SPAs) for birds, in accordance with the Birds Directive and Special Areas of Conservation (SACs), according to the Habitat directive. Together, SPAs and SACs form the Natura 2000 network of protected areas. The main purpose of Natura 2000 network is a long-lasting and sustainable conservation of habitat types listed in Annex I and species listed in Annex II from Directive 92/43. The process of establishment of the NATURA 2000 network in Serbia started in 2018.

The role of the ecological network in the protection of biological diversity

By recording spatial units important for preserving Serbia's biodiversity and incorporating them into a single database, the basis for achieving the objectives of the Nature Protection Act defined in Article 2 of the Law has been formed. Spatial data is a precondition for the preservation and improvement of biological, geological and landscape diversity by aligning human activities, plans, programs,

bases and projects with the sustainable use of renewable and non-renewable natural resources, as well as timely prevention of negative impacts and improvement of the state of harmed parts of nature and landscape. An integral overview of all elements of the ecological network, showing spatial or functional connections between spatial units, as well as the identified threatening factors, enables the institutes to define the conditions of nature protection that harmonize development interests with the needs of long-term conservation of our natural resources.

By integrating measures of protection and improvement of the ecological network into spatial plans, the basis for improving the state of harmed parts of nature is created by connecting isolated habitats.
By preserving the existing purposes in the areas of isolated habitats of the ecological network, it is possible to form future protected areas in accordance with the national interests and international obligations of Serbia. The forthcoming process of valorization of these sites should determine which of them have conditions for the permanent preservation of natural values, and for which there are other priorities of sustainable development. In the case of strictly protected and protected species, protective measures must also be respected beyond the limits of protected assets. By incorporating migratory pathways and significant habitats for reproduction or nutrition, measures can be directed to spatial units that are necessary for the survival of populations of these species. Identifying the locations of crossing of ecological corridors with infrastructure networks provides a safe passage to wild species using certain technical solutions or the construction of special passages, in accordance with applicable regulations. Spatial definition of elements of the ecological network serves not only for the protection of the target species, but also through the spatial planning, enables the optimization of the funds allocated for the protection of the environment and nature.

From the aspect of administrative activities, including the preparation of planning documents, the ecological network of Serbia unites a significant part of the spatial units that are especially important for the protection of renewable resources. While deciding on the use of natural resources or spatial planning, ecosystem services are not presented, although the prosperity of a given area largely depends on them. The best example is the great rivers as ecological corridors, within which the habitats are also a priority for protection in Serbia and in Europe. On the watercourses measures are applied for the protection of water resources (protection of the regime and water quality), whose condition influences the development of economic activities.

Most spatial units, crucial for the development of ecological processes on which the sustainable development of a society rests, is in a closely natural or partially altered state, providing greater opportunities in creating the ecologically and economically most rational spatial solution for their wise use. The ecological network serves as a tool for identifying and reserving these spatial units whose value is not recognized in the processes of transition and privatization.

2.2.1. Indicator: CLC habitat changes inside Ecological network in Serbia

Author/Institution: Slavisa Popovic, Nemanja Jevtic/ Environmental Protection Agency,

Key messege: In the period from 2006-2018. In the course of the year, almost all natural and semi-natural habitats have increased

Assesment: 

Changing the surface and fragmentation of natural and semi-natural habitats, according to the CORINE Land Cover typology, in the area of the Ecological Network of Serbia (without the territory of the autonomous province of Kosovo and Metohija) is a very important indicator of pressure on natural habitats, but at the same time of the protection efficiency.

Inside the area of the Ecological Network of Serbia (without the territory of the Autonomous Province of Kosovo and Metohija), the surface area of almost all natural and semi-natural habitats has increased, while simultaneously reducing the fragmentation of the same habitats in the period 2006-2018.

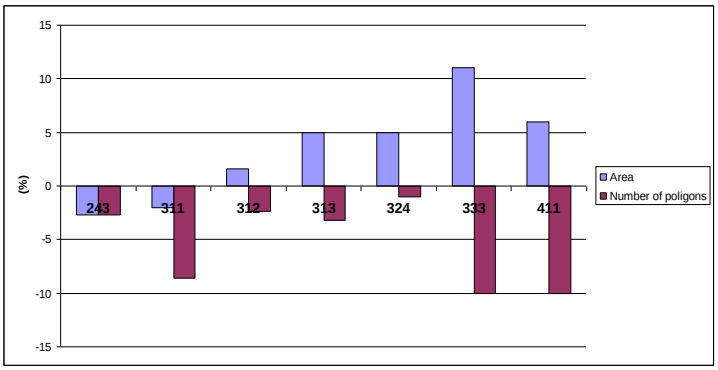


Fig. 2.2.1.1. CORINE Land Cover area and poligons change in Ecological Network of Serbia

The area of predominantly agricultural land with a significant area under natural vegetation (class 243) decreased by about 2.7%, while the fragmentation decreased by 2.7%. The area of deciduous forests (class 311) was reduced by about 2% with a decrease in fragmentation by 8.6%. The area of coniferous forests (Class 312) increased by 1.6% with a decrease in fragmentation by 2.4%. The area of mixed forests (class 313) increased by 5% with a decrease in fragmentation by 3.2%. The surface of the transitional shrub forest vegetation (class 324) increased by 5% with a decrease in fragmentation by 1%. There is no change in the surface of the natural grasslands (class 321) with a decrease in fragmentation by about 4%.

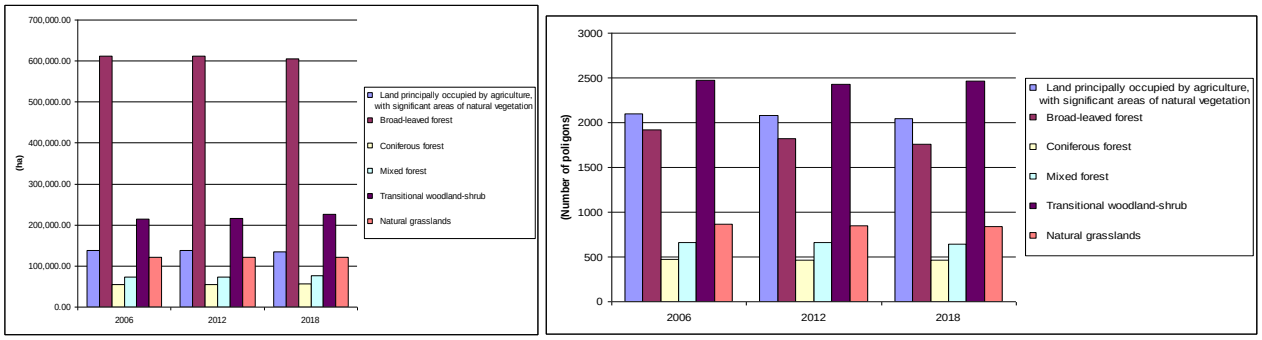


Fig. 2.2.1.2. CORINE Land Cover area (left) and fragmentation (right) changes of forested habitats and grassland.

The surface area with diluted vegetation (class 333) increased by 11% with a decrease in fragmentation by 10%. The area of swamp land increased by 6% with a decrease in fragmentation by 11%. It is important to note that the surface of the bare rock (class 332) increased by over 50% with an increase in fragmentation by over 40%.

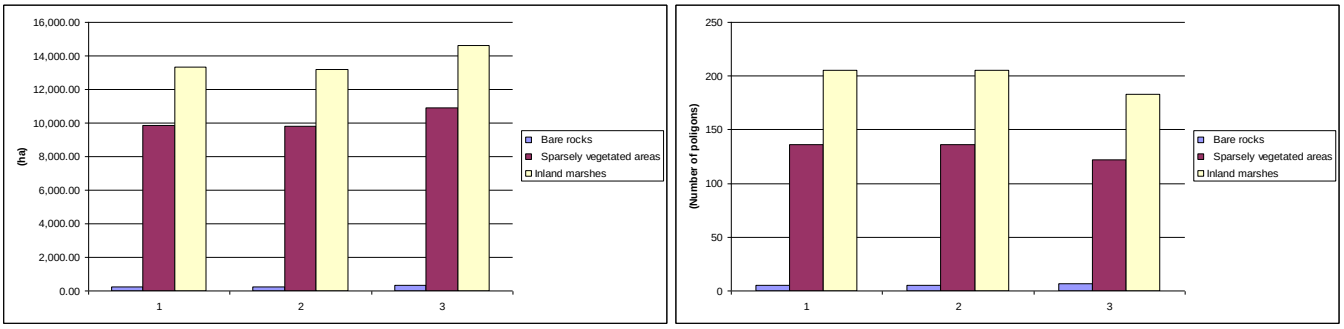
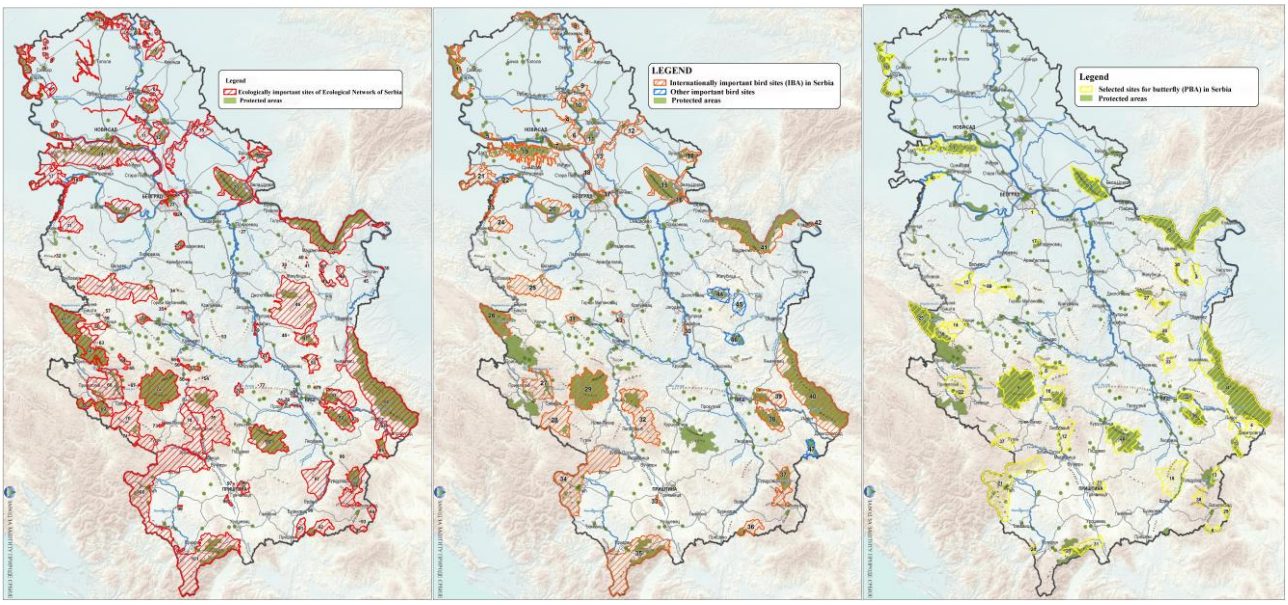


Fig. 2.2.1.3. CORINE Land Cover area (left) and fragmentation (right) changes of non-vegetated habitats and inland marshes.

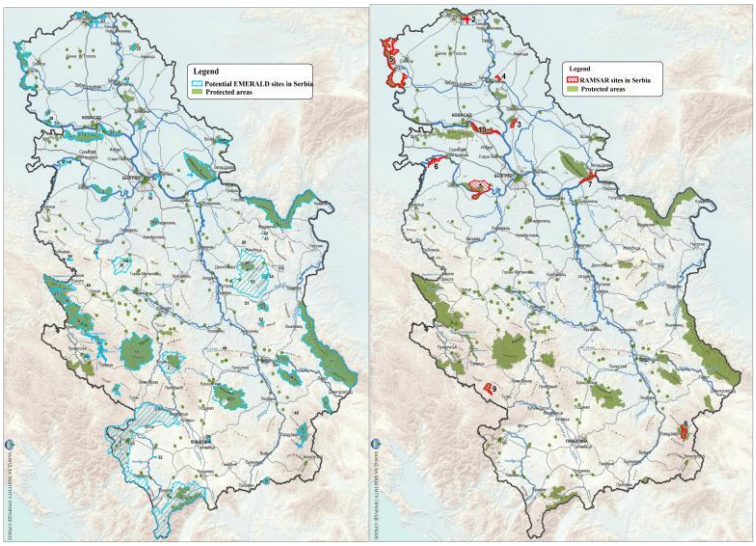
The ecological network of Serbia is comprised of 101 areas and it represents an assembly of functionally connected or spatially close ecologically significant areas, which through their biogeographic presence and representativeness significantly contribute to the conservation of biodiversity and sustainable utilization of resources, including the ecologically significant areas of the EU Natura 2000. Up to now, 61 sites have been nominated for the European Emerald Network. In 2009 42 Important Bird Areas (IBA) with the total coverage of 1259624 hectares, which represents 14.25% of the territory of the Republic of Serbia have been identified (Puzović et al., 2009). Furthermore, 62 areas of Important Plant Areas (IPA) have been defined and they encompass a surface of 747300 ha or 8.5 % of the territory of the Republic of Serbia. Also, 40 areas of Prime Butterfly Areas (PBA) have been identified. The total surface

of all PBA surfaces is 903643 hectares, which represents 10.2% of the territory of the Republic of Serbia. Important wetland 10 Ramsar sites total area 61522 ha or 0.7 % of teritory.

Map. 2.2.1.4. Map of diferent ekological networks in Serbia. Source: Institute for Nature Conservation of Serbia



Ecological network **Important Birds Areas (IBAs)** **Prime Butterfly Areas (PBA)**



EMERALD sites RAMSAR sites

Project Important Plant Areas in Europe - IPA in Europe, coordinated by Plant-life International, is an initiative to point out the habitats that are most important for the preservation of the wild flora of Europe. So far, 399 IPA areas have been identified in the EU countries that have entered the Natura 2000 network. In the countries that are not yet members of the EU, an additional 510 IPA areas are identified for the conservation of plant species and their natural habitats.

In Serbia in 2005, 59 habitats of international significance were preserved for the preservation of floral diversity. These habitats comprise 8.5% of the teritory of Serbia.

Project Important Bird Areas (IBA) managed by BirdLife International is one of the key projects for the conservation of bird fauna and their habitats. In more than 200 countries around the world, over 10,000 IBA areas have been identified, of which about 4,000 are

in Europe. In Serbia, 16 areas were identified in 1989, 35 in 1997, and in 2009 the number of IBA areas increased to 42. The collection area of these internationally significant areas for birds in our country is 1,259,624 ha, of which 43.7 % are in protected areas. The project Prime Butterfly Areas in Serbia (PBA) was realized in 2003 under the auspices of the Butterfly Conservation Europe organization from the Netherlands. The purpose of the project was to identify and protect habitats important for the preservation of butterfly fauna. In accordance with this project, 40 significant areas have been identified in Serbia for the 38 most important types of butterflies out of 193 types of butterflies we have in our country. The sum of the area important for the survival of the most important types of butterflies amounts to 10.22% of the territory of Serbia. In the process of joining the European Union, Serbia has identified areas that should be part of the Emerald Network, which is important for preserving biodiversity. The Emerald network also represents a European ecological network for the conservation of wild flora and fauna and natural habitats in those non-EU countries. The Emerald network was created in 1998 by the Council of Europe in support of the Berne Convention and preparations for the implementation of the Habitats Directive. This network consists of Areas of Special Conservation Interest (ASCI), that is, habitats of particular national and international significance from the aspect of conservation of biological diversity in the territory of all states signatory to the Berne Convention. The project of establishing the Emerald network in Serbia was realized in 2005 and 2006. In the process of identification of the Emerald area, 61 areas have been processed, especially important for the protection and conservation of wild plant and animal species and their habitats. The total surface of these areas is 1.019.270 ha, which makes up about 11.5% of the territory of Serbia. Of the above number of potential Emerald areas, 51 already have the status of protected areas in accordance with national legislation, one area has the status of the Biosphere Reservation, 9 areas declared as Ramsar areas, 36 areas of international importance for plants (IPA), 34 areas of international importance for birds (IVA), 28 areas are selected areas for butterflies (PBA). In addition to the ecological networks Natura 2000 and Emerald, a pan-European ecological network is being developed in the area of Europe, defined as an action topic of the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) adopted at the Ministerial Conference in Kiev in 1995. The Pan-European Ecological Network (PEEN) should cover protected areas of national importance, the Natura 2000 and Emerald ecological networks, Ramsar sites, internationally significant plant areas (IPAs), internationally significant areas for birds (IBA), selected areas for butterflies (PBA), habitats of rare and endangered species of national and international significance, natural or semi-natural habitats within artificial ecosystems of primarily large agricultural areas. Based on the Convention on protection of wetlands and their Biodiversity (Convention on Wetlands, Ramsar, 1971), ten protected areas of Serbia have been given the status of internationally significant Ramsar areas. These are: Obedska bara, Carska bara, Ludaško jezero, Slano kopovo, Labudovo okno (part of the special nature reserve of the Deliblatska peščara), Gornje Podunavlje, Zasavica, Vlasina, Koviljsko-petrovaradinski rit and Karajukića bunari on Peštersko polje. The total surface of these areas is 55,630 ha.

2.2.1.1. Case study Prime Hoverfly Area (PHA)

Author/Institution: dr Dubravka Milic, dr Ante Vujic, dr Snezana Radenkovic/ PMF University of Novi Sad, Biology and Ecology Departement

Assesment: 

Hoverflies are a valuable group of species in need of conservation and monitoring, due to their large contribution to pollination, biological control, and role as indicators of ecosystem change. Though hoverflies are a well-known group of insects, there has been little documentation of their current conservation status. These flies have reached a high level of diversification, with about 6.000 species known. Under the National legislation of Serbia 44 species of hoverflies are listed as protected, while 33 species are categorized as being strictly protected. In this study we categorized 155 hoverflies species as a species that need conservation.
We evaluate the adequacy of the National Protected Areas (NPA) for hoverfly conservation, an important pollinator group. In addition we propose an approach for systematic inclusion of important conservation areas. Using long-term hoverfly monitoring data (over 35 years), we create Prime Hoverfly Area (PHA) in Serbia. Finally, we analysed the degree of overlap between the PHA and a similarly designed habitat network aimed to conserve butterflies, since this is of interest in planning conservation strategies for pollinators.
In order to create new area for hoverflies, we defined five criteria for the identification of species in need of conservation: 1. Protected and strictly protected species by Serbian legal act, 2. Species distributed only in Europe, or species of European concern, 3. Species restricted by range to the Balkan Peninsula (Balkan endemics), 4. Species with restricted distribution on the Balkan Peninsula and very restricted distribution in Serbia (3–5 localities), 5. Species connected with specific habitat type listed in Annex I of the Habitats Directive. Moreover, we defined five criteria for the selection of areas important for conservation of hoverflies: 1. Site contains threatened species at national level and species of European concern Criterion, 2. Site contains national endemic species with demonstrable threat Based on Important Plant Areas criteria, 3. Site contains near endemic/restricted-range species with demonstrable threat Based on Important Plant Areas criteria, 4. The site is known or thought to hold a significant component of the group of species whose distributions are largely or completely confined to one biogeographical regions in accordance with Habitats Directive Based on

Important Bird Areas criteria and 5. The site supports species connected with particular habitat, refer to Annex I of the Habitats Directive.

We found that the NPA network is insufficient, as it does not cover the ranges of 18% of considered 155hoverfly species; 34% of the identified area (PHA) lies outside of a national protection area (NPA) network. The area of the proposed PHA outside of the NPA is small (1.36% of the national territory), but its protection would greatly improve hoverfly conservation by increasing the inclusion of hoverfly habitats for previously unprotected species and by including hoverfly biodiversity hot spots. Hoverflies and butterflies may be assumed to have similar ecological demands because they are both pollinators that strongly depend on plant composition and distribution. However, we found that a large area of the PHA was outside of the PBA (52% overlap), highlighting the importance of considering multiple groups in planning comprehensive conservation strategies for pollinators.

Although most insect conservation areas are butterfly and beetle focused; conservation network design targeting pollinators may be improved by the inclusion of hoverflies. This is supported by the large amount of long-term monitoring data on their presence in Serbia. Because pollinators require preservation of rare microhabitats, it is especially important to consider the needs of multiple species in conservation network design.



Episyrphus balteatus *Scaeva pyrastri* *Helophilus trivittatus*



Leucozona lucorum *Mallota fuciformis* *Volucella pellucens*

https://www.sciencedirect.com/science/article/abs/pii/S0006320716301197
Fig. 2.2.1.1.1. The research is done under the projects:

Conservation strategies for the preservation of protected and strictly protected species in Serbia—hoverflies (Insecta: Diptera: Syrphidae) as model organisms, Grant Number 173002.

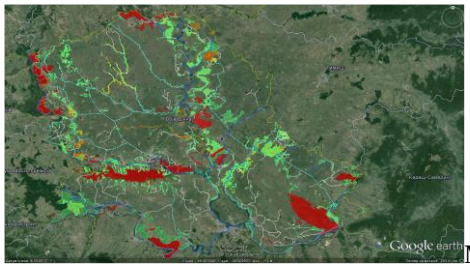
“Evaluation of Ecological Networks in AP Vojvodina as support for nature conservation”(0601-504/3).

2.2.1.2. Case study: Ecological network in Vojvodina

Author/Institution: Dr Biljana Panjkovic/Provincial Institute for Nature Conservation

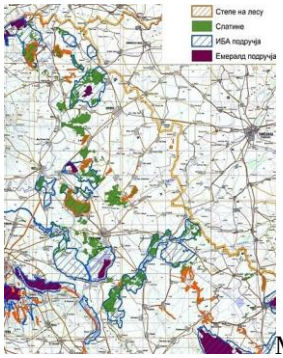
Assesment: 

The first step towards the formation of the ecological network of Serbia was the isolation of the Emerald network area with the implementation of the Convention on the Conservation of European Wildlife and Fauna and Natural Habitats. The establishment of an ecological network of areas of importance for the EU started in 2009 within Twining SR07-IB-EN-02 project "Strengthening the Administrative Capacity of Protected Areas in Serbia - Natura 2000". The Law on Nature Protection (2009) defines the notions related to the ecological network, and the tasks of establishing, as well as measures for the protection and improvement of the network are defined by the Regulation on the ecological network of the Republic of Serbia (2010). Based on the Regulation of the ecological network, the Provincial Institute identifies the boundaries of parts of the ecological network in the area of AP Vojvodina. In addition to the protected areas, it also keeps a database of habitats of strictly protected and protected species, as well as habitat types important for the conservation of biological diversity, in accordance with the relevant Regulations. By the end of 2018, 665 spatial units were identified, with total area of 163 900 ha, which is about 7.61% of the area of AP Vojvodina. Habitats were identified on the basis of field data and presented in the form of limited areas, within which the coverage of the main habitat categories was estimated at an accuracy of 5% to 10%. In the area of the Province, ecological corridors of regional importance and a large number of local corridors have been identified. The database is complemented in conjunction with identification and habitat mapping activities, and is available to the public in accordance with the law.
National ecological network (APV): 665 spatial units, total area of 163 900 ha (7.61%)
Total under the ecological network 16.52%. (protected areas and habitats of strictly protected species of spatial units)



Map. 2.2.1.2.1. Ecological network in Vojvodina

2012 Provincial Institute for Nature Conservation: "Expert documentary basis in the area of nature protection for the preparation of the Spatial Plan for the specific purposes of the multifunctional ecological corridor Tisa" - the Regulation on the ecological network of the Tisa River is defined as an ecological corridor of international importance. The study carried out identification of natural values within the scope of the plan, as well as the assessment of the functionality and accessibility of the river corridor Tisa and the salt marsh-steppe corridor Banat. The data and measures provide guidelines for determining the uses of spatial units within the river corridor, as well as in the zone of influence on the Tisa corridor.



Map: 2.2.1.2.2. Salt marsh-steppe coridor of Banat should provide a connection of grass habitats from the border with Hungary to the .Potamišje area

Man and Biosphere (MAB) in Serbia

2.2.2. Indicator name: Habitat changes in UNESCO MAB biosphere reserves

Author/Institution: dr Jovana Dzoljic/ College of applied professional studies, Vranje, Slaviša Popović/ Environmental Protection Agency

Key messege: In the period from 1990-2012. On the territory of MAB in Serbia, number of forests has increased

Assesment: 

2.2.3. Sub-indicator: Protected Area „Golija“, as a part of UNESCO MAB biosphere reserve

Nature Park "Golija" in Serbia is one of the most forested areas in Serbia. In the period from 1990 to 2018, there was an increase in the area under the forests from 47 588.30 ha in 1990 to 48 240,24 ha. The recorded regeneration of forest ecosystems correspond to the authors Popović and Džoljić (2016) that in the period 1990-2012 on the whole territory of Serbia the forests have increased. One of the reasons for the renewal of the vegetation is reduced anthropogenic pressure in this area. In these regions, in the last twenty years, there has been significant migration of people to cities and the abandonment of the village (Džoljić, 2017), which is why the areas are exposed to natural succession.

According to the results of the latest CORINE Land Cover in 2018 the development of two areas with sports and recreational facilities have been identified, which occupy an area of 133.54 ha (Fig. below) and can significantly improve the development of the local economy.

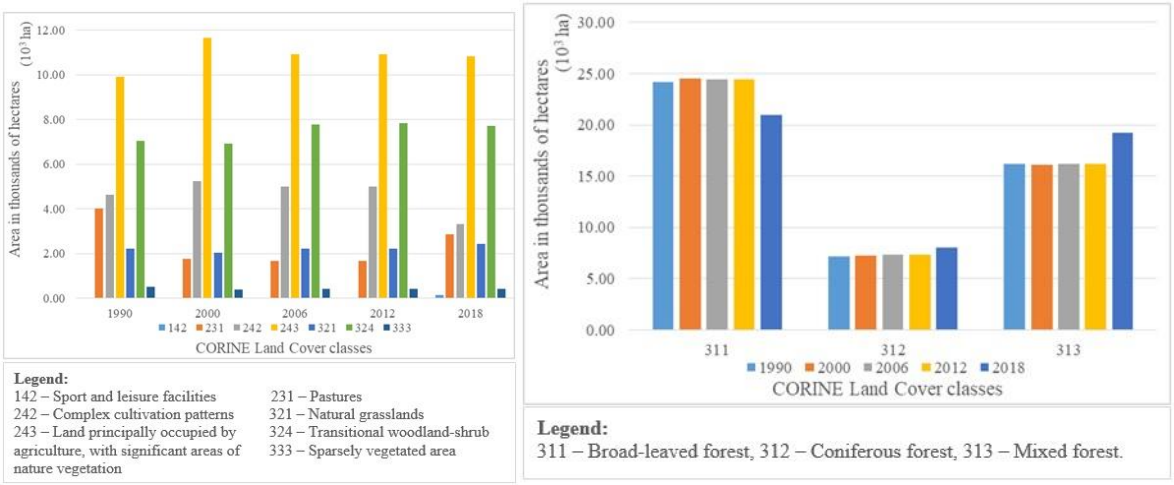


Fig. 2.2.3.1. CORINE Land Cover habitats changes in Golija

In the area of nature park in 1990, the area under the pastures covered the territory of 4,012.97 ha, but in the next 10 years it was reduced to only 1 757.06 ha (Fig abow), which is accompanied by a decrease in the number of these habitats (Tab. below). In the following period (2000 - 2012), the area was slightly changed with the trend of decreasing the number of habitats.

Tab. 2.2.3.2. Number of CORINE habitat types in protected area „Golija“

CORINE habitat types	1990	2000	2006	2012	2018
142	0	0	0	0	2
231	55	35	32	32	52
242	59	63	60	60	39
243	133	133	131	131	125
311	73	72	72	72	63
312	53	52	52	52	43
313	88	89	89	89	49
321	33	34	36	36	32
324	81	91	99	99	96
333	3	4	5	5	5

The reason for this may also be the conversion of these habitats into cultivated land (4 631.74 ha in 1990, and 5 004.82 ha in 2012). In 2018, an increase in the area under pastures was recorded along with an increase in the number of habitats, while the complexes of the cultivated land show a decrease in the area but an increase in the fragmentation of this habitat type.

The class of mainly agricultural land with a significant area under natural vegetation shows an increase in the area (from 9,928.74 ha in 1990 to 10 829.65 ha in 2018), while simultaneously consolidating and linking these habitats, which indicates the restoration of vegetation and the dominant processes of natural succession.

Since the beginning of the protection and management of the nature park and the definition of the area of the biosphere reservation (2001), there has been an increase in areas under forest ecosystems. Surfaces under broad-leaved forests show a decrease in the area in the period 1990 - 2018 (from 24,189.45 ha to 20,971.99 ha), at the expense of mixed (16,116.34 ha to 19,265.27 ha) and coniferous forests (7 182.51 to 8 002.97 ha), while reducing fragmentation in all three classes.

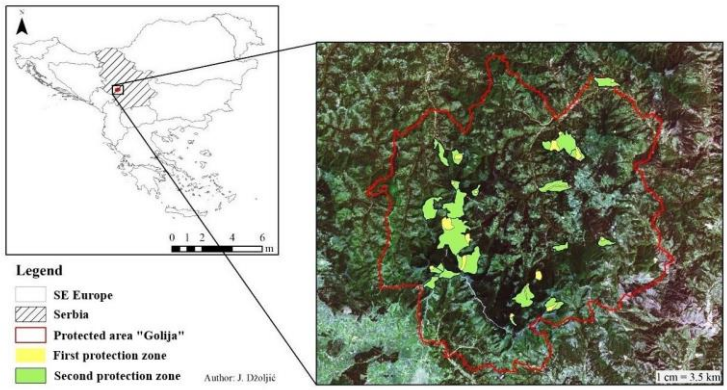
Natural grasslands mostly have stable ecosystems, as well as the trend of increasing and strengthening of these habitats (2 418.40 ha in 2018). The transition zone forest / shrub area shows minor oscillations in the surface, but also a decrease in fragmentation, and in 2018 it occupies an area of 7 715.77 ha. Reducing the area of areas with diluted vegetation is accompanied by an increase in the number of these habitats, which can be partly explained by the succession of vegetation to other classes.

2.2.4. Sub-indicator: Habitat changes in Protected Area „Golija“ according to LANDSAT imagery

Author/Institution: dr Jovana Džoljić/Colledge of applied professional studies, Vranje

Assesment: 

By the Decree of the Government of the Republic of Serbia from 2001 ("Official Gazette of RS No. 45/01), the Golija Mountain area was declared a nature park in order to preserve the cultural and natural values of this area. Also, the natural created values in this area have met the criteria of the UNESCO program "Man and Biosphere", and part of the territory was declared in the same year the Golija-Studencia Biosphere reservation.



Map 2.2.4.1. Map of the nature park “Golija”.

Today remote monitoring si the best available technology for detecting changes in nature (Eastman et al, 2013; Osunmadewa, Csaplovics, Majdaldin, Adeofun, & Aralova, 2017; Džoljić, 2017). The analysis of LANDSAT satelite images from the period prior to the designation of the Golija area for the protected area and 15 years after, allows the monitoring of changes in the vegetation cover. Satelite images (Tab.1) are taken from the open USGS database. Classification methodology, the supervised classification method is used for analysis, enables the extraction ov different classes or topics from unprocessed satelite images, and includes preliminary pre-processing of images (Džoljić, 2017)

Tab 2.2.4.2. Used satelite images

	Landsat Scene Identifier	D/M/G	Time	Latitude	Longitude
1	LE71860302000210EDC00	28/7/2000	09.13164199136Z	20.279	43.186
2	LC81860302014224LGN00	12/8/2014	09.22079514155Z	20.3199	43.1848

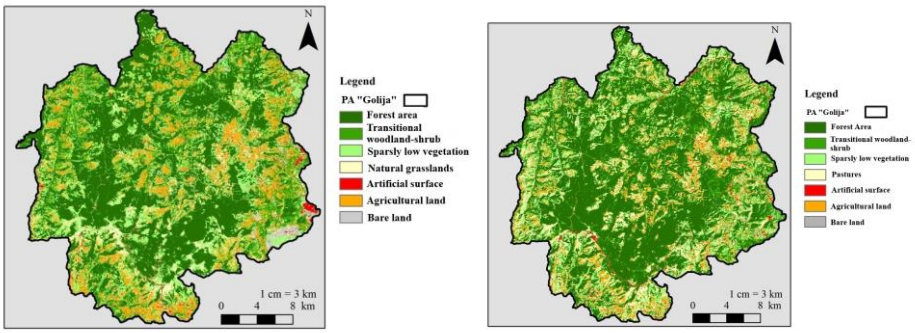
The main economic activities in the area of Golija Mountain are forestry, livestock, agricultural activity, grazing as well as the collection of wild and cultivated species of aromatic and medicinal plant species, mushrooms, forest fruits, etc. However, the lack of investment and economic crisis has led to a decrease in the living standard of the population , which is confirmed by the negarive population trend in this area as well as the migration of the local population to cities (Džoljić, 2017). All this led to reduced anthropogenic pressure on this area, whic together with applied conservation measures caused the recovery of vegetation.

The results of the analysis (Image 1 and 2) showed an increase in the area under the forest in the analyzed period by 6%, most likely due to the applied measures of protection and recovery of vegetation, which is confirmed by the reduction of the area under the transition class forest-shrub surface by 3% Tab 2).

Reduced anthropogenic pressure also greatly contributes to the recovery of vegetation. Reduction of the surface was also observed in the class of the area with diluted vegetation by 2%, while the area of natural grasslands increased by 5%, which can be explained by reduced anthropogenic pressure and natural succession of vegetation.

The negative demographic trend and the abandonment of the village can also explain the reduction of areas under agricultural land by 4.42%. The class of bare surfaces occupies the smallest area, but there is a decrease in the area of this class due to the recolonization of such spaces. Also, it should be kept in mind that due to small areas and insufficiently representative samples, a technical error may occur, that is, the vastness of these classes is replaced by artificial areas, wich may indicate a incorrect result.

The change in the class of the artificial surface is less than 1%. This class includes mainly roads as well as objects that have not changed in the analyzed period. Only areas that were under fire in 2010 and 2012 are changed but they are a subject to natural regeneration, and a change of 0.30% can be attributed to the recovery of these habitats.



Map 2.2.4.3. Image of protected area „Golija“ in 2000 (left) and 2014 (right).

Tab 2.2.4.4. Representation of vegetation classes in 2000 and 2014.

Class	Area (ha) 2000.	%	Area (ha) 2014.	%
Forest	30 966	41	35 821	47
Transitional woodland/shrub area.	12 967	17	10 466	14
Area with diluted vegetation	13 970	18	11 992	16
Pastures	5 152	7	8 977	12
Artifical surfaces	1 069	1	1 296	~2
Agricultural surfaces	10 379	14	7 028	9
Bare surfaces	1 360	2	284	<1

Enlargement the area of artificial surfaces indicates a possible increase in anthropogenic pressure in the future. The increasing rural, ethno or eco-toursm should not be ignored because it contributes to the reconstruction of rural households. Together with investing in infrastructure and improving connectivity with larger cities, it will undoubtedly lead to the popularization and development of this site, which will influence the surface change of the agricultural and urbanized areas. Therefore, changes in soil cover and habitat types must be closely monitored.

Literature:

Džoljić, J. (2017). *Change detection in vegetation cover and size of urbanized zones at UNESCO Biosphere reserve "Golija-Studenica", Serbia* (Master Thesis). Departement of Geoinformation in Environmental Management, CIHEAM-Mediterranean Agronomic Institute of Chania (MAICh), Chania, Greece.

Popovic, S., & Dzoljic, J. (2016). Serbian Forest Indicators by CORINE Land Cover. Saarbucken, Germany: LAP LAMBERT Academic Publishing. Retrieved from http://www.sepa.gov.rs/download/publikacije/SerbianForestIndicatorsCorineLandCover.pdf

2.2.4.1. Case Study: Living With Brown Bear in Golija-Studenica Biosphere Reserve

Author/Institution: Ivana Jovanović & Vladan Bjedov/ Institute for Nature Conservation of Serbia

Assesment: 

Key Messages/Lessons learnt

 Despite the Brown bear population growth and the considerable growth of man-bear conflicts reported in Southwestern Serbia, the fear of Brown bear is more irrational than founded in realistic chances of its encounter and potentially dangerous situations.

 Cohabitation of the bears and people living in the BR is ensured by continuous field research and monitoring of the Brown bear and by undertaking mitigation measures such as financial compensation for the damages, provision and adequate positioning of the additional feeding places and hosting educational workshops in the local communities.

 Educational programs for the local communities proved to be the key approach for better understanding of the large predators, traditionally feared among humans. In many cases, these large predators are the keystone species, so the long-term enforcement of the proposed conservation measures benefits the entire protected ecosystem.

 strengthening the bond between men and nature in the BR ensures both conservation of biodiversity and improvement of the living conditions of the locals.

Biosphere Reserve description

Golija-Studenica BR is the first established Biosphere Reserve in Serbia. Formed in 2001 around both exceptional natural values of Golija Mt., protected also nationally as Golija Nature Park, and significant cultural heritage of Studenica Monastery (XII century), which was listed as the World Heritage Site in the Category of Cultural Heritage by UNESCO in 1986.
Over 70% of Golija NP has been designated for Golija-Studenica BR, with the large majority of most valuable localities, both in cultural and natural aspect, included in its approx. 54.000ha of size (Figure 1). Well-preserved forests take up the majority of both NP and BR area.
With the altitude of 1833 m a.s.l., Golija Mt. is the highest mountain of Southwestern Serbia. Rich in water, with many springs, streams, rivers and peat bogs, it hosts diverse and for the most part, undisturbed habitats of high biodiversity. Alike many high mountains of the Balkan Peninsula and of the Western and Southwestern Serbia, Golija Mt. possesses strong refugial character. Its unique complex of microrefugia supports survival of many endemic and relict species of flora and fauna.

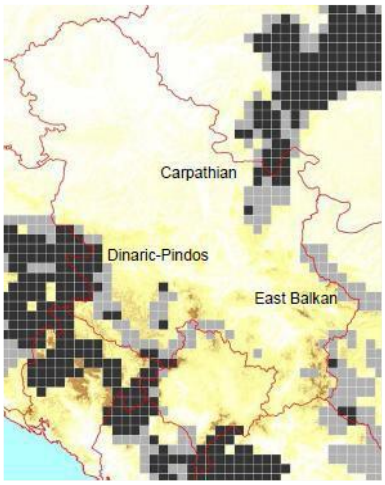
North of the Golija mountain ridge, well-preserved and old-growth forests of mainly Oak, Beech, Fir and Spruce dominate the landscape and represent the climax potential vegetation (Figure 2). On the southern slopes of the mountain, vegetation of mountain fields, pastures and meadows develops as a secondary vegetation type, the result of both abiotic and anthropogenic factors influence.

Pic.2.2.4.1.1. Forested landscape of Golija Mt. (Photo: Bjedov, V.)

Within the Nature Park area, about 8,000 people reside in 36 rural settlements under 5 Municipalities. Despite depopulation trend in the last decades in this mountain area, it is still very much alive. The local way of life has not changed significantly over the years, with the traditional livestock rearing and crop production practices still preserved.
Sustainable use of forest for timber production is the dominant use of natural resources in the BR. Gathering of nature products, such as fruits, herbs and fungi is widely practiced in this mountain region, both by the locals and the organized commercial harvesters. Eco-tourism, related to natural values, wild nature and beautiful landscape, and ethno-tourism are both developed.

BR challenges

With all the human activities in the BR, especially the ones taking place in heavily forested regions of the Golija Mt., a dose of risk is associated, due to pure wilderness of this mountain, which was for centuries known as both Grey wolf and Brown bear roaming territory.
Brown bear (*Ursus arctos*) is the largest Carnivore in Serbia and in Europe. Constantly decreasing population trends in XX century have resulted in near endangerment of this species in Serbia, as well as in Europe.
Brown bear is in Europe protected by the Bern Convention and the EU Habitats & Species Directives. In Serbia, Brown bear has been a permanently protected game species (unhunted game species) by the Law on Game and Hunting since 1993. Law on Nature Protection, set in 2010, regards Brown bear as a strictly protected species by the Rulebook on declaration and protection of protected and strictly protected wild species of plants, animals and fungi. Three out of 10 Brown bear populations in Europe are present in Serbia (Figure 3). Europe's largest one, of the Carpathian Mts., is present in Eastern Serbia, while Europe's second largest one, stretching from Dinaric Mts. to Pindos Mts., reaches Southwestern Serbia. Population of the Eastern Balkans is represented with just a few individuals roaming through Stara planina Nature Park in Southeastern Serbia.



Map. 2.2.4.1.2.Brown bear populations in Serbia, *dark cells: permanent presence; grey cells:* periodic or *sporadic occurrence* (Photo: Kaczensky et al. 2012; Ćirović & Paunović, 2016)

The Dinaric-Pindos population is the largest Brown bear population in Serbia, counting about 120 individuals. The population size is increasing, along with the range expansion. The preferred Brown bear habitat is forested mountain area, less inhabited, but with extensive livestock farming, which is why Golija Mt. had traditionally been inhabited by this species, whose residential population was growing since the beginning of XXI century, when the nature protection measures regarding both the species and the area in question were determined.

Pic. 2.2.4.1.3.Signs of Brown bear increasing presence in the NP/BR (Photo: Bjedov, V.)

Main threats for Brown bear in Serbia include habitat degradation and loss, Illegal killing and negative human perception along with a low acceptance due to fear for personal and property safety. Commonly bad public perception of large carnivores originates from the damage they cause to humans, as in livestock depredation, as well as beehives, orchards and property damages. Negative attitude is especially common in directly affected rural communities. The often misidentification of the damage-maker by lack of evidence leads to unjustly bad reputation of species such as Brown bear.
Ministry of Environmental Protection compensates the damage caused by protected species in Serbia, by establishing the Commission for Determining Compensation of Damage Inflicted by Protected Species, which decides on the submitted applications. Their data show a significant increase in bear-inflicted damages in Golija NP.
Although being aware of and accepting the Brown bear presence on Golija Mt. „since always“, the locals are not exactly welcoming its increasingly frequent presence in their close surroundings. With a healthy respect of this noble beast, the locals are taught from early on how to look after themselves in the woods and no bear attacks were recorded in this area in more than 100 years. However, there were many close encounters, despite the fact that both the humans and the bears try to avoid them.

Initiatives/Actions on SDG 11, 15 & 16

Recently, the Manager of both Golija NP and Golija-Studenica BR - Public Enterprise „Srbijašume“, became aware of Brown bear population increase due to the number of bear sightings, tracks and marcations their rangers, along with the locals, have reported. Concerns arose when the bears started to roam near human settlements, which meant that the encounter was more likely and the fear for safety started to spread in the local communities. The main concern, though, were the local children, many of whom took everyday hike of several kilometers to and from school, route of which often lead through undisturbed wilderness (Figure 5).

Pic. 2.2.4.1.4. Village of Golija Mt. (Photo: Jovanović, I.)

In 2017, a long-term project “Monitoring of Brown bear (*Ursus arctos*) in Golija Nature Park” was launched, funded by the Ministry of Environmental Protection and carried out by the Institute for Nature Conservation of Serbia and PE „Srbijašume“. The main Project objectives were to: map all recent (camera footage and field research) and historic data (literature data) regarding the Brown bear presence in the Golija NP; determine the residential population size and structure, individual home ranges and territories; determine bear migratory corridors that are habitat related, and analyze migratory patterns in regard to adequate positioning of additional feeding places; inform and educate the rangers as well as the local communities about the Brown bear population in the NP; address the safety concerns of the locals.

Practical Outcomes/Achievements

Several automatic capturing cameras were set up over additional feeding places in the PA and close to 40 days of field research have so far been conducted. Additionally, cameras were set ad hoc over the beehives where damages were reported (Figure 6). The already existing cameras on places for additional feeding of game animals were also used. The analysis included interviews with the rangers and with the locals, as well as the statistics and data of the Commission for Determining Compensation of Damage Inflicted by Protected Species, such as the number and position of reported bear-inflicted damages in the NP/BR.
The baseline of the Project was to determine Brown bear population size on Golija Mt. and continuously carry out monitoring (i.e. population dynamics, feeding behavior, geographical distribution, dispersal patterns) for the purpose of better understanding the bear population ecology. So far, the Project has confirmed permanent or occasional presence of 15 to 20 individuals of both sexes and various ages, with possible existence of five independent reproductive groups (females with cubs) within the NP/BR.

Pic. 2.2.4.1.5.Female bear with three cubs captured on automatic capturing camera set over frequently visited beehive (Photo: PE „Srbijašume“)

The main Project goals are to strengthen the Brown bear protection in Golija NP/Golija-Studenica BR by providing adequate additional feeding places and by improving local population perspective of having this animal as their neighbor. Providing suitable educational programs for the local communities is the key to fight the prejudice they may have in regard of the Brown bear and to feel and be safer. New places for additional feeding are to be installed during the course of this project and positioned to distract animals from human settlements. Positioning will be based on the determined resident bears' home ranges and bear migratory patterns.

In 2018, two educational workshops were held. The purpose of the first workshop was to present the main outcomes of the first year of the project to the Managers and to discuss future steps. The second workshop was of a larger scope, aiming to introduce both rangers and the locals with the findings of this project regarding the Brown bear population in Golija NP.

Pic.2.2.4.1.5. Presentation of the project results in educational workshop for the rangers and locals, as well as on local TV stations (Photo: INCS)

In the following years of the project, educational programs will further be developed, concentrating on the local communities. The overall goal of the project is to promote Brown bear population increase as the added value of this Protected Area and to involve local communities in the Brown bear protection and monitoring programs. The Manager intends to support opportunities for local sustainable development through the establishment of eco-tourism contents in Golija NP/Golija-Studenica BR, such as bear watching activities for visitors of the Protected Area.

2.2.5. Sub-indicator: Protected Area „Gornje Podunavlje“, as a part of UNESCO MAB biosphere reserve “Backo Podunavlje”

The Special Nature Reserve " Gornje Podunavlje " is one of the best preserved wetland units throughout the Danube River, which has been under the protection of the state since 1989. The “Gornje Podunavlje” reserve is located on the border junction of Serbia, Croatia and Hungary and is part of a complex ecosystem that represents the largest flooding area on the mid Danube stream. In order to protect and conserve the entire floodplain, UNESCO declares this area for the MAB cross-border biosphere reserve "Bačko Podunavlje" in 2017.

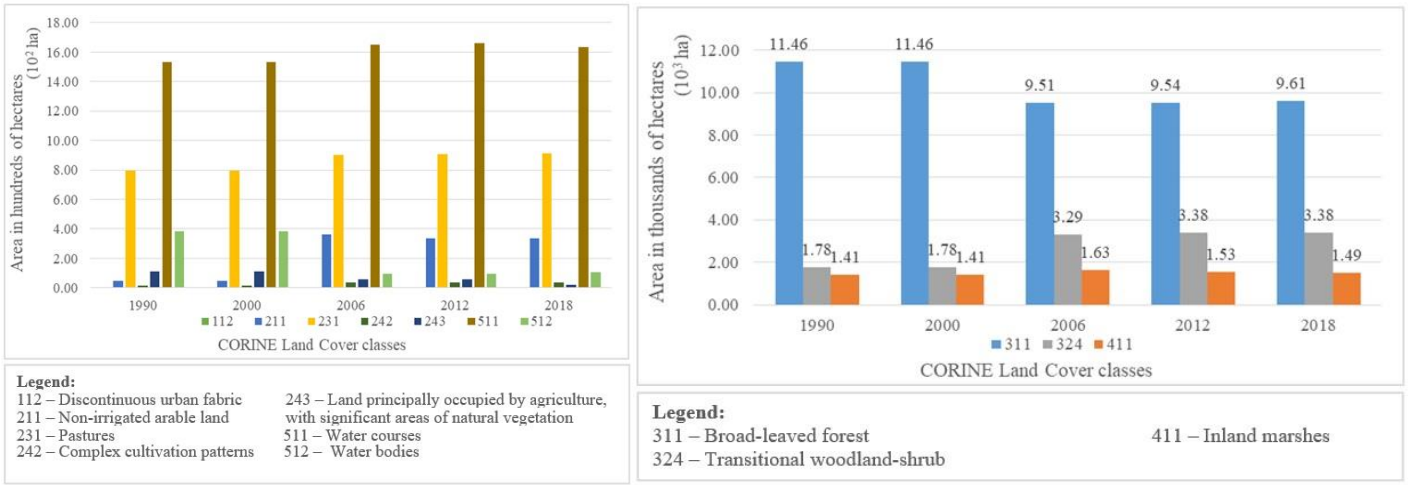


Fig. 2.2.5.1. CORINE Land Cover habitats changes in Gornje podunavlje

According to the results of the analysis, it can be concluded that in this area there are two parts of urbanized surfaces and a negative trend of surface changes from 3.54 ha (1990) to 0.25 ha in 2012 was recorded. In the following period, no change in size was recorded (Fig above and Tab. below). Although there are a large number of weekend settlements in this area, according to the 2011 Statistical Office of the Republic of Serbia, there is a decrease in the number of inhabitants in this area, which enables the domination of natural processes and natural habitat restoration.

Tabela 2.2.5.2. Number of CORINE habitat polygons in protected area „Gornje Podunavlje“

CORINE habitat types	1990	2000	2006	2012	2018
112	2	2	2	2	2
211	10	10	8	8	8
231	2	2	8	7	7
242	4	4	5	5	5
243	8	8	4	4	3
311	31	31	39	35	32
324	36	36	49	50	48
411	25	25	22	21	15
511	1	1	5	5	2
512	4	4	2	2	2

The surface of the cultivated farm land that is increasing but it also comes to the consolidation of areas, from only 45.21 ha in 1990, increased to 336.08 hectares in 2018. There is an increase the Pasture area from 12.67 ha to 35.48 ha with an increase in the number of habitats in 2006.
After 2006, neither the area nor the number of pastures changed significantly and in 2018 it occupies 34.69 ha. It can be concluded that in this area, despite negative demographic data, the anthropogenic activity is not weakened; there is even a greater pressure on the area.
This is supported by the fact that the area of predominantly agricultural land with a significant area under natural vegetation decreases from 112.51 ha in 1990 to 56.67 ha in 2006 and only 20.53 hectares in 2018 , with the expected decrease in the number of these areas.It is interesting to note that in the analyzed period the area and number of watercourses increased in 2006 from 1 533,00 ha (2000) to 1,651.50 ha. In 2018, the area was slightly smaller (1 635,90 ha), but there was a noticeable surface consolidation (Fig and Tab. above). Unlike watercourses, the number and area of water basins decreased from 384.42 ha in 1990 to just 94.45 ha in 2006, but in 2018 the area increased to 107.19 ha. It can be assumed that a reduction in the number of water basins caused an increase in the number of watercourses in 2006 and 2012, but the number of watercourses continued to decline in 2018. The cause of this can be changes in climate parameters.
The results of the analysis of broadleaf forest surfaces, primarily of the wetland floodplain forests, show a decrease in the area of 11 458.14 ha in 1990 to 9 508.84 ha in 2006 with a higher degree of fragmentation. In the following period, the trend of increase in the area under forests (9 610.39 ha in 2018) was recorded, at the expense of the transitional forest/shrub surfaces. Increasing the surface of the transition area from 1 782.38 hectares in 1990 to 3 381.62 ha, corresponds to the changes recorded in the class of broad-leaved forests (Fig above). It can be assumed that changes in these classes occurred in response to changes recorded in water basin and watercourse classes, that is, that a higher amount of water in water basins (107.19 ha) and a smaller number of watercourses positively influence the state of the natural forests and the transitional areas (Tab. above).

It is important to note that in this area there is a positive trend of changes in surface under land swamps while simultaneously consolidating these habitats, from 1 406.67 ha in 1990 to 1 493.55 ha in 2018. Oscillations in the change in the surface of these habitats can be related to changes in the surface of the watercourse class.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Undefined managers of ecological network,
- Undefined duties and obligations of managers of ecological network,
- Legal status of HPS needs to be better defined,
- Financial base for further establishment and management of ecological network is needed.

2.3 Protection and evaluation of landscape types

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 2

Aichi target

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

In 2007, the Republic of Serbia signed the Convention and ratified it with the pass of the Law on the Confirmation of the European Convention of area in 2011 ("Official Gazette of the Republic of Serbia", No. 4/11). In this way, the quality area management policy is institutionalized and international and cross-border cooperation in this area is intensified. The objectives of the European area Convention are twofold: preserving the regional diversity of landscapes and places of unique character, as well as improving the quality of the area by restoring existing ones or creating new values. The application of the Convention implies prior identification and assessment of the area.
Due to the lack of data on significant and characteristic features of the area, protection of the area is realized in two ways: the creation of protected areas or the protection of certain (visual, structural) characteristics of the area. According to Article 33. The area of exceptional characteristics is a protected area of recognizable appearance with significant natural, biological, ecological, aesthetic and cultural-historical values, which over time evolved as a result of the interaction of nature, the natural potential of the area and the traditional way of life of the local population. A cultural landscape of exceptional features is also distinguished, making cultural and historical values particularly valued and prominent from the aspect of nature protection.
The possibility of prohibiting or limiting activities that jeopardize the structure of an area significant for the conservation of biological diversity is ensured through a professional basis (if any). In these cases, the regulations for the protection of habitats or species, for example, in cases of the need to preserve area elements with the role of ecological corridors or the ban on cultivation of green areas on the bare area surfaces where this may impair the natural composition of habitat types and the survival of specialized species.
The Law on the Spatial Plan of the Republic of Serbia 2010-2020 ("Official Gazette of the Republic of Serbia", No. 88/2010) establishes the policy of protection, planning and management of Serbian landscapes. In accordance with this plan, the goal is to integrate the issues of the area (quality of the land) into the spatial planning system (spatial and urban plans). As a legal instrument for the realization of this goal, it is stated ... "the confirmation of the EKP, the integration of the issues of the area into the Law on Planning and Construction (establishing the obligation to develop a Study on the areas or making the characterization of the area as part of integral space planning at all levels); the Law on Nature Protection , The Law on Forests, the Law on Agricultural Land, the development of the Study of impact the area of plan and project development, the proclamation of the protection regime of revalued natural and cultural areas and environmental units in settlements.

2.3.1. Indicator Name: Trend of Forest area change in Serbia

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Key messege: In the period from 1953-2018 the area under forest has dubbled

Assesment: 

The indicator shows trend of changes of forested area in the territory of the Republic of Serbia. It is used by forest authorities but also by biologist and ecologists in order to assess percentage of forested area compared to the total area of the Republic of Serbia. Changes in forest area due to forestation, renewal or deforestation, represent an indicator for sustainable forest management and to monitor the role of forest ecosystems in the global carbon cycle.

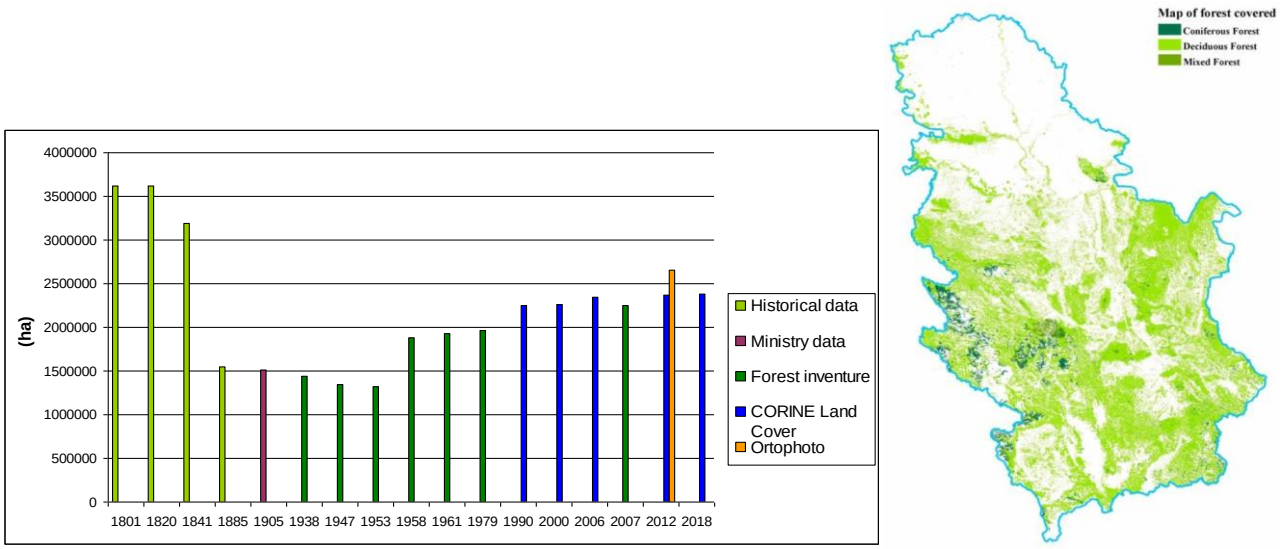


Fig. 2.3.1.1. The trend of the change of the area under the forest (left) (without the territory of AP Kosovo and Methodical) and map of the forest in the territory of the Republic of Serbia

According to CORINE Land Cover for 2018, the area under forest in the Republic of Serbia (excluding the territory of the AP Kosovo and Metohija) is 2380917 ha, which represents 30% of the territory, while according to SPOT5 satellite images the area is 2 654 000 ha, which is about 35% territories. In the period from 1953-2012, there was an increase in the area under the forest for over a million hectares, an increase of 75% compared to 1953.

Based on SPOT5 satellite images with a resolution of 10 m, epoch 2010/2011, the area under the forest is 31 956 km2, which represents about 36% of the territory of Serbia. The area of deciduous forests is 29 442 km2, the area of coniferous forests is 1 965 km2, and the area of mixed forests is 549 km2.

Apart from loess planes, swamps, rites, salt marshes and high-mountain belts above the natural upper forest border, the territory of Serbia belongs to forest biomes. Namely, in Serbia, the natural conditions are such that the primary climatogenic forest vegetation could cover 85% of its surface. Although there are no written data, it is assumed that in the medieval Serbian state, the forestry was approximate to the potential, between 75 and 80%. Because of this, Stefan Nemanja (1113 - 1199) allowed the inhabitants of Dubrovnik to cut our forests for the needs of shipbuilding without compensation. Forest cutting continued after Nemanja, due to the expansion of pasture areas and the development of mining. Forest cutting continued during the time when the forests were exploited not only for to mining, but also because of the more developed cattle breeding. Therefore, Emperor Dušan (1308-1555) by the Article 23 of the Dušan Code of 1349, banned the miners of Sas from indefinitely reducing the forests and settling down on the areas that have been cleared.

The ban on unlimited deforestation was later expanded to the nobility, and the inhabitants of the villages Ljubižnja and Skorobijnja in the Prizren region were forbidden to "poorate" the mountain on the property of the Prizren monastery. At the time of the Turkish occupation, from 1718 to 1721, only 50-60 000 inhabitants lived in Serbia due to population displacement. Due to depopulation, the forests conquered their old premises and covered over 80% of the territory. However, at the beginning of the XIX century, especially after the First Serbian Uprising, the population began to return. In 1820, 500,000 inhabitants lived in Serbia and 2,492,882 inhabitants in 1900, which led to massive deforestation, primarily for the expansion of agricultural land and extensive livestock breeding.

For this reason, in 1885, the forests decreased to only 32%. This was not the end of the destruction of forest vegetation, after the Second World War it covered only 21.4% of the territory, which is the smallest forest covering surface in the history of these areas. Thanks to the measures of afforestation, melioration, care and protection of forests, as well as the migration of the population from mountainous areas, in the second half of the 20th century the area under the forests was somewhat increased, so today the forests cover 30.6% of Serbia. However, Vojvodina, as a typical agrarian area, has remained permanently without forests.

2.3.1.1. Case study: Ecosystem status of forests in Serbia

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Assesment:

Of all types of vegetation the most developed forest vegetation is consisted of 49 indigenous trees,40 deciduous and 9 coniferous. At the beginning of the nineteenth century forests covered 75-80% of Serbia, while today 30% of the territory is under forests, and 4.9% of the territory is under shrub and bush vegetation. The forest supply has the highest amount of sprout forests (64.7%),followed by compositions of high origin (27.5%) and artificially grown compositions (7.8%). The areas are covered with beech forests (29.4%), Austrian oak (15.3%) birch forests, aspen and black locust (9.9%), Sessile oak forests (7.7%), Hungarian oak forests (7.1%) pine forests (5.6%), European hornbeam forests (5.3%), spruce forests (3.8%). In the autochthonous forest genetic resources, endemic and relic taxons - Balkan pine(*Pinus peuce*), Bosnian pine (*Pinus heldreichii), Serbian spruce (Picea omorika), European yew* (*Taxus baccata*), Balkan maple (*Acer heldreichii*), etc. are the most valuable

Forest species: The analisys shows percentage of presence of different species, according to 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.

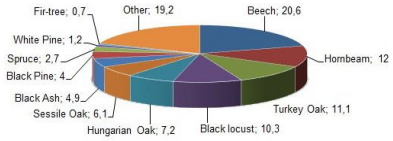


Fig. 2.3.1.1.1.Tree species broken down by the number of trunks

Mixed tree species: The analisys shows percentage of tree species by volume, in the inventory unit. Almost 50% are forests consisted of 2-3 tree species, there are 44% of forests with 4-5 tree species, while forests with only one tree species cover only 7% of the inventory unit. The forest eco-systems in the territory of the Republic of Serbia have a very favorable status.

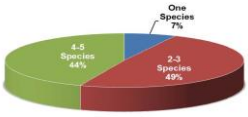


Fig.2.3.1.1.2. Mixed tree species

Types of forests: The anallisys shows the percentage of each forest type in the total surface covered by forests. According to data from Forest Inventory and the Ministry of agriculture-Forest Directorate, boreal forests are the most prevalent, and represents 91.27% of the overall forests. The most common are oak (32 %) and beech forests (29.3 %).

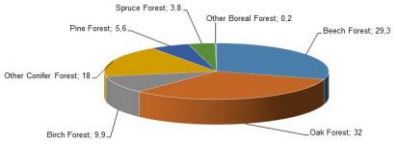


Fig. 2.3.1.1.3. Composition of forests in the Republic of Serbia

2.3.2. Indicator Name: Dead wood in forests

Author/Institution: **Slaviša Popović/ Environmental Protection Agency**

Key messege: The total amount of dead trees in the forests of Serbia **16.260.414 m^3**

Assesment: 

The indicator shows the amount (volume) of the upright and prostrate dead wood in the forests, which are important habitats for a large number of species. Larger quantities of such wood in the forest caused greater biodiversity of forest habitats because it is very important substrate component for many species. The quantity of dead wood ensures the continuity and sustainability of habitats (biotopes), especially for ornithofauna and entomofauna that live in the forests and whose habitat is sometimes limited to small parts of dead wood of specific type.

Dead wood in the forests are important habitats for a large number of species, especially upright and prostrate dead wood. Larger quantities of such wood in the forest caused greater biodiversity of forest habitats because it is very important substrate component for many species. Quantity of dead wood is calculated by the analysis and assessment of the number and volume of the standing and lying dead wood in the forest, with a minimum length of 2 m and trunk diameter of 10 cm per hectares of forest, and their timber mass expressed in a cubic meters per hectare (m^3 / ha), respectively in tones per hectare (t / ha), for a five year period.

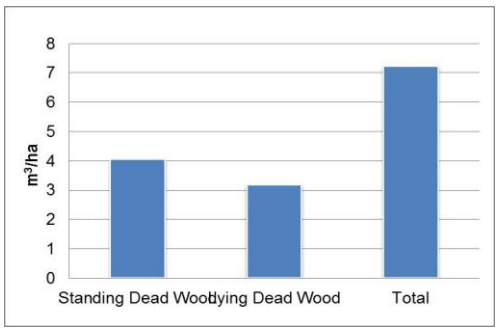


Fig. 2.3.2.1. Dead wood in forest

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 m 3 . Average standing dead wood volume is 4.05 m 3 /ha, and lying dead woods volume is 3.17 m 3 /ha, in other words the total concentration of dead wood in our forests is 7.22 m 3 /ha, in central Serbia it is 7.18 m 3 /ha, and in Vojvodina 7.75 m 3 /ha, which is considerably above the norm of 2-3 m 3 /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.

2.3.3. Indicator Name: CLC Change of intended land use

Author/Institution: **Slaviša Popovic/ Environmental Protection Agency**

Key messege: There is a decrease in agricultural land in the period 2006-2018. Years

Assesment: 

The indicator 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 2006, 2012 and 2018. The analysis of contributions by specific categories of intended land use for urban development in Serbia in the period 2006-2018 showed which type of land is occupied mostly. Analysis of the change of intended land use in 2006-2018 period shows that most changes occurred under artificial surface category (34.605 ha increase). Agricultural land in the observed period reduced by 86492 ha. Surfaces under the category of forests and semi-natural areas increased by 220485 ha, humid regions – classified under inland wetlands – increased by 8487ha, while areas under water basins increased by 17542 ha, mostly as a result of construction of artificial lakes.

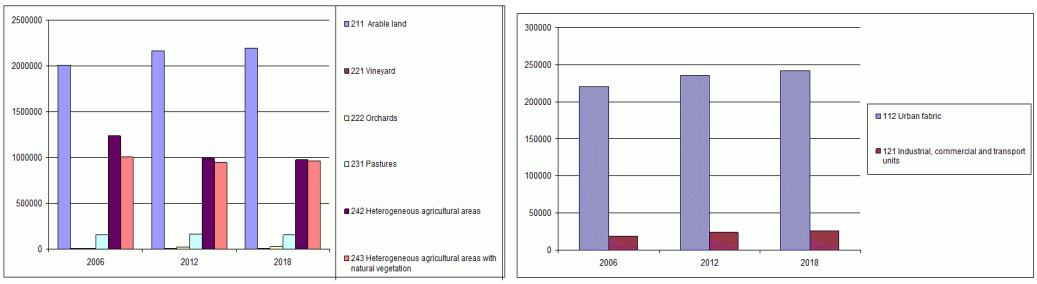


Fig. 2.3.3.1. CLC change of agricultural and urban areas in Serbia (without of territory of Kosovo and Metohija)

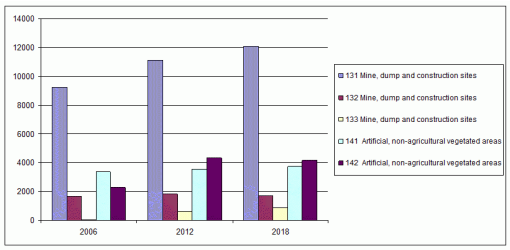


Fig. 2.3.3.2. CLC change of industrial area in Serbia (without of territory of Kosovo and Metohija)

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Habitats of many known endangered species in RS are still not included in protected areas, and they are sometimes deteriorated even within PAs,
- Insufficient field pro-active conservation measures,
- Lack of field data and knowledge on species occurrence, trends, drivers and threats,
- Administratively and practically improperly implemented procedures issued to harmonize and minimize human impact on biodiversity,
- Habitats of some endangered species in RS are not properly managed (e.g. over-exploited, under-grazed, eutrophication…),
- Insufficient field-guarding and ex-situ conservation activities (e.g. although wild animal sanctuary in Palić ZOO works well, there is a need for more sanctuaries),
- There is a need for better enforcement of compensation and mitigation measures for projects impacting biodiversity, as well as for better implementation of measures of decreasing human-wildlife conflicts,
- Although combated, wildlife crime is still present, e.g. killing, collecting, poisoning, capturing…

Improvement of the system of protected areas and ecological networks indicators system

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
2.1. Increasing the area of protected areas and management effectiveness	2.1.1. Trend of Protected areas changes	N		C11	
	2.1.2. CLC habitat changes in Protected Area in Serbia	N			2.1.2.1. Case study: Ecosystem status of Pannonia open sand in Serbia 
					2.1.2.2. Case study: Change of open-sand habitats in Deliblatsk sand region since XIX century 
	2.1.3 **Monitoring and improving the status of protected areas**	N			
	2.1.4. Change in the amount of funds allocated from the Budget to Protected Areas	N			
	2.1.5. Change in the amount of funds allocated from the compensation for Protected Areas	N			
	2.1.6. Sources of financing of national parks in Serbia	N			
	2.1.7. Change in the amount of funds invested in the protected areas in Vojvodina	L			
	2.1.8. Protected Area Management Effectivness	L			
	2.1.9. Habitat changes in selected protected areas	L			2.1.9.1. Case study: Restoration of steppe habitats on Fruška gora and Deliblato Sands in XXI century 

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
2.2 Establishment and development of the ecological network of the Republic of Serbia	2.2.1. CLC habitat changes inside Ecological network in Serbia	N		B5 and D14	2.2.1.1. Case study: Prime Hoverfly Area (PHA) 
					2.2.1.2. Case study: Ecological network in Vojvodina 
	2.2.2. Habitat changes in UNESCO MAB biosphere reserves	N			
	2.2.3. Sub-indicator: Protected Area „Golija“, as a part of UNESCO MAB biosphere reserve				
	2.2.4. Sub-indicator: Habitat changes in Protected Area „Golija“ according to LANDSAT imagery				2.2.4.1. Case study: Living With Brown Bear in Golija-Studenica Biosphere Reserve 
	2.2.5. Sub-indicator: Protected Area „Gornje Podunavlje“, as a part of UNESCO MAB biosphere reserve “Backo Podunavlje”				
2.3 Protection and evaluation of landscape types	2.3.1. Trend of Forest area change in Serbia	N			2.3.1.1. Case study: Ecosystem status of forests in Serbia 
	2.3.2**. Dead wood in forests**	N			
	2.3.3. CLC Change of intended land use	N			

National Target 3

Sustainable use of natural resources

Rate of progress toward the implementation of the selected target

-Progress towards target but at an insufficient rate 

Priority Area	Priority actions	Aichi target	Progress Assessment	National Progress Assessment
Priority Area 3. Sustainable use of natural resources	Priority action 3.1.	D14, D15 and D16		

Article 5 of the Convention on Biological Diversity states that "each Contracting Party shall, to the extent necessary and possible, cooperate with the other Contracting Parties, directly or, if necessary, through the competent international organizations, in respect of areas are outside the jurisdiction of national courts and in relation to other issues of common interest, with a view to preserving and sustaining the use of biological diversity".

In order to fulfill its obligations and ensure the successful conservation of biodiversity, especially with regard to sustainable use of biodiversity, international and regional cooperation needs to be improved.

Priority Actions toward National Target 3

3.1 Developing mechanisms for sustainable use and equitable distribution of biodiversity components

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 3

Aichi targets D14, D15 and D16

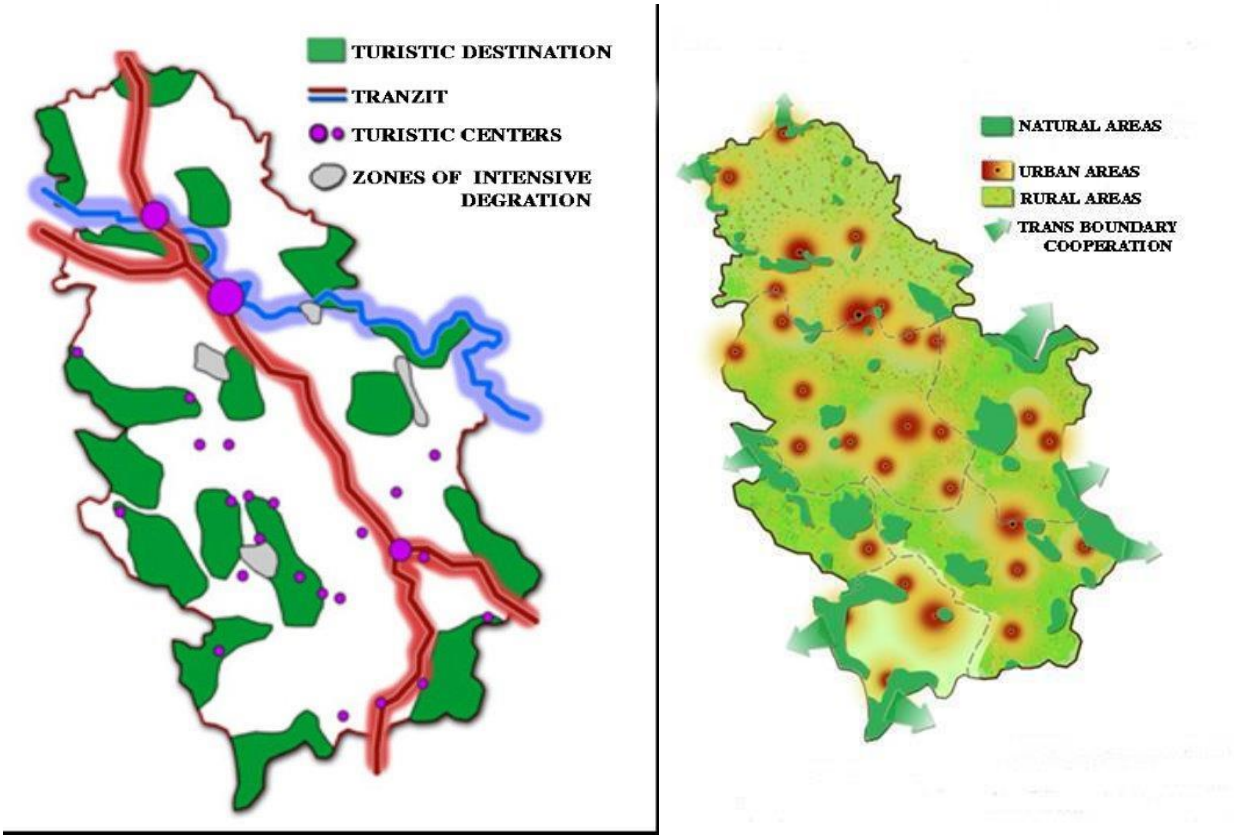
Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- X Measure taken has been partially effective 

The measure relates to basic resources of natural systems in Serbia – land, agricultural and forest resources, heir sustainable use and equitable distribution of biodiversity components in each natural system.

Degree of resources utilization depends on their size, availability, society development and the population size in a defined territory. Under this measure resource capacities are defined in relation with the population size, and data are obtained on the basis of the census and the data taken from the Statistical annual reports of the Statistical Office of the Republic of Serbia, mainly. According to analysis in the 5th National report to CBD, it is evidenced that capacity and availability of natural resources have a big impact on and influence of the complete environmental system to the human health and well-being. In terms of that, indicators connected to this measure shows trends connected to the changes of land, agricultural and forest resources which contains biodiversity components (wood, medicinal and aromatic plants, non-timber forest products, fish, hunting species…).

Nowadays, genetical resources are not considered as a common heritage and can not be treated as goods with a free access. Each state has the sovereign right to regulate access to own genetical resources and to support traditional knowledge. Article 15 of the CBD provides a framework for regulating and protecting knowledge and genetical resources in order to facilitate access and fair and equitable distribution of profits. Thus, sustainable use of genetical resources has an economic, ecological and socio-cultural dimension. It also contributes to food safety, rural development, employment opportunities and the improvement of population standards. Sustainable agricultural production systems are those that allow the conversion of available resources into human food and agricultural products, without reducing the availability of these resources in the future or causing environmental degradation. But indicator related to Change of intended land use will show trends in the change of use of agricultural, forest and other semi-natural and natural land into urban land and other artificial surfaces. This might threat sustainable agricultural production systems and cause inaquitable distribution of biodiversity components in natural systems.



Map. 3.1.1. Structure of land use, natural and artificial areas in Serbia

Total freshwater fishin indicates the quantity and structure of caught fish in tones.

According to the Forests Directorate Data, number of population of the main hunting species are monitored, for the following species: rabbit and pheasant populations, boar, quail population and doe population.

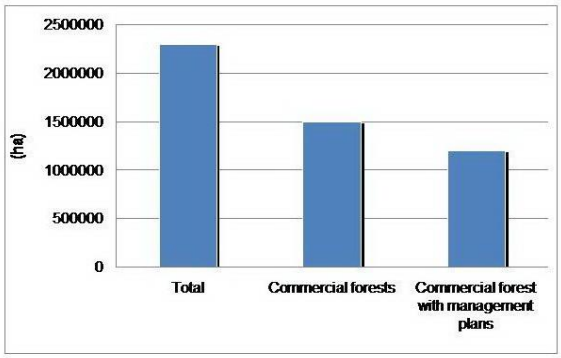
3.1.1. Indicator Name: Forest management plans

Author/Institution: Slavisa Popovic/Environmental Protection Agency

Key messege: Total forest area for comercial use is about 65% of all forest area

Assesment: 

The indicators relates to the total surface of commercial forests and commercial forests with planned management in Serbia compared to the forested surface. Sustainable forest management refers to the total area of forest covered by the plan. The management plan may be operating type (management plan) or less specific. May be registered or approved by the cost of the public authorities, but that does not necessarily constitute a precondition. 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.



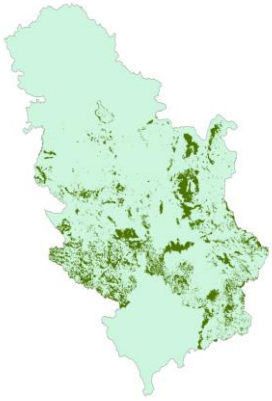


Fig. 3.1.1.1. and Map. Forest area under management plans

3.1.1.1. Case study: Forest certifications in Serbia

Author/Institution: Dejan Miletic/ Public Enterprise Srbijasume

Assessment: 

Today, two internationally recognized forest certification schemes can serve to guide foresters on implementing sustainable forest management, to control the foresters up against the qualifying standards and to prove to stakeholder that the forests are being managed sustainably: The Forest Stewardship Council (FSC®) and the Programme for the Endorsement of Forest Certifications schemes (PEFC™). Both forest certification schemes are defining Criteria and Indicators for Sustainable Forest Management, which have to be met before a forest management can achieve certification.
The FSC system develops the international FSC standards, including the centerpiece for Sustainable Forest Management by FSC called The FSC Principles and Criteria, which consist of 10 principles and 70 criteria, which has to be met by all forest management worldwide if wanting to achieve FSC certification.
In terms of certification schemes in Serbia, only public forests are certified through the Forest Stewardship Council (FSC®) certificate. PE Srbijasume has certified 834.439 ha and PE Voivodinasume has certified 128.789 ha, which corresponds to 100 % of

the managed forests in both enterprises. Forests administered by the National Parks and non-state forests are currently not covered by any certification schemes.

Assessment of compliance of the enterprise with the requirements of certification are on regular basis inspected by an authorized certified companies, which supervises that gives a recommendation for the holding of internationally active recognized FSC® certificate.

3.1.2. Indicator Name: Forest increment and wood cutting

Author/Institution: Slavisa Popovic/Environmental Protection Agency

Key messege: Harvesting of woog is about 1/3 of increament

Assesment: 

The indicator measures sustainability of timber production as a potential for future availability of timber and wood cutting in forests. Wood cutting is the most important indicator of forestry as a commercial sector, but at the same time an indicator of the anthropogenic pressure. Timber volume in the forests of the Republic of Serbia amounts to 363 million m3, which is around 161 m^3/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.
In 2015 in the forests of the Republic of Serbia around 2,954,000 m3 of wood was logged, with was about 10 % more than the previous year. 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.

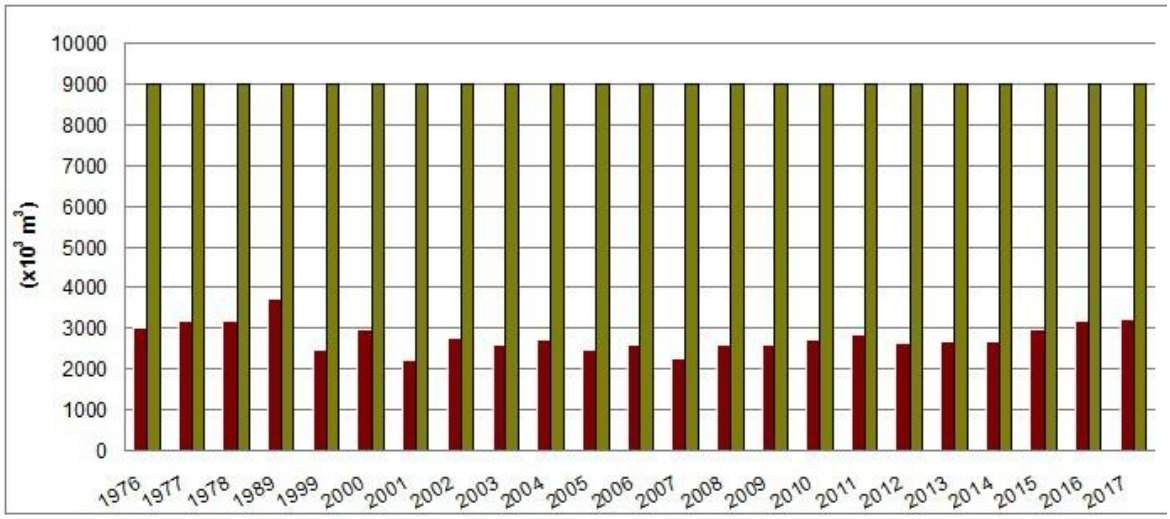


Fig. 3.1.2.1. Annual increment and wood cutting

3.1.3. Indicator Name: Timber consumption and sale

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Key messege: In the last decade, the production of state-owned forests is increasing

Assesment: 

The indicator shows trend in production of state-owned forest range of products, the ration of firewood to industrial wood and trend of share of industrial wood as opposed to firewood. 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. 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. 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 aforestation is by almost 8,000-9,000 hectares lower than in 2007 and in 80-ies of the last century, when annual aforestation amounted to around 10,000 ha

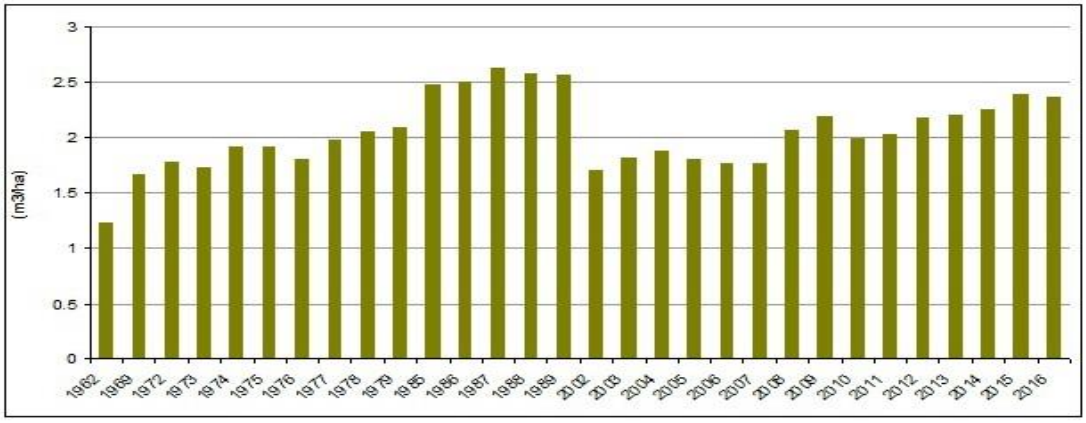


Fig. 3.1.3.1. Timber assortments from state-owned forests

3.1.3.1. Case study: Ecosystem servicies in Bosut forests

Author/Institution: Slavisa Popovic/ Environmetal Protection Agency

Assesment:

The case study for the Bosut forest addresses the four basic "benefits of nature", that is "ecosystem services" which the subject area provides and from which flood safety depends, the sustainability of forest income , the preservation of nature and the well-being of the local population.

If ecological flooding of the forest complex and the increase in the number of animals, is applied, (pigs) grown in the forest, together with integrated management and establishment of protected areas, and increase in the value of the four most important ecosystem services of Bosut forest is expected:

- Profit in wood production would be 30 to 50% less sanitary deforestation, that is, proportionally higher yield of quality industrial wood, as the current losses due to inappropriate water regime would be reduced;
- Forest retention would be able to accept between 100 and 200 m^3 of water, which would be a great benefit in the defense of floods;
- with an increased number of pigs (5-7 times) fed in the forests (reducing the costs of additional food by 2 times), the income from traditional animal husbandry would be 10-14 times higher. Also, the quality and taste of meat obtained in comparison to pig meat obtained from pig farms would be better
- For six types of habitats, planktonic communities and 11 animal species, selected as the most important, the ecological status, the number of individuals, population and the increase of occupied / settled space would be improved. Since the selected types are indicators and so called "umbrella species", it is expected that the said improvement would have a positive effect on the overall biodiversity of the area.

For many other ecosystem services (water and air treatment, hunting, mitigation of climate extremes, tourism, aesthetic services, pollination, control of harmful organisms), improvements are also expected, which at this level of the study cannot be quantified.
Extensive cultivation of pigs in Bosut forests, in the area of Posavina, has a history of more than 2000 years, described conditions, this way of traditional, multi-purpose forest management is brought to the brink of extinction due to the lack of transfer of acquired knowledge to the new generations.

It is a difficult and demanding job that no longer attracts the young people. There are 17 active pig keepers in this area with only about 1000 pigs. Of the many marshes within the forest area on only a few grazing is still happening.

Pic.3.1.3.1.1. Traditional pig photo „šiljkara“ Photo: Provincial Institute for Nature Conservation

Pigs can increase the diversity of wet habitats. Thus, for example, the habitats under the great pressure of acorn fruit are covered with very rare and protected Nanocyperion species: *Ludwigia palustris, Marsilea quadrifolia, Hottonia palustris, Callitriche palustris*. And other species characteristic of mud habitats, such as *Lindernia procumbens, Cyperus fuscus, Heliotropinum supinum, Gnaphalium uliginosum, Eleocharis acicularis* have been found in several places where there is intense presence of acorn fruit.

Pic. 3.1.3.1.2. Small humid habitats in the forest, morass, represent specific habitats under the forest structure

Pic. 3.1.3.1.3. Swamp at the location of Varadin where there is an intense presence of acorn fruit with *Hottonia palustris* and *Ludwigia palustris*

If the situation was to be significantly improved, primarily through the establishment of regular forests flooding and depressions in the periods important for the eagles, as well as through the increase in the number of pigs in the forests, swamps and clearings, there would have been an improvement in the food habitats, as well as the quantity and availability of food, especially in the period of reproduction.
In that case, it could be expected that in the period of 10 years first stabilization would occur, and then increase in the number from the existing 10 to a maximum of approximately 15 pairs in the entire area of Bosut forest

Pic. 3.1.3.1.4. White-tailed (Haliatus albicilla), Otteh (Lutra lutra). Photo: G. Farkas

In the case of restoration of the natural flooding regime by establishing retention, where all of the 1.304,85 ha of marshes would be optimally flooded, and under water during the spring period, it could be expected that half of this area (about 650 ha) could be under swamp vegetation.
From the standpoint of preservation and protection of otter this scenario would have double benefits. The indicated increase in the otter population in marshes would be multiple (200-300%), but within the entire Bosut forest complex this increase is observed in relation to the total population, which is presently primarily inhabited in watercourses, and not in the marshes, and which in this case scenario would increase by about 30%.
https://balkangreenenergynews.com/wp-content/uploads/2018/06/ESAV-case-study-Bosut- Forests-2018.pdf

3.1.4. Indicator name: Collected wild flora and fauna

Author/Institution: dr Radomir Mandić/ University Futura, Slavisa Popovic/Environmental Protection Agency

Key messege: Use of wild flora and fauna increase

Assesment: 

In addition to cultivated plant types, overall agro-biodiversity of Serbia also includes wild plant species that represent important components of food production and agriculture (forage crops, medical and aromatic herbs, decorative plants, honey plants, wild fruit). Various agro-ecosystems (arable farms, orchards, vineyards, meadows, pastures, brink and ruderal habitats) and components thereof, including weed flora and vegetation also contribute to overall agro-biodiversity of Serbia.

The diversity of species that dwell in natural fields (meadows and pastures) has not been well studied or estimated, but number of species within the described 273 plant associations has been estimated at more than 1,000. Total number of medical and aromatic plant species in our flora is about 700, out of which 420 have been officially registered. 280 of these are traded as commodities. Honey plants are primarily found in meadow, forest and agro-ecosystems, and their number in our country has been estimated at approximately 1,800. In most general sense, flora agro-biodiversity includes weed and ruderal plants as agro-ecosystem components. The studies conducted to date on weed flora diversity in Serbia reveal that the number of weed species represents 28% of the total flora (more than 1,000 species).

Areas under forests in Serbia include combination of deciduous forest (beech and oak), in the percentage of about 60.7%, conifer forests, in the percentage of 4.7%, and mixed deciduous-conifer forests, which cover 33% of the area. With regard to autochthonic forest genetic resources, greatest value is seen in endemic and endemo-relict species (*Pinus peuce, P. heldreichii, Pinus nigra ssp. gocensis, Picea omorika, Taxus baccata, Prunus laurocerasus, Acer heldreichii, Fraxinus pallisae, Forsythia europaea, Corylus colurna, Daphne blagayana, D. Mesereum* and others). Within forest genetic resources, in addition to the natural rarities, great importance is given to wild fruit species. Eighty-eight species of wild fruit have been identified within the natural forest associations of Serbia, 12 of which are endangered species.

Among genetic resources of medical and aromatic herbs, greatest importance is given to genetic diversity of commercially important species (chamomile, mint, sage, hypericum, yarrow, oregano, bearberry, valerian, plantain, primula, etc.), as well as to sorts of limited areals and to those that are for some reason endangered. Looking at the genetic resources of medical and aromatic herbs and the need for their conservation, coordinated monitoring activity, which would look into the status of their populations, has not been implemented for a long time, while general conservation strategy at national and international levels have not been developed yet. This is one of the main reasons for the recommendation related to establishment of ECPGR Working Group for Medical and Aromatic Herbs (1999).

The wild relatives are of particular importance as genetic resource in improving and selecting cultivated plants, especially at the level of resistance to various abiotic and biotic stressful external factors. More than a half of cultivated plants have direct relatives within forest and herbaceous plant associations. As far as it is known, there have been no attempts to develop inventory and perform characterization of these genetic resources in our country, except for wild relatives of fruit species.

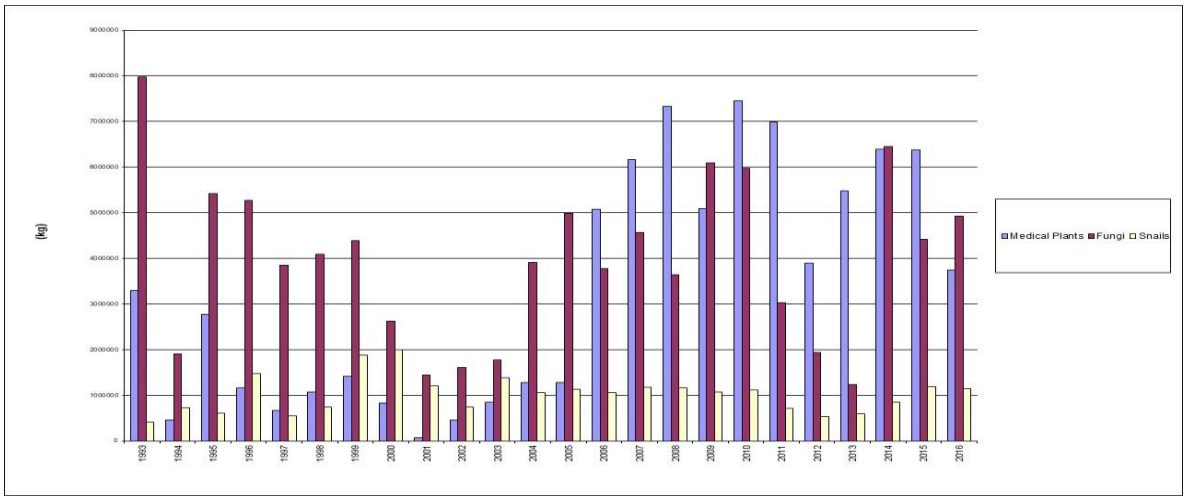


Fig. 3.1.4.1. Trend of colected medical plants, mushrooms and snails in Serbia.

The collection of medicinal herbs shows upward trends starting from 2004, the quantities of mushrooms collected are constantly increasing and are conditioned by weather conditions (whether the year is good for mushrooms or not), snails are kept constant on quantities that are approved, while frogs over the Last 5 years have not been collected because excessive collecting has damaged the age structure of populations, so there are not enough adult individuals in the wild. Weather conditions by years (bad year for mushrooms due to the great dry season, the same goes for snails, some years are bad for juniper because it does not yield every year, the dry season affects the quantity and quality of medicinal herbs.

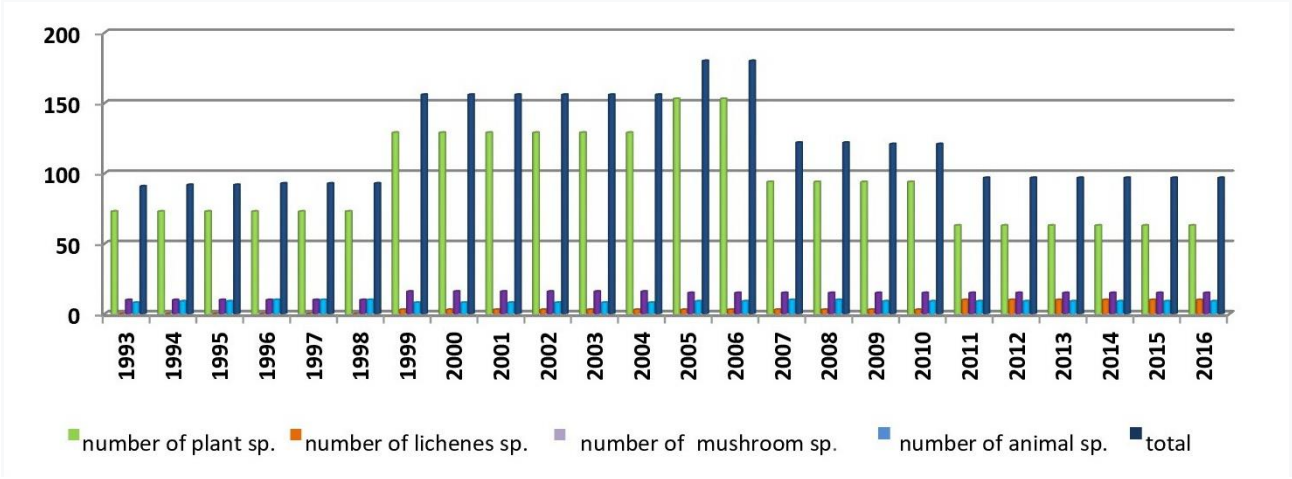


Fig. 3.1.4.2. Graphical owerview of wild flora and fauna number of species covered by the regulations

Since 1993, in Serbia, the collection and placing on the market of wild species of plants, mushrooms and animals has been legally regulated, by the Order on putting control of the use and trade of wild plant and animal species (Official Gazette of RS, Nos. 50/93 and 36 / 94). Today, permits for the collection and trade of wild plants, mushrooms and animals are issued on the basis of the Decree on the Control of the Use and Trade of Wild Flora and Fauna (Official Gazette of RS, Nos. 31/05, 45/05, 22/07, 38/08, 9/09 and 69/11), and the licenses are issued by the Ministry of Environmental Protection, based on the opinion of the Institute for Nature Protection of Serbia.

By processing the data collected during 24 years, it has been established that the regulations from 1993-2016 included a total of 179 wild medicinal plant species, of which today with the control of collection and trade 63 are included. Analysis of the data for the stated 24-year period, it was established that 50 types of plants from 1993 to 2016 were collected in quantities of more than 10,000 kg per year, depending on the year of collection. Of these, 36 types of plants are still under the control of collection and trade, and 14 species are removed from the list of regulations even though quantities collected are significant. The number of taxons (species and genus) of mushrooms covered by the control of the use and trade of wild flora and fauna in the period 1993-2016 amounted to 21 (19 species and 2 genuses: *Agaricus* spp. *Button* mushroom and *Morshella* spp. True morrel). Mushrooms are traditionally collected in southeast, central and western Serbia.

1) **Sub-indicator: blueberry, juniper, rosehip**

Blueberry is the plant species that is most collected in Serbia. Blueberries are mostly collected in quantities of 2.482.000 kg., 2010. Total collected in the period 1993-2016, was 23,599,374 kg, while the average collected amount was an annual quantity of 983,307 kg.

Rosehip is the second species in terms of the amount of collection from nature. Thus, with licenses, in 2013, 2,250,060 kg were collected, 16,960,660 kg were collected in total, while 942,259 kg was annual collected average. Rosehip would have been the most collected plant, but the list of the Regulation on Collection Control and Traffic is from 1999, so there is no data for the first 6 years (1993-1998).

Juniper is the third type of medicinal plant that are most collected in quantities. Thus, in 1995, licensed collection was 2.500.000 kg of Juniper, a total of 16.367.767 kg, while the average annual collection was 681.990 kg

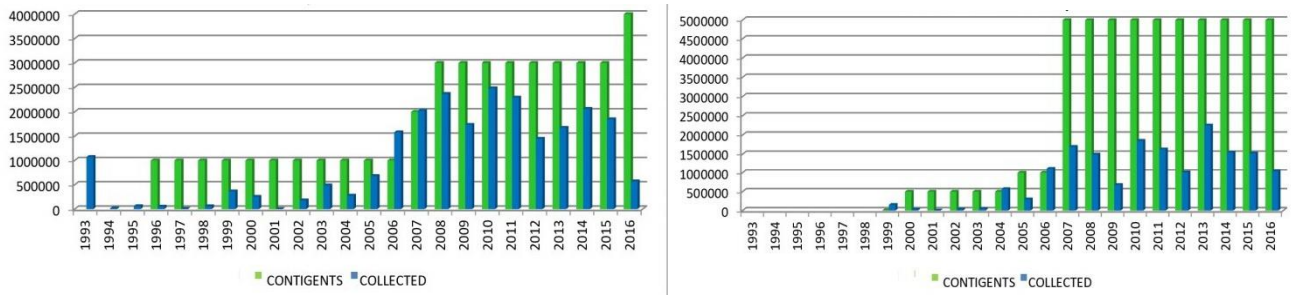


Fig. 3.1.4.3. Regulated contigents and collected blueberries (left) and rosehip (right)

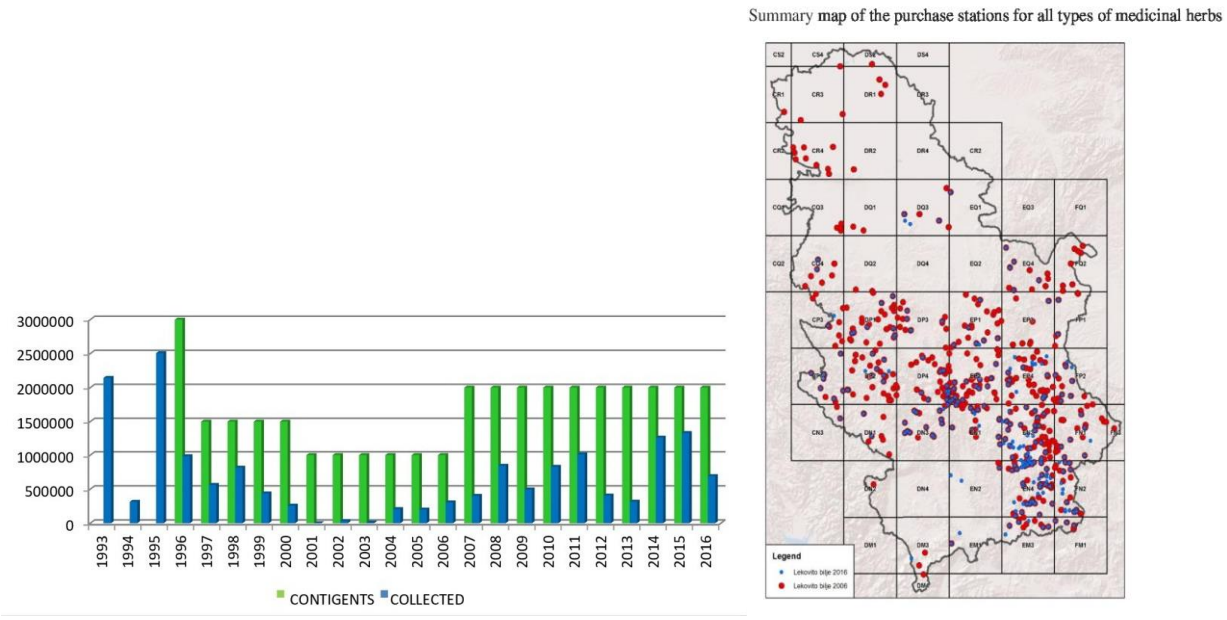


Fig. 3.1.4.4. Regulated contigents and collected juniper (left) and area of medicinal plans collection (right)

2) Sub-indicator: penny bun, golden chanterelle

Of the mushrooms, the most harvested is penny bun, the maximum amount collected in some years is about 5,000,000 kg. The oscillations seen on the chart are related to whether the year was dry or rainy, and not for the demand of this species abroad. The total amount of harvested penny bun during 24 years was 69.007.482 kg. The average amount of harvested penny bun in the observed period is 2,875,311 kg, which is the largest amount collected for any wild species harvested from nature.
The maximum amount collected was in 1993, in the amount of 5.186.100 kg. The maximum amount was collected in 1993. and amounted to 2,600,000 kg, the total amount collected for the stated period was 22,968,407 kg, while the average amount collected was 957,016 kg.
The collection of truffles in Serbia has been growing over the past twenty years, many people are engaged in gathering and trading without permits and records of collectors and trained dogs. So the truffle harvesting is largely out of control. The quantities collected are illegally exported to the Western market (Slovenia, Italy, France). One of the reasons is the calculated fee price paid to the state (for white truffles about 100 Euros per kilogram, and for the other two types of black truffles 11 and 15 Euros per kilogram). Consequently, increased controls of customs authorities, police and environmental inspections are needed.

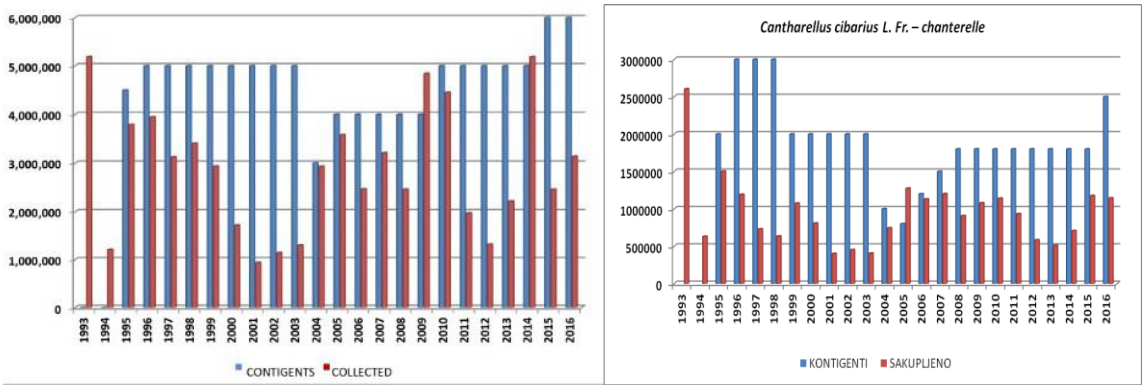
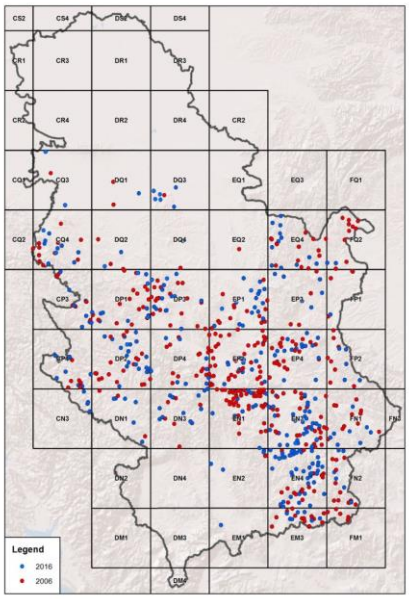


Fig. 3.1.4.5. Regulated contigents and collected boletus (left) and chanterelle (right)



Map. 3.1.4.6. Summary map of collection sites for all types of mushrooms

3) Sub-indicator: vineyard snail, green frogs

The number of species included in the control of wildlife use and trade in the period 1993-2016 amounted to a total of 13. The current Decree on the Control of Use and Trade covered 9 species of animals. The most endangered species of animals harvested from nature are undoubtedly snails. By analyzing the Annual Reports of the Institute for Nature Protection of Serbia for the period 1993- 2016, for species of animals, it is noted that the most affected by collecting are three types of snails: Helix pomatia-vineyard snail, Helix lucorum-forest snail and Helix aspersa-garden (Mediterranean) snail. The vineyard snail is the most collected. When it comes to harvesting and trade of snail from the nature, it was observed that large quantities were collected over the approved period, especially in April and May, when the snails are the most active due to reproduction. Large quantities are illegally exported to Republika Srpska (BiH), Macedonia, Montenegro, Kosovo and Metohija and others. According to the Annual Reports of the Institute for Nature Conservation of Serbia, according to the findings of the Institute at the time when the collection is not allowed (April, May), from 5,000 to 7,000 tons are collected. In the mentioned reports, it is stated that this is a common practice from previous years, and that inspection control must be strengthened, especially at well-known purchase points, warehouses-refrigerators, for those enterprises dealing with the trade-processing and export of snails.

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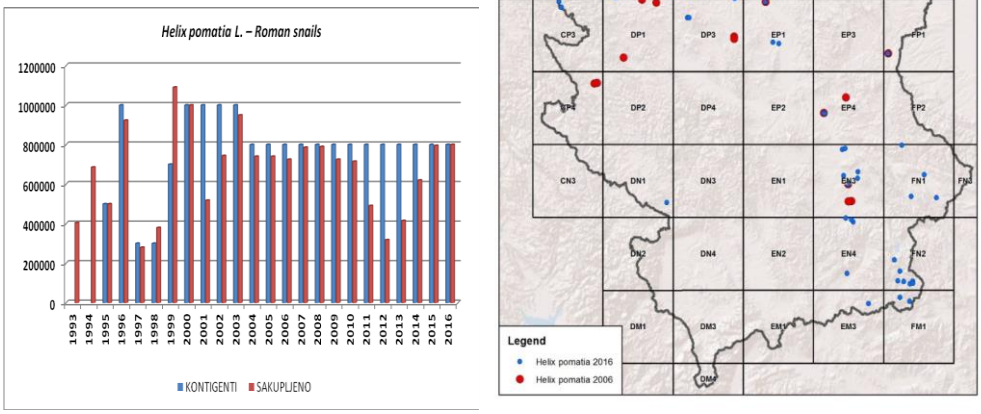


Fig. and Map. 3.1.4.7. Regulated contigents and collected Roman snails (left) and map of purchase stations of Roman snail

Frogs are animal species that are after snails, also threatened by collection.

3.1.4.1. Case study: Mineral composition of honey in Serbia

Author/ Institution: Dr Dejan Radovic/ Faculty of Security Study, University of Belgrade, Slavisa Popovic/ Environmental Protection Agency

Assesment: 

Serbia has very good prerequisites for the development of beekeeping (apiculture), distinguished by heterogeneous relief and climatic conditions and by the existence of various honeybee pastures. Considering the area of wild flora, it would be possible to breed up to 800,000-bee colonies. However, disregarding this possibility, the current utilization of capabilities is only 33.4 %, resulting in annual production of 4000–5000 tons of honey.

Honey composition is tightly associated to its botanical origin, which is closely related to the geographical area from which the honey originated. The volatile composition is very dependent on the geographical location even for the same plant species, as accumulation of phytochemicals depends on climatic conditions (sunlight and moisture), soil characteristics, and the presence of different minerals arising from soil. This suggests that the chemical composition of the honeys even of the same floral origin may be quite different. Due to the botanical origin given by the particular flora and the ecosystem diversity conditioned by the given territory, honey may have unique characteristics. Indeed, the estimation of honey quality by consumers depends on its organoleptic characteristics, which are strongly dependent on botanical origin of the honey and to some extent on its geographical origin.

Twelve minerals were quantified for each honey sample (K, Na, Ca, Mg, Fe, Zn, Mn, Cu, Ni, Cr, Co and Cd). Potassium was the most abundant mineral component, considering all the investigated samples.

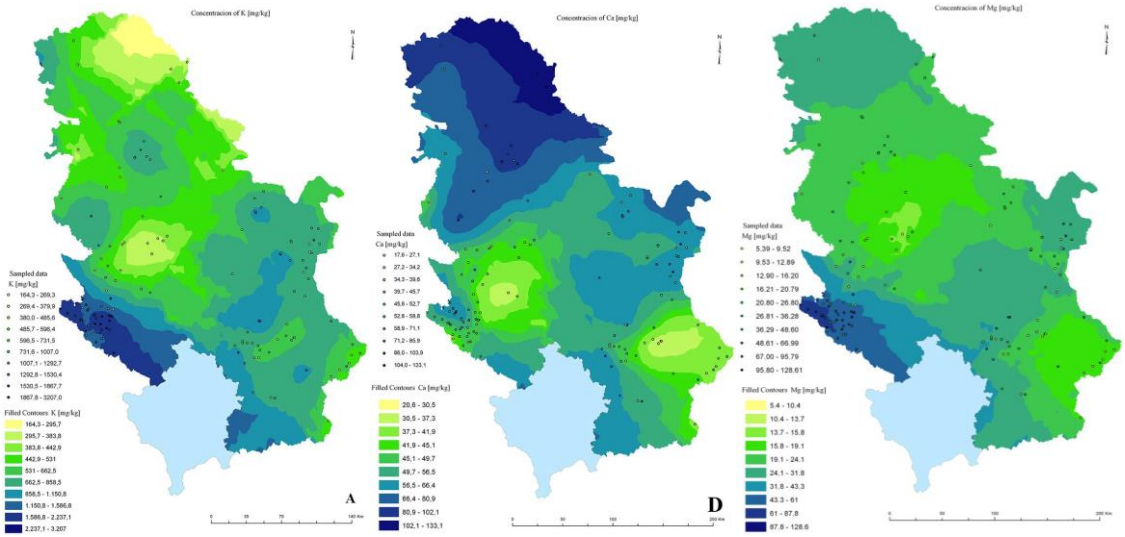


Fig. 3.1.4.1.1. GIS spatial distribution of K, Ca and Mg content in multifloral honey.

Calcium and magnesium were the next most common elements, followed by sodium, iron, and zinc. Sodium and magnesium were also present in significant amounts in all the studied samples, but several times lower than the potassium content and 2-time lower than the calcium content. Magnesium was present in higher amount in the samples coming from the Zlatibor mountain area (50 mg kg–1) than in the samples coming from the rest of Serbia (15–22 mg kg–1). The rest of the studied minerals (Zn, Fe, Cu, Mn, Co, Cr, Ni and Cd) were present in minor quantities and some of them could be detected in trace amounts (μg kg–1).

3.1.5. Indicator: Export of wild flora and fauna

Author/Institution: dr Radomir Mandić/ University Futura

Key messege: The amount of collected medicinal herbs is larger than the exported

Assesment: 

In order to compare the data, the quantity of collected herbs according to the data of the Institute for the period 2004-2016, is 66,565,575 kg, which is 48,758,293 kg more than it was exported or exported amount is 3.73 times less than the collected. According to the Annual Reports of the Institute for Nature Conservation of Serbia, licenses issued include 30-40% of actually collected quantities from nature, which means that the quantities actually collected are 2.5-3.3 times higher than shown, or on average 2.9 times is more accumulated than the recorded quantities. According to the data of the Customs Administration, the average export price of medicinal herbs is 3,05 EUR / kg.

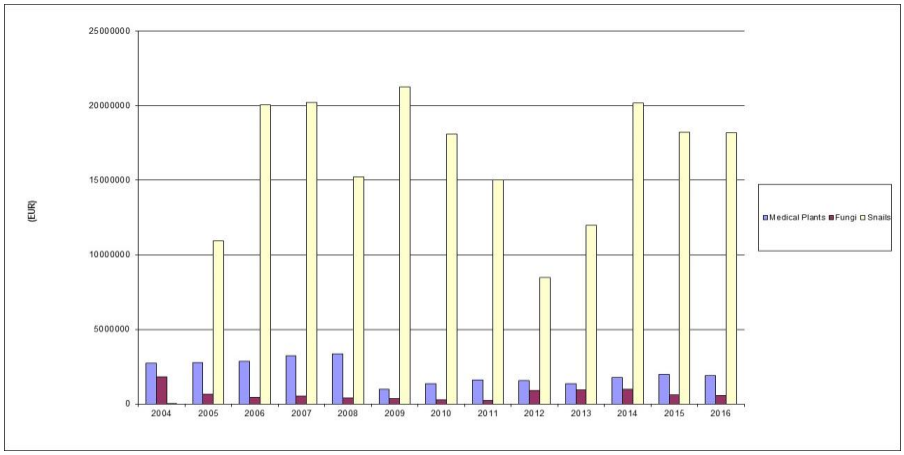


Fig. 3.1.5.1. Exported medicinal plants and fungi from Serbia

In order to compare the data, it was calculated how much mushroom from nature was collected for the period 2004-2016, according to the Institute's data, this amount is 54,944,939 kg, which is 1.86 times less than it was exported. The average export price according to the data of the Customs Administration for the period 2004-2016, for all types of mushrooms is 1.86 EUR / kg. The above data show that the amount of exported mushrooms was almost two times higher than the collected amount, which confirms that the collection and export of mushrooms from Serbia is largely in the gray zone. A large amount of truffles are collected and exported without permission, as are all three types of the true morels. The average recorded collected quantities of mushrooms in the last four years amount to about 4.5 million kg, while the average quantity of exported mushrooms according to the data of the Customs Administration for the same period is about 13.6 million kg, which is 3 times more, some is exported illegally, so the amount collected is at least 4 times higher than recorded.
In order to compare the data, the number of snails collected from nature for the period 2004-2016 was calculated, and this amount is 12,763,354 kg, which is 3.2 times more than it was exported. According to the data of the Customs Administration, the average export price for snails was 2,20 EUR / kg, which is actually less than the real export price of semi-processed snails, which is around 4 EUR / kg, the problem are so-called "fictitious contracts " that do not show the real price.
According to the data from the Annual Reports of the Institute for Nature Conservation of Serbia, about 5-7 thousand tons snails are illegally collected and exported annually. The snails are illegally exported as well as other wild species through: Republika Srpska, Macedonia, Croatia, etc. According to the data from the annual reports of the Institute for Nature Protection of Serbia, about 600 tons of snails have been collected for the last four years, and taking into account that at least 5 times more is collected from nature illegally, an average annual quantity of about 3.6 million kg of snails is obtained.

The purchase price from the nature according to the obtained data is about 0.6 EUR / kg, so the purchase annual potential of snails (recorded and unregistered) is about 2.2 million Euros. The export potential of snails (recorded and unregistered) is around 14 million Euros.

3.1.5.1. Case study: Ethno-botanical research of diversity and use of medicinal plants in the protected area “Stara Planina”

Author/Institution: Dejan Miletic/ Public Enterprise Srbijasume

Assesment: 

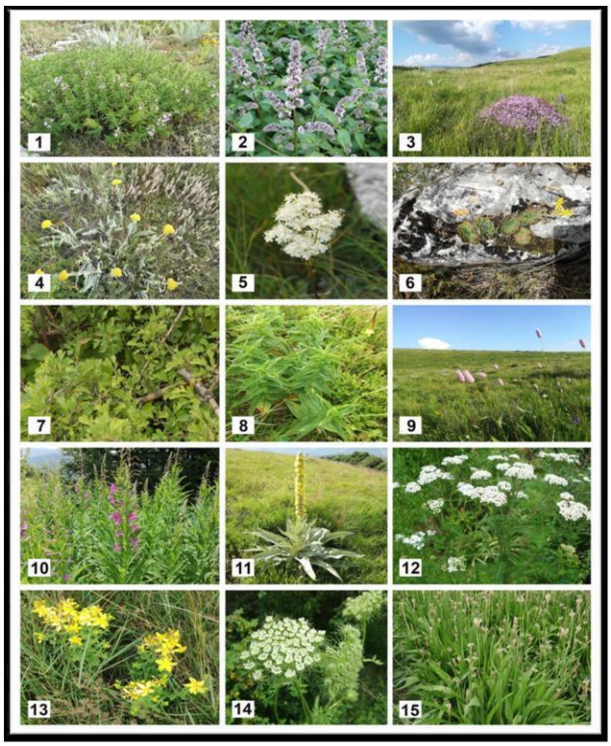
The flora of the Stara Planina mountain makes about 1200 taxons, which is about 34% of the total flora of Serbia, among which there are 115 endemic species, 40 species that represent the natural rarities of Serbia, 50 species listed on the European flora list (some of which are classified in the category of critically endangered), 52 forest, shrub and herbaceous plant species. The "Stara Planina" abounds in medicinal plants many of which are protected by the Law. The tradition of the use of medicinal herbs for various purposes in the area of "Stara Planina" is very long and rich, and represent a significant cultural-historical heritage. A large number of plants are used in fresh, and especially in dry condition, in many households in the local health care. The role and importance of medicinal herbs in a region is best illustrated by the diversity of its use. Medicinal plants are also a very important natural resource of each country and should be used wisely and rationally. This implies ensuring the development of rural areas with the conservation and preservation of biodiversity, the preservation of traditional cultures, as well as the helping science in finding new raw materials.

However, over-harvesting and destruction of habitats due to anthropogenic pressure threatened the survival of some species, for example, *Adonis vernalis* L., *Arctostaphylos uva-ursi* L. and *Gentiana lutea* L. which are on the EU lists of the Wild Fauna and Flora Protection and Trade Regulation. In the last few years, in the rural areas of Serbia, such as the "Stara Planina" region, trends of permanent depopulation have been observed which could cause a partial loss of traditional knowledge. The ethnobotanical heritage of "Stara Planina" should be promoted in the broadest sense, and this would be reflected in the special protection of certain localities and the economic progress of this region, which is in line with its biological, ethnic and cultural diversity. In this regard, JP "Srbijašume" as a manager of the "Stara Planina" Nature Park, carried out a project entitled "Ethnobotanical research on diversity and use of medicinal plants on "Stara Planina". The value of the Project amounted to 1.597.733,33 dinars, and the Project was co-financed by the Ministry of Environment in the amount of 500.000,00 dinars.

The research aimed at contributing to the preservation of the diversity of medicinal herbs of the "Stara Planina" and promoting traditional ethnobotanical and ethnomedicine knowledge of the researched area of JP "Srbijašume" was carried out in cooperation with the Institute for Biological Research "Siniša Stanković" from Belgrade.

The goal of the Project was to research the medicinal herbs of "Stara Planina" and their medicinal properties with the aspect used in traditional and alternative medicine by the local population and the people. Also, the realization of the Project included: determining diversity and quantitative representation of medicinal plants in the area of "Stara Planina"; assessing the degree of vulnerability of medicinal flora diversity and proposing appropriate protection measures, taking into account the quantitative representation of certain species; analysis of the use of medicinal herbs in phytotheraphy; proposing the method and time of harvesting/collecting (in accordance with the phenophase) of medicinal herbs or their parts, with the maximum preservation of their number, diversity and habitat; assessment of the potential for sustainable development of natural resources of medicinal herbs in the "Stara Planina" region, as well as the examination and suggestion of the possibility of cultivating important plant species, either from the aspect of demand (which reduces the pressure of natural populations), either from the aspect of nature protection

Pic. 3.1.5.1.1.1. Harvesting (1); identification of plants in the field (2); interviewing the local population (3); methods of preparing the medicinal herbs for use (4-16)



Pic. 3.1.5.1.1.2. Neke od lekovitih biljaka Stare planine: 1) *Satureja montana* L. (rtanjski čaj); 2) *Mentha piperita* L. (pitoma nana); 3) *Thymus serpyllum* L. (majčina dušica); 4) *Achillea clypeolata* Sm. (žuta hajdučka trava); 5) *Filipendula ulmaria* L. (medunika, suručica); 6) *Sempervivum tectorum* (čuvarkuća); 7) 49 *Crataegus monogyna* Jacq. (glog beli); 8) *Gentiana asclepiadea* L. (šumska sirištara, svećica, otodovka); 9) *Persicaria bistorta* (L.) Samp. (srčenjak); 10) *Chamaenerion angustifolium* (L.) Scop. (kiprovina); 11*) Verbascum phlomoides* L. (divizma); 12) *Achillea millefolium* L. (bela hajdučka trava); 13) *Hypericum perforatum* L. (kantarion); 14) *Angelica archangelica* L. (anđelika); 15) *Plantago lanceolata* L. (uskolisna bokvica)

3.1.6. Indicator Name: Species diversity – Macromycetes (Macrofungi) species number trend at the Kragujevac exhibitions

Author/Institution: dr Nebojša Lukić/ Sumadija mycological society (NGO), Kragujevac

Key messege: Greatest number of mushroom species was in 2014

Assesment: 

The indicator shows trend of the appearance (number) of species and sporocarps (fruiting body) per species on the examined habitats. The change in the appearance frequency within long-term period indicates changes in the habitats, environmental conditions, which affects the health of forests, meadows and other fungi habitats. Upward population trend indicates that the ecosystem is stable and healthy. There have not been any significant changes of environmental conditions for a long time. Especially condition of the forest is strongly connected with condition of the present mycorrhizal fungi. Downward population trend indicates that there has been changes in environmental conditions and that the ecosystem is not stable anymore. Degradation of habitats leads to downward population trend of macrofungi.

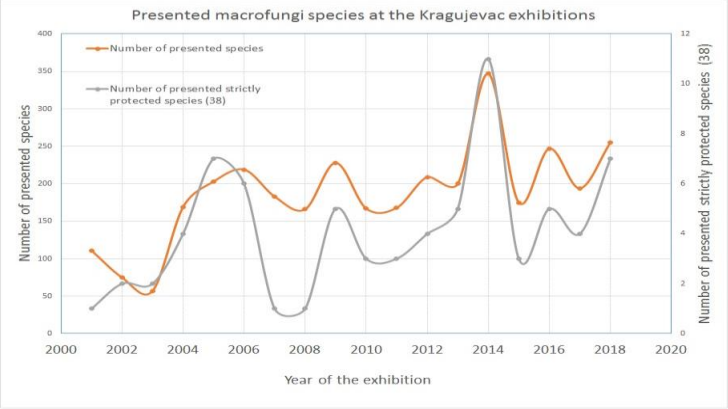


Fig. 3.1.6.1. Number of fungi species presentet at the exibition in Kragujevac.

Habitat protection of the rare macrofungi species, spreading of the forest areas, reducing of the chemical use in agriculture can lead to upward macrofungi population trend. Disappearance, degradation or fragmentation of habitats, especially forests (mycorrhizal fungi), pollution of the air, water and soil, climate changes, inadequate and excessive gathering of fruiting bodies for money or food, inevitably causes downward trends.

3.1.7. Indicator Name: Fresh water fishing

Author/Institution: Slaviša Popović/ Environmental Protection Agency

Key messege: Inland water fish harvesting decrease

Assesment: 

Fished Freshwater fish increased by about 7% compared to 2016.

During 2018, 2083 t of fish were caught, which is about 6% less than in 2017. Amount of sterlet caught was reduced by about 35%, carp for about 6%, zander for about 8%, while catches of catfish increased by about 4% and pike by about 9%.

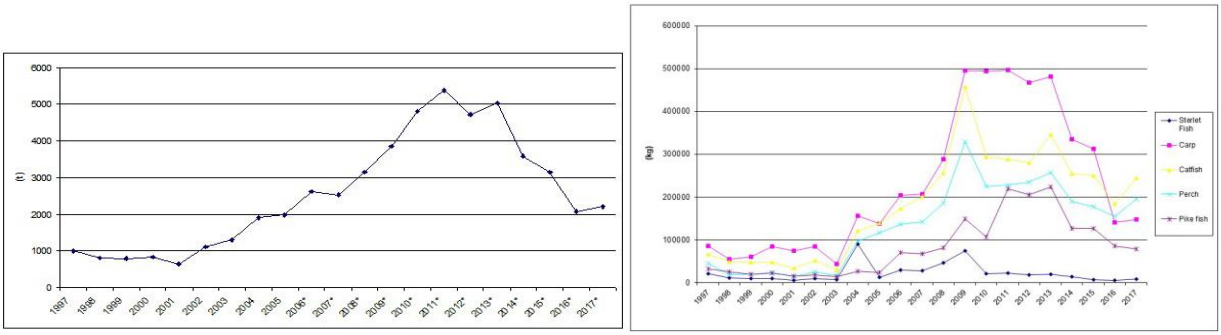


Fig. 3.1.7.1. Fresh water fishing (left) and structure of harvested fresh water fish by species (right)

The number of professional fishermen (378) decreased by 20 fishers compared to 2017. The total number of issued recreational fishing licenses was 85,426, which is about 4% more than in 2017. The intensity of sport fishing decreased by about 14%, while the intensity of commercial fishing increased by over 16% compared to 2017.

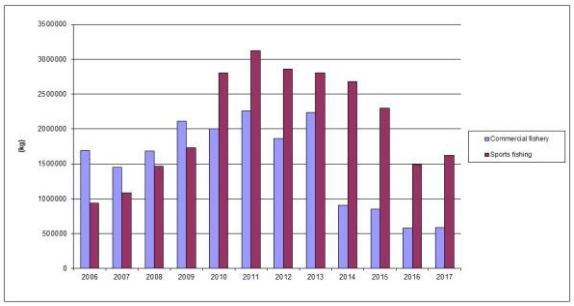


Fig.3.1.7.2. Volume of commercial and sport fishing

The indicator represents the quantity and structure of caught fish. Quantity of production of organic biomass (primarily fish) in aquatic ecosystems and water quality. The indicator is also used to monitor trend of volume of caught fishes by sports fishing and commercial fishery. Volume is expressed in kilos, and for sports fishing increased from 2010, while commercial fishery volume shows a declining trend. During 2015, 3,150 t of fish was caught, which is by 12% less than in 2014. The reduction was observed also in following years (2016 and 2017). Carp catch was reduced by 6 %, catfish by 2 %, and perch by 7 %. 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

3.1.7.1. Case study: Ban on fishing Sterlet sturgeon *Acipenser ruthenus* in Serbia

Author/Institution: Duska Dimovic, Goran Sekulic/ WWF Adria

Assesment: 

WWF Adria sent Official request for a 5 year Sterlet fishing ban in the Republic of Serbia to the Ministry of Environmental Protection in June 2018. This letter was supported by the national association of anglers and association of commercial fishermen, but also by IUCN Sturgeon Specialist Group.

Supporting official request for a Sterlet fishing ban The Assessment about the status of Sterlet sturgeon *Acipenser ruthenus* in Serbia was prepared by scientists Dr. Miroslav Nikčević and Dr. Branislav Mićković. Assessment included distribution of Sterlet in freshwater ecosystems in the Republic of Serbia, types of Sterlet habitats, identification of specific habitats important for the biological needs such as: spawning, wintering, growth, nutrition and movement; description of abiotic factors of Sterlet habitats: depth, substrate granulation, temperature, flow rate, conductivity, water transparency and analysis of published scientific papers on the distribution of Sterlet and their habitats. Regarding fisheries, Sterlet catch data in Serbia for the past 20 years was collected and fishing areas management plans along Danube were analyzed in order to collect information and data on habitats for spawning, threats and the amount of catch. Assessment included also a list of factors of threat and proposal of protection measures.

Finally, as part of the assessment mentioned above and collected data, detail Map of habitats of Sterlet in Serbia was prepared to show the distribution of habitats of Sterlet in Serbia. Maps includes also information about the average water temperature, sediment granulometry and water depth
.
Reasoning for this initiative was based on the analysis of the status of the Sterlet and the drastic decline in the population. WWF Adria recognized the necessity to intensify the protection regime of this species to enable the survival and recovery of this valuable indigenous species in the fresh waters of the Republic of Serbia. Lack of comprehensive analysis of the populations of Sterlet in the territory of Serbia, and well supported reasons to conclude that population is subject to intensive fishing pressure, including poaching, urgent and immediate application of the precautionary principle and the principle of conservation of natural resources was necessary. The Study has shown that the Sterlet is intensively fished during the catch season, but also during the closed season, when fishing is prohibited to allow undisturbed spawning. There was also a problem of capturing fish below the legal minimum size, which prevented the population to recover and establish a sufficient size to become stable self-sustaining. As a proof of the extensive fishing pressure on Sterlet population, it was common and very widespread trade of the Sterlet below the allowed measure at the markets, in shops and restaurants in Serbia (mainly in the Danube Region).

National campaign was conducted in June 2018 for introduction of Sterlet (*Acipenser ruthenus*) fishing ban in Serbia. Campaign was supported by United anglers of Serbia and Associations of commercial fishermen of Serbia.

In December 2018 Ministry of Environmental Protection of Republic of Serbia adopted a permanent fishing ban on Sterlet, that was put in force from 1st of January 2019 (through: *Ordinance for the conservation and protection of the fish fund -Naredba o merama za očuvanje i zaštitu ribljeg fonda*)

3.1.8. Indicator Name: Fragmentation of the river habitats

Author/Institution: Slaviša Popović/ Environmental Protection Agency

Key messege:U periodu od 1930-2010. povećava se indeks fragmentacije u Srbiji

Assesment: 

The indicators is used to show relation between the length of all rivers in Serbia and number of dams in the rivers. SELAR database collects information about total number of dams in the rivers in Serbia in order to calculate Fragmentation index. Fragmentation index in Serbia shows significant increasing since 1930 and have a big impact on fish biodiversity in the rivers.

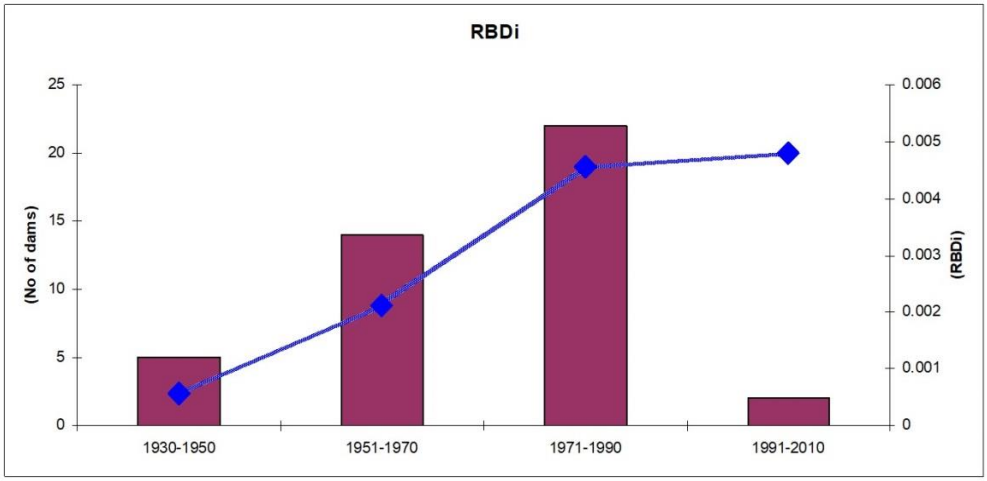


Fig. 3.1.8.1. River Barier Density index in Serbia.

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. The largest numbers of dams are with a height of up to 20 m, while 5 dams are height of about 100 m

3.1.8.1. Case study: Effects of Djerdap Gorge on fish catch in Danube

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Assesment: 

The hydropower and navigation system "Djerdap 1", a complex and multipurpose facility, was built on the 943th kilometer of the Danube from the mouth of the Black Sea. The largest hydro-technical structure on the Danube, with a total length of 1,278 meters, is completely symmetrical and designed so that each country (SRB and RO) disposes of the same parts of the main facility, which are maintained and used in accordance with the agreement and the conventions on construction and exploitation. HPP "Djerdap 2" is the second joint Serbian-Romanian HPP on the Danube. It was built on 863 km of the Danube from the mouth of the Black Sea. Both power plants produce about 20% of the electricity produced by "Elektroprivreda RS".

However, the construction of dams on the Danube resulted in a significant negative effect, primarily on the sturgeon species, which could no longer sail upstream.

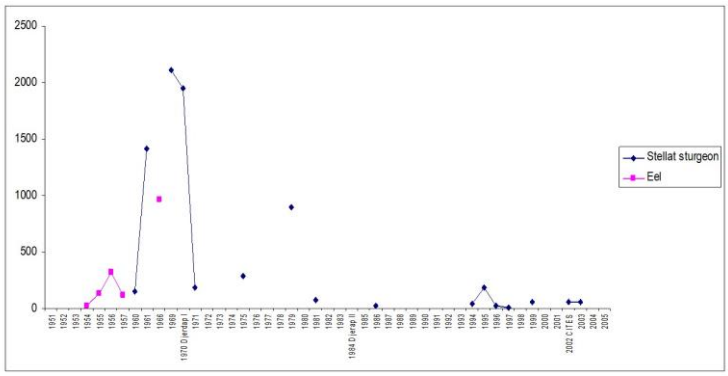


Fig 3.1.8.1.1. Change of Stellat strurgeon and eea fish catsch in Danube in Serbia.

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. 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 forbidde.

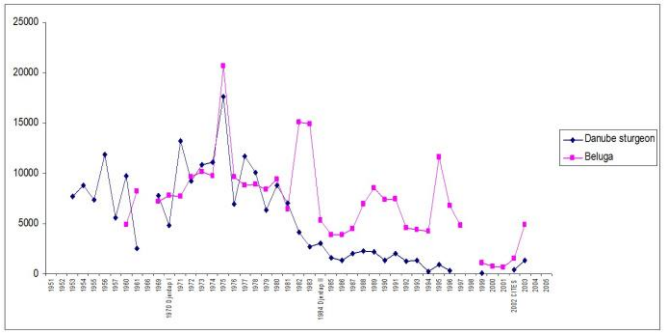


Fig 3.1.8.1.2. Change of Danube strurgeon and beluga fish catsch in Danube in Serbia.

3.1.9. Indicator name: Mini-hydro power plants

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Key messege: Since 2010, 126 derivative small-hydro power plants have been built

Assesment: 

Unlike large rivers on which powerful power plants are built, where the engineering building is located in the barrier itself, these rivers do not have enough water mass for this method of electricity generation. Therefore, the second approach is chosen. In the case of derivative mini-hydropower plants, the process begins with the construction of a small dam and the formation of water intakes. Then, the processed wide tubes, which are buried in the trenches along the riverbed, are brought in using machines. On average, they are between one and three kilometers long, sometimes even eight. The water drop required to start the turbine is obtained by placing the river in the derivative tube, and directing its flow through that tube, down to the engineering room located downstream, where the current is produced. They are built in mountainous areas because of the natural inclination of the terrain, and with it the natural water drop, play a key role in the process. Construction is inexpensive, because nature has already done half of the work on its own.Based on the data of the Register of privileged electricity producers (http://mre.gov.rs/doc/registar-020818.html), 126 derivative mini- hydro power plants have been built in Serbia since 2010. There is a trend of increasing the number ofminihydro power plants.

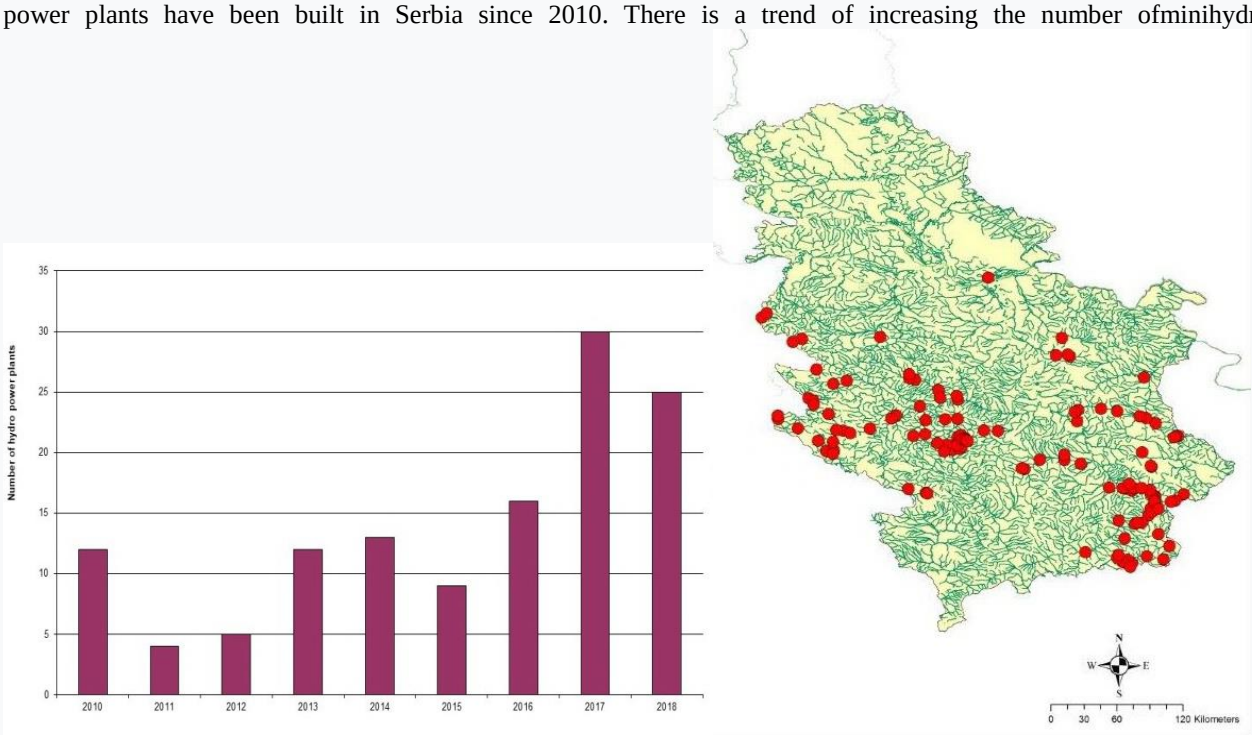


Fig 3.1.9.1. Trend of number of built SHPP and locations with SHPP in Serbia

However, due to the potentially harmful effect of the derivative mini-hydro power plant on biodiversity, numerous activities of the association of citizens and the professional public to limit the construction of mini hydro power plants have been carried out, they also demand a ban on building within protected areas.

Concerns about the conservation of natural resources were also expressed by experts in an open letter addressed to Minister of Environment Goran Trivan and the mayor of Pirot, Vladan Vasic. The decree was signed by Dean of the Faculty of Forestry, Ratko Ristic, Dean of the Faculty of Biology, Zeljko Tomanovic, Dean of the Faculty of Geography Dejan Filipovic, Dean of the Faculty of Mining and Geology, Dusan Polomcic, as well as Pavle Pavlovic the Director of the Institute for Biological Research "Sinisa Stankovic".

In a letter from the professor to the minister, it is stated that an unacceptable activity is related to the use of the area in the "Stara Planina" Nature Park with unique ecosystems and the biodiversity of trout fish, as well as numerous other groups of plants and animals that represent a common good for the local population and all citizens of our country. Experts warn that planned construction 58 SHPP in the "Stara Planina" region endanger the traditional way of life, the existence of the remaining inhabitants of villages containing protected cultural and historical units. Serbia is the poorest country in the Balkans when it comes to domicile surface waters. The water wealth of our country is under the additional negative effects of numerous polluters, bad management, and above all, the massive construction of SHPP threatens to completely destroy the remaining valuable resources, as stated in the letter. "We fully understand the obligation to partly replace energy production at the expense of fossil fuels with "green" energy derived from renewable sources. However, SHPP are more than modest energy producers: if all 856 facilities were built, according to the existing Cadastre, up to 3.5 percent of the required amount of electricity would be provided at the annual level, but at the same time the most valuable hill- mountain watercourses would be destroyed (an example of the "Jošanička reka'' on the slopes of Kopaonik), with the disturbance of the area, bio and geodiversity, "the professors warned. In the letter they reminded that Serbia and the Balkans are one of the most important areas of diversity of stream trout in Europe, and that mini-hydro power plants are built on these rivers. The fish trails built on these plants serve only to satisfy formal rules. They do not have any purpose, because the stream trout is not a migratory species and does not use fish trails. In addition, the change in the water regime affects the alteration and destruction of river habitats with the flora and fauna, the natural hatcheries of the fish, and the change in the volume and dynamics of erosion in the river bed. In addition, the regime of sprout cultivation with water from the river bed (which is introduced in the pipeline) is disturbed, so that there is a decrease in the volume or drying of local wells, which also endangers the water supply of the population - the letter states with a remark: "All this is manifested in the experience of Western European countries, and in particular SHPP in the Alpine regions of Germany, Austria, Italy and France, which has prompted numerous discussions in these countries, as well as at the level of the European Union on the minor energy benefits of SHPP, and the large and disproportionate ecological damage that they cause. As country with insufficient funds, we have to draw lessons from the mistakes of others, and not foolishly rush to make our own. "Four Deans of the University of Belgrade and Director of the Institute for Biological Research at the end of their address point out, that today there are more efficient and cost-effective, and in terms of preserving space and environment, more sustainable options for producing energy from renewable sources (wind energy, solar energy, biomass energy, geothermal, etc.). On the contrary, there is no alternative to pure water and life without it is impossible.

3.1.9.1. Case study: Mapping the most valuable rivers in Serbia

Author/Institution: Goran Sekulic, Duska Dimovic/ WWF-Adria

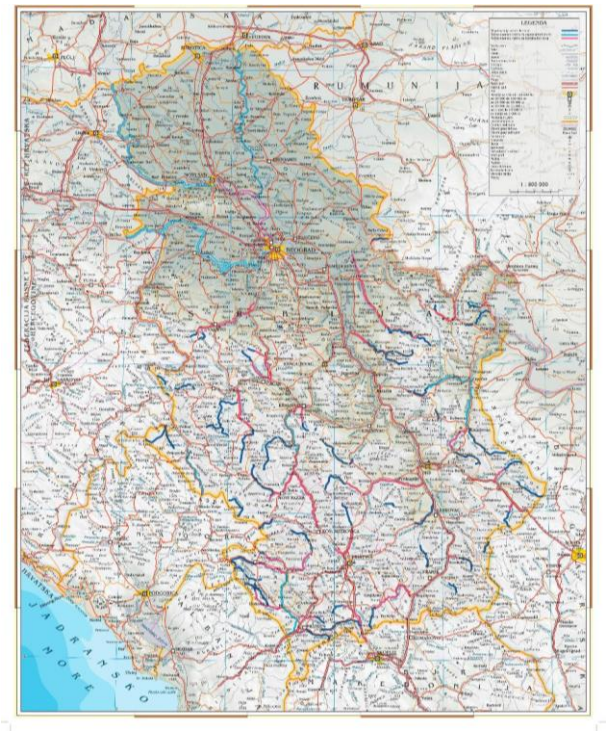
Assesment: 

Together with numerous water management and nature conservation experts, WWF assessed 129 watercourses in Serbia with a total length of 9256 km and with a watershed surface of 35 852 km2. River sections identified as the most important for conservation are presented on the map of the most valuable rivers of Serbia. The results showed that slightly more than 30% of the analysed rivers were identified as the most well-preserved and most valuable ones for nature protection. This clearly indicates that most of the river ecosystems have been significantly altered and disturbed and that it is necessary to invest significant effort to keep the remaining preserved habitats from further degradation. The map, based on this data, shows which river and river currents are considered the most valuable.

To determine the importance of watercourses, criteria based on data on hydrological and morphological characteristics, vegetation, water quality, land use and the presence of endangered fish species are combined. The process involved the collection of relevant data from the relevant institutions and their GIS analysis. The data obtained after the analysis were additionally checked with experts in the field of protection of water and fauna of fish in order to obtain a final list of the river of special importance. Rivers are firstly classified by type, and then divided into river sections. The analysed river sections are then classified in relation to the river type, habitat type and their condition. The status of the river sections was evaluated in relation to five parameters: hydrology, water quality, morphology, riparian vegetation and the form of land use. Each parameter is given a certain numerical value, and in relation to the sum of the parameter values, the state of the river sections is classified into five categories (very good, good, moderate, poor and bad).

All river sections with very good and good condition are automatically classified as "the most valuable river sections". The main assumption in this approach is that river segments in a very good and good condition can preserve the basic characteristics of the biodiversity of the given river and habitat type. Data on the distribution of threatened fish species (listed in the IUCN red lists), endemic fish species and protected area data were used to calculate the total biological importance index (TBI) for each river section. All river sections with an index of TBI between 80-100 are designated as priority sections for conservation. An additional two parameters were analysed to gain complete insight into the condition of the watercourses, that is, representativity and connectivity. The representativeness analysis adds importance to the sections with the moderate or poor status, if they represent the rare or only representatives of a given habitat type. The connectivity analysis considers the longitudinal connection between the river sections that are considered as significant.

This analysis aims to raise attention to the level of threats rivers in Serbia are exposed to and to propose scientifically based methodology for their further conservation. WWF will continue to cooperate with relevant institutions to help define these zones and ensure their comprehensive legal protection.



Map. 3.1.9.1.1. Map of the most valuable rivers in Serbia

More information on: http://www.wwf.rs/vesti/?uNewsID=238150

3.1.10. Indicator Name: Renewable energy sources

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Key messege: In the period from 2009-2018, 222 objects for renewable energy production of electricity have been built

Assesment: 

Since 2009, when in the Republic of Serbia for the first time a legal framework was established with incentive measures ("fid-in" tariffs), by December 2018, 222 new facilities were built for the production of electricity by the "OIE", the total installed capacity of 111 MW, these are:

1) 100 small hydro power plants with total installed capacity of 63 MW (including two old, reconstructed plants: Ovčar Banja and Međugorje);

2) 105 solar power plants of 8,78 MW;
3) 4 wind power plants with a capacity of 25 MW, and 5 wind power plants gained the status of a temporarily privileged producer with a total power of 475 MW,
4) 13 biogas power plants with a total power of about 14 MW
The source of the data is the Register of privileged producers of electrical energy

(http://mre.gov.rs/doc/registar-020818.html)

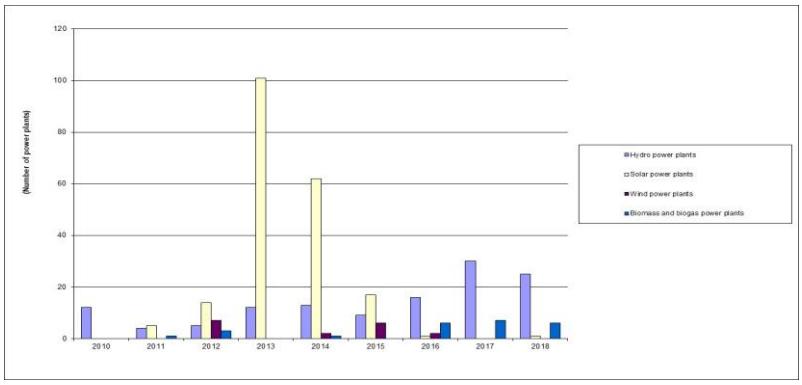
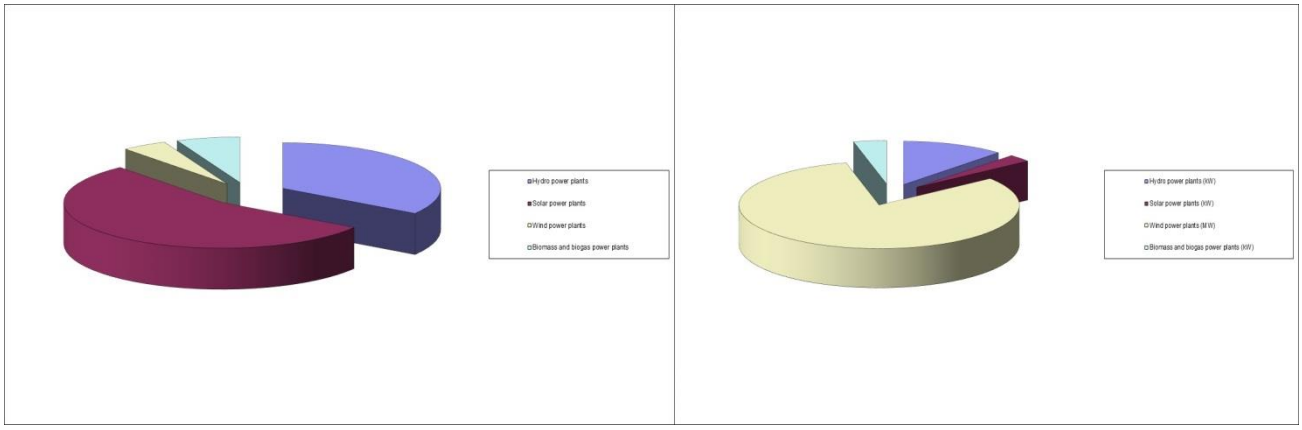


Fig 3.1.10.1. The number of all types of renewable energy power plants since the introduction of the "fid-in"



Pic. 3.1.10.2. Structure and installed capacity of all types of power plants on RES since the introduction of the "fid-in"

3.1.11. Indicator Name: Population dynamics of the main hunting species

Author/Institution: Slaviša Popović/ Environmental Protection Agency

Key messege: There was little difference in the size of the population of the main hunting species

Assesment: 

The indicator shows the size of populations of the selected main hunting species in the Republic of Serbia: doe, boar, rabit, pheasant, quail. Institute for Nature Protection collects data regarding wolf, bear and lynx. According to the Forests Directorate Data, there were slightly differences according to the size of populations of the main hunting species registered. Rabbit and doe populations decreased during the hunting year 2015/2016 (by 10% approximately). Pheasant population size increased by around 1%. Quail population size increased by around 4%, and boar population about 5%.

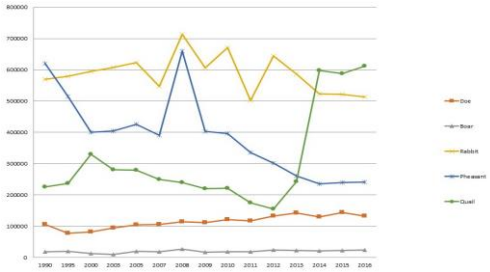


Fig. 3.1.11.1. Trend in size of population of the selected main hunting species

In the same period, the amount of large game caught (deer, wild boar, fallow deer) was increased, while the amount of small game caught (pheasant, quail, rabbit) was reduced. Annually about 7,800 foxes and 170-180 wolves were killed.

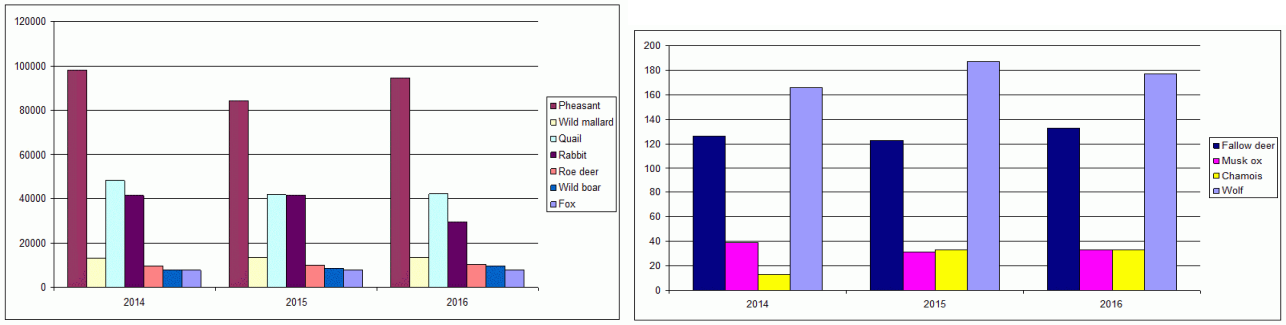


Fig. 3.1.11.2. Size of harvested populations of the main hunting and selected species

3.1.12. Indicator Name: The intensity of tourism on the mountains

Author/Institution: Maja Krunić-Lazic, Slavisa Popovic/ Environmental Protection Agency

Key messege: Number of tourists in mountain areas increase

Assesment: 

Environmental Protection Agensy is in charge for environmental information system in wich this indicator is developed. The indicator shows the trend of arrivals and overnight stays, the temporal and spatial distribution by tourist resorts, in order to monitor the pressures on the environment and biodiversity.Under the term arrivals means the number of tourists staying one or more nights in the accommodation facility in the observed period . The night belongs to the number of overnight stays by tourists realize in the accommodation facility.

There are no statistics for all protected areas in the mountains. Also, do not correspond the surface protected area with surface tourists area on the mountains, so it is not possible to calculate a 'total tourist density' (the number of arrivals and overnight stays on the protected area). The most interestin sites for the tourists were Zlatibor, Kopaonik, Tara and Divcibare mountains. Les intrastig were Goc, Stara Planina and Mokra Gora mountains. In the period 2010-2018 number of visits and tourist nights is dubled on Zlatibor and Kopaonik mountains.

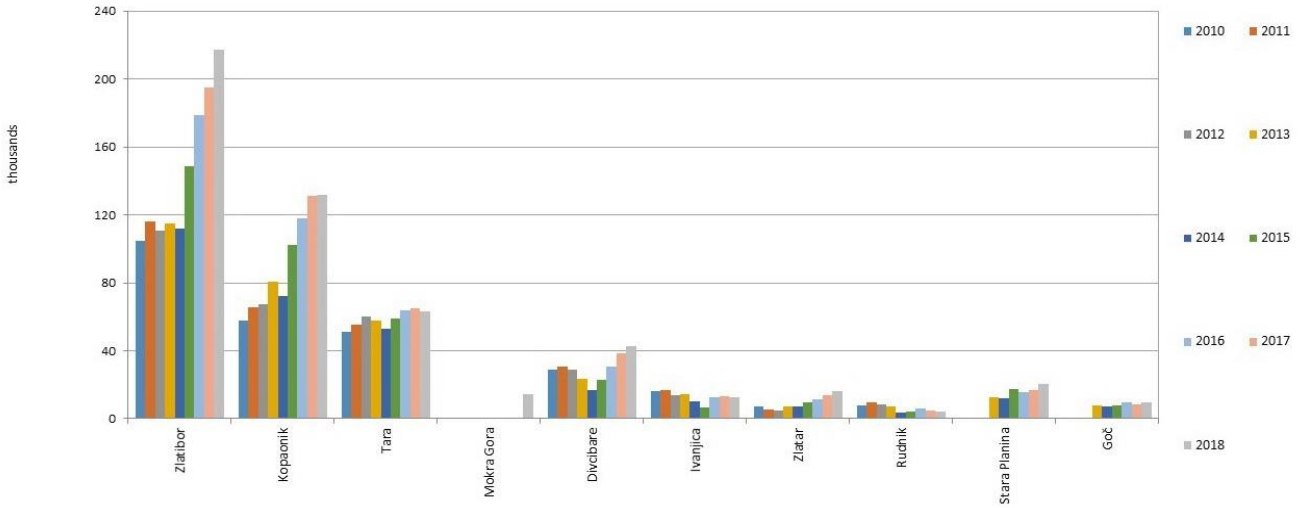


Fig. 3.1.12.1. Trend of turists arrival in mountainous areas

Protection and preservation of the environment is an important segment for the sustainable development of tourism, so special attention is given to maintaining the quality of the environment. Special attractions are the protected natural areas as a property of great importance for the development of tourism. Bearing in mind that the negative impacts of tourism on the environment reflects primarily on natural resources and biodiversity, sustainable management of protected natural areas is an essential condition for increasing tourism. In this context, the Tourism Development Strategy of the Republic of Serbia until 2025 („Official Gazette of RS ", number 98/2016), one of the main objectives also includes sustainable ecological development and introduce monitoring of protected areas in the area of tourism activities, taking into account all potential positive and negative effects of the development of tourism might have on them.

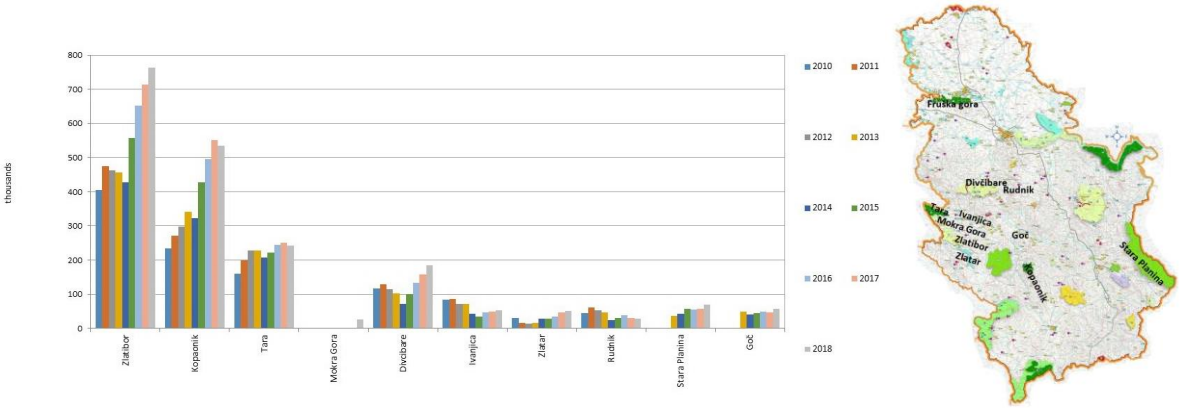


Fig. and Map.3.1.12.2. Trend of tourists nights in mountainous areas (left) and map of main touristic locations on mountains (rignt)

3.1.12.1. Case study: Impact of tourism on the protected areas National Park "Kopaonik"

Author/Institution: dr Lidija Amidzic/ Univerzity Singidunum

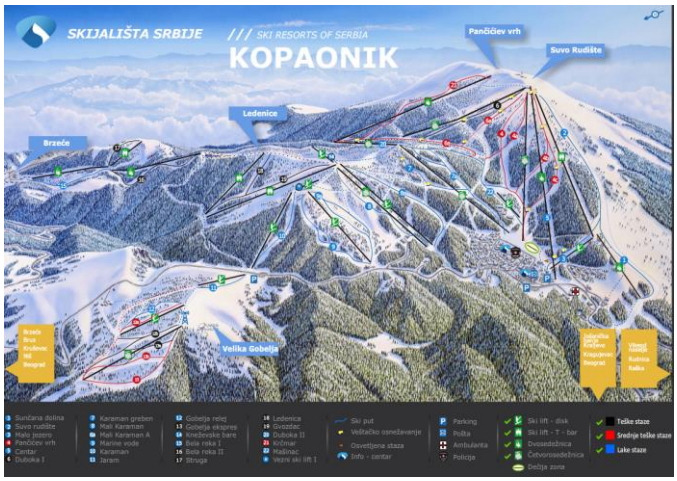
Assesment: 

The National Park "Kopaonik" occupies an area of only 11,969, 04 ha. In addition to the small area, the problem of preserving the biodiversity in the National Park "Kopaonik" is a marked fragmentation and degradation of natural habitats due to the development of tourist infrastructure and the expansion of construction zones. Especially vulnerable is the zone of subalpine communities of spruce and high mountain pastures. The consequences of anthropogenic pressures on wild species and gravel habitats are already visible because of the disappearing species in Kopaonik such as bear (*Ursus arctos*), lynx (*Lynx lynx*), chamois (*Rupicapra rupicapra*), capercaillie (*Tetrao utogallus*), Roller (*Coracius garrulus*), Griffon vulture (*Gyps fulvus*), Chough (*Pyrrocorax graculus*), booted eagle (*Hieraaetus pennatus*), billed Chough (*Pyrrocorax pyrrocorax*), puzgavac (*Tichodroma muraria*), etc.

Tab. 3.1.12.1.1. Structure of areas under the protection regimes in the National Park "Kopaonik"

National Park "Kopaonik"		
Surface structure according to Protection regimes	ha	%
Protection regime I degree	1..477,79	12,23
Protection regime II degree	3.604,74	29,84
Protection regime III degree	6.886,51	57,93
Total surface	11.969, 04	100%

According to the spatial plan of the special purpose area of the National Park "Kopaonik" (Official Gazette of RS, No. 95/09), construction land occupies a total of 401.1 ha, while the construction areas under the infrastructure (tourism, transport, water, energy and telecommunication). All construction areas and construction areas under infrastructure are mostly located in the protection zone of the National Park and in the zone under the protection regime III degree, and to a lesser extent in the zone under the II degreeprotection regime.



Map. 3.1.12.1.2. Map of ski trials on Kopaonik mountain.

The main Alpine ski trails (without connecting trails, which will be about 50% of the length of the main trails and about 30% of their surface) are planned in the length of about 190.5 km on an area of about 955 ha, of which in the NPK area there are around 128 km and 640 ha (64.3 ha in the zone of II protection degree and 575.7 ha in the zone of protection degree III), in the protection zone NPK about 56.5 km and 282.5 ha, or about 1.4% of the protection zone and outside the area of the Spatial plan, about 6.5 km and 32.5 ha. The average through the forest track for ski trails will amount to around 179 ha in the area of NPK. There are 47,795 modern skiers in this area (Table below), which besides the total infrastructure represents an extremely strong pressure on biodiversity.

Tab. 3.1.12.1.3. The main Alpine ski trails in the Alpine ski area sectors of the Spatial Plan

Skiing sector	Lifts		Gondolas		Length of ski slopes in (км)	Number of simultaneous skiers
	Number	length (км)	Number	length (км)		
I- south	8	7,1	1	3,0	17,5	4.375
II- southwest	10	11,5			22,0	5.500
III- southeast	5	6,2			13,0	3.250
IV- east	4	3,3			7,0	1.750
V-B- east	8	8,4			17,5	4.420
VI-B- east,	9	6,9			14,5	3.625
VII- west	11	12,1			29,0	7.250
VIII- northwest	6	6,4			15,0	3.750
IX- north	11	15,6			34,0	8.500
X- northeast	6	13,1			21,5	5.375
In total	**78**	**90,6**	**1**	**3,0**	**190,5**	**47.795**

3.1.12.2. Case study: Impact of tourism on the protected areas Nature Park "Stara planina"

Author/Institution: dr Lidija Amidzic/ Univerzity Singidunum

Assesment: 

The problem of preserving biodiversity in the Stara Planina Nature Park is a small share of the area under the I level of protection (3.65%) and the fragmentation of habitats in the II and III level protection regime.

Table. 3.1.12.2.1. Degrees of protection regime.

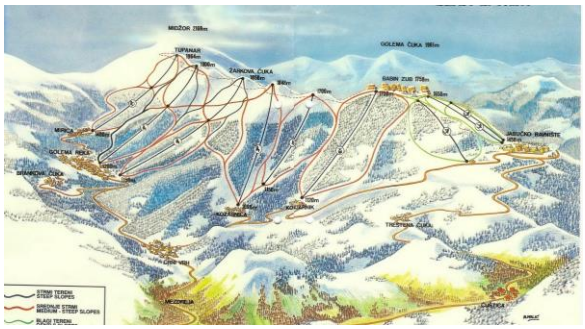
Nature Park "Stara planina"		
Surface structure according to Protection regimes	km²	%
Protection regime I degree	41,60	3,65%
Protection regime II degree	196,79	17,21
Protection regime III degree	904,93	79,15
Total surface	1143,32	100%

Based on the Spatial Plan of the Nature Park and the tourist region of Stara Planina (Official Gazette of the Republic of Serbia No. 115/08), in high mountainous area of the Nature Park Stara Planina has been allocated 6 sectors of the Alpine ski resorts as follows:

1) the sector "Golema Reka" in the territory of the municipality of Knjaževac with a capacity of 9,500 to 15,700 modern skiers, with 10 main lifts and 30 to 63 km of alpine ski trails;
2) the "Topli Do" sector in the territory of the Municipality of Pirot (Basin of the Toplodolska River), with a capacity of 8,000 to 13,400 simultaneous skiers, with nine main lifts and 25 to 54 km of alpine ski trails;
3) the "Mramor / Gostuša" sector in the territory of the municipality of Pirot (basins of Toplodolska and Gostuška rivers) with a capacity of 4,800 to 8,000 modern skiers, with six main lifts and 19 to 32 km of alpine ski trails;
4) the sector "Dojkinci / Kopren" in the territory of the Municipality of Pirot (the basins of the Dojkina and Jelovica rivers) with a capacity of 5,900 to 9,800 modern skiers, with seven main lifts and 20 to 39 km of alpine ski trails;
5) sector "Jelovica / Rosomač" on the territory of the municipality of Pirot (basins of Jelovica and Rosomačka rivers) capacity of. 7,000 to 11,600 simultaneous skiers, with 10 main lifts and 21 to 46 km of alpine ski trails;
6) Sector "Senokos / Srebrna glava " in the territory of Dimitrovgrad Municipality (the river basin of the Kamenica River) with a capacity of 6,000 to 10,000 simultaneous skiers, with seven main lifts and 28 to 40 km of alpine ski trails.

Table. 3.1.12.2.2 Lenth and surface of ski trails.

	Minimum length of ski trails (km)			Minimum area under ski trails (ha)		
Protection regime / Sector	II degree	III degree	in total	II degree	III degree	in total
Golema Reka	19	11	30	95	55	150
Topli Do	9	16	25	45	80	125
Mramor / Gostuša	4	15	19	20	75	95
Dojkinci / Kopren	5	15	20	25	75	100
Jelovica / Rosomač	14	7	21	70	35	105
Senokos / Srebrna glava	19	9	28	95	45	140
Vidlič	0,85	10,8	11,65	4,25	54	75
In total	70,85	83,8	154,65	354,25	419	773,25



Map.3.1.12.2.2. Map of ski trails.

In accordance with the strategic objectives defined in the said Regional Plan, the Nature Park "Stara Planina" will enable the presence of 41,200 to 68,500 simultaneous skiers to use the capacity of 49 lifts and 143 to 274 km of ski trails in the protection regime II and III degrees which is an example of extreme fragmentation degradation and destruction of sensitive natural ecosystems in the protected area.

3.1.13. Indicator name: Domestic material consumption and resource productivity

Author/Institution: Maja Krunić-Lazic/ Environmental Protection Agency

Key messege: The increase in resource productivity is higer than domestic materials consumption growth

Assesment: 

Environmental Protection Agensy is in charge for environmental information system in wich this indicator is developed as a part of sustainable use of natural resources. The indicator is calculated annually at the national level, based on data of the Eurostat. Indicator shows trend of domestic material consumption (DMC) and trend of resource productivity. Resource productivity is elementar indicator os sustainable production and consumption and it is a part of 17 UN goals of Sustainable developement acording to Agenda 2030. Resource productivity is calculated as the racio beteween gross domestic product (GDP) and domestic materials consumption (DMC) and shows how much productive is use of resources. If GDP increase higher than DMC, productivity of resources increase and vise versa.

Total domestic materials consumption (DMC) in Serbia increased from 0.099 million tons in 2001 to 0.112 million tons in 2017, an increase of 12.9%, ie the trend has a negative significance. By way of comparison, in the same period, the DMC in the EU declined by 9%. DMC per capita in Serbia has increased from 13.28 tonnes in 2001 to 16,03 tonnes in 2017, an increase of 20.7%, that trend has a negative connotation.

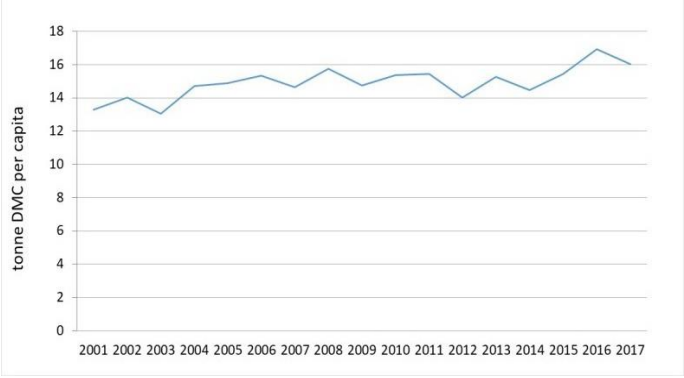


Fig. 3.1.13.1. Domestic consumption of material (DMC) per capita

Main components of total DMC are biomass, fossil fuels, non-metallic minerals (usually materials used in construction), metals (and metal ores). The share of the four major components of the total DMC varied widely between 2000 and 2017. The biomass share significantly oscillated, with a downward trend of 36% to 24%, while the share of fossil fuels increased from 36% to 43%. Non-metallic minerals vary from 25 to 14%. The smallest group is metals and metal ores, which are increased from 8% to 19% DMC in Serbia.

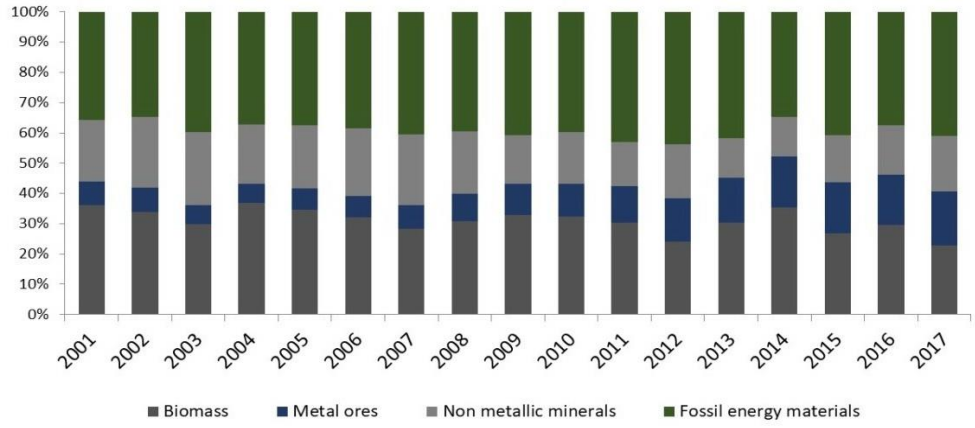


Fig. 3.1.13.2 The structure of domestic material consumption

In the period 2001-2017, the increase in resource productivity is by 48%, GDP by 71%, and DMC by 16%. Which means that Serbia has achieved only a relative decoupling economic growth from resource consumption, that is the trend has a relatively positive meaning. For comparison, during the same period in the EU resource productivity has increased by 38%, and GDP by 24%, while the DMC fell by 10%. Accordingly, the EU has achieved an absolute decoupling economic growth from resource consumption, that trend has a positive meaning.

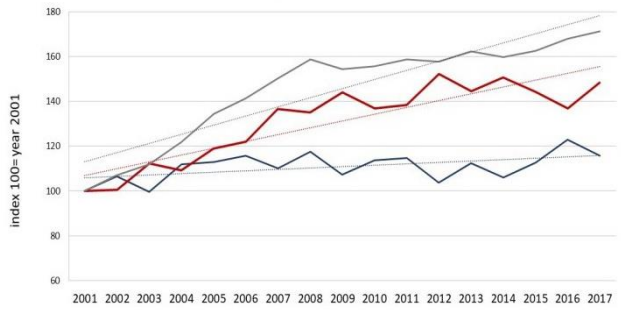


Fig. 3.1.13.3.Domestic materials consumption and resourse productivity in Serbia

3.1.14. Indicator: Mapping of High Nature Value (HNV) Farmland in Serbia

Author/Institution: Dr Dragana Vidojevic/ Environmental Protection Agency

Key message: 11.872 km^2 of agricultural land in Serbia is a great natural value

Assesment: 

The first step towards applying the HNV farming concept in Serbia involves developing and applying indicators to identify the distribution of HNV farmland. The mapping of High Nature Value (HNV) Farmland in Serbia was carried out in several steps, as described below. Mapping has included several institutions managed by the Environmental Protection Agency. Relevant classes from CORINE land cover (CLC) inventory were selected and divided into two groups on the basis of available botanical data. The first group includes land cover classes 231, 321 and 411, and the second includes classes 211, 221, 222, 242, 243, 324, 333. Mapping of the first group of CLC classes was based upon a comprehensive set of literature and other data sources relating to grassland vegetation. This group includes the habitats and plant communities of pastures (231), natural grasslands (321) and inland saline habitats, i.e. inland salt marshes (411) for which phyto-sociological records are available (data collected and kept at the Department of Applied Botany, Faculty of Agriculture, University of Belgrade). The second group of CLC classes serves as an indicator of all other potential HNV farmland types, for which no detailed botanical data exist. CORINE land cover data, information on Important Bird Areas (IBA), Important Plant Areas (IPA), Prime Butterfly Areas (PBA) and Protected Areas (PA) were transformed into a national coordinate system so that these data could be analysed and represented spatially. The location and distribution of IPA, PBA, PA, Important Bird Areas (IBA) and protected areas in Serbia, including national parks, nature parks, landscapes of outstanding features and nature reserves (where data are available), were mapped. A layer of habitat areas was added to the map. This process was performed using botanical (phyto-sociological) records of grassland communities from individual sites and localities situated within broader geographical units, such as mountains, lowlands, sands, plateaus, canyons and gorges, etc. In a biological and ecological sense, habitats usually fully correspond to particular vegetation types, including types of grassland and their related grassland communities.

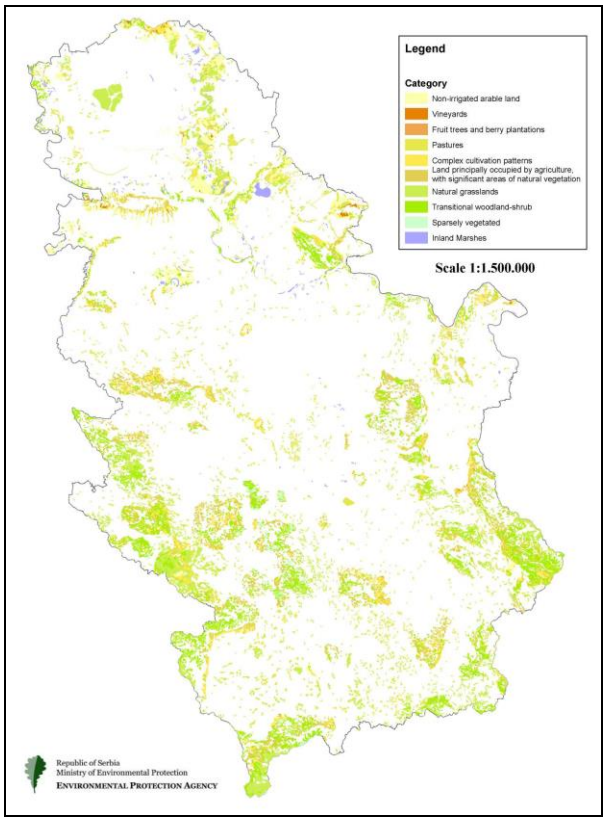
The corresponding layers were created and translated into a single coordinate system. The indicative location and distribution of HNV farmland in Serbia was identified as follows:

• areas identified by the following CORINE land cover classes - 231, 321 and 411;

• areas identified by the following CORINE land cover classes - 211, 221, 222, 242, 243, 324, 333 – AND which overlap with one of the IPA, PA, IBA, PBA or Habitats layers.

CORINE land cover classes 231, 321 and 411 were automatically assumed to correspond to HNV farmland. Class 231 (Pastures) does not distinguish between pastures grazed at low intensity and those under more intensive grazing. Therefore this broad identification of HNV farmland should be considered as indicative only and further analysis is warranted in the process of targeting agri-environment measures in the future. That said, it is likely to be a fairly good estimate of Type 1 HNV farmland given that the area of intensively-grazed grasslands has dramatically decreased in recent decades and the majority of grasslands are grazed extensively at very low stocking densities. The extent of HNV farmland was calculated and the map processed.

The indicative distribution of High Nature Value (HNV) farmland in Serbia is presented in the map below.



Map. 3.1.14.1. High Nature Value (HNV) farmland in Serbia - Indicative map of the possible distribution

This is not a final and definitive map, but a preliminary version using available data within a limited time frame. It indicates that approximately 11,872 km^2 of agricultural land in Serbia is High Nature Value. This is equivalent to approximately 19% of the total agricultural area, and 13% of the total territory of Serbia. It should be stressed that the area of HNV farmland in Serbia is likely significantly higher, as the approach followed supports the identification of Type 1 HNV farmland (farmland with a high proportion of semi-natural vegetation) and does not fully capture Types 2 and 3 HNV farmland (farmland with a mosaic of low intensity agriculture and natural and structural elements or that which supports rare species or a high proportion of European or World populations.

3.1.15. Indicator: Organic agriculture

Author/Institution: Dr Dragana Vidojevic/ Environmental Protection Agency

Key message: **The percentage of organic production area compared to the used agricultural area in 2018 is 0.2%**

Assesment: 

The indicator shows increase in the spread of organic farming and their share in total agricultural production.

1) The percentage of organic production area compared to the used agricultural area in 2018 is 0.2%;
2) There is a decrease of area under organic farms
3) Of the total area under organic production, the most present are areas under grain, then fodder and industrial plants.

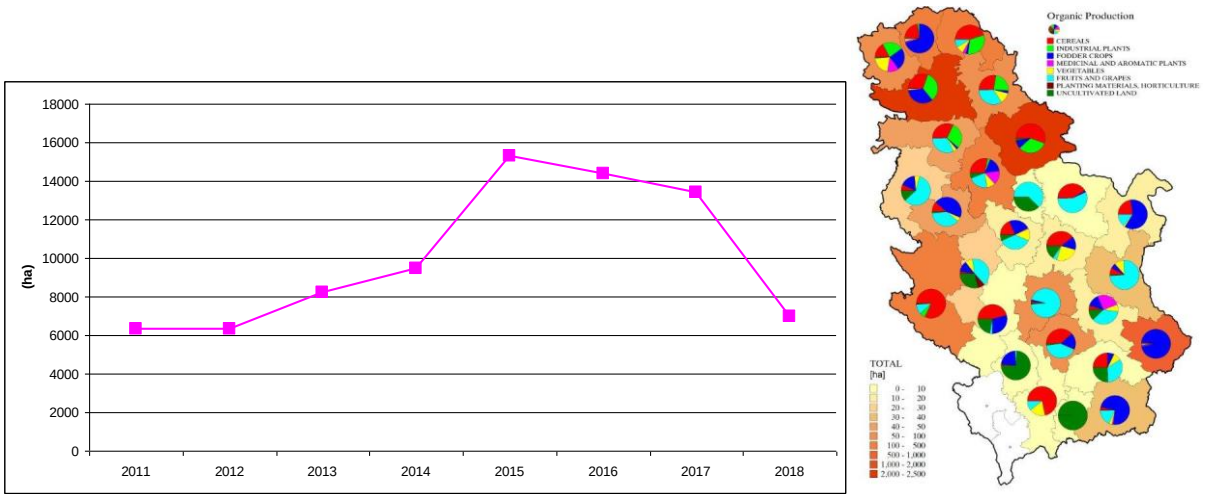


Fig. 3.1.15.1. Areas on which organic farming methods were applied in the period 2011-2018 (left) and organic production by categories of plant crops 1n 2018 (right)

According to the Ministry of Agriculture, Forestry and Water Management, the total area on which the organic production methods were applied in 2018 is 6976,48 ha.

Based on the data on present areas under certain categories of crop cultivation grown in accordance with organic production, in 2018 the areas under caryopsis (grain) (36.79%), fodder plants and industrial plants (24.62%) are the most present. Data analysis by districts shows the largest surfaces in South-Banat and South-Bačka County.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- lack of knowledge how to deal with this issue related to sustainable use of biodiversity
- low awareness on need to use biodiversity in sustaianble way
- lack of adequate financing
- inequitale distribution of use of biodiversity components
- inadequate protection of genetical resources

Sustainable use of natural resources biodiversity indicators system

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
3.1. Developing mechanisms for sustainable use and equitable distribution of biodiversity components	3.1.1. Forest management plans	N		**D14, D15 and D16**	3.1.1.1. Case study: Forest certifications in Serbia 
	3.1.2. **Forest increment and wood cutting**	N			
	3.1.3. Timber consumption and sale	N			3.1.3.1. Case study: Ecosystem services in Bosut forests 
	3.1.4. Collected wild flora and fauna	N			3.1.4.1. Case study: Mineral composition of honey in Serbia 
	3.1.5. Export of wild flora and fauna	N			3.1.5.1. Case study: ETNOBOTANIČKA ISTRAŽIVANjA RAZNOVRSNOSTI I UPOTREBE LEKOVITIH BILjAKA NA PODRUČJU PP „STARA PLANINA“ 
	3.1.6. Species diversity – Macromycetes (Macrofungi) species trend at the Kragujevac exhibitions	L			
	3.1.7. Fresh water fishing	N			3.1.7.1. Case study: Ban on fishing Sterlet sturgeon Acipenser ruthenus in Serbia 
	3.1.8. Fragmentation of the river habitats	N			**3.1.8.1.** Case study: **Effects of Djerdap Gorge on fish catch in Danube** 
	3.1.9. Mini-hydro power plants	N			3.1.9.1. Case study: Mapping the most valuable rivers in Serbia 

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
	3.1.10. Renewable energy sources	N			
	3.1.11. Population dynamics of the main hunting species	N			
	3.1.12. The intensity of tourism on the mountains	N			3.1.12.1. Case study: Impact of tourism on the protected areas National Park "Kopaonik" 
					3.1.12.2. Case study: Impact of tourism on the protected areas Nature Park "Stara planina" 
	3.1.13. Domestic material consumption and resource productivity	N			
	3.1.14 Mapping of High Nature Value (HNV) Farmland in Serbia	N			
	3.1.15. Organic agriculture	N			

National Target 4

Improving public policy and public participation in decision-making

Rate of progresses toward the implementation of the selected target

- Progress towards target but at an insufficient rate 

Priority Area	Priority actions	Aichi target	Progress Assessment	National Progress Assessment
Priority Area 4. Improving public policy and public participation in decision-making	Priority action 4.1.	A2, A3, E20		
	Priority action 4.2.	A1 and E19		

Legislative framework for environmental protection

The legislative framework for environmental protection has its foothill in the Constitution of the Republic of Serbia, which defines the right of citizens to a healthy environment, as well as the duty of citizens to protect and improve the environment, in accordance with the law. As one of the mechanisms for ensuring the sustainable use of biological and geological diversity in the Republic of Serbia, the National Strategy for Sustainable Use of Natural Resources and Goods ("Official Gazette of the Republic of Serbia" No. 33/2012) has been passed. In 2011, Serbia signed the Nagoya Protocol on access to genetic resources and a fair and equitable distribution of the benefits arising from their use to the Convention on Biological Diversity, which was ratified in 2018, and the state during the report period participated in the Intergovernmental Committee for implementation of Nagoya Protocol.

Regulation	Year
National strategy for sustainable use of natural resources and goods	2012
Biodiversity strategy of the Republic of Serbia for the period from 2011 to 2018	2011
National environmental protection program	2010
Law on spatial planning of the Republic of Serbia	2010
National sustainable development strategy	2008
National strategy for admission of Serbia and Montenegro to the European Union	2005
Law on the proclamation of the law on the confirmation of the Convention on Biological Diversity	2001
The Nagoya Protocol on access to genetic resources and the just and equitable distribution of benefits arising from their use alongside of Convention on Biological Diversity, ratified in 2018.	2018
The decree on the Ratification of the Convention on swamps of International importance, especially as bird habitat swamps (Ramsar Convention)	1977
Law on the Confirmation of the Convention on the Conservation of European wildlife, fauna and natural habitats (Bern convention)	2007
Law on the confirmation of the Convention on the Conservation of migratory wild animal species (Bonn Convention)	2007
Agreement on the Conservation of African-Euro-Asian migratory birds of aquatic habitat (AEWA)	
Agreement on the conservation of bats in Europe (EUROBATS)	
Law on the confirmation of Convention of the International Trade of Endangered Species of Wild Fauna and Flora (CITES)	2001
Council Directive 92/43/EEC on the conservation of natural habitats and wild fauna and flora	
Council Directive 79/409/EE3 and 2009/147/EC on the conservation of wild birds	
Council Regulation 338/97 EC on the protection of wild flora and fauna and their regulation and trade	

Laws and strategies in the field of environmental protection

The basic principles of protection and improvement of nature are given in the Law on Environmental Protection ("Official Gazette of RS", No. 135/2004, 36/2009, 36/2009 - second law, 72/2009 - second law, 43/2011 - decision US, 14/2016, 76/2018 and 95/2018 - second law). This law regulates the management (use and protection) of natural resources and means, then preventive measures and conditions of environmental protection as well as remedial measures; system for issuing environmental permits and approvals; access to information and public participation in decision-making and other forms of environmental protection.

The Law on Nature Protection ("Official Gazette of RS" No. 36/2009, 88/2010, 91/2010, and 14/2016 and 95/2018 – second law) regulates the protection and conservation of nature, biological, geological and landscape diversity. This law also defines the obligations of the manager of protected natural assets in passing management plans, the drafting of the Nature Protection Strategy and the state of nature report at the five-year level.

In addition to the Environmental Protection Act and the Law on Nature Protection, there are a number of other laws relevant to the field of nature protection, especially in the domain of the use and protection of forest, hunting, fishing and genetic resources for food and agriculture. A detailed list of laws and by-laws, which define nature protection more closely, is provided in Annex 5.

The strategic framework for nature protection is defined through the strategic documents and the Government's determination to join the EU, through the National Environmental Protection Program and through sectoral strategies (agriculture, forestry, etc.). The most important strategic documents are:

The National Environmental Approximation Strategy for the Republic of Serbia ("Official Gazette of the Republic of Serbia" No. 80/2011) (NEAS) was passed in order to provide the basis for admission negotiations in relation to Chapter 27. For the sector of nature protection, arrangements to the rationalization of the Nature Conservation Act and the inclusion of the Natura 2000 area in the overall legal framework for protected areas. According to NEAS, the implementation of EU regulations on endangered species will be implemented through the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES), together with the issue of transposition / implementation of the Animal Welfare Directive (95/88 / EC).

The National Environmental Protection Program has been passed in January 2010 ("Official Gazette of RS", No. 12/2010). This Program defines the basic goals and criteria for implementation of environmental protection with priority protection measures, conditions for application of the most favorable agricultural, technical, technological, economic and other measures for sustainable development and environmental management, long-term and short-term measures for prevention, mitigation and control of pollution, carriers, manner and dynamics of realization, as well as the necessary means for realization. In 2014, the Draft Action Plan for the implementation of the National Environmental Protection Program for the period 2015-2019 was prepared.

The National Strategy for the Sustainable Use of Natural Resources and Assets (Official Gazette of the Republic of Serbia No. 33/2012) was adopted in 2012 and provides general and specific objectives for the protection, management and improvement of the state of protected areas, protection, management and sustainable development of biodiversity, geological diversity and the landscape diversity in the Republic of Serbia. Indicators were presented to monitor the achievement of sustainable use of protected areas, biodiversity, geodiversity and landscape diversity, also a list of indicators for monitoring the implementation of the National Strategy.

In the Spatial Plan of the Republic of Serbia from 2010 to 2020 ("RS Official Gazette" No. 88/2010), one of the basic goals of the further development of the Republic of Serbia is the conservation of nature and the sustainable use of natural resources, while respecting the following criteria : sustainability, quantity, usability (exploitation), vulnerability, sensitivity, and reproducibility. According to the PPRS, the concept of the development of nature protection of the Republic of Serbia will be implemented within protected areas, protection of strictly protected and protected wild species, preservation of habitats of national and international significance and establishment of an ecological network. Regional spatial plans, spatial plans of special purpose areas, spatial plans of local self-government units and urban plans contain the conditions of nature protection, which are determined by the nature protection institutes. In order to fully implement the aforementioned planned documents, nature protection measures are defined as rules of regulation.

The Strategy for Agriculture and Rural Development of the Republic of Serbia for the period 2014-2024 ("Official Gazette of RS", No. 85/2014) also dealt with the theme of biodiversity related to genetic resources and includes plant, animal and forest genetic resources. One of the key principles mentioned in the Strategy refers to responsible management of resources and their preservation for the next generations, with a long-term better conservation of biodiversity. In accordance with this principle, a strategic development goal has been identified that relates to sustainable resource management and environmental protection. So far, the Strategy for the Development of Hunting has not existed in the Republic of Serbia, but it has been defined through legislation and certain strategic documents as the basis for the development of the sector. The legal framework for the development of the sector is the Spatial Plan of the Republic of Serbia, as well as the Law on Wildlife and Hunting. This law defines the conditions for the use, management, protection and improvement of wildlife populations and their habitats.

The Strategy for the Development of Forestry of the Republic of Serbia ("Official Gazette of the Republic of Serbia", No. 59/2006), as one of the objectives implements, preservation and improvement of biodiversity in forest areas as part of the concept of sustainable forest management.

Fire Protection Strategy for the period 2012-2017. ("Official Gazette of the Republic of Serbia" No. 21/2012) includes the prevention of fire-starting and effective forest fire fighting. A special threat from forest fire is defined in planning documents for forest management.

The following Action Plans were prepared: Action plan for the conservation of swamp areas in the Republic of Serbia, Action plans (strategic plans) for the protection of Brown bear (Ursus arctos), Wolf (Canis lupus) and Lynx (Lynx lynx), Action plan for management of Sturgeon in Fishing Water of the Republic of Serbia (2005), Action Plan for larval fish Management in Fishing waters of the Republic of Serbia (2006).

Long-term program of measures for the implementation of the breeding program in the Republic of Serbia for the period 2015-2019. In the field of animal production in autochthonous breeds, the "Official Gazette of the Republic of Serbia" No. 76/2015 proposes conservation in the pure breed because of their genetic potential.

International agreements, conventions and contracts in the field of environment protection

By succession, the Republic of Serbia became a signatory to the Rio Declaration on Environment and Development of 1992, while the Law on the Confirmation of the Convention on the Biodiversity of the United Nations was adopted in 2001. The Convention recognizes the sovereign right of each State to regulate its resources and biodiversity, but States are expected to provide support for the three main objectives of the Convention:

1) protection of biological diversity;

2) sustainable use of biodiversity components;

3) fair distribution of profits from the use of genetic resources.

The Sustainable Development Program by 2030 (2030 Agenda for Sustainable Development) was adopted at the United Nations Summit on Sustainable Development in September 2015. This program encompasses 17 new Sustainable Development Goals, or global goals, in accordance with which policy and funding will be guided over the next 15 years, starting with the historical obligation to eradicate poverty.

The concept of sustainable development goals was created at the United Nations Conference on Sustainable Development, Rio + 20, held in 2012. The aim of the conference was to create a set of universal goals that place in balance the three dimensions of sustainable development: ecological, social and economic.

Global goals are replacing the Millennium Development Goals (MDGs), which gathered the world, in September 2000, around a fifteen-year program aimed at tackling the problem of poverty and its consequences.

The Republic of Serbia has signed numerous international agreements on nature protection, including the Convention on the Protection of World Cultural and Natural Heritage, the UN Convention on Biological Diversity with accompanying protocols (the Protocol on Biosafety - the Cartagena Protocol and the Protocol on access to genetic resources, the just and equal distribution of benefits derive from their use along with the Convention on Biological Diversity - Nagoya Protocol), Convention on swamps of international importance, in particular as a habitat for swap birds - Ramsar Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora - CITES, Convention on the Conservation of Migratory Species of Wild Animals - Bonn Convention and Complementary Agreements, Agreement on the Conservation of African-Euro-Asian Migratory Birds of water habitats (AEWA) and the Agreement on the Conservation of Bats in Europe (EUROBATS), the Convention on the Conservation of European Wild Fauna and Flora and Natural Habitats - the Berne Convention, the Framework Convention on the Conservation and Sustainable Development of the Carpathians - Carpathian Convention, the European Landscape Convention.

European union regulations

The European Union biodiversity protection strategy by 2020 has been passed with the aim of halting the loss of biodiversity in the EU by 2020, in line with the Biodiversity Convention. The strategy contains 6 goals and provides precise guidelines for achieving these goals.

The basis for the legislation in the field of nature protection is the Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43 / EEZ) and the Conservation of Wild Birds Directive (2009/147 / EK), on the basis of which the ecologically important areas of the European Union are determined, Natura 2000. In addition to the aforementioned, in the area of nature protection, the Directive on the keeping of wild animals in zoos (99/22 / EEZ), Regulation 1143/2014 on the prevention and management of the introduction and spread of invasive alien species, as well as the set of EU trade regulations the wild world that applies the CITES Convention at the EU level.

It should be noted that the acquis Communautaire as a body of EU legal acts includes, inter alia, audits, international agreements concluded by the EU with third world countries and international organizations, agreements between the Member States, general legal principles, acts passed by the EU bodies of the European Union on the basis of authorization and in accordance with the procedures stipulated in the founding agreements (decrees-regulations, directives, decisions, recommendations and opinions, as well as instructions, regulations, decisions of the declarations, resolutions, strategies, action plans, measures, etc.) and the case law of the Court of Justice of the European Union.

Framework documents in the EU integration process are the National Strategy on admission of Serbia to the EU (June 2005) and the Stabilization and Association Agreement between the European Communities and their Member States, on one hand, and the Republic of Serbia on the other ("Official Gazette of the Republic of Serbia", no. 83/08), and the National Program for the Adoption of the Legal Framework of the European Union is a detailed, multi-year plan for harmonizing domestic regulations with EU regulations. The Ministry of Environmental Protection is responsible for the development and implementation of Chapter 27 - Environmental Protection and Climate Change.

The document, status and plans for the transposition and implementation of the acquis Communautaire for Chapter 27 - Environment and Climate Change (the so-called Post Screening Document for Chapter 27) was adopted by the Government of the Republic of Serbia in September 2015, following the first bilateral meeting for Chapter 27. The purpose of this document is to provide up-to-date information on the transposition and implementation plans of the Republic of Serbia in order to achieve full compliance with EU regulations.

The document was developed within the Negotiating Group 27, in consultation with the AP Vojvodina, local self-governments and the civil sector, approved within the negotiating structure of the Republic of Serbia. As such, it reflects the current understanding of Serbia regarding the necessary investments, the estimated costs associated with them, and the planned deadline for their realization. It is based on the best information currently available, and follows the strategic direction defined in the National Environmental Approximation Strategy passed on October 13, 2011.

Chapter 27 is one of the most extensive chapters in the negotiations with the European Union, and the Negotiation Group 27 includes nearly 30 institutions and about 150 members. It is planned for the Ministry of Environmental Protection to prepare a negotiating position for Chapter 27 by the end of the year.

The Government of the Republic of Serbia passed, with the Action Plan in 2011, the first Biodiversity Strategy of the Republic of Serbia for the period from 2011 to 2018 ("Official Gazette of the Republic of Serbia" No. 13/2011). This strategy defines 11 strategic areas and 28 specific goals in the protection of biodiversity with over 140 different activities that are necessary for achieving the set goals. However, this strategy did not define indicators for monitoring the achievement of goals and implementation of the action plan, nor indicators for monitoring the implementation of the strategy itself. In order to fulfill the commitments undertaken by the signing of the UN Convention on Biological Diversity, in accordance with Article 6 of the Convention and Decision No. X / 2 passed at the Tenth Meeting of the Conference of the UN members on the Convention on Biological Diversity, held in 2010 in Nagoya (Japan) In 2014, the process of revision of the 2011 Biodiversity Strategy was initiated in Serbia and the development of the Strategy for Nature Protection of the Republic of Serbia for the period 2017-2027.

The process of strategy development started within the project "Biodiversity conservation planning at the national level in support of the implementation of the Strategic Plan of the Convention on Biological Diversity for the period 2011-2020. in the Republic of Serbia ", funded by the Global Environment Facility (GEF), in cooperation with the United Nations Development Program (UNDP) as the implementing agency.

Working Group for the revision of the Biodiversity Strategy of the Republic of Serbia for the period from 2011 to 2018, in accordance with the global Strategic Plan of the UN Convention on Biological Diversity for the period from 2011 to 2020, has been formed by Decision No. 119-01-95 / 2015-17 since 23.02.2015. The members of the Working Group were representatives of relevant institutions, primarily ministries responsible for environmental protection, agriculture, forestry, education, science, construction,

transport and infrastructure, as well as the Environmental Protection Agency, the Provincial Secretariat for Urban Planning and Environmental Protection, the Institute for the protection of the nature of Serbia, the Provincial Institute for Nature Protection.

According to the Nature Protection Act ("Official Gazette of the Republic of Serbia", No. 36/2009, 88/2010, 91/2010, and 14/2016), the Nature Protection Strategy was introduced as a mechanism for the implementation of ratified international treaties in the field of nature protection which defines long-term goals and measures for the preservation of biological and geological diversity and the manner of their implementation. The strategy is developed on the basis of the Report on the state of nature submitted by the competent Institute for Nature Protection of Serbia, in cooperation with the Provincial Institute for Nature Protection. The Strategy sets out the long-term planning framework and the policy of integral nature protection, including the preservation of biodiversity, landscapes and geo-heritage. It is defined that this strategic document in particular contains principles and general objectives, an assessment of the situation, specific objectives and activities for their implementation, as well as possible sources of financing.

In accordance with the aforementioned, the Draft Nature Protection Strategy of the Republic of Serbia has been prepared for the period from 2019 to 2025 with the Action Plan. The process of strategy preparation also included public insight into the draft document, as well as harmonization with the submitted comments. During the preparation of this report, the Strategy Proposal was in the process of alignment with the Law on the Planning System of the Republic of Serbia ("Official Gazette of the Republic of Serbia" No. 30/18) regulating the planning system of the Republic of Serbia, i.e. managing the public policy system and midterm planning.

A favorable state of biodiversity means the existence of an effective system for preserving biodiversity. In order to improve the management of the biodiversity conservation system in Serbia, it is necessary to improve the policy framework, as well as the institutional and financial framework.

One of the objectives of the Draft Nature Protection Strategy is to integrate conservation of biological diversity into other sectors, especially those that directly use and manage natural resources - agriculture, forestry, hunting, fishing, use of plant and animal life, mining, electricity generation and tourism through incorporating the principles of preserving biodiversity into their policies, plans, programs and production systems.

Article 13 (a) of the Convention on Biological Diversity, its part relating to Education and Public Information, provides that all Parties are required to "promote and encourage the understanding of the importance of conserving biodiversity and the measures it requires, as well as to disseminate information through media and include these topics in educational programs". Aichi target 17 relates to improving the implementation of the Biodiversity Strategy through participatory planning, knowledge management and capacity building.

Public information and communication are important when supporting biodiversity measures and strategies. All stakeholders should be involved in finding opportunities to conserve biodiversity, and therefore it is necessary to establish an operational framework for education, information and public inclusion.

Priority Actions toward National Target 4

4.1 Inclusion of nature protection in other sectoral policies through amendments and the implementation of sectoral regulations through existing legal remedies

This measure is aimed to create and implement integrated policies for the conservation and sustainable utilization of biodiversity into policies, plans, programmes and production systems at the national level, oriented towards production, economic activity and development. There is a need for the integration of biodiversity into production sectors in Serbia, especially those which have a direct benefit on natural resources and manage these resources – agriculture, forestry, fishing, utilization of plants and animals, mining, production of electric power and tourism.

The existing mechanisms for the conservation of biodiversity and the integration of biodiversity goals into other sectors are implemented through the Law on Nature Conservation and Conditions of Nature Conservation, the Law on the Strategic Evaluation of the Influence on the Environment ("The Official Gazette of the Republic of Serbia", No. 135/2004 and 88/2010), the Law on the Evaluation of the Influence on the Environment ("The Official Gazette of the Republic of Serbia", No. 135/2004 and 36/2009), and this has also been stipulated through appropriate assessment as a future instrument.

The Law on Nature Conservation introduces a new instrument for nature conservation in Serbia – appropriate assessment, which represents a basic protection mechanism of the European ecological network Natura 2000. In Serbian legislation, appropriate assessment is closely connected to the ecological network and its primary purpose is conservation of the basic values of ecologically significant areas that have been defined by the Decree on the ecological network. The procedure of adoption of the Decree on appropriate assessment is currently ongoing in Serbia, and the implementation of this instrument within nature conservation will be defined closely.

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 4

Aichi targets A2, A3, E20

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

Red books in Serbia

The first Red Book in Serbia was created in 1999 - the Red Book of the flora of Serbia I, which refers to extinct and endangered plant species and contains 171 plant taxons, which makes up about 5% of the total flora of the Republic of Serbia. Out of that number, four endemic taxons are irreversibly lost from the world's gene pool; 46 taxons have disappeared from the Republic of Serbia, but they can still be found in neighboring areas or ex-situ conditions (botanical gardens); 121 species are extremely endangered, with a high chance of disappearing from our territory, or from the world in the near future, if they are not given proper attention.

The second Red Book - Red Book of Butterflies of Serbia was published in 2003 and contains the analysis of 57 species of butterflies that make up 34% of the fauna of butterflies of the Republic of Serbia. One species is considered extinct (Leptidea morsei), and 11 species are endangered.

The Third and Fourth Red Book - Red Book of Fauna of Serbia I Amphibians and the Red Book of Serbia II Reptiles, were published in 2015. The Red Book of Amphibians contains five species of Caudata (one species of Salamander and four species of Newts) and five species of amphibian Tetrapods (frogs). There are three species of turtles, seven species of lizards, and six species of snakes in the Red Book of Reptiles.

Fifth Red Book - The Red Book of Fauna of Serbia III Birds, was published in 2019. In the Red Book of Birds, 352 species were

recorded reliably, and the risk of extinction was estimated for nesting populations of 255 species and non-nesting populations of all bird species. In the process, a database was used with more than 312,000 finds collected by numerous bird experts.

Sixth Red Book - Red Book of Fauna of Serbia IV Orthopterans, was published in 2019. The book shows 35 taxons, which the authors consider potentially threatened or on the verge of total extinction from Serbian fauna. This is the first published book on Orthopterans on the world level, which gives an insight into this group of insects and their condition in Serbia, with special emphasis on the species that are endangered or on the verge of total extinction, in order to point out the necessity of comprehensive protection of the most endangered species.

The Preliminary List of Species for the Red List of Vertebrates was drafted from 1990- to 1991, prior to the publication of red books. On this list there is a species of jawless fish, and 30 species of fish, 22 species of amphibians, 21 species of reptiles, 72 species of mammals, and a large number of birds (353 species). It should be noted that in the meantime the criteria of the Red List and then defined categories of vulnerability of certain species have changed significantly.

Protected species

In accordance with the Nature Protection Act, wild species that are endangered or can become endangered, which have special significance from the genetic, ecological, ecosystem, scientific, health, economic and other aspects, are protected as strictly protected wild species or protected wild species. In Serbia, 1,759 species are protected as strictly protected and 854 species are protected wild species of plants, animals and fungi. A special type of protection refers to species that may be compromised by excessive and uncontrolled harvesting from the nature.

The use of some species of mammals, birds and fish is regulated by other acts, such as the Law on Wildlife and Hunting ("Official Gazette of RS", No. 18/2010) and the Law on the Protection and Sustainable Use of Fish Funds ("Official Gazette of RS", no. 128/2014).

Of species on the list of protected wild species (Annex 2 of the Ordinance on the designation and protection of strictly protected and protected wild species of plants, animals and fungi), a total of 97 wild species of plants, animals and fungi are under control of use and trade. Of these, 63 types of plants (2 types of fern and 61 seedlings), 15 types of mushrooms and 10 types of lichens (the entire genus Usnea, total of 8, except for species that are strictly protected) and 9 species of animals (2 species of reptiles, 3 species of amphibians and 4 types of invertebrates).

In accordance with the Law on Nature Protection, according to the opinion of the Institute for Nature Protection, the Ministry of Environmental Protection issues licenses for research of strictly protected and protected wild species for scientific and educational purposes, in order to keep records on the manner and extent of their use, as well as factors endangering protected and strictly protected wild species in order to determine and monitor the status of their populations. Records on issued permits and reports after carrying out scientific research are conducted by the ministry in charge of nature conservation and nature protection institutes.

In addition to protected areas and protected species, protected natural assets are mobile protected natural documents, which represent parts of geological and paleontological heritage, as well as biological documents with exceptional scientific, educational and cultural significance (certain fossils, minerals, crystals and mineral species, druse, botanical and zoological collections and individual preserved organic type products).

The law prohibits the collection and / or destruction of movable natural documents, as well as the destruction or damage to their findings.

Geological diversity of the republic of Serbia

The protection of geological diversity [1] in the use and spatial planning is accomplished by implementing measures of nature conservation, geological and paleontological documents, as well as geoscientific facilities in conditions of in-situ and ex-situ protection (Law on Nature Protection, "Official Gazette of RS", no. 36/2009, 88/2010, 91/2010, and 14/2016).

The space that includes the territory of the Republic of Serbia is built of various types of rocks created through a long history of development that dates back to the oldest epoch of geological history - Precambrian, through Paleozoic, Mesozoic, Cenozoic to the youngest period - Quaternary, which continues to this day. This area during the Cenozoic period in geotectonic sense, represented a part of the northeastern Alpine orogen, whose tectonic movements led to the formation of new deposition centers (Pannonian, Peri-Pannonian and Dacian basins) in the process of gravity sinking, mainly during the Oligocene and the older Miocene. On the other hand, the Dinaric mountain ranges, the Serbian-Macedonian masses and the Carpatho-Balkanides were in the process of constant rise, which was the result of compression caused by movements and the collision of the Adriatic plate with Dinaric orogen, and this compression has reflected on the increase in the thickness of the earth's crust in the mentioned areas. Therefore, during the Neogene, we can distinguish the following large tectonic units in the territory of Serbia: Dinaric, Serbian-Macedonian masses, Carpatho-Balkanides, Pannonian and Dacian basins.

Serbia is a country with a long tradition of geological exploration and protection of geological objects, written traces of some initial forms of protection date from the XIV century, and the first detailed geological research was initiated by the founders of natural sciences in Serbia in the early 20th century botanist Josif Pančić, academician Jovan Žujović and their followers.

The unique policy of protecting Geo-heritage in Serbia began in 1995, when the National Geological Council was established. The National Environmental Program for 2005 sets out the development of the National Strategy of Geo-diversity as one of its goals. Serbia, among other things, showed its commitment to the sustainable use of Geo-heritage on the international level, as well as membership in the European Geological Heritage Conservation Association (ProGEO). The value of the Geo-heritage according to the unique concept was adopted by this association in 1996, which began a unique policy of Geo-heritage protection, when a division of geo-objects-representants (A-I) was adopted, on the basis of which characteristic geo-structures are distinguished that depict the specificity of geodiversity: A) Paleo-biological (macro and micro fauna, flora, traces, stromatolites, biochemical); B) Geomorphological (caves, volcanoes, waterfalls, fjords, zircons, karst, etc.); C) Paleo-ecological (former climates, global sedimentary geology, fossil indicators); D) Magmatic, metamorphic and sedimentary petrological, textured and structural; E) Stratigraphic (sequences, stratotypes of the upper limits, interval of stratotypes, biozone type of objects of wide significance, paleomagnetic events, etc.); F) Mineralogical; G) Structural (main tectonic or gravitational structures); H) Economic (intrusive, spill, metallic and non-metallic deposits, mines and quarries ..); and I) Other representatives (historical, for the development of geological science). On the basis of this division, each member state of the association should form an inventory of Geo-heritage objects. With completion of the inventory of Geo-heritage objects, the preparation of the priority list should follow.

The inventory of the Geo-heritage objects of the Republic of Serbia was completed in 2005 and includes about 650 geological, paleontological, geomorphological, speleological and neo-tectonic objects, i.e.: 130 objects of historical geological and stratigraphic heritage, 58 objects of petrological heritage, 192 geomorphologic heritage objects, 42 neo- tectonic activities and geophysical heritage, 80 objects of speleological heritage, 19 objects of hydrogeological heritage, 18 objects of pedological and geo-archaeological heritage, 13 groups of objects with climatic specificities, as well as 99 objects ex-situ geo-heritage.

The terms geological diversity and geodiversity are equally used in the document and relate to a set of geological formations and structures, phenomena and forms of geological structure and geomorphological characteristics of different composition and method of formation and various paleo-ecosystems altered in space under the influence of internal and external geodynamic factors during geological periods.

4.1.1. Indicator Name: Endangered and protected species

Author/Institution: Slavisa Popovic/ Environmental Protection Agency

Key messege: There are 2,628 species protected on the territory of the Republic of Serbia

Assesment: 

The indicator describes the pressures on biodiversity and the responses, according to the lists of endangered and protected species at national and international level. In the territory of the Republic of Serbia 2,628 species are protected, out of which 1,760 are strictly protected.

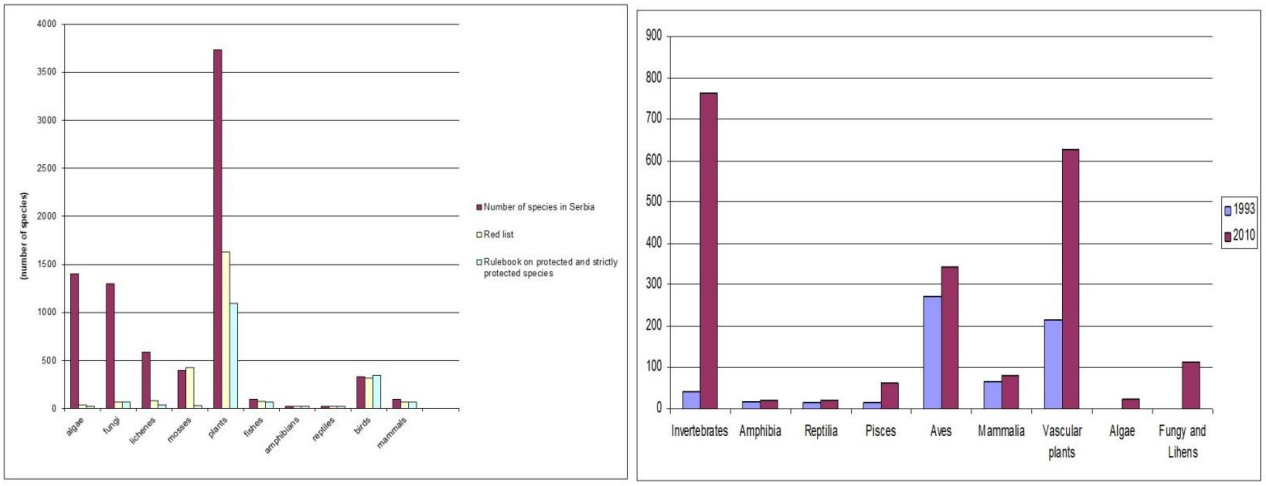


Fig. 4.1.1.1. Total number of species by taxa, endangered and protected species (left) and increase of protected species number in Serbia.

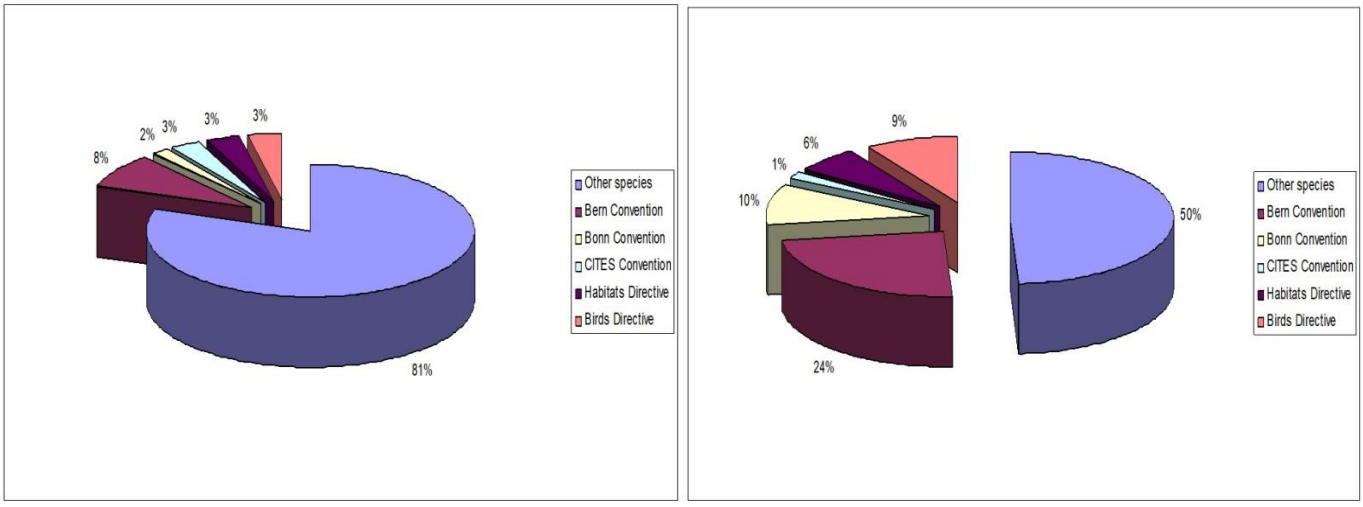


Fig. 4.1.1.2. Structure of protected species by international conventions.

Fifty percent of protected species at national level are listed on some of the Conventions and Directives (Bern and Bonn Convention, Habitats and Birds Directive). Other species (another 50%) are protected only at national level.

4.1.2. Indicator name: Financing the environmental protection

Author/Institution: Maja Krunić-Lazic/ Environmental Protection Agency

Key messege: Environmental finansing increase

Assesment: 

Serbian Environmental Protection Agency in its annual Reports on the State of Environment in Serbia and on Economic instruments for environmental protection shows this indicator. The indicator shows the trend of environmental protection financing, as well as the structure of finansing sources.The main source of financing environmental protection is the budget of the Republic of Serbia, and the distribution of funds depends on the budget balance options. Other sources include provincial and municipal budgets, revenues from charges and fees, commercial sector funds, and funds can also be provided from donations, loans, international aid, instruments, programmes and funds from the EU, UN and other organisations.

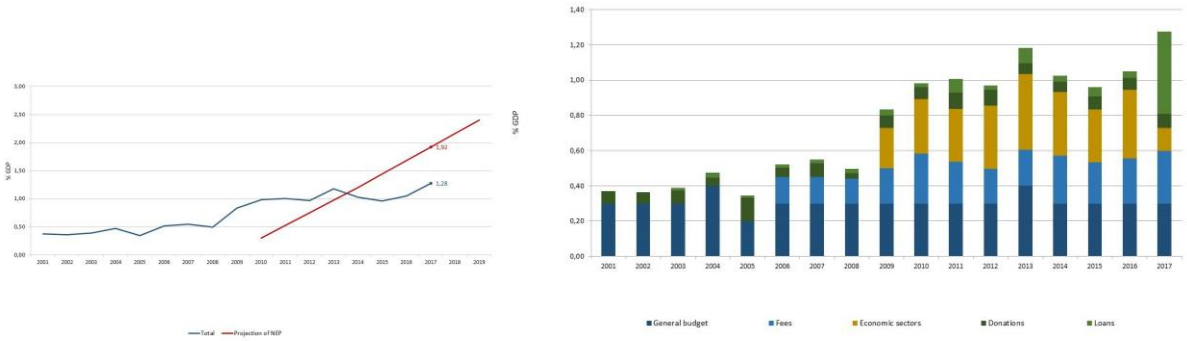


Fig.4.1.2.1. Financing environmental protection (left) and sructure of environmental protection financing(right) in Serbia

Sources of financing environmental protection in the Republic of Serbia include funds from the national budget allocated through the ministry, institutions and dedicated funds, the budget of AP Vojvodina, as well as the budgets of local self-governments, and funds that come through numerous bilateral and multilateral agreements. The most important international funds are certainly pre-admission funds of the EU.

Basic competencies in this area are within the Ministry of Environmental Protection. The financial framework for nature protection, especially in the period 2011-2014, was not sufficiently realized, which was influenced by several changes in the structure of the ministries responsible for environmental protection, which also reflected the reduction in the allocation of financial resources for this area. For the environmental protection sector, only 0.4% of gross domestic product, i.e. 0.9%, was allocated in the aforementioned period, if local contribution from the industrial and private sector are taken into account.

Funding of protected areas is mainly done from budget resources, from the use of natural resources, revenues generated from tourism, donations and other sources. Most of the budget funds coming to protected areas go to the current costs of financing institutions and employees. The Ministry of Environmental Protection, as a ministry responsible for protected areas at the national level, finances activities in protected areas through projects, which contributes to a greater degree of utilization of funds for the protection and improvement of biodiversity in natural assets. In 2012, 2013 and 2014, the Ministry allocated approximately 1.4 million euros annually to protected areas (150 million dinars in 2012 and 160 million dinars in 2013 and 2014), while for 2015 a total of about 1.7 million euros (210 million dinars) were allocated. The average share of protected area funding from the state budget is around 25%.

The Ministry of Environmental Protection also finances projects in the field of nature protection, for the development of individual action plans for the protection of endangered species, the production of red books and red lists of endangered plant and animal species and the establishment of an ecological network of the Republic of Serbia.

The Government allocates funds from the budget of the AP Vojvodina to the Provincial City Planning and Environmental Protection Bureau. The funds allocated by the Secretariat in 2012 and 2013 for the improvement of biodiversity and protected areas amount closely to 100 thousand Euros per year (12 million dinars), in 2014 about 180 thousand Euros (22 million dinars), while in 2015 almost 170 thousand Euros (RSD 20 million) were allocated.

In the period from 2009 to 2012, the financing of nature protection was also carried out from the Environmental Protection Fund.

The Ministry of Education, Science and Technological Development finances the preparation of basic, technological and integral projects from various scientific fields through competitions, and therefore research related to the field of nature protection. According to the data of the Ministry for financing national projects dealing with biodiversity research for the period from 2011 to 2014 approximately 8.5 million Euros (nearly one billion dinars) were allocated.

The Ministry of Agriculture and Environmental Protection has prepared a proposal for the IPARD II program of the Republic of Serbia for the new program period 2014-2020, which the European Commission has passed and defined 175 million euros for its implementation. It is planned that several sectors of agriculture will be supported through the IPARD program, and only agro-ecological production will be accredited for agroecological measures, while the funds for this measure will be available from 2017.

In addition to the IPA funds, the Republic of Serbia also provides support for environmental projects through donations, loans, international assistance funds and funds and programs from United Nations instruments, international organizations, such as the Instrument for Pre-Admission Assistance (IPA), the Swedish Development Assistance (ODA), the Global Environment Fund (GEF), the World Bank, the European Bank for Reconstruction and Development, Serbia has full participation in the Seventh Framework Program for Research and Technological Development (FP7), as well as in the new Horizon 2020 cycle - the EU Research and Innovation Framework Program.

4.1.3. Indicator Name: Income from fees for use of natural resources

Author/Institution: Maja Krunic-Lazic, Slavisa Popovic/ Environmental Protection Agency

Key messege: Nature conservation finansing increase

Assesment: 

Indicator shows the trend of income from fees for use of natural resources, as well as the structure and distribution. Serbian Environmental Protection Agency in its annual Reports on the State of Environment in Serbia and on Economic instruments for environmental protection shows total revenues from environmental fees. The income from fees for natural resources use is created for the purposes of this Report. Fees are one of environmental economic instruments, aim of which is to promote reduction of environmental pressures by applying the "polluter pays" and "user pays" principles. This indicator helps to answer a question about how much financial resources are obtained from the natural resources use, according to the principle üser pays“.

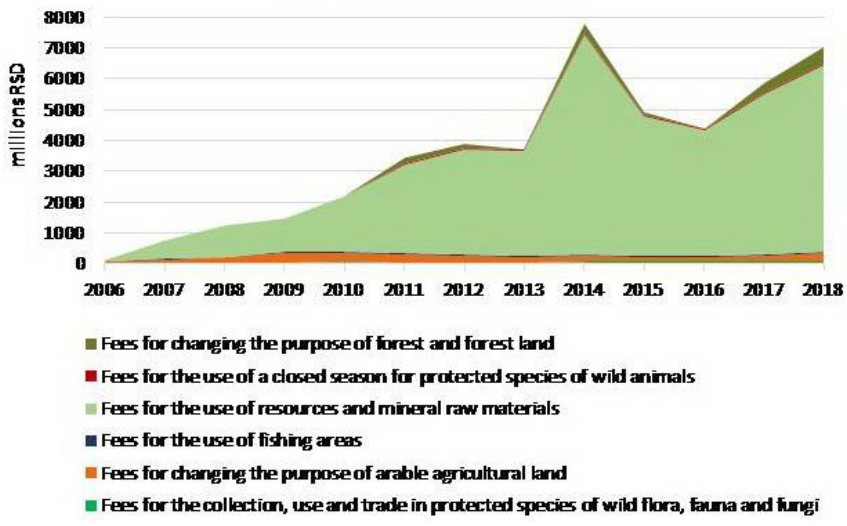


Fig. 4.1.3.1. Trend in income from natural resources use fees

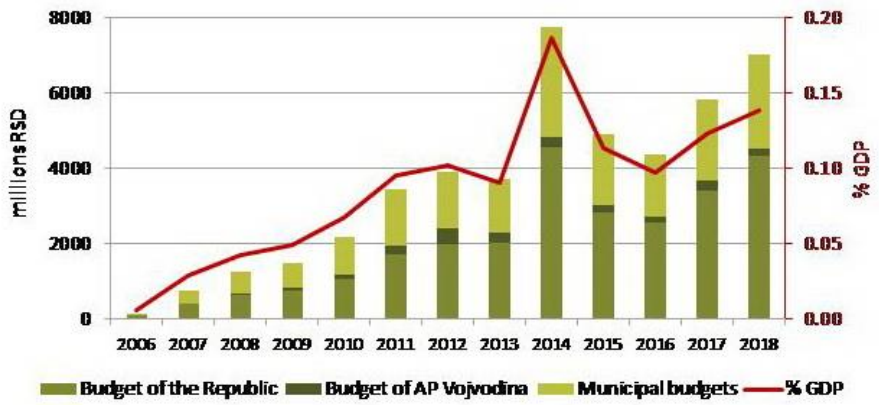


Fig. 4.1.3.2. Distribution of income from natural resources use fees

In 2018, revenues from fees for the use of natural resources amounted to 7,038 million dinars (0.14% of GDP). Revenues are in accordance with the regulations distribute in the following way: the state budget is RSD 4.337 million (0.09% of GDP), the budget of the AP Vojvodina is 178 million RSD (0.004% GDP), and the total municipalities budgets are 2.523 million RSD (0.05% GDP).

In the structure of total fees 2018, Fees for the use of resources and mineral raw materials dominate and their share is 85.7%. In the period 2006-2018, the increase in these fees indicates an increase in the use of mineral resources.

The share Fees for changing the purpose of forest and forest land is 7.9%, and Fees for changing the purpose of arable agricultural land 3.9%. The increase in these fees in the reporting period means that forest land and arable agricultural land now become urban or industrial land.

Fees for the collection, use and trade in protected species of wild flora, fauna and fungi, Fees for the use of a closed season for protected species of wild animals, and Fees for the use of fishing areas are in the function of direct protection of biodiversity. Their share in the structure of total fees of 2018 is respectively 0.6%, 1.3% and 0.6%

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- Lack of inter-sectoral cooperation,
- Not satisfied inclusion of biodiversity issues in other sectors,
- Slow procedure for adoption Laws and by-Laws connected to nature protection

4.2 Increasing the level of knowledge and awareness of the importance of biodiversity and promoting public participation in conserving biodiversity

By this measure it is aimed to increase the level of knowledge and awareness of the importance of biodiversity of wider public and stakeholders in Serbia. Biodiversity as a subject of research projects and plans for conservation are mainly of interest of research institutions, universities, national and provincial institutes for nature protection, ministry responsible for nature protection and only few civil society organizations (national and international). Due to low awareness on importance of biodiversity, most of the people are not interested, or might be interested, but they do not know how to contribute to biodiversity conservation. Research priorities in environmental protection and climate change, within which the monitoring of ecosystems and protection of biodiversity are included are recognized by the Ministry of Education, Science and Technological Development and financed through national projects. In the last couple of years scientific projects financed by the Ministry have not been selected and supported due to lack of financing. Some international organizations did effort to continue supporting projects related to nature protection, but when the project finished, all activities and initiatives also stopped.

By the Law on Nature Protection, the administrative authority that establishes the act for designation of protected area informs the public and conducts public hearing on the proposal for the act for the designation of a protected area. Promotion of public participation in conserving biodiversity is mainly in the agenda of international organizations and national civil society organizations which deal with nature and biodiversity protection. Their activities are oriented to the local communities and specific problems they are faced on. Through the annual calls for the civil society organizations announced by the Ministry of environmental protection and Provincial Secretariat for urbanism and environmental protection, they have opportunity to submit projects and to involve more public to participate in conserving biodiversity.

For the implementation measure, please indicate to which national or Aichi Biodiversity target(s) it contributes

National target 4

Aichi targets A1 and E19

Assessment of the effectiveness of the implementation measure taken in achieving desired outcomes

- Measure taken has been partially effective 

4.2.1. Indicator name: Biodiversity and nature protection in scientific research

Author/Institution: dr Marina Soković, dr Jasmina Grubin/ Ministarstvo prosvete, nauke i tehnološkog razvoja

Key messege: For the period of 2011 to 2018, about 4.59 % of funds for financing projects in the field of biodiversity were allocated in relation to total funds for all projects financed by the MPNTR

Assesment: 

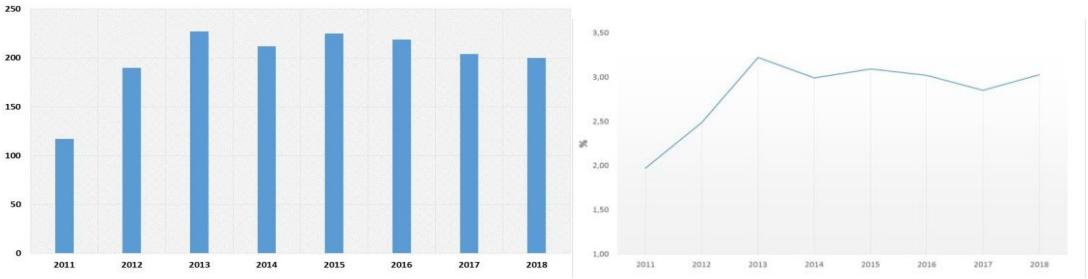


Fig. 4.2.1.1. Number of, and stake in, published scientific papers

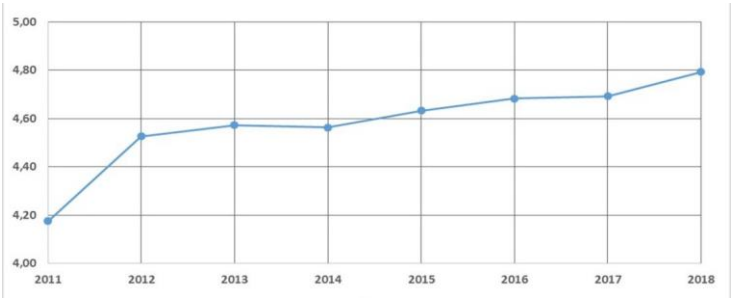


Fig. 4.2.1.2. The stake in funding for projects in the field of biodiversity

Data are provided for the period of 2011 to 2018 (current project cycle). Research on biodiversity and nature protection deals with about 4.92% of researchers engaged in about 2.33% of projects in relation to the total number of funded researchers, or projects within all research programs. The largest number of projects is implemented in the field of Biology, followed by Biotechnology and Agriculture, Arranging, Protection and Use of Water, Land and Air and Environmental Protection and Climate Change. In the period of 2011 to 2018, about 2.86% of scientific results in the field of biodiversity were published in internationally recognized journals, compared to the total number of scientific results published by scientists from Serbia engaged in projects in the field of biodiversity (financed by MPNTR) for the same period.
For the period 2011-2018, an average of 4.59% of funds for financing projects in the field of biodiversity were allocated, on average, for all projects financed by the MPNTR.

4.2.2. Indicator Name: Public participation through financing the projects of NGOs in Vojvodina

Author/Institution: Lorand Vigh, Olivia Tešić, Tamara Stojanović/ Provincial Secretariat for Urban Planning and Environmental Protection

Key messege: The number of supported projects and the amount of funds decreased from 2010 to 2016

Assesment: 

Indicator shows the relation between number of all of the supported projects and the projects which is related to biodiversity protection, but also the relation between amount of the total funds for the projects per year and the funds for the biodiversity protection projects during 2010-2016.

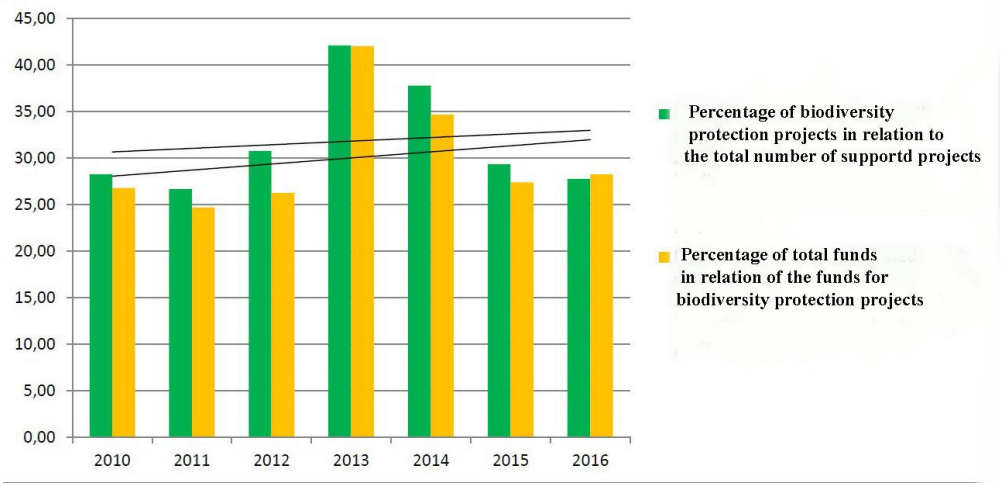


Fig. 4.2.2.1. The percentage ratio between number of supported projects and amount of funds for NGOs in Vojvodina

It is important to add that in the period from 2010-2011 funds were provided also through the Environmental Protection Fund of the Republic of Serbia. The results show that the funds varied from year to year but reached the highest level during the period 2010-2011 due to additional financial sources. Generally, the number of supported projects (Chart 1) and also the amount of funds (Chart 2) decreased from 2010 to 2016, but in the case of a percentage ratio of the total number of supported projects and biodiversity protection projects, as well as in the case of a percentage of the amount of financial resources spent on all projects in relation to biodiversity protection projects (Chart 3), there is a slight positive trend. This means that the number of projects and the amount of funds allocated for biodiversity protection projects has increased over time as compared to the total funds available for the work of NGOs in Vojvodina.

4.2.2.1. Case study: WWF Nature Academy

Author/Institution: Sonja Badjura, Goran Sekulic/ WWF Serbia

Assesment:

Within the project „Protected Areas for Nature and People“ WWF have implemented WWF Nature Academy program in five protected areas in Serbia (National parks Fruška Gora, Tara and Đerdap, Special nature reserves Gornje Podunavlje and Protected landscape Avala).
In the WWF Nature Academy teachers and students learn over 8 months about:
• Protected areas – their importance and value, and begin cooperating with the protected area they will become ambassador for;
• Ecological footprint – how our lifestyle influences nature and what can we change;
• Active citizenship – how to become active and influence others;
• Project cycle – how to develop and implement an environmental school project in cooperation with the protected area;
• Communication skills – how to work with various stakeholders and media.

In addition, WWF works with protected area managers to support them in development of specific environmental educational programs and helps them in establishing structured and long-term cooperation with local schools. Up to now, the project involved: 5 protected areas, 20 schools, 110 teachers, over 300 students directly involved in activities and more than 4000 reached with educational programs.

Pic. 4.2.2.1.1. Following the steps of the first botanists

This is an educational program for high school students and college students interested in biology and botanical research. It has been taking place over the last 8 years in which 180 young people from Vojvodina Province took part. The aim of this program is to familiarize with the basic methods of botanical research and the popularization of natural sciences, natural and cultural historical values, as a prerequisite for their inclusion and engagement in active protection of biodiversity, nature protection and sustainable use.
Every weekend seminar brings specific topics in scientific research, with demonstration of many scientific methods and which are practiced directly with participants. During these seminars they go through:
- training on basic principles of nature protection and protection of biodiversity, sustainable development and proper use of natural resources

- phase of “botanisation”, field work, collection, determination and preparation of plant material, with special emphasis on endangered, strictly protected and protected species, with mentoring of experienced field biologists and researchers.
- ethnobotanics, a specific multidisciplinary science, which collects knowledge about the use of plants by people. Ethnobotanic research is an excellent model that can familiarize the traditions and habits of the population within a protected area and thus enable the development of existing and the creation of potentially new sustainable uses of plant resources.
The seminars take place in the National park Fruška Gora and Special nature reserve Koviljsko-Petrovaradinski rit which are in the vicinity of Novi Sad, capital of Vojvodina Province.

Goranski eko kampovi
The Goranski Eko Camps (GEKs) have been held regularly since 1997, and are intended for children of elementary school age. They get to know the different ecosystems and relationships that exist within natural habitats. They are gaining knowledge through mini-research and fieldwork, within protected areas (National Park Fruška gora and Special nature reserve Koviljsko-petrovaradinski rit). Complete educational program is adapted to school children. Since last year, camps have been thematically conceptualized, lasting for three days and dealing with various topics:
Pticoljub (Birdlover) - to get to know the species of birds nesting in the floodplains and forests along the Danube,
Buboljub (Buglover)- to learn to identify and distinguish groups of insects
Cvetoljub (Flowerlover)- to learn to recognize edible and medicinal herbaceous or woody plants
Medoljub (Honeylover)- to get to know the species of bees, honey plants and beekeeping
Drvoljub (Treelover)- to learn about types of forests and forest communities

With the selection of these topics, we wanted to teach children about groups of plants and animals that are direct indicators of the current state of ecosystems and the environment. In this way, children with their own activity find out how much their environment is endangered, who endangers it and how to engage in its preservation and protection. Over the last 5 years, over 220 elementary school students have been educated on basic principles of nature protection and biodiversity protection.

A bag full of ecological ideas
The program includes creation of three bags- sets of requisites for educational games in three different natural habitats - in the meadow, in the forest and near the water. The bags are accompanied with the a with photographs and detailed instructions for implementation of workshops in nature. Teachers are trained to use games and methods from these courses in their everyday work and school classes in biology and nature conservationist. In addition to the manual, we have prepared curricula for each class.The results show that children react very well to the described workshops, they are interested in such learning and better acquire knowledge about nature protection, biodiversity and sustainable development.

Obstacles and scientific and technical needs related to the measure taken: Please describe what obstacles have been encountered and any scientific and technical needs for addressing these, including technical and scientific cooperation, capacity development activities or the need for guidance materials.

- low awareness on need to protect biodiversity
- low level of knowledge of wider stakeholders on possibilites to contribute better biodiversity conservation
- lack of financing scientific projects regarding biodiversity protection
- low level of contribution of local communities to the biodiversity conservation

Improving public policy and public participation in decision-making indicators system

Priority action	Indicators	Level National/Local (N/L)	Progress assessment	Aichi target	Case study
4.1 Inclusion of nature protection in other sectoral policies through amendments and the implementation of sectoral regulations through existing legal remedies	4.1.1. Endangered and protected species		N	**A2, A3, E20**	
	4.1.2. Financing the environmental protection		N		
	4.1.3. Income from fees for use of natural resources		N		
4.2 Increasing the level of knowledge and awareness of the importance of biodiversity and promoting public participation in conserving biodiversity	4.2.1. Biodiversity and nature protection in scientific research		N	**A1 and E19**	
	4.2.2. Public participation through financing the projects of NGOs in Vojvodina		L		4.2.2.1. WWF Nature Academy