The Battle for Sutjeska

The National Park "Sutjeska" - "Dead Capital" or a Laboratory in Nature

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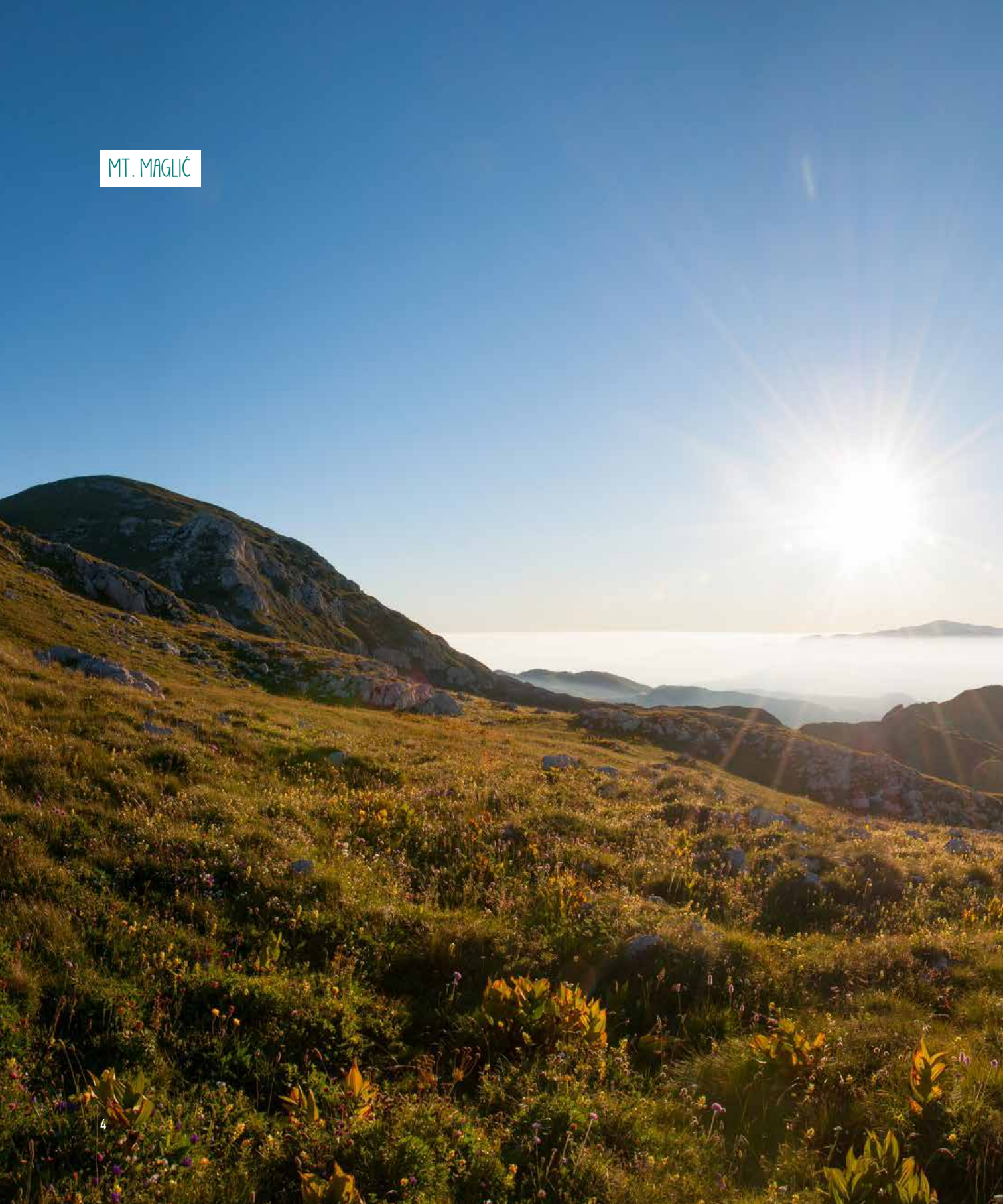
BITKA ZA SUTJESKU

The Battle for Sutjeska

THE NATIONAL PARK "SUTJESKA" - "DEAD CAPITAL" OR A LABORATORY IN NATURE

THE CAMPAIGN ENTITLED THE BATTLE FOR SUTJESKA WAS INITIATED AS A RESPONSE TO PLANS FOR THE CONSTRUCTION OF SMALL HYDRO POWER PLANTS IN THE NATIONAL PARK "SUTJESKA". THE INVESTOR „DRINA HYDRO ENERGY", FROM UGLJEVIK, PLANS TO BUILD FIVE SMALL HYDRO POWER PLANTS, TWO ON SUTJESKA AND THREE ON HRČAVKA RIVER. THE GOVERNMENT OF THE REPUBLIC OF SRPSKA PROCLAIMED THOSE SMALL HYDRO POWER PLANTS, WITH THE CAPACITY OF MEAGER 13MW, AT THE HEART OF OUR OLDEST AND BIOLOGICALLY MOST DIVERSE NATIONAL PARK AS BEING IN THE INTEREST OF THE PUBLIC. ALL THE PROFESSIONALS IN THE FIELD, THE LOCAL COMMUNITY, THE CIVIL SECTOR AND THE WIDER PUBLIC HAVE FIERCELY STOOD UP AGAINST THIS, POINTING OUT THE LONG-TERM CONSEQUENCES AND THE LACK OF THE ECONOMIC COST-EFFECTIVENESS OF THAT PROJECT.

DECEMBER 2015.


MT. MAGLIĆ

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SUTJESKA RIVER

INTRODUCTION

Within the campaign entitled "The Battle for Sutjeska", the aim of which is to stop the plans for the construction of small hydro power plants in the National Park "Sutjeska", a scientific research into the canyons of the rivers Sutjeska and Hrčavka has been conducted. With an aim of gaining new data on the state of flora, fauna and fungi of this region, we engaged 21 experts who researched these canyons in the period from 25 June to 2 July 2015. In a relatively short time period we managed to conduct a research of 12 groups of organisms, and therefore what you have in front of you are the experts' opinions on the state of respective groups, their biology and ecology, national and international protection, vulnerability and sensitivity of certain species, as well as on what is currently the most important – the impact of the construction of the planned hydro power plants on their survival.

Even though we managed to refute the Environmental impact assessment of the hydro power plants on Sutjeska and Hrčavka at the District Court in Banja Luka, we have not stopped at that. Our goal is to prove that ignoring the professionals in this field as well as their knowledge in these kinds of cases is both irresponsible and ill-grounded, but also extremely dangerous. It is not only the people who have dedicated their lives to researching these species and their knowledge that are ignored, but also millions of years of evolution which had created those species on such a unique place as Sutjeska by all means is.

This publication represents a characteristic continuation of the previous one (*The Battle for Sutjeska, Expert Opinions on the Planned Hydro Power Plants in the National Park Sutjeska*) and thereby sheds light in an even more argumentative manner on the actual importance of this region, how incomplete our knowledge of it is and how necessary it is to preserve it.

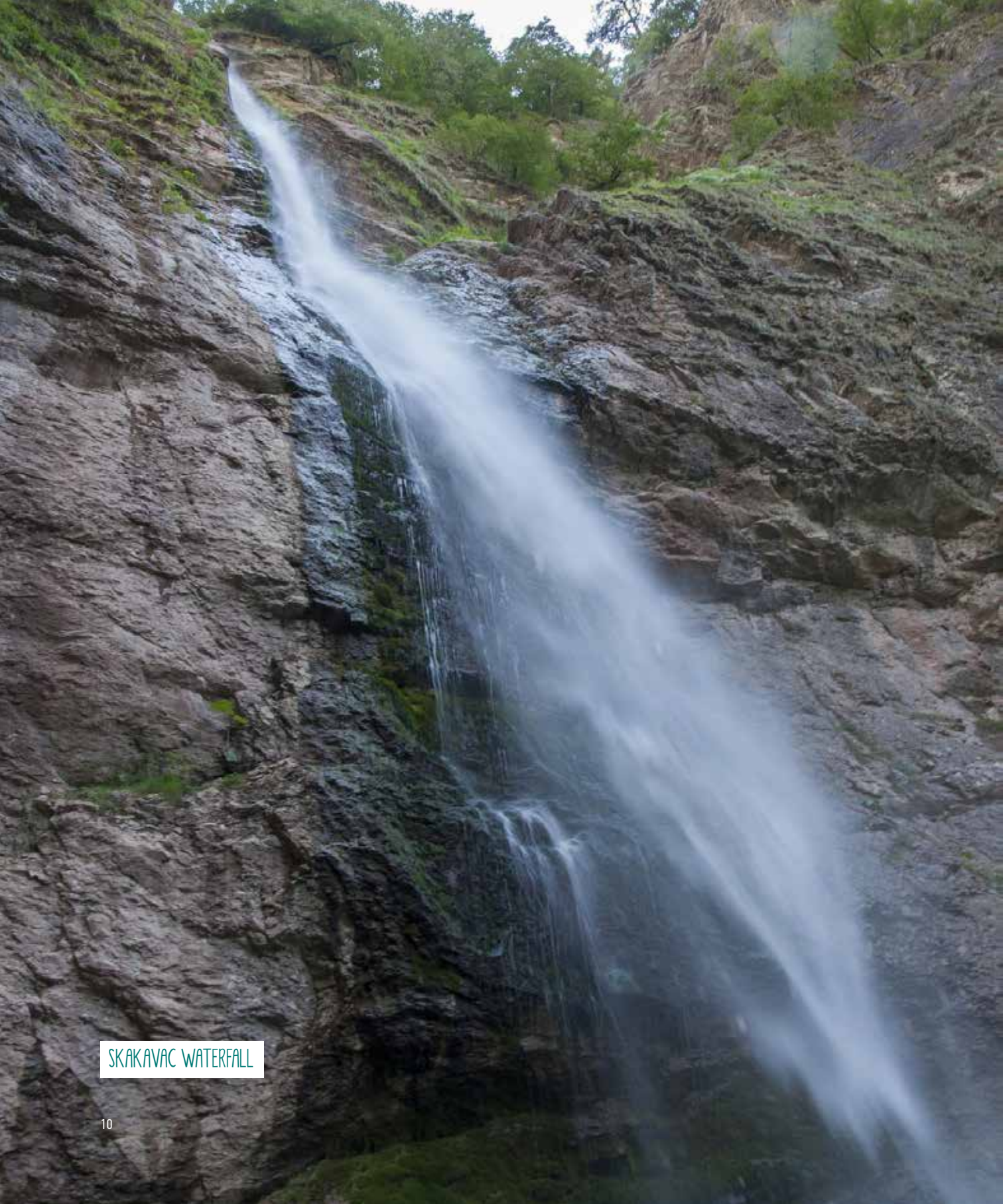
For some organisms, this research represents the first source of data for the region of the National Park Sutjeska (e.g. bats); for others it represents the confirmation of the existing data (plants), or the source of completely new data, and often even new species for Bosnia and Herzegovina (fungi, moss...).

These data are extremely important for science and reveal the diversity of the life in Sutjeska, of which not even scientists are fully aware. European dipper, gland bellflower, brown bear, the Greek stream frog, Rosalia longicorn, the Eurasian water shrew, etc. are only some of the species you will come across while reading this publication. If in only seven days of research we managed to find some completely new species, imagine how much more is still hiding in the hidden areas of this National park, let alone the rest of our country.

Despite the claim by the minister Golić that Sutjeska is a "dead capital", it is far from it. Sutjeska represents a true laboratory in nature that should remain preserved, in order to be used for the purposes of science, tourism, strengthening of the local communities and the preservation of the traditions of that region.

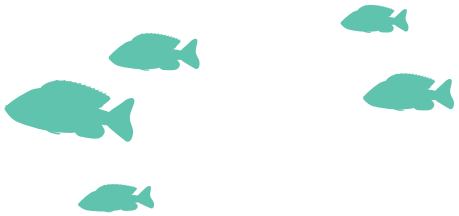
And now – turn the page and immerse yourselves in a small part of the living world we have managed to discover in our oldest National park, which we will fight to preserve until the last atoms of our strength.

IVA MILJEVIĆ & NATAŠA CRNKOVIĆ
CENTER FOR ENVIRONMENT



SKAKAVAC WATERFALL

NATIONAL AND INTERNATIONAL REGULATIONS GOVERNING THE ENVIRONMENTAL PROTECTION IN B&H



The area of environment protection in Bosnia and Herzegovina is regulated by means of laws at the entity levels (The Republic of Srpska and the Federation of Bosnia and Herzegovina), as well as at the level of the Brčko District. A part of the jurisdiction over the environmental protection falls under the state level and is bound with the international obligations adopted by Bosnia and Herzegovina, via the Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina.

Some of the most important ones are stated in this text.

INTERNATIONAL REGULATIONS

IUCN Red List of Threatened Species is a list of endangered plant and animal species established back in 1963. This is the most comprehensive world list of the kind. It includes the global status of the protection of plant and animal species.

IUCN (*International Union for Conservation of Nature*) is the world's leading authority on the issue of the status of species protection.

The degrees of threat according to IUCN are:

- **EX** – "extinct",
- **EW** – "extinct in the wild",
- **CR** – "critically endangered",
- **EN** – "endangered",
- **VU** – "vulnerable",
- **NT** – "near threatened",
- **LC** – "least concern",
- **DD** – "data deficient", insufficient data in order to establish the degree of threat

TABLE 1 THE DEGREES OF THREAT ACCRODING TO THE IUCN RED LIST

THE DEGREE OF THREAT							
EXTINCT SPECIES		ENDANGERED SPECIES			NEAR THREATHENED	LEAST CONCERN	DATA DEFICIENT
EX	EW	CR	EN	VU	NT	LC	DD

The Directive on the Protection of Natural Habitats and Wild Fauna and Flora (Council Directive 92/43/EEC). In 1992 the EU adopted the Habitats Directive. It introduces the measures of protection of the European flora and fauna, with the exception of birds (which are part of a special Birds Directive), includes additional 1000 species (plants, mammals, reptiles, amphibians, fish, certain groups of invertebrates), as well as more than 230 types of habitats (certain types of swamp, grass, forest, sea and other habitats).

For 218 habitat types from Annex I and for the species from the Annex II of the Directive (294 animal and 449 plant species), the states suggest to the European Commission the pSCIs sites (the proposed sites of communal importance), which, after the evaluation and approval process, they pronounce the regions of Natura 2000. In Bosnia and Herzegovina, a project of implementation according to the Directive on Habitats was started back in 2006, whereby the regions that in future would be nominated for the network of Natura 2000 were defined at the end of 2011.

The Bern Convention is a convention on the protection of the European wild species and natural habitats. It is a binding international legal instrument in the area of environment protection, which covers the natural heritage of the European continent and some countries of Africa. Its goal is the preservation of wild animals and plants and their natural habitats, and it encourages European cooperation in this field. A special emphasis is placed on the need for the protection of endangered habitats and vulnerable species, including migratory species. The Bern convention was opened for signature in Bern, Switzerland in 1979, and it became effective in 1982, having been ratified in five countries. It currently has 50 state parties, including Bosnia and Herzegovina, which ratified the convention on 17 November 2008 and thereby formally undertook the obligations borne by this document.

UN Convention on Biological Diversity (CBD) is the first international agreement that regulates the entirety of the problem of the protection of the biological diversity at the global level. The fundamental international principle in the environment protection, the preservation of the biological diversity is considered the most important strategic task, as well as the common concern and responsibility of all the signatory countries. It was passed in Rio de Janeiro in 1992, during the United Nations Conference on the Environment and Development. Bosnia and Herzegovina signed the Convention in 2002.

The Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement the goal of which is the prevention of an uncontrolled trade and commercial exploitation of endangered species, the maintenance of ecological equilibrium within the populations of the species that are the subject of international trade, as well as providing support to the signatory countries in achieving sustainable trade. It was established as the system of monitoring of the international trade, based on the process of issuing import and export approvals, which is established in all the signatory countries. CITES is also known as the "Washington Convention". It became effective on 1 July 1975 and since then, 180 countries of the world, including Bosnia and Herzegovina, signed the Convention, making it the most widely accepted international convention from the point of view of the environment protection.

The Agreement on the Conservation of Populations of European Bats (EUROBATS) became effective in 1994, and currently counts 32 member states. It is one of the agreements that are under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the goal of which is to ensure active protection of the endangered migratory animal species across the whole region of their distribution. The EUROBATS agreement protects all 52 European species of bats, via legislation, education, implementation of protection measures and international cooperation between state parties, as well as those that have not yet signed the Agreement. In a geographical sense, the Agreement covers the region of the west Palearctic. The implementation of the EUROBATS Agreement is coordinated by the Secretariat (EUROBATS Secretariat) located in Bonn, Germany.

Even though certain efforts have been made by the NGO

sector, Bosnia and Herzegovina has still not signed the EUROBATS Agreement, one of the reasons being the impossibility to set aside 1.000 Euro for the yearly membership fee.

RELEVANT LAWS IN BIH

One of the key steps in the protection of species is to determine the scope and causes of threat to those species in certain geographical regions. For these purposes, the Red lists are used. A Red list represents a list of endangered species classified by the categories of threat. In Bosnia and Herzegovina, Red lists are adopted at the level of entities (the Red list of RS/FBiH).

In the Republic of Srpska, the Government of the Republic of Srpska passed a Regulation by means of which the Red list of the protected species of flora and fauna of the Republic of Srpska was adopted. Unfortunately, this Red list only partly satisfies the form, considering that it does not have a very important category that would determine the degree of threat to those species. In the Federation of Bosnia and Herzegovina, the Ministry of Environment and Tourism adopted the Red list of endangered wild species and sub-species of plants, animals and fungi.

FOR THE REPUBLIC OF SRPSKA:

- **The Law on Nature Protection** (the "Official Gazette of RS", no. 20/14)
- **The Law on Environment Protection** (the "Official Gazette of RS", no. 71/12, 79/15)
- **The Law on National Parks** (the "Official Gazette of RS", no. 75/10)

FOR THE FEDERATION OF BOSNIA AND HERZEGOVINA:

- **The Law on Nature Protection** (the "Official Gazette of FBiH", no. 66/13)
- **The Law on Environment Protection** (the "Official Gazette of FBiH", no. 33/03)

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PLANT WORLD

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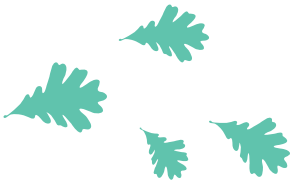
SAVE THE WATERSIDE PLANT WORLD



Plants (**Kingdom Plantae**) are in many ways a special part of the living world. In the course of Earth's turbulent past, through a long developmental period, these organisms have opted for a strange life strategy – namely to turn a little bit of water and a little bit of sun into a green life body, and to use this body and its fruit to feed many others, including their enemies. This is what makes them an irreplaceable part of nature, the foundation on which life itself rests.

There are about 400 000 different plant species described today, and most of them live in tropics, where they have the most water and the most sun at the same time. However, numerous plant species are adapted to extremely cruel living conditions, in which they have found themselves in the course of their mission, which is to secure life for others by securing it for themselves. Thus the cruelest regions of the planet become tame only when they are inhabited by plants. Given that they cannot move, the survival of plants in a certain region depends solely on the capacity to adapt to the newly created situation. However, if there occur fast and sudden changes that the plants are unable to follow, due to the impossibility of running away, and the length of time it takes to build an efficient defense mechanism, they are reduced in number, and sometimes even disappear completely. This is why every fifth plant species in Europe is considered endangered today.

A large number of plants are adapted to life in specific conditions. Some are tied to running and still waters, others to exposed mountain reefs, and there are those that are tied to steep rocky cliffs, or to a particular type of geological medium... This is why we say that a high diversity of plants is usually a reflection of the diversity of habitats, variety of stem substrates, or combination of the activity of several ecological factors and the like. This holds for Sutjeska and its surroundings too. Today we take pride in there being so few regions in Europe which, in various fields of natural sciences, can be compared to the region of high mountains of the Southeast Bosnia and the impressive canyons that the rivers Tara, Piva and Sutjeska, together with their tributaries, have cut in between them. It is precisely owing to their wild nature that these slopes and mountain giants have attracted numerous tourists, researchers and nature lovers to cruise over the vast landscapes of Zelengora, Maglić, Volujak and so on. All of them have contributed to the fact that, at least in terms of the extent to which it has been researched, we know this area better than anyone else today. But do we actually know it well enough?

Of all that can be positively said in the context of how far the flora of the mountains in the Sutjeska basin has been researched, almost nothing can be applied to the regions of the very watercourse. Despite the fact that the river Sutjeska is the symbol of this park and a tomb for about 7500 soldiers from the World War II, it is even today known as a hard-to-bridge-over, inaccessible, "bloody river that roars and flows".

The scarcity of the floristic data from its cruelest and narrowest part, which is called Vratar, exists thanks to the old caravan road through this narrow passage, which was later turned into a regional road connecting Foča with Eastern Herzegovina. It was Professor Radomir Lakušić who firstly discovered the Sutjeska bellflower (*Edraianthus sutjeskae*), and then, together with Čedomil Šilić, also described a new community of rock cracks known as Edraiantho-Daphneetum malyanae Lakušić et Šilić 1968. Unfortunately, these are the only data that these, but also all the other botanists left to us, which we can safely connect to the river Sutjeska and its immediate surroundings. The case with other rivers and streams of the National Park is even harder, with the exception of the

basin of the Perucica stream, which is nowadays mostly encompassed by a further-researched rainforest reservation of the same name.

This is the reason why systematic research of flora and vegetation along this as well as other rivulets in the National park was started a few years ago. It is conducted by the organizations from the non-governmental sector, partly through their regular programmes, and deliberately against the planned construction of small hydro power plants, which have engaged eminent experts from the respective areas. Two-year-long research of the flora of the coastal zones of Sutjeska and Hrčavka has shown an exceptional wealth of these, otherwise poorly researched ecosystems in Bosnia and Herzegovina. So far, 433 species of vascular plants and 119 species of moss have been registered on 140 locations in the narrower coastal region in total. Considering that a comprehensive report of the achieved results has not been planned here, we provide you only with an overview of the registered protected and endangered species of higher plants (Table 1), and a brief commentary on the possible consequences that these species would suffer from the construction of the hydro power plants.

TABLE 1 ENDANGERED AND PROTECTED PLANT SPECIES OF NARROW COASTAL ZONE OF THE SUTJESKA AND HRČAVKA RIVERS

No.	Species	Red list of Republic of Srpska	EU Habitats Directive	Proposal for the Red Book of B&H (Šilić 1992-95)	IUCN Rred List
1	*Aconitum anthora* L.	+		R	
2	*Adenophora liliifolia* (L.) A.DC.	+	+	V	LC
3	*Allium saxatile* M. Bieb.	+		V	LC
4	*Amphoricarpos autariatus* Bjelčić et E. Mayer	+		R	
5	*Anthericum liliago* L.	+		V	
6	*Aquilegia nigricans* Baumg.	+			DD
7	*Arenaria gracilis* Waldst. et Kit.	+		R	
8	*Asperula beckiana* Degen	+			
9	*Asperula taurina* L.	+			
10	*Asplenium lepidum* C. Presl	+		R	
11	*Aster alpinus* L.	+		V	
12	*Athamanta turbith* (L.) Brot. subsp. *haynaldii* (Borbás et Uechtr.) Tutin	+		R	
13	*Bupleurum karglii* Vis.	+		R	
14	*Cardamine raphanifolia* Pourr. subsp. *acris* (Griseb.) O.E.Schulz	+			
15	*Cephalanthera longifolia* (L.) Fritsch	+		R	
16	*Cephalanthera rubra* (L.) Rich	+		R	
17	*Cerastium decalvans* Schloss. et Vuk.	+		V	
18	*Clinopodium thymifolium* (Scop.) Kuntze	+		R	
19	*Dactylorhiza maculata* (L.) Soó	+		V	LC

No.	Species	Red list of Republic of Srpska	EU Habitats Directive	Proposal for the Red Book of B&H (Šilić 1992-95)	IUCN Rred List
20	*Daphne laureola* L.	+		R	
21	*Daphne malyana* Blečić	+		R	
22	*Dianthus carthusianorum* L.	+			
23	*Dipsacus pilosus* L.	+		V	
24	*Edraianthus graminifolius* (L.) A.DC.	+			
25	*Edraianthus sutjeskae* Lakušić			R	
26	*Epilobium alsinifolium* Vill.	+			
27	*Epilobium dodonaei* Vill.	+			
28	*Helictotrichon blavii* (Asch. & Janka) C.E.Hubb.	+		R	
29	*Hieracium humile* Jacq.	+		R	
30	*Hieracium waldsteinii* Tausch	+		R	
31	*Juniperus sabina* L.	+		R	LC
32	*Kernera saxatilis* (L.) Sweet	+		R	
33	*Knautia sarajevensis* (Beck) Szabó	+		V	
34	*Lactuca pancicii* (Vis.) N.Kilian & Greuter	+		V	LC
35	*Lilium martagon* L.			V	
36	*Malcolmia orsiniana* (Ten.) Ten. subsp. *angulifolia* (Boiss. et Orph.) Stork	+		R	
37	*Micromeria croatica* (Pers.) Schott	+		R	
38	*Minuartia clandestina* (Port.) Trinajstić	+		R	
39	*Petasites kablikianus* Tausch ex Bercht.			R	
40	*Phyteuma orbiculare* L.	+		R	
41	*Poa pumila* Host	+		R	
42	*Pseudofumaria alba* (Mill.) Liden subsp. *leiosperma* (Conrath) Liden	+		R	
43	*Salix triandra* L.	+			
44	*Satureja subspicata* Bartl. ex Vis. subsp. *Subspicata*	+		V	
45	*Saxifraga marginata* Sternb.	+		R	
46	*Scabiosa cinerea* Lapeyr. ex Lam.			R	
47	*Scabiosa graminifolia* L.	+		V	
48	*Scrophularia scopolii* Hoppe ex Pers.	+		R	
49	*Sorbus austriaca* (Beck) Hedl.	+			
50	*Telekia speciosa* (Schreb.) Baumg.	+		V	
51	*Teucrium arduinii* L.			R	

The National park Sutjeska, which counts about 1800 registered species of vascular plants, is one of the floristically richest regions of Europe, with a huge number of endemic plants, relicts, endangered and rare species. They are mostly tied to the high mountain and canyon ecosystems, which used to be refugee centres where the species managed to survive an unfavorable period during the ice ages. A small number of those species is tied to watercourses, but those species are closely adapted and very sensitive to changes in the living conditions, which can cause rapid decrease in the number of their populations and a complete disappearance. Research shows that about 50 such protected and endangered plants grow on coastal habitats around Sutjeska and Hrčavka. However, neither do all of them have an equal importance for the protection of these watercourses, nor are all the regulations that mention them equally significant. To give an example, the global list of endangered species (IUCN) completed the assessment of the degree of threat for a relatively small number of taxons, so that the following can be found on this list: silver fir (Abies alba), English walnut (Juglans regia), white willow (Salix alba), Norway spruce (Picea abies) and many others, which are common in the National Park "Sutjeska" and are not significant for protection at the national level. This is why we have here singled out only the most sensitive ones, whose populations would be severely damaged, and their survival brought into question by the potential construction of small hydro power plants:

Adenophora liliifolia

***Adenophora liliifolia* (gland bellflower)** is a plant species which is endangered and protected across Europe, whose populations are the subject of constant monitoring. It is significant for the European Union, and is therefore found in Annex II of the Habitats Directive, as a plant species due to which the regions of the European ecological network are singled out. Until this year it was not known for the region of the National park "Sutjeska". Given that it was also found at the estuary of Sutjeska and Drina, it can be assumed that the findings from the surroundings of Tjentište are realizing a continuity with the above mentioned. The species is very sensitive to changes in the water regime and in the upper basin of the river Drina it is inextricably tied with the coastal strip formations with black alder, while occurring rather rarely in other transitional habitats. With the construction of the hydro power plant on the river Piva, this species almost fully disappeared from this river's basin, as well as from the basin of the river Drina, due to constant fluctuations of water in the coastal zone.

Edraianthus sutjeskae

***Edraianthus sutjeskae* (Sutjeska's bellfower)** is, as its name suggests, the real representative of this national park in the world scientific circles. Discovered and described (locus classicus) on the rocks of Vratar in the Sutjeska canyon, where even today, at the end of spring, it embellishes the cruel vertical rocky slopes with an intensive violet-blue color. It is precisely here that this rock-endemic species survived the terrors of ice ages and started its centuries-long path of conquering the surrounding rocky cliffs. This is why this finding site is extremely

important, not only for the preservation of this spokesperson and promoter of our most beautiful national park, but also as the confluence of a large number of relict, rare and endemic plant forms that grow here together with it. The one that particularly stands out among them is the rock-endemic species of the Drina basin, *Daphne malyana*, which has a very similar life story.

Lactuca pancicii

Lactuca pancicii is an endemic species that inhabits wet and nutritive-substances-rich banks of small mountain rivers and brooks. It replaces on the Southeastern Dinarides the vicar and cognate Alpine Sow-thistle (*Cicerbita alpina*), which grows in similar places of the mountain zone of Alps and Northwestern Dinarides. *Lactuca pancicii* regularly frequents the coastal strip formations of alder, where it gives, together with the gland bellflower, a specific stamp to these communities, still unfamiliar to science. It is very sensitive to changes in the water regime, which would make its populations significantly reduced, and due to the cutting down of these woods and the arrangement of the bath, they would be brought on the verge of extinction. Hence the banks of Sutjeska and Hrčavka should be left as an inexhaustible scientific polygon for numerous future researches that would make a contribution to the popularization of science and the promotion of the National park Sutjeska.

Epilobium dodonaei

Epilobium dodonaei represents a glacial relict, which managed to get during the ice age to the upper parts of the flow of the torrential rivers in Dinarides. From here it spread to some ruderal habitats, especially rubbles, canals and ditches around roads, which are rather moist in the spring. This plant is an important element of the vegetation of the torrential watercourses deposits, where it builds in its original milieu the communities not yet studied on the territory of Bosnia and Herzegovina. These habitats, recognized as endangered and important for the European Union, would be most afflicted by the construction of the hydro power plants, and therefore have to be the subject of conservation in the protected regions, and not devastation or extinction. Similar conditions and ecology are shared by the endangered butterfly dock (*Petasites kablikianus*), dominant in the communities on somewhat more moist torrential deposits, which could share the same faith by the planned interventions.

EVERY DEATH IS PAINFUL

The waterside ecosystems of torrential rivers fall under the category of the most sensitive ecosystems in general. The speed of their disappearance upon the effect of the activity of the threat factors can be compared to the speed of dying of a man sentenced to life without water. Plants are, just like men, afflicted due to the impossibility of performing the fundamental life functions: development and multiplication, which are reflected through:

- the impossibility of water absorption, which becomes unavailable due to eroded water regime, when the plants need it most. This lack of water results in drying up and death.
- premature completion of the life cycle, where the plant is forced to bloom and gets pollinated. The seed falls on the earth in an unfavourable dry time. Its germination is disabled, and the future of the population is all the more certain: deterioration and dying – just a bit longer and more painful.
- the impossibility of pollinating, because the waterside plants are usually adapted in such a manner that they are pollinated by water insects. The number of these organisms significantly decreases due to the eroded water regime, which is why the plants become sterile. The outcome is equally fatal as in other sterile organisms.

Likewise, the plants of these ecosystems are used to life in unfavorable conditions, so that they cannot live without them. A planned change of an ordinary life of these plants lasting for centuries would probably result in something similar to the fast movement of Eskimos from the coldness of Siberia, in the same attire, into the heat of Sahara, with the expected high rate of survival and changing of life habits. Certain fundamental changes would be reflected through the following:

- withdrawal before the invasion of stronger species, given that the newly created living conditions are more suited to those that surround and wait for a favorable moment. The requirement for the survival of the existing plants is the cruelty of constant spring and autumn torrents, which are 'friend to some – foe to other'.
- the loss of roof over the head, for a physical attack of men would primarily result in the clearing of woods and thicket, which keep their residents safe from all sorts of disasters;
- destruction of foundation, for the earth diggings destroy their only connection with the planet – roots, jugular veins of a plant organism. As a distinguished professor once said – "to drive a dredger into the stream means the same as to throw a bomb."
- taking away the living space, because the installation of pipelines is accompanied by "the arrangement" of the bed, by building or concreting. This leaves a narrow space to the surviving individuals for spreading, like a man decaying in a solitary confinement, surrounded by thick walls and concrete;
- poisoning by lethal poison, as there is a high risk of leakage of motor oils in such inaccessible terrains. And the only thing certain to a poisoned organism is death.

It is hard to refrain from the impression that all of this would be happening in a National park, the place of calm and piece for the plant and animal world. What remains is the hope that common sense and the right on life will win after all.

EPILOBIUM DODONAEI

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MOSS

JOVANA PANTOVIĆ & MARKO SABOVLJEVIĆ

MOSS

Bryophytes are an evolutionary-wise old group of plants that were first to inhabit the land. They include three different groups of plants – moss, liverworts and hornworts. They are specific by their build and life cycle. Their dimensions are small, and they are mostly up to several centimeters high. In comparison to vascular plants, they do not have transport tissues or cuticle, and hence acquire water and nutritious substances from the air across the whole surface of the body, which is why they can grow on a variety of substrates.

What connects these three groups of organisms and simultaneously separates them from other land plants is the dominant gametophyte generation, on which antheridia and archegonia, that are male and female sex organs, the fusion of which creates the sporophyte generation that practically lives like a parasite on the gametophyte, taking away from it the nutritious substances via special thread-like structures, that is, the so-called haustoria. The sporophyte is the place where spores by means of which the plant is scattered are developed, and from which the gametophyte is further developed. This is how the life cycle of these plants ends. Given that the impregnation of these plants depends on the presence of water, they are very frequent on moist habitats, but it needs to be said that many species have also adapted to life in dry conditions, which they survive in the state of rest. Moss can spend quite long periods in this state, coming to life only for a few seconds when the water appears in the habitat.

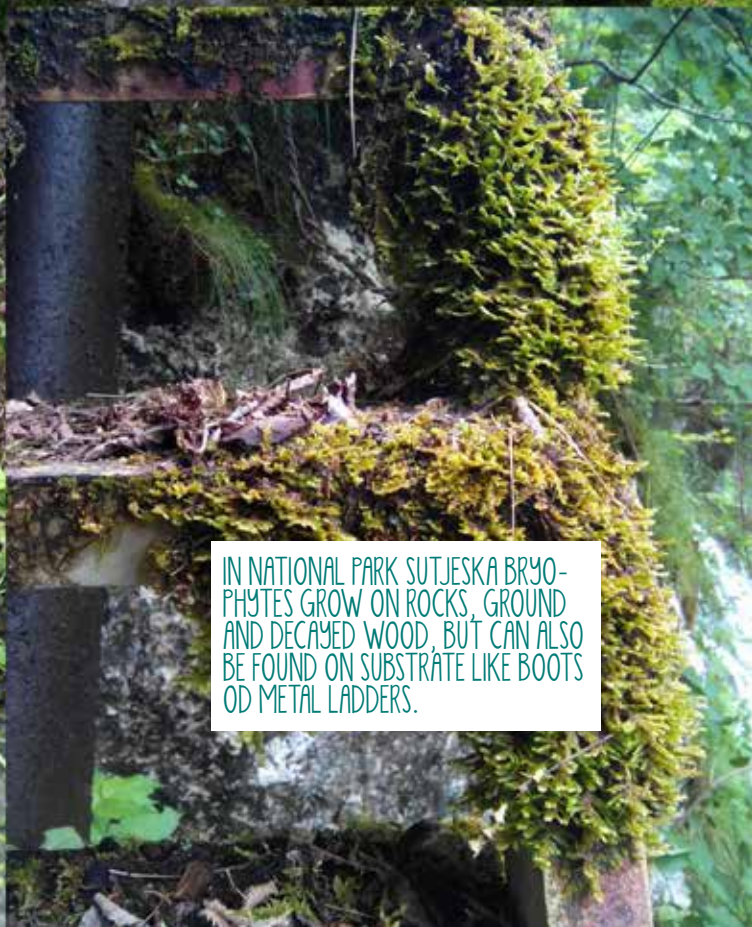
General appearance of moss *Encalypta sp. In this photograph the sporophyte developed on the gametophyte can be seen.*

Bryophytes can be found on the most diverse habitats across the planet and are characterized by an enormous wealth of species, which are sometimes estimated at 25 000. In boreal environments they dominate by their biomass and productivity and are therefore important as a huge reservoir of carbon and the source of nitrogen. They are also important in many ecosystems as water filters, thermal insulators of land and the protection from rinsing and erosion.

In the peatlands, the so-called white moss contribute to a great extent to water accumulation and plant biomass, and thereby contribute to the formation of peat, the layers of which can be used as fuel. They are weak competitors in relation to other plants, and hence find and inhabit specific microhabitats. Likewise, they represent pioneer species in inhabiting barren habitats such as fire sites and rocks, and they are preparing the soil for the growth of other plants and organisms.

Given the fact that they have no other defense mechanisms, they synthesize many secondary metabolites whose application is vast, both in agriculture, where it is used against small mammals, and in pharmaceutical industry. They can also be used for the monitoring of the atmospheric pollution, because they also take in the pollutants into their cells by adopting nutritious substances via the body surface.

A total of 119 species of bryophytes were recorded by bryological research into the canyons of the Sutjeska and Hrčavka rivers, out of which 100 are species of real moss from the group of Bryophytes and 19 liverwort from the group of Marchantiohyta. Even though botanical field



IN NATIONAL PARK SUTJESKA BRYO-PHYTES GROW ON ROCKS, GROUND AND DECAYED WOOD, BUT CAN ALSO BE FOUND ON SUBSTRATE LIKE BOOTS OD METAL LADDERS.

research of this region has been done before, there do not exist published data on the flora of bryophytes of this region.

Research revealed a significantly large number of bryophytes, which is explained by the specificity of the habitat, a large number of microhabitats and the climate that is dominant there. Namely, due to constant rock breaking off (new empty niches and microhabitats), high temperature amplitudes during the day, as well as the constant water spraying in the lower parts, the canyons represent a suitable habitat for many types of moss, otherwise weaker competitors in relation to vascular plants. Also, the north-south oriented canyon on the Balkan peninsula have enabled the passage of warm Mediterranean climate deep towards the north, and on the other hand, the vertical cliffs enable the preservation of the moist air layer, which is why you can find here the types of the Mediterranean as well as arctic-boreal areal type, or types of watery but also extremely dry habitats. Therefore, due to the clash of impacts on a small space, one can come across the south areal types, such as *Leptodon smithii* (Hedw.) F. Weber & D. Mohr, boreal-arctic areal types such as *Amphidium mougeotii* (Schimp.) Schimp, or ecologically divergent species such as xerophytes *Didymodon rigidulus Hedw*. and its water cognate *Barbula crocea (Brid.)* F. Weber & D. Mohr.

Many of the recorded species (*Brachythecium rivulare* Schimp., *Cinclidotus spp*., *Fontinalis antipyretica* Hedw., *Platyhypnidium riparioides* (Hedw.) Dixon, *Racomitrium aquaticum* (Brid. ex Schrad.) Brid., *Schistidium rivulare* (Brid.) Podp. and others) are tied to a narrow rock zone on the river bank, in the zone of water wetting, where they build specific rheophile and riparian moss communities.

On the rocks and trees in the vicinity of water also grow many rare species such as *Leptodon smithii* (Hedw.) F. Weber & D. Mohr, *Neckera besseri* (Lobarz.) Jur. *Jungermannia atrovirens* Dumort. but also many other, who in otherwise dry lime regions need wet air in order to develop, which is provided by numerous watercourses of these regions.

The research revealed even seven species of bryophytes which are new for the flora of Bosnia and Herzegovina, five of which are species of moss and two of liverworts. All these species were found on different locations along the canyon of the Hrčavka river. The liverworts *Cololejeunea rossettiana* (C. Massal.) Schiffn and *Porella arboris-vitae* (With.) Grolle in the Hrčavka canyon are recorded on shadowy and moist lime rocks rich in moss, very close to the watercourse itself. Even though they have been recorded in many countries of the Southeastern Europe, they are rather rare, especially *Cololejeunea rossettiana* (C.Massal.) Schiffn, which is found on many regional red lists.

TABLE I TABLE WITH SPECIES OF NATIONAL AND INTERNATIONAL SIGNIFICANCE

Name of species	Red list of bryophytes of Serbia*	EU Habitats Directive
Buxbaumia viridis (Moug. Ex Lam. & DC.) Brid. Ex Moug. & Nestl.	CR	+
Schistidium rivulare (Brid.) Podp.	CR	
Amphidium mougeotii (Schimp.) Schimp.	VU	
Nowelia curvifolia (Dicks.) Mitt.	VU	
Cololejeunea rossettiana (C. Massal.) Schiffn.	LR	
Anomodon longifolius (Schleich. ex Brid.) Hartm.	DD	
Barbula crocea (Brid.) F. Weber & D. Mohr	DD	

* The valid Regulation on the Red list of the protected species of flora and fauna of the Republic of Srpska does not include a single species of nonvascular plants, and therefore the species protected in Serbia are presented here.

The moss *Campylophyllum sommerfeltii* (Myrin) Hedenäs grows in the cracks of lime rocks on the banks of Hrčavka, in the moss community that grows immediately above the zone of constant water wetting. Two new species of moss from the genus *Pohlia* (*P. andalusica* (Höhn.) Broth. and P.proligera (Kindb.) Lindb. Ex) were found on clay shales, in the pioneer plant community that develops in the rock cracks.

The species *Anoectangium aestivum* (Hedw.) Mitt. and *Fissidens serrulatus* Brid. were found on a wet and shadowed earth road, that goes down to the river. *Anoectangium aestivum* (Hedw.) Mitt. Is otherwise a rare European species – in the region of the Southeastern Europe it is recorded only in Romania, where it is protected, of course.

The above stated newly recorded species were found on one of the two researched locations. Very little is known about their distribution and diffusion in this region, as well as about the population numbers, and it is only further research that can and will give new data on their life history, ecology and the state of being endangered. Also, it is expected that the revision of the materials will reveal even more new and interesting species and taxons with particularly valuable biological features, which are also of special interest for conservation.

The canyons of the rivers Hrčavka and Sutjeska undoubtedly represent the region of special biological circumstances and according to diversity could be classified into IBrA areas (Important Bryophyte Areas), not only by the alpha diversity of bryophytes, but also according to the ecological and geographical particularities of the bryophyte flora, as well as by species worthy of attention according to the international agreements such as the Bern Convention or EU Habitats Directive.

INTERESTING SPECIES

BUXBAUMIA VIRIDIS

The species *Buxbaumia viridis*, or Green bug moss, was found in the upper course of the river Hrčavka. This is a rare and protected species in the whole of Europe – besides being found on the regional lists of many countries it is also present on the European Red list of bryophytes, as well as on the list of Bern Convention and EU Habitats Directive. It is one of the indicators of well-preserved old coniferous, beech and mixed beech-spruce woods, where it develops on moist and rotten logs. It has a specific and unique appearance: the visible part of the plant is a relatively big green sporophyte that develops from an imperceptible gametophyte that grows immersed into the wooden mass in decay. The gametophyte is reduced and actually represented by protonema, which is why this moss is said to be neotenic.

Buxbaumia viridis, species that is listed on the EU Habitats Directive, as well as on the red lists across Europe

SCHISTIDIUM RIVULARE

Schistidium rivulare is a species of moss that grows on stones and tree roots on the banks of fast-flowing rivers, a little bit above the zone of constant wetting. However, during the period of high water level, this species is found immersed in water. It has dark brown color, and the capsules of sporophytes are wide, dark red and hidden in leaves that surround it, so that it is sometimes hard to notice. It is a rare species and is found on the Red list of Bryophytes of Serbia.

THE NEGATIVE IMPACTS OF SHPPS

The construction of SHPPs on Hrčavka and Sutjeska would significantly alter the hydrological conditions of this area, and thereby the habitats of many species, thus bringing into question their very survival.

In the forest zone next to the watercourses, on wet soil, rotten logs as well as moist rocks grow many species the survival of which requires moist conditions that these watercourses provide. Likewise, in the narrow zone next to the water there are dominant specific rheophile and riparian moss communities, which build hydrophilic and aquatic species intolerant to drying up, so that the drying up of the these rivers' beds would lead to the death of these populations. On the other hand, even the slowing down of the watercourses and water accumulation would have a negative impact on the bryoflora. Such threatening and destroying of the populations and/or changing of their genetic structure could bring into question the very survival of many rare and endangered species, as well as several newly recorded species that so far have only been known to exist in this region of the whole Bosnia and Herzegovina. The international conventions and directives obligate the signatory countries to unconditionally protect the habitats of special values with species of special importance.

FISSIDENS SERRULATUS

COLOLEJEUNEA ROSSETTIANA

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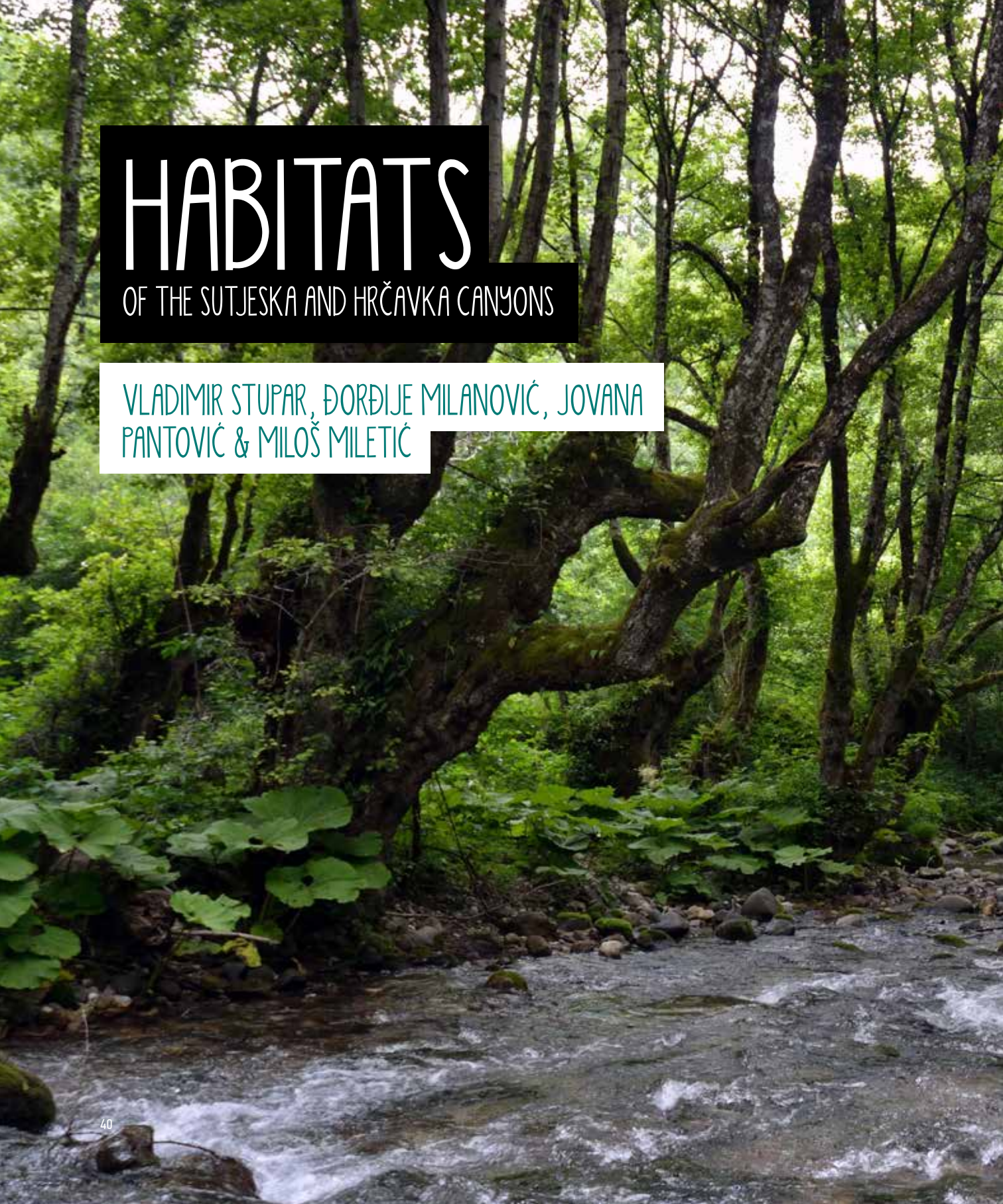

HABITATS
OF THE SUTJESKA AND HRČAVKA CANYONS

VLADIMIR STUPAR, ĐORĐIJE MILANOVIĆ, JOVANA PANTOVIĆ & MILOŠ MILETIĆ

In the beginning of the work on environmental protection in Bosnia and Herzegovina, a special emphasis was placed on geomorphologic and hydrologic facilities, as well as plant and animal species, whereas habitats were most often protected indirectly, through the nomination of facilities worthy from some other points of view (e.g. national parks, natural reserves (such as rainforests) and the like). However, at the global level, practice showed that the species protection is more efficient if it is realized through the protection of their habitats. This is why there arose the need for legal mechanisms, which would enable the protection of the very habitats at the global (European) level. The Bern Convention appeared in 1979 as the first international legal instrument for the protection of habitats in Europe, proposing a list of habitats that should enjoy the status of protection in all the European countries. However, given that this convention did not have a mandatory character, the countries approached it in an arbitrary and non-aligned manner. This is the reason why the member states of the EU adopted the European Habitats Directive in 1992, which provides in the Annex I the list of habitat types that are of importance for the protection on the territory of EU. Every member state of the Union is obligated to protect the stated habitats within the ecological network Natura 2000, which has to be prepared and adopted by the date of a state's accession to the European Union. In that sense, the provisions pertaining to the ecological network Natura 2000 were included in the legal regulations in the area of the environment protection in BiH, with a special emphasis on the preservation of all the habitats found in the Annex I of the Habitats Directive. Virtually all the habitats along the watercourses of Sutjeska and Hrčavka are found in this Annex, which is why it is not hard to conclude that they should enjoy a special treatment at the level of entities as well as at the level of the very Bosnia and Herzegovina itself (Table 1).

Besides that, the project of development of the Red list of the European habitats is in progress, which will feature all the habitats that are in some sense endangered at the European level. Almost all the coastal habitats in the canyons of Sutjeska and Hrčavka are found on this list too (Table 1).

The habitats in the canyons of Sutjeska and Hrčavka represent the types whose genesis, development and survival directly depend on the water regimes of the mentioned watercourses. Some of them are to a large extent endangered by the construction or the plans for the construction of the small hydro power plants even in the EU states, and are therefore recognized as habitats that have to be protected within the territory of the European ecological network Natura 2000, and it is precisely for this reason that they are included in the Annex I of the EU Habitats Directive. Many of these habitats have the label of priority for protection (in Table 1 they are marked with *, which in fact means that at least 60% of the habitat surface in the country has to be protected).

TABLE I HABITAT TYPES PRESENT IN THE RESEARCH AREA THAT ARE DIRECTLY ENDANGERED BY THE CONSTRUCTION OF SMALL HYDRO POWER PLANTS

Habitat type	EU Habitats Directive	Red list of the European habitats
Mountain rivers and the herbaceous vegetation along their banks	+	+
Mountain river banks covered by the communities of bitter willow (*Salix eleagnos*)	+	+
Hydrophilic edge communities of high greens from the mountain to Alpine level	+	+
Stoned sources with reef formations*	+	+
Limestone rocks with chasmophytic vegetation	+	+
Tilio-Acerion forests on steep slopes, screes and ravines*	+	+
Broadleaf forests on fluvisol soil*	+	+
Continuous fast mountain streams with mossy communities	+	+

THE MOST ENDANGERED HABITATS

MOUNTAIN RIVERS AND HERBACEOUS VEGETATION ALONG THEIR BANKS

The habitat includes gravel banks around fast and colder mountain watercourses (often torrential), which are covered with pioneer herbaceous and bushy species, most frequently with the mountain plants domination. These habitats are characteristic for the lower areas of the boreal part of Europe and higher mountains of the Central and Eastern Europe. The canyon of Sutjeska represents the only place where this type of habitat has been registered for BiH until now. By channeling the torrential watercourses these pioneer yet permanent stadiums would very soon become overgrown and disappear from the map of BiH.

HYDROPHYLIC EDGE COMMUNITIES OF HIGH GREENS FROM THE MOUNTAIN TO ALPINE LEVEL

Herbaceous vegetation on the torrential deposits along Sutjeska

Waterside communities with burdocks next to Hrčavka

This habitat also directly depends on the regime of wetting and develops on humus and wetlands of usually higher altitudes. It most often inhabits the region between the forest ecosystems or clearances and the very watercourses. On the territory of research they appear as the boundary part of the forest in the immediate vicinity of the watercourses with an obvious moisture of air and land, where they are particularly characterized by two herbaceous species with the biggest leaves in our flora, that is, the so-called butterburs *Petasites hybridus* and *Petasites kablikianus*. By channeling Sutjeska and Hrčavka this habitat would lose the greatest part of its surface, partly owing to the eroded water regime, and particularly due to the arrangement of the bed around the pipeline.

BROADLEAF FORESTS ON FLUVISOL SOIL

This is another habitat type that depends directly on the wetting regime, and is thereby a habitat with the priority of protection according to the Annex I of the Habitats Directive. This type is represented in the canyons of Sutjeska and Hrčavka by strip formations of black alder and mostly

Strip formations of alder next to Hrčavka

occurs on fluvisols that regularly and briefly become blue. Even though they occupy small surfaces, these formations represent very rare ecosystems that would to a large extent be eroded by a change in the water regime. Additional pressure on this habitat would be inevitable cuts for the purpose of laying pipelines, which would directly endanger them on the greatest part of their surface in the canyons. A special value of these habitats is seen in that fact that a plant species from the Annex II of the Habitats Directive, namely the so-called gland bellfower (*Adenophora liliifolia*), which would, of course, disappear together with this forest. Besides the gland bellflower, *Peucedanum aegopodioides*, the endemic species of the Balkan peninsula, which is tightly adapted for life in the coastal strip forest communities, especially of black alder, together with *Lactuca pancicii*, gives a special stamp to

High greens with *Lactuca pancicii*

this habitat type. From the point of view of science, the importance of these forests is immeasurable, primarily because it is about a new and yet non-described plant community, which is yet to be the subject of numerous thorough researches.

CONTINUOUS FAST MOUNTAIN STREAMS WITH MOSSY COMMUNITIES

Communities with moss next to Hrčavka

This habitat is represented by small, shallow, fast mountain streams, in which the water is cold during the whole year and rarely exceeds 10°C in summer. It is rich in oxygen, and the sediment consists of bigger stones and rocks, because the speed of water does not allow finer sediment accumulation. Rich and interesting communities of moss develop here instead of the vascular plant communities, and it is because of them that these watercourses are known. It does not take a lot of thinking to conclude that this habitat, which is endangered at the European level, would completely disappear by the channeling of Sutjeska and Hrčavka.

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FUNGI

NEDIM JUKIĆ & NIHAD OMEROVIĆ

FUNGI

Fungi are classified among the most poorly researched groups of living beings. To date, approximately 100 000 taxons have been described, and it is estimated that the total number of different species of fungi on Earth is considerably above 1 000 000, and hence it is likely that they represent the second largest group of living beings, immediately after insects. In our country, fungi were sporadically researched in the past, and the number of scientific works on the incidence and diversity of certain species is rather low.

From the ecological point of view, fungi are divided onto: saprotrophes (decomposers of organic matter), symbionts (fungi that are mycorrhizal with certain plant species) and parasites (species that live like parasites on other fungi, insects and the like). Their role of decomposers and cleaners in nature is irreplaceable.

The largest number of non-described and undiscovered species of fungi is hiding in the tropical band, although it should be pointed out that even our region, and the European continent in general are rich in areas and species which have not been sufficiently researched or are completely unknown to the current taxonomy.

One of such locations and epicenters of biological diversity is the National park Sutjeska, with the accompanying watercourses of Hrčavka and Sutjeska.

The class Ascomycota represents the largest group of fungi (cca. 65 000 species). In Bosnia and Herzegovina, the research and official data on this class are reduced to the minimum (the research into individual species within this group of fungi in the last several years has been continually conducted by the members of the Amateur Mycological Association from Sarajevo).

The focus of research on the territory of the National park Sutjeska was precisely placed on the species of Ascomycetes that inhabit the sand or muddy banks of Hrčavka and Sutjeska (terrestrial species), then species that inhabit periodically or constantly flooded logs and branches (aquatic and semi-aquatic species), as well as the species that live like parasites on moss (*bryoparasitic*), while only secondarily the list of all the other registered species, both ascomycetes and basidiomycetes, was made.

In the course of exploration of the canyons of Sutjeska and Hrčavka, 66 species of fungi were recorded, 35 of which belong to the class of Ascomycota, and 31 to the class of Basidiomycota. Due to the specificity of the life cycle of fungi – the appearance of fruitful bodies in a shorter time period of the year, as well as the absence of fruitfulness in one or several years – these results are only a concise cross-section of the total diversity of this group of organisms, according to which, however, one can safely project their much larger presence in these habitats.

Last year on the territory of the National park Sutjeska, that is, on the banks of Hrčavka and Sutjeska, a shorter and selective research was also realized, within which some very valuable findings were recorded. A total of 24 fungi species was registered in the middle and second half of August, 22 of which belonging to the class Ascomycota and two members of the class of Basidiomycota.

The results of research that was sporadically conducted on the territory of the National park in the last two years undoubtedly point to the fact that this is a very specific and unique habitat, when it comes of the diversity of fungi. During the mentioned research, a total of eight new species for Bosnia and Herzegovina was found, although that is probably not the final number. Besides that, a significant number of species that had always been considered insufficiently researched or rare fungi species was also discovered.

TABLE I PARTICULARLY INTERESTING FUNGI SPECIES DISCOVERED IN THE COURSE OF RESEARCH OF SUTJESKA AND HRČAVKA CANYONS

Species	IUCN Red list of Europe	Note
Psilopezia nummularia Berk.	Germany – VU, Norway – NE	Rare in the world
Vibrissea filisporia f. boudieri A. Sánchez & Korf	N/A	First finding for BiH, rare in the world
Octospora hygrohypnophila Dissing & Sivertsen	N/A	First finding for BiH
Patinella hyalophaea Sacc.	N/A	First finding for BiH, very rare in the world (found only on two locations outside BiH)
Rimbachia bryophila (Pers.) Redhead	The Czech Republic - DD, Great Britain - NT, France – 4 (0-5)	Rare in the world
Marcelleina persoonii (P. Crouan & H. Crouan) Brumm.	Germany – very rare/potentially endangered, The Netherlands – VU	Rare in the world
Peziza montirivicola Perić	N/A	Described in 2015 as a new species for science (Perić, 2015); the fourth registered finding in the world, the first finding for BiH

PSILOPEZIA NUMMULARIA BERK

The species that grows on wood soaked in water in the late stage of decomposition. It is up to 3 cm in diameter. According to etymology (name), it is a "fungus of barren surface, with the body pressed close to the medium, in the shape of a coin."

Similar to it macroscopically is the more common aquatic species *Adelphella babingtonii* (Berk.) Pfister, Matocec & I. Kusan.

Psilopezia nummularia

VIBRISSEA FILISPORIA F. BOUDIERI A. SÁNCHEZ & KORF

The species of the genus *Vibrissea* are aquatic and semi-aquatic organisms; V. filisporia f. boudieri grew on the branch immersed in water, immediately next to the bank below the basin on Tjentište. Its size is up to 3 mm, and apothecia are of an intensive yellow color. It has long, threadlike, spirally twisted spores (adaptation to the water environment) that use great power to catapult themselves from the ascus.

Vibrissea filisporia f. boudier

OCTOSPORA HYGROHYPNOPHILA DISSING & SIVERTSEN

This fungus lives like a parasite on the moss species *Hygrohypnum luridum*, induces galls on apical cells of the rhizoid. Its size is from 0,5 to 2 mm, and its color orange. Its host looks for lime, shadowy and moist habitats, such as, for example, where Hrš wells flow into the river Sutjeska, where it was recorded in July 2015.

Octospora hygrohypnophilla

PATINELLA HYALOPHAEA SACC.

Its size is about 0,5 mm, and its color is black. It grows on wet trees next to rivers. This species was first found and described by Italian mycologist Pier Andrea Saccardo in 1875. No findings of this kind, however, were mentioned in the subsequent 137 years, all the way until 2012, when it was recorded in Canada, and then in 2014 and 2015 in Bosnia and Herzegovina too. The findings from 2015 come from the bank of Sutjeska, on the location of Vratar.

Patinella hyalophaea

Rimbachia bryophila

RIMBACHIA BRYOPHILA (PERS.) REDHEAD

It belongs to the group of fungi that are also called *Cyphelloidi*. What is in question are basidiomycetes which are reminiscent in their morphological characteristics of ascomycetes. Their size ranges from 0,3 to 0,7 cm. This species lives like a parasite on the moss from the genus *Mnium*, and it requires the presence of moisture and water. It is generally rare in all countries in which it has been found, and it is spread across the northern hemisphere.

MARCELLEINA PERSOONII (P. CROUAN & H. CROUAN) BRUMM.

The diameter of the fruitful body ranges from 0,5 to 1,0 cm, and the color is dark violet. The color of apothecium stems from the violet-blue pigment in paraphyses. It inhabits moist land, that is, the habitats with a constant water presence, usually the banks of faster and slower streams. Its name comes from one of the mycologists who are most to thank for the establishment of the starting points of fungi taxonomy - Christiaan Hendrik Persoon. The genus *Marcelleina* today counts eleven different species.

Marcelleina persoonii

PEZIZA MONTIRIVICOLA PERIĆ

The species was described as being new for science by the Montenegrian mycologist B. Perić, and the work on the same was published in November 2015. This work contains the findings from National park Sutjeska too. This species of the genus Peziza inhabits the mountain and sub-mountain banks of the streams (rivers and brooks), and in that sense requires an uneroded and preserved habitat.

Apart from the registered findings of only one fruitful body from the bank of the river Hrčavka (leg. N. Jukić, 25.06.2015.), the species had been registered earlier in Montenegro and Switzerland.

Peziza montirivicola

THE IMPACT OF HYDRO POWER PLANTS ON FUNGI

Bearing in mind the unique biodiversity that would seriously be eroded by the construction of small hydro power plants on Hrčavka and Sutjeska, that is, by the drying up of those rivers to some extent, we can safely state that the fungi inhabiting the coastal areas of these fast rivers will be extremely endangered. The greatest degree of threat primarily pertains to aquatic and semi-aquatic species of ascomycetes that inhabit riparian habitats. From the ecological aspect, they are very important indicators of the preservation of certain habitats and the conditions of the rivers themselves.

The principal negative impacts on the group are the habitat fragmentation, as well as the pollution of land and water.

The habitats of fungi in the zone around the watercourses are formed under the influence of constant wetting of the surrounding soil and continuous soaking of the remains of herbaceous and woody plants. They are fully dependent on the natural water regime, the coastal vegetation and the structure of the soil, and are considered extremely sensitive. A drastic change in the water regime (the reduction of the flow, drying up, the interruption of the river wholeness) would cause a change and disappearance of the existing habitats, and thereby the disappearance of a larger number of species of fungi living in those habitats.

VIBRISSEA FILISPORIA F. BOUDIERI

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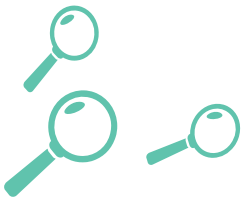
MACROZOOBENTHOS

JELENA ĐUKNIĆ, NIKOLA MARINKOVIĆ & VANJA MARKOVIĆ

MACROZOOBENTHOS



In this capricious part of the world, which some named the Balkans, beauty is not lacking. Clear mountain water, still and impetuous, diffused turquoise that keeps quiet and roars primaeval stories, there at the navel of our universe, beauty abides. Glorified in songs, unsung beauty. Sutjeska! The premonition of stones and water in embrace.

The National park Sutjeska is the oldest national park in BiH. Extremely valuable in terms of nature, its preservation is recognized at the international level too. The region is characterized by the great wealth both in terms of habitats and the living world – flora and fauna. Those smaller and not so conspicuous and known inhabitants, despite being all around us, are particularly characterized by huge diversity. No, we are not thinking of bacteria, viruses and similar vermin, sorry – microorganisms, but of those that are a bit larger, and which sometimes, or rather often at that, can be really conspicuous – mosquitoes, flies and similar organisms. Those smaller, but still not too small beings, are denoted as "macro-invertebrates" – that is "large invertebrates". Apart from the mentioned pests, other insects also fall under this group, and so do crabs, mollusks, warms and other organisms. These organisms inhabit all habitats, both land and wet habitats, swamps, lakes, brooks and rivers. While those land or dry land relatives, who are just a little less shy, inhabitants of water, especially fast mountain watercourses, hide very successfully from the eyes of random passers-by and a few curious persons. These rather shy water "macroinvertebrates" are sometimes expertly denoted as MZB – Macrozoobenthos.

Macrozoobenthos is an ecological group that is made of macroinvertebrates that spend part of their life cycle or the whole life cycle at the bottom of the water ecosystems. A relatively poor ability of movement and a relatively long life span, together with a pronounced sensitivity to allochthonous influences of certain representatives, separates this group as an adequate model of the system of monitoring of changes in water ecosystems during a certain time period.

The research of macrozoobenthos in the National park was conducted in the summer of 2015. The main aim of the research was to collect the data on the diversity of this component of the fauna on the given region and familiarize with the present macrozoobenthos communities. The stated communities are very sensitive to more pronounced changes in the habitat and relatively quickly react to them by changing the composition, that is, the incidence and number of the constitutive members (taxons). In accordance with the fundamental principle of ecology (the integrity of the system), changes in any constitutive components, in this case the community of macrozoobenthos, are inevitably reflected. These changes in the living environment have a direct impact on the most sensitive members of the community of benthos organisms, and through them on the other members of the ecosystem and the functioning of the ecosystem itself.

The construction of small hydro power plants leads to hydromorphological changes in the watercourses, which are most pronounced in the very physical-chemical features of water (via changes in the water and temperature balance), due to which there occurs an increased sensitivity of such watercourses to different organic load.

The composition of the communities of macrozoobenthos of the researched rivers (Sutjeska, Jabušnica and Hrčavka) is typical for fast mountain rivers that are characterized by low water temperature, high flow, high oxygen saturation and a small quantity of dissolved organic substances. In these communities, the representatives of the insect species Ephemeroptera, Plecoptera, Trichoptera and Diptera dominate in number and diversity. It is precisely these stated groups that are characterized by a huge number of taxons sensitive to pollution, changes in the environment and those that are marked as vulnerable and endangered,

both at the national and international lists. On the basis of the processed materials, it can be said that the three examined rivers are characterized by a high species diversity of macrozoobenthos. Several species, which are classified as rare and interesting for the region of Bosnia and Herzegovina (*Epeorus yugoslavicus, Oreodytes alpinus, Riolus subviolaceus*), have also been recorded. In the case of a few undetermined taxons, there is the possibility that these are also rare and interesting species (above all in the case of Drusus sp., the representative of Isopodes and Dipters).

In the course of the exploration of the fauna of the river Hrčavka, Jabušnica and Sutjeska's bottoms in June 2015, a total of 103 taxons from 16 taxonomic-ecological groups were collected. Out of these 103 taxons, 62 are determined up to the level of species, 30 taxons to the level of genus, 7 taxons to the level of the family, while the individuals of five taxons within the order of Isopodes, of the family of Heteroptera, sub-order Hydracarina, sub-class Oligochaeta and the phylum of Nematods have not been determined.

During the exploration of the river Hrčavka, the presence of 15 taxonomic-ecological groups of macroinvertebrates were recorded (Platyhelminthes, Nematoda, Nematomorpha, Oligochaeta, Hirudinea, Bivalvia, Gastropoda, Hyracarina, Amphipoda, Isopoda, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera and Diptera), while in the rivers Sutjeska and Jabušnica nine groups were recorded respectively (Sutjeska: Oligochaeta, Gastropoda, Hyracarina, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Hemiptera and Diptera; Jabušnica: Platyhelminthes, Oligochaeta, Gastropoda, Hyracarina, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera and Diptera).

The partake of the insect component in the community of macroinvertebrates is the highest in all the rivers examined. Thus the groups Ephemeroptera, Diptera, Trichoptera and Plecoptera are present with a high number of individuals by location. Even 459 individuals of Ephemeroptra (location Sutjeska 3) and 499 individuals of Diptera (location Jabušnica) were collected from only one location.

On the basis of the research it can be stated that the rivers Sutjeska, Jabušnica and Hrčavka represent an interesting habitat when it comes to water macroinvertebrates on the territory of Bosnia and Herzegovina. A great diversity of communities was perceived too, within which there are several rare taxons. The majority of recorded taxons are indicators of an extremely clear water, rich in oxygen, and those taxons prefer fast torrential watercourses and an adequate lower and relatively constant water temperature. The species recorded during this research are tied to specific physical-chemical conditions that prevail here, as well as to a specific terrain morphology. Some of the identified taxons such as *Epeorus yugoslavicus* Samal,1935 and *Riolus subviolaceus* Müller, 1817 are rare in the region.

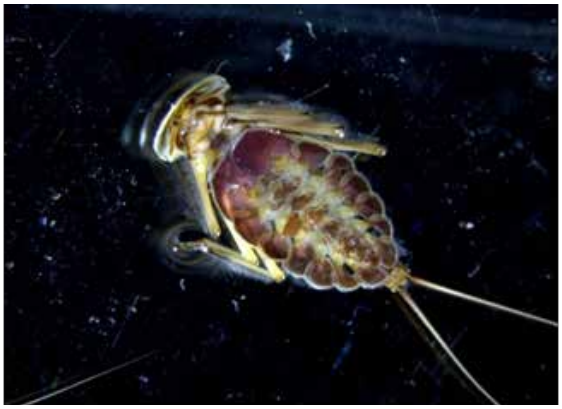
Certain taxons such as *Drusus* sp. can represent potential endemic species. On the other hand, certain species, such as *Oreodytes alpinus* (Paykull, 1798) have not been recorded in BiH yet. It is certainly worth mentioning the species from the Red list of the protected species of flora and fauna of the Republic of Srpska, among which are the shrimp *Gammarus balcanicus*, square-tailed worm *Eiseniella tetraedra*, as well as several species of rock insects (the insects from the group of Plecoptera) from the genuses *Leuctra, Dinocras* and *Perla.*

What can be stated as species of clear mountain waters that can potentially get on the Red list (and which are already present on the same lists of the neighboring countries) are the Yellow Sally stonefly *Isoperla grammatica*, ephemerals (insects from the group of Ephemeroptera) of the genuses *Epeorus* and *Rhitrogena*, as well as caddis flies (insects from the group Trichoptera) from the genus *Drusus.*

The appropriacy of the identification of all the interesting/rare taxons will be checked by competent taxonomists as soon as possible (taxonomic expertise). On the basis of the composition of the communities, it can be said that the anthropogenic impact on these three rivers, above all on Hrčavka, is currently minimal. The auto-purification power of rivers by far exceeds the impact that man currently has on them, and that is how it should stay.

EPEORUS (IRON) YUGOSLAVICUS SAMAL, 1935

Epeorus (Iron) yugoslavicus Samal, 1935 is a species from the order Ephemeroptera (mayflies). The nymphs of this species are tied to aquatic ecosystems, and namely exclusively fast-flowing rivers and streams. The species is particularly stenovalent in relation to the high number of physical-chemical parameters. Thus the optimal water temperature is 13°C, although the populations with a fewer number of individuals can also be found at the temperature 5-14°C. E. yugoslavicus requires that the oxygen in water should be >10, high speed of water and stony medium. This species is very rare in the region, while in Serbia it has been classified as CR (Critically endangered) according to IUCN requirements. It is precisely due to these reasons that any factors that cause changes in the abiotic parameters in the habitat are unfavourable. Those changes in the habitat include: wood cutting, erosion, water turbidity, disorder of the speed of watercourse, and all those are the consequences of the construction of small hydro power plants. This conditions the setting of necessary measures of protection, such as the monitoring of populations and stricter protection of the macrohabitat. The habitat of the river Sutjeska and Hrčavka with its wider surrounding should be proclaimed protected natural area, while this species should be placed on the list of natural rarities of BiH.



Epeorus (Iron) yugoslavicus

RIOLUS SUBVIOLACEUS MÜLLER, 1817

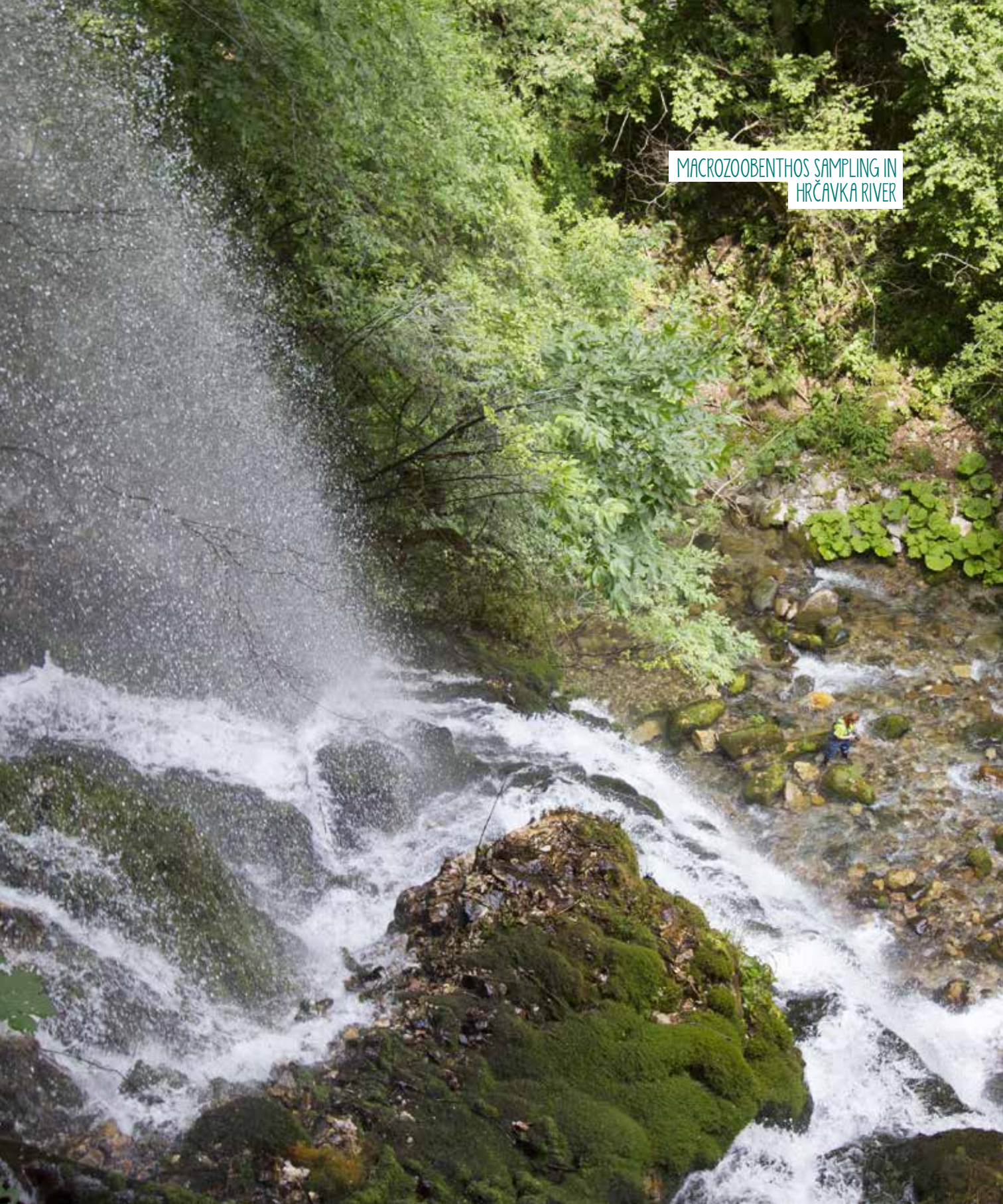
Riolus subviolaceus Müller, 1817 is a species from the order of aquatic Coleoptera (beetles). *R. subviolaceus* inhabits the areas with high water flow, with an often low temperature and high concentration of oxygen, where the medium is made of bigger stones covered in moss and algae. They require abiotic parameters characteristic for the upper courses of mountain rivers. Larvae and adults of this species are tied to the microhabitats such as precisely these mosses where they move and feed. They are found in communities with other species of the order Coleoptera, such as *Elmis aenea* Muller 1806 and *Hydraena gracilis* Germar, 1824.

Riolus subviolaceus

ISOPERLA GRAMMATICA PODA, 1761

Isoperla grammatica Poda, 1761 is a species of the order Plecoptera (stoneflies) whose nymph of a medium size inhabits the fast flowing rivers and streams with stony medium. The nymph is slow, small and spends most of the time under stones, where the trout and other benthivorous fish cannot find it.

When they are ready to metamorphose into winged adults, the nymphs are found in the shallow waters, usually abandoning water by climbing up the vegetation or partly immersed stones. They are stenovalent in relation to a



MACROZOOBENTHOS SAMPLING IN HRČAVKA RIVER

large number of abiotic parameters characteristic for the upper flows of mountain rivers. The species *I. grammatica* is found on the Red list of the surrounding countries and the monitoring of its populations, as well as the protection of its habitats, is necessary.

Isoperla grammatica

BAETIS PAVIDUS GRANDI, 1949

Baetis pavidus Grandi, 1949 is a species of the order Ephemeroptera (mayflies). While the winged adults live a few days at most, do not have a developed digestive system and die immediately after mating that happens in flight, their larvae have a longer life span and are tied to the aquatic ecosystems.

The larvae are 3.5-5.5 mm big, are thermophilic and rheophilic.

They are found in the littoral zone of small and medium rivers and streams. Their larvae are often confused with the larvae of the group *Baetis lutheri*, which consists of several species (*B. lutheri, B.nigrecens* and *B. esterlensis*) due to similarity of morphology and small differences in taxonomic characters. The species *B. pavidus* is rare in the region. Thus it was classified as EN (endangered) species in Serbia, according to the requirements of IUCN. It is important to monitor the state in nature, both in terms of the number of population and preservation of habitats that it inhabits.

Due to all stated above it is necessary to undertake adequate measures with the aim of timely protection of this habitat. It can be assumed with considerable safety that the hydro-morphological changes, created by the construction of small hydro power plants, would to a large extent influence the present communities of macrozoobenthos, and thereby the very ecosystem researched. It would lead to changes in the physical-chemical composition of water and substrate type.

When it comes to macro-invertebrate communities that inhabit these courses, there is no doubt that they would change.

It is hard to speak of the proportions of negative consequences caused in this manner, but it is certain that the presence of certain rare species would be brought into the question. On the other hand, the erosion of these communities could have as its consequences the erosion of food chains in these ecosystems. Above all, there would be high impact on ichthyofauna, to which this group of organisms represents the main source of food. The disappearance of species that are important in the food chains would lead to fulfilled niches that are adequate for some invasive species, and the consequences of that are impossible to see at this moment.

At the end it should be stated that the majority of these courses are found within the National park and thereby are under the strict and the most severe protection regimes. Each intervention of man into the functioning of these ecosystems can only have negative consequences on the living world in them.

It is very important that in the coming period more research gets conducted on the whole courses of the researched rivers, in order to create a clearer picture of the diversity of species on these types of habitat.

Let us not forget, beauty can save the world only if that world previously saves and preserves that beauty. Let us preserve Beauty. Let us preserve Sutjeska!

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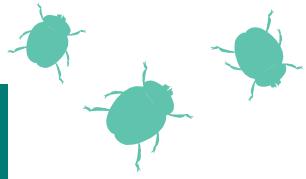
INSECTS

DEJAN KULIJER, IVA MILJEVIĆ & SLAVEN FILIPOVIĆ



INSECTS

Insects represent the key chain link of the land and freshwater ecosystems and dominantly the most numerous group of organisms on the planet. Despite the fact that they are often inconspicuous, they are found everywhere around us, performing a significant role in nature. Without insects, the functioning of the nature's fundamental processes would be impossible. Still, even despite this huge significance they have, very little is known about insects, which often results in insufficient attention being paid to the protection of these organisms. Scientific research has huge significance in overcoming this problem. This is particularly important in Bosnia and Herzegovina, considering the exceptionally low level of knowledge of the distribution of species and habitats, which represents the most significant problem in the assurance of quality and long-term protection.

According to the results of seven-day research in the canyons of Hrčavka and Sutjeska, on the territory encompassed by the plan of the construction of small power plants, 14 species of dragonflies were identified, 116 species of butterfly and over 100 species of beetles, 25 of which are species of insects which are protected in the Republic of Srpska, as well as nine species protected by means of international agreements. In the canyons of Hrčavka and Sutjeska, even seven species of insects stated in Annex II of the Habitats Directive, which makes these canyons the most significant region for insects in the proposed Natura 2000 network in BiH.

DRAGONFLIES (ORDER ODONATA)

Dragonflies represent a small group of insects (with somewhat less than 6 000 species in the world), which are important indicators of the state of preservation and changes in freshwater ecosystems. Owing to its size and vivid colors, dragonflies are popular even in the wider public, and are therefore often denoted as the ambassadors and bearers of the protection of these habitats.

Many species of dragonflies are today faced with the threat to survival. Given that they spend the first phase of the life cycle in water, they are sensitive to pollution, drying up and degradation of water habitats and the surrounding vegetation. In addition, apart from the water habitats, adult insects in the phase of maturation, hunting and mating also need various land habitats and vegetation, such as river corridors, lawns and woods.

The number of dragonflies in Europe, which are specialized for running waters, is small. Among them there are species which, due to the sensitivity of their habitats, are rather vulnerable to negative impacts of man. The representatives of the genus *Cordulegaster*, particularly stand out in this respect, within which two species are present in BiH: Balkan goldenring (*Cordulegaster heros*) and sombre goldenring (*Cordulegaster bidentata*). Because of the fact that they live in specific habitats, their distribution is of a dispersed character. They inhabit mountain brooks and rivulets, have a narrow ecological valence and can hardly adapt to changes in the living environment, and are therefore particularly endangered by the destruction of forest habitats, as well as the drying up and rearrangement of brooks.

Balkan goldenring *(Cordulegaster heros)* is an endemic species of the Southeast Europe, above all the Balkan Peninsula. It inhabits shadowed brooks and rivers with a sandy bottom, partly covered in tiny sand and organic substrate in which the females lay their eggs. Larvae spend three to five years of life buried in the shallow waters or on the very surface of the sediment. For the survival of this species, the preservation of forest habitats, as well as clean running water rich in oxygen, are necessary.

Besides the Balkan goldenring, another species of this genus lives in our areas, namely the **sombre goldenring *(Cordulegaster bidentata)***, which also inhabits smaller running waters, especially small, forest brooks in the mountain region of our country. In the course of our research, the sombre goldenring was a particularly numerous species, while the Balkan goldenring was registered only

TABLE I PREOTECTED SPECIES OF DRAGONFLIES (ODONATA) REGISTERED IN THE RESEARCH AREA OF THE CANYONS OF RIVERS SUTJESKA AND HRČAVKA

Species	Common name	Red list of protected species of Republic of Srpska	EU Habitats Directive
Calopteryx splendens (Harris, 1782)	Banded Demoiselle	+	
Calopteryx virgo (Linnaeus, 1758)	Beautiful Demoiselle	+	
Ischnura pumilio (Charpentier, 1825)	Small Bluetail	+	
Enallagma cyathigerum (Charpentier, 1840)	Common Bluet	+	
Coenagrion puella (Linnaeus, 1758)	Azure Bluet	+	
Pyrrhosoma nymphula (Sulzer, 1776)	Large Red Damsel	+	
Platycnemis pennipes (Pallas, 1771)	Blue Featherleg	+	
Aeshna grandis (Linnaeus, 1758)	Brown Hawker	+	
Aeshna cyanea (Müller, 1764)	Blue Hawker	+	
Cordulia aenea (Linnaeus, 1758)	Downy Emerald	+	
Cordulegaster heros (Theischinger,1979)	Balkan Goldenring		Annexes II and IV
Libellula quadrimaculata (Linnaeus, 1758)	Four-spotted Chaser	+	
Libellula depressa (Linnaeus, 1758)	Broad-bodied Chaser	+	
Orthetrum coerulescens (Fabricius, 1798)	Keeled Skimmer	+	
Orthetrum brunneum (Fonscolombe, 1837)	Southern Skimmer	+	

on the territory of Tjentište, which is the first discovery of this species in the National park Sutjeska.

The main cause of the threat to these two species is above all the destruction and fragmentation of habitat. The regulation of the watercourse and the destruction of forests represents a special threat to these insects.

The Balkan goldenring is classified as a vulnerable species (VU) on the Red list of dragonflies of the Mediterranean, while both species are classified as nearly threatened species (NT) on the last IUCN Red list of dragonflies of Europe. In BiH, neither *C. heros* nor *C. bidentata* are found on the list of endangered and protected species.

Besides that, the Balkan goldenring is also found on the Annex II of the EU Habitats Directive, which means that BiH is obligated to identify the regions for the protection of this species that will be included in the European ecological network Natura 2000.

Cordulegaster heros

Beautiful demoiselle (*Calopteryx virgo*) inhabits the running waters across our country. It is a particularly numerous species on smaller and faster rivers with the preserved band of coastal vegetation and sandy or gravelly bottom.

Beautiful demoiselle is a characteristic species of our rivers and one of our most beautiful dragonflies. The male specimens have a flamboyant, metallic-blue or bluish-green color of wings and the body, while the female ones are somewhat less conspicuous, and of bronze-green color. We can often see these beautiful insects as they fly across rivers or are having rest on the branches of the trees on the bank. The larvae of *C. virgo* develop among underwater vegetation, plant detritus or tree roots. Given that it inhabits small courses with water rich in oxygen, this species is sensitive to eutrophication, rearrangement and slowing down of rivers, as well as the destruction of waterside, woody vegetation. It is found on the Red list of the protected species of the Republic of Srpska.

Calopteryx virgo

Brown hawker (*Aeshna grandis*) is a large dragonfly with characteristic brown color of the body and the wings of amber glow. *A. grandis* is an extremely rare species of the Balkans for which the National park Sutjeska represents the most significant habitat in Bosnia and Herzegovina and one of the rare habitats on Dinarides. The area of the park, above all the mountain lakes on Zelengora, are inhabited by an extremely numerous population of this species,

Aeshna grandis

while a large number of individuals live and feed during maturation in the canyons too. In the Republic of Srpska, it is found on the Red list of the protected species.

BEETLES (ORDER COLEOPTERA)

Beetles represent the most numerous group of insects and the largest group of living organisms on the planet, with around 400 000 species described so far. Out of this number, around 29 000 is present in Europe, whereas there are no reliable data on the number of species in BiH.

Among the endangered species of beetles, saproxylic species are particularly incident, and those are species for which the National park Sutjeska represents one of the most significant regions for the protection in BiH, and probably in the region too. Among them there are several Natura 2000 species: *Lucanus cervus, Osmoderma eremita, Rosalia alpina, Morimus funereus, Cucujus cinnaberinus* and *Cerambyx cerdo.* However, the information about their presence has so far mainly been grounded on old literature data. Due to their sensitivity to changes in habitats and dependence on the presence of old trees in woods, these species are used as indicators of the preservation of these ecosystems.

TABLE 2 PROTECTED SPECIES OF BEETLES (COLEOPTERA) REGISTERED IN THE COURSE OF RESEARCH IN THE CANYONS OF THE RIVERS SUTJESKA AND HRČAVKA

Species	Common name	Red list of protected species of Republic of Srpska	EU Habitats Directive	Bern Convention
Morimus funereus (Mulsant, 1862)	The longhorn beetle	+	Annexes II i IV	+
Rosalia alpina (Linnaeus, 1758)	The Rosalia longicorn	+	Annexes II i IV	+
Cucujus cinnaberinus (Scopoli, 1763)	Cinnabar flat bark beetle	+	Annexes II i IV	+
Lucanus cervus (Linnaeus, 1758)	The stag beetle	+	Annexes II i IV	+
Dorcus parallelopipedus (Linnaeus, 1785)	The lesser stag beetle	+		

The Rosalia longicorn (*Rosalia alpina*) is one of the most beautiful types of longhorn beetles (Cerambycidae) in Bosnia and Herzegovina. It is easily recognizable by its characteristic light blue color and large black spots that represent an excellent camouflage on the bark of the beech trees.

Rosalia alpina

inhabits mostly the mountain regions of the central and southern Europe, the south of Scandinavia and parts of Eastern Europe. The larvae of this species develop in old trunks, above all the beech, but can also live in other kinds of deciduous trees. Due to the destruction of the habitat, the Rosalia alpina disappeared from numerous regions in Europe in the 20th century, which is why it was included into the lists of endangered species in many countries. The species was also included into Annex II and IV of the EU Habitats Directive, and it is protected by the Bern Convention. On the international Red list it was classified as a vulnerable (VU) species. In the Republic of Srpska it is found on the Red list of protected species.

Due to its beauty and attractive appearance, the Rosalia alpina has a significant role in the campaigns for environmental protection, attracting the attention of the public and pointing to the vulnerability of forest habitats and the importance of their preservation.

The longhorn beetle (*Morimus funereus*) is a large beetle of gray color with four big black spots on the back of the body. As all the other species of longhorned beetles, it possesses a pair of long antennae that exceed the body length in male specimens, while being considerably shorter in female specimens.

Morimus funereus

Even though the common name of the species is beech longhorned beetle, this species can also be found on

Lucanus cervus

various kinds of oak, maple, poplar and other kinds of deciduous as well as coniferous trees. It inhabits the Balkan Peninsula, Mediterranean and central Europe, while in BiH it can be found across the country, especially in the preserved forest mountain regions.

Due to forest destruction, this species is in many countries found on the list of endangered species, as well as on the Annex II of the EU Habitats Directive, which means that all the member states of the European Union are obligated to protect its habitats. The longhorned beetle is also protected by the Bern Convention, and is found on the Red list of protected species in the Republic of Srpska too. In contrast to the majority of other longhorned beetles, these insects do not fly, which makes them even more sensitive to habitat destruction.

The stag beetle (*Lucanus cervus*) belongs to our biggest, most interesting and most famous species of beetles. The name stems from the large tubercles on the head of the male specimen that are reminiscent of the dear horns, which these insects use to fight for the female counterparts. The stag beetle inhabits oak forests where it feeds on the sap of the oak trunk, let out at the point of damage.

The destruction of oak forests, especially old trunks that are necessary for the survival of this species, has significantly influenced the reduction in the number of this population, and even the disappearance of the stag beetles from many regions of Europe. Owing to all the greater threat to the species and its habitats, it has been included on the list of endangered species in many countries, while the attractive appearance has classified it among the most important charismatic (flagship) insect species that represent a significant part of numerous campaigns for the protection of nature in Europe. The stag beetle is protected by the Bern Convention, the EU Habitats Directive, as well as the Red list of the protected species of the Republic of Srpska.

BUTTERFLIES (ORDER LEPIDOPTERA)

In the last several decades butterflies, together with vertebrates and plants, have been the best studied organisms, and hence their number and diversity are used as the criterion for the valorization of potentially endangered regions and the biological monitoring of the state and quality of the environment. One of the best indicators of a healthy and balanced state of the ecosystem is the presence of a large number of butterflies. They lay their eggs on a plant tissue on which the young individuals feed and go through all the phases of development until adulthood.

On the territory of the National park Sutjeska, daily butterflies were studied by Sijarić (1970, 1974), whereby 112 species were registered on the territory of the National park, while the nightly butterflies are rather poorly researched and literally almost unknown, except for the family of Tortricidae.

In the course of the seven-day research of the butterfly fauna in the canyons of Hrčavka and Sutjeska, 68 species of daily butterflies were identifies, among which there are seven new species for the National park, and 48 species of nightly butterflies, 47 of which are species as yet unrecorded in the Park.

Among the species found in the course of our explorations there are also those that are important for the establishment of the Natura 2000 network in BiH, namely the following: *Euphydryas maturna* and *Euphydryas aurinia*, as well as three species stated in the Annex IV of the EU Habitats Directive: *Euphydryas maturna, Phengaris arion* and *Parnassius mnemosyne*. The populations of these species require a special treatment when it comes to protection. Seven discovered species are found on the Red list of protected species of Republic of Srpska: *Euphydryas aurinia, Euphydryas maturna, Apatura ilia, Apatura iris, Limenitis populi, Phengaris arion* and *Phengaris alcon*, while the IUCN Red list of Europe features two species: *Euphydryas maturna* (VU) and *Phengaris arion* (EN). Seven new species of the daily butterflies for the region of the National park Sutjeska were also found, and namely these: *Heteropterus morpheus, Pieirs napi, Phengaris alcon, Libythea celtis, Boloria dia, Coenonympha glicerion* and *Brintesia circe*. When these species are added to the earlier inventory we obtain 199 species for the whole park area.

In the course of the research 48 species of the nightly butterflies were recorded, whereby all but *Celypha lacunana* were registered for the first time in the region of the National park Sutjeska.

Taking into consideration the scale that is used to determine the wealth of species, the region of the National park with its 119 species ranks among the highest, which justifies its extremely huge significance for the protection of nature and biodiversity in BiH.

The Marsh Fritillary (*Euphydryas aurinia*) inhabits the palaearctic region, while in Europe it is particularly present in its Central and South parts. This beautiful butterfly with square frets of golden-brown and black color on its wings inhabits different types of mainly wet meadows and lawns. Even though it is distributed across the whole of Europe, it most commonly appears locally and is restricted to the areas with preserved habitats.

Euphydryas aurinia

TABLE 3 PROTECTED SPECIES OF THE BUTTERFLIES (LEPIDOPTERA) REGISTERED IN THE RESEARCH AREA OF THE CANYONS OF RIVERS SUTJESKA AND HRČAVKA

Species	Common name	Red list of protected species of Republic of Srpska	IUCN Red list of Europe	EU Habitats Directive	Bern Convention
Euphydryas maturna (Linnaeus, 1758)	The Scarce Fritillary	+	VU	Annex II and IV	+
Phengaris arion (Linnaeus, 1758)	The Large Blue	+	EN	Annex IV	
Parnassius mnemosyne (Linnaeus, 1758)	The Clouded Apollo			Annex IV	
Euphydryas aurinia (Rottemburg, 1775)	The Marsh Fritillary	+		Annex II	+
Apatura ilia (Denis & Schiffermüller, 1775)	The Lesser Purple Emperor	+			
Apatura iris (Linnaeus, 1758)	The Purple Emperor	+			
Phengaris alcon (Denis & Schiffermüller, 1775)	Alcon Blue	+			
Limenitis populi (Linnaeus, 1758)	The Poplar Admiral	+			

Due to the disappearance of habitats this species has seen a constant decrease in the numbers in many countries; in the Netherlands it has completely disappeared, whereas in many other countries the population has been reduced by a third. The Marsh Fritillary is protected by means of the EU Habitats Directive and the Bern Convention, and is also found on the Red list of the protected species of the Republic of Srpska.

The Scarce Fritillary (*Euphydryas maturna*) inhabits the Central and East Europe, Caucasus, Ural Mountains, Kazakhstan, South and West Siberia, Transbaikal and Mongolia. In Bosnia and Herzegovina it is a rare species recorded on a small number of locations. It is recognizable by its characteristic patterns on both sides of the wings,

Euphydryas maturna

where red color and the pronounced big white frets on the lower side of the wings dominate. It can be seen from May until the fist half of July. It inhabits the wet deciduous forests, usually with maple and poplar, as well as ravines surrounded by mountains. The larva feeds on the leaves of a larger number of plant species, among which are maple, aspen, poplar and narrow-leaved plantain.

The species is extremely sensitive to changes and anthropogenic impacts in the habitats, which is manifested in constant reduction of the number of its populations in its areal. This is confirmed by its status on the Red list of Europe, where it has been included in the category of a vulnerable species (VU). Likewise, it is found on the Red list of protected species of the Republic of Srpska, and is protected by the Habitats Directive (Annex II and IV) and the Bern Convention.

The Large Blue (*Phengaris arion*) lives in the South and Central Europe, as well as towards the north across Russia and Siberia, China and Japan. It is a local species, but it is widely distributed on the Balkan Peninsula. In BiH it has been recorded on a large number of locations. It can be found and seen on dry habitats, often covered in bushes, meadows next to rivers and rocks, from the sea level to the altitude of 2 000 meters. It is easily recognizable by its huge black speckles on the upper side of the wings. The blinking blue color dominates.

Phengaris arion

It is protected by the Habitats Directive (Annex IV), is found on the Red list of Europe with the status of an endangered species, and it has also been entered on the Red list of protected species of Republic of Srpska.

The Clouded Apollo (*Parnassius mnemosyne*) can be found in a large number of European countries, but is nowhere numerous. Its areal ranges from Europe across Turkey, Transcaucasia, Lebanon, Syria, Iraq, Afghanistan to the Central Ural and Siberia. In BiH it is more commonly found on hilly and mountain regions, where it prefers wetter habitats. It is a recognizable butterfly with the white fundamental color, and two black spots on the upper side of the wings. It is active from May to July via a single generation. The larva feeds on the species of the genus *Corydalis.*

Parnassius mnemosyne

The species is stated in the Annex IV of the EU Habitats Directive and the Red list of protected species of Republic of Srpska.

The hummingbird hawk-moth (*Macroglossum stellatarum*) also known as a hummingbird, is a type of the nightly butterfly which can be found in moderate regions of Europe, Central Asia and the North Africa. It flies during bright days, but also often in the evening hours and even in the rain, which is unusual for nightly butterflies. The hummingbird hawk-moth is an interesting butterfly which, like the hummingbird, flies above the flowers waving its wings even up to 90 times per second, and produces a sound similar to buzzing. It is considered that it has good sight my means of which it distinguishes between flamboyant colors, especially blue ones. It is recognizable by its long tongue that it uses to drink the flower sap, and in that way is a good pollinator. It is migratory species that can cross more than 3 000 km in 14 days and is deemed one of the fastest species among all butterfly. A certain number of individuals live through the winter in our regions, hidden in wood holes, below rocks, holes, houses and the like. The species is not protected.

Macroglossum stellatarum

THE IMPACT OF THE PLANNED HYDRO POWER PLANTS ON INSECTS

Insects belong to the group of organisms that would be most afflicted by the potential change of water regime, should the hydro power plants be built. Generally speaking, the species that are tied to the running waters are considerably more sensitive to small changes of the ecological parameters than the insects that inhabit still waters. The life communities of the bottom of fast and cold waters and streams are evolutionarily adapted to specific conditions of these habitats, so that even the smallest changes in temperature, specific water flow regime, the structure of the bottom due to changes in sedimentation, amount and quality of the organic matter, concentration of the dissolved oxygen in water, would undoubtedly lead to a drastic reduction in their numbers and raise the issue of survival of many species. All these changes would occur in the region that is established exactly in order to provide these species with a safe place and ensure an unobstructed life cycle, which they have been developing through their multi-millennial evolutionary path.

Apart from that, the planned interventions would have an impact on the whole fauna of the river and several kilometers downriver, due to the change in the habitat, and this has not been taken into consideration in the studies of the environmental impacts as a cumulative effect of all the planned hydro power plants. The impacts such as the fragmentation of the river continuity, the creation of slowdowns and lacustrine formations, as well as the disappearance and degradation of parts of the river and waterside habitats will be permanent and have a negative impact on the majority of species. These changes can particularly be important in the most preserved and relict ecosystems, such as those in the canyons of the rivers in the National park Sutjeska, which, in fact, are the ones that stand out in terms of the highest number of endemic species. Insects from the order Odonata, Ephemeroptera, Plecoptera and Trichoptera are very sensitive to changes in watercourses that occur as the result of the construction and work of the hydro power plants, and it is precisely these groups that are characterized by the presence of a large number of endemic and/or endangered/protected species in the National park Sutjeska. Hydrologic interventions and the construction of smaller accumulations and dams can lead to the disappearance of more than a half of some groups of insects such as Ephemeroptera, Plecoptera or Trichoptera, including a complete disappearance of endemic and endangered species that have a narrow ecological valence.

The specificities of the fauna of the insects in the canyons of Sutjeska and Hrčavka and the main impacts of the construction of the planned hydro power plants on these organisms are given in the following overview:

- changes in the level and variation of the brooks due to rearrangement of the rivers disturb the natural transport of sediments, making the habitats unfavourable for the survival of species whose larvae depend on the structure and amount of sediments, such as the various species of Trichoptera or Odonata.
- the body of these organisms is fully adapted by its shape to surviving in the habitats with fast water current, as well as their movement and passive nutrition, catching food carried by the water current. One of the most significant physiological adaptation of the insects that inhabit running waters is tied to the gas exchange, that is, the use of oxygen dissolved in water, because they do not have the possibility to surface at high speeds of the watercourse.
- the reduction in the number or the disappearance of the populations of organisms would indirectly afflict other land organisms, such as fish or birds, to which these insects are the main food sources.
- the consequences of the erosion of the natural flow regime in brooks and rivers are manifested in the habitat degradation, which can sometimes be expressed even far down-river from the very catchment of the hydro power

plant central station, where the changes of the natural water regime occur, the regimes of temperature of water and the very habitat, and all this leads to the reduction of the health of the whole aquatic ecosystems.

• besides the direct impact of the very hydro power plants central stations, the preparatory works and the construction of the hydro centrals would have a negative impact on the water and the surrounding land habitats. Given the specificity and sensitivity of the ecosystem of this region, any kind of construction works can significantly erode the structure of the land ecosystems. The removal of vegetation and the construction works cause the soil erosion and lead to long-term degradation of significant areas of the surrounding land habitats, as well as the covering of the water course with a huge amount of sediments, which makes them unfavourable for the survival of a large number of water organisms.

Macroglossum stellatarum

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FISH

IVAN ŠPELIĆ & MARKO BUDIĆ

FISH

Fish have a very important role in the water ecosystems, and the most incident in those ecosystems, in terms of numbers and mass, are vertebrates. They often serve as food to land animals, hence the energy and nutritious substances are easily transferred from the water to the land habitats. Fish are also the oldest vertebrates and have developed into a rather diverse group. Today we can find them in all the seas and oceans, as well as in the majority of water ecosystems, except for those most extreme ones (e.g. extremely alkaline and sour lakes, internal seas of extreme salinity, thermal sources with very high temperatures...).

The main division of fish according to the habitat where they live is onto the sea and fresh water ones, even though there are exceptions. There are fish that hatch in fresh waters and then migrate into the sea where they grow up and come back for spawning into fresh waters, such as anadromous species (e.g. some species from the family Salmonidae). The fish that have a reversed life cycle (they live in fresh waters and spawn in the sea belong to the catadromous species (e.g. eel). We can also divide fish into two large groups by the skeleton construction: cartilaginous (sharks, ray...) and bony species (the great majority of today's species).

The body of the fish consists of the head, body and tail. The shape of the body depends on the fish's lifestyle. The fish that live in strong currents or constantly move have a spindled, extended body (trout, tuna, blue shark); those in the still waters or slow rivers have somewhat more compressed, high body (carp), and if they live at the bottom then they have a wide and flattened body (catfish, ray, plaice).

Fish make use of the fins to move. We distinguish between the even (chest, stomach) and odd (dorsal, anal and caudal) fins.

"Long-distance" swimmers (swordfish, marlin) have huge chest fins (like wings on an airplane) in order to maintain direction more easily, while the hunters in the ambush have fins shifted towards the end of the body in order to have a high starting speed for the attack (pike).

The shape of the mouth is also adapted to the lifestyle and depends on the type of food. The predators and filtrates (they feed on plankton, algae...) have terminal mouths (conger, pike, carp). If the fish feeds on the insects from the surface, then it mostly has upper mouths (bleak, redstart), while the fish that feed at the bottom have lower mouth (nose carp, ray, loach).

As they live in water, fish do not breathe by means of lungs, but via gills. Gills consist of a large number of gill leaves (lamellae) which have a great blood circulation in order to exchange oxygen and carbon dioxide between the blood and the surrounding water more easily. In order not to be damaged, the gills are protected by a gill cover or operculum. Anabantids are fish that have both gills and primitive lungs so that besides the oxygen from water they can also use the oxygen from the atmosphere. The body of the fish can, but does not have to be covered in shells; however, all fish are covered by a layer of mucus that facilitates movement and protects them from infections. Fish lay their eggs (fish-roe) even though there are several species that give birth to the young. In the initial phase of life all fish are larvae. In the course of the growth, larvae are all the more similar to adult individuals and switch to the characteristic nutrition.

RESULTS OF THE RESEARCH

The field research in the National park was conducted between 28 June and 1 July 2015 in order to make an inventory of the fish species in the stated rivers and describe a possible impact of the construction of small hydro

TABELA I FISH SPECIES IN SUTJESKA AND HRČAVKA

Family	Species	Common name
Cottidae	*Cottus gobio* (Linnaeus, 1758)	The Bullhead
Salmonidae	*Salmo labrax* (Pallas, 1814)	Black Sea salmon
Salmonidae	*Thymallus thymallus* (Linnaeus, 1758)	Grayling

power plants on the established ichtyofauna. This research confirmed three species of fish for this region: Black Sea salmon (according to more recent research this species ought to be called black sea trout), grayling and the bullhead (Table 1). According to the information obtained, even the Danube salmon (*Hucho Hucho*) used to live here, but it has not been found. The Black Sea salmon and grayling belong to the rank of bony fishes Salmoniformes (salmons) and the family Salmonidae (trouts). The bullhead belongs to the rank of bony fishes Scorpaeniformes (mail cheeked fish) in which the majority of species are sea fish, as well as to the family Cobitidae or bullheads.

All three species recorded in these two small rivers are characteristic for the mountain type of the watercourse. They need fast current, cold water and a lot of oxygen for survival and multiplication. The most incident species of this area is the stream trout, then the bullhead, and only then comes the grayling.

CURIOSITIES

In the course of the research it could be seen that the bullhead prefers the calmer parts of the course and the sandy bottom. We would find it mainly behind larger stones or in small runlets from the river where the current is weaker. In the far upper, shallow parts of the rivers solely smaller trout individuals were found. This comes as no surprise if we know that trout migrate before the spawn into the upper parts of the course and then come back down water. Juvenile trout in those shallow parts do not need to fear the cannibalism of the adult individuals, to whom this kind of habitat is not suitable, and besides have enough food given that in those parts there are no other species. When those young trouts grow up, then they themselves go down into the lower, somewhat deeper parts of the river. It should be pointed out that the stream trouts in the Black Sea basin are classified into a new species, the Black Sea line of the stream trout, *Salmo labrax* Pallas, 1814, which differs from the Atlantic line of the stream trout, *Salmo trutta* Linnaeus, 1758.

SPECIES

SALMO LABRAX (BLACK SEA SALMON)

Salmo labrax

Their body is spindled, somewhat flattened laterally. It has black and red spots and frets on its body. The red frets are fewer in number than the black ones. They can come in nuances, ranging from crimson red to completely light red.

Salmo labrax

During the spawn time, the colors are more pronounced. The belly is silvery, yellowish or light gray, while the back and spine colors range from light to dark green, dark gray or dark brown, or almost even black. The lateral parts of the body are mainly greenish or yellowish. This coloration of the body depends on the habitat, age and the size of the very fish.

Its length is 40 cm on average, weight up to 800 grams, but there are significantly bigger catches. In the Black Lake on Durmitor (Montenegro) a stream trout weighing 12,5 kg has been caught. In the accumulation lake Lokvara (close to Delnica), which belongs to the Dunav basin, a Black Sea salmon the size of 124 cm and the weight of 25,5 kg, aged 15-16 years, was caught in 1968.

In our waters two forms of the species *Salmo labrax* are present, namely the stream (*S. labrax var. fario*) and the lake form (*S. labrax var. lacustris*). The stream trout inhabits the cold mountain brooks and rivers. The most important factors for survival are fast water flow, well-oxygenized water and water temperature below 25°C during the whole year. Trouts that are 20cm long and weigh 150 g are capable of multiplication, but many of them stay sterile and do not spawn. The male specimens (20-25 cm) and female specimens (25-30 cm) are sexually mature when they 2-3 years old. During the period of spawn the trouts take on various nuances of colors - their lateral parts of the body change the color, particularly at male specimens. The spawn starts in the middle of September and lasts according to the circumstances until December, January and February. The female lays fish-roe with the diameter of 4-5 mm, which is yellowish, reddish or orange. The period of incubation depending on the temperature lasts 60-90 days. It feeds on bugs, amphibians and small fish.

THYMALLUS THYMALLUS (GRAYLING)

A relatively small mouth and poorly developed teeth makes them almost imperceptible. The upper jaw reaches to the frontal eye edge. The back fin is unusually big and colorful. In the period of spawn, the color is more intensive, while in male specimens the back part of the dorsal fin gets increased.

It has small round black frets on the back and lateral parts, while on the lateral parts there are longitudinal stripes on top of that. The spine is greenish-gray, the lateral parts of the body silvery-yellow, and the belly is white. It grows up to 60 cm (the male specimens). The maximal recorded weight is 6,7 kg and the maximal recorded age is 14 years.

Thymallus thymallus

It lives in the running, clear and well-oxygenized waters with a shallow, gravelly or sandy bottom. It also occurs in lakes, more rarely in brackish waters. It feeds on the bottom's fauna, insects that fall into water, and rarely with younger fish. They reach their sexual maturity in the third or the fourth year of life, and in some rivers only after the age of five. It spawns from March to May at the temperature of 6-10 °C and the depth of around 1,5 m. It migrates upwards looking for the place to spawn. Those are mainly calmer and shallow, sandy or gravelly places in the brook or the river. The female lays the fish-roe of yellow color and the size of 2,5-3,5 mm on average. The fertility of the females is 6000 – 7000 pieces of fish-roe per one kilogram of its body weight. It feeds differently and namely by the individuals from the groups of: Ephemeroptera, Diptera, Trichoptera and Plecoptera. It is very sensitive to dirtying.

COTTUS GOBIO (BULLHEAD)

The body is naked. The head is huge and wide, flattened back-belly-wise. There is a small thorn hidden in the skin on the preoperculum. There are dark spots and frets on all the fins except the pelvic fins. It never has cross-sectional stripes on the pelvic fins. The lateral stripe is usually full and always ranges across the middle level of the body. The pelvic fins are short and never reach to the anal opening. The maximal size is 18 cm, and the maximal age is five.

Cottus gobio

It lives on the hard bottom (below stones) in brooks, rivers and lakes, and rarely in brackish waters in the waterside zone. They mainly live individually. It feeds on small benthic invertebrates, mainly bugs and crabs, and sometimes smaller fish as well. It spawns in the spring and at the beginning of the summer.

The fish-roe glues itself to the stone and is guarded by the male specimen.

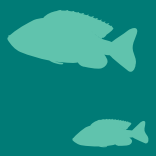
THE NEGATIVE IMPACT ON THE SPECIES

The construction of the small hydro power plants bears with itself several negative impacts on the ichtyofauna:

- represents a barrier in migrations (if a dam for lifting up the water level should be built)
- there is the risk that the fish enters the pipeline that leads to the turbines
- changes in the water level in the area between the output and return pipe
- changes in the physical-chemical conditions in the area between the output and return pipe
- changes in the structure and appearance of the bottom and the waterside area between the output and return pipe
- changes in the water regime and the dynamics of the sediment in the area between the output and return pipe.

Another potential danger is that the new areas with calmer and warmer water are inhabited by invasive species that are not characteristic for such watercourses, such as chub, pumpkinseed and pike. These species can render irreversible damage to the local species.

THYMALLUS THYMALLUS



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AMPHIBIANS AND REPTILES

ANA ĆURIĆ & ALEKSANDAR SIMOVIĆ

AMPHIBIANS

Amphibians (Amphibia) belong to the ectothermic ("cold-blooded") groups of vertebrates. At this moment there are 7461 species registered in the world's online base, which are basically divided into three groups. The order Anura (from the Greek a(n) – meaning "without" and oura – meaning "tail") includes the vertebrates that do not possess the tail. The order Caudata contains the amphibians with a lizard-like appearance of the body, which we call salamanders and newts. The order Gymnophiona (from the Greek gymnos meaning "naked: and ophis meaning "serpent") includes the amphibians with a snake-like body and they almost exclusively inhabit the tropical and subtropical regions. It is considered that the amphibians as a group stem from certain groups of fish in the early Devonian period (around 416 to 397 million years ago). This group is the first group of vertebrates that spends a part of their life cycle on the land. Adaptations in terms of lung organs have facilitated land inhabitation. The characteristic of the whole group is that they go through the period of larvae and metamorphosis in their life cycle, for which they need water.

The skin of the amphibians is rather thin and mucous, and mainly pretty much interspersed with blood vessels, which enables them to exchange gases through skin. The mucous that the amphibian skin constantly exudes has the role to keep it wet, as well as a protective role.

Impregnation can be external and internal (with certain tailed amphibians). Several species of amphibians spends their whole life in water. Amphibians are distributed across the world, except in the polar regions (Arctic and Antarctic), ocean peninsula and some desert regions. The greatest diversity is present in the tropical and subtropical bands, while somewhat lesser number inhabits the moderate zones. In the moderate regions, the majority of the species stay calm during the cold period of the year.

TAILED AMPHIBIANS (Caudata) are animals with an extended body with well-developed tail, which is cylindrical or laterally flattened, and with two pairs of legs of similar length. The number of toes on the front legs is four and on the back legs five. They manage water extremely well, where they are mostly helped by the tail, while on land they do not get on pretty well and are rather slow. Tailed amphibians do not have the eardrum, or an auditory canal. Aposematic (threatening) coloration is frequent in the representatives of this group, and so is the presence of sex dimorphism (differences in the external appearance at male and female specimens). Tailed amphibians have complex systems of mutual recognition and complicated rituals of courting and mating. Males produce and release on the medium (forest linen or the bottom the water basin) the sperm packages (the so called spermatophore); females catch them by the cloaca and take them into their reproductive tract: the impregnation of the mature ovary cells is internal. Some groups of tailed amphibians lay eggs (oviparous), while there are others as well as, which throw out completely formed larvae that look like adults, but always have external gills.

AMPHIBIANS "WITHOUT TAIL" (Anura) are animals that do not have the tail in the adult stadium. Those are animals with short and plump body with two pairs of legs, whereby the back legs are far more developed in relation to the front legs and which enable them to move by jumps on the land, as well as excellent swimming capacities in water. The toes at the back feet are connected by swimming skins in the majority of these species, which additionally improves their movement in water. They have huge eyes and possess the eardrum. Frogs possess the possibility of communicating and almost every species has a different type of this communication, through which it can also be identified. Impregnation is external, and the eggs of the frogs are covered by a mucous gelatin mass that protects them from drying up and mechanical damages. Larvae hatch from eggs (the so-called tadpoles), which in their physical appearance are not reminiscent of

adult specimens. These tadpoles have a short, egg-like body and a long flattened tail. They breathe via gills that are mostly covered by skin (internal gills). During metamorphoses, the tail gets slowly shortened, and the back feet start to form first. Many species of frogs abandon water habitats after metamorphoses.

REPTILES

REPTILES (Reptilia) also belong to the ectothermic (cold-blooded) vertebrates. To date, 10 272 species (according to the world's online base) have been described in this group. The representatives of this group have well-developed breathing organs (lungs). The emergence and appearance of reptiles is tied to the period of early Carboniferous period (about 350 million years ago). It is considered that they were developed from a group of lizard-like amphibians (Anthracosauria) who have adapted to the dry land lifestyle. Reptiles saw the height of their adaptive radiation in the period of Mesozoic and were the dominant group of vertebrates on the planet for about 135 million years. Today they are divided into five groups. The rank of scaled reptiles (Squamata) contain two huge groups, and namely snakes (Serpentes) and lizards (Lacertilia), while the remaining three groups comprise: crocodiles (Crocodylia), turtles (Testudines) and the unique group of tuatara (Sphenodontida) that is considered very old (with one representative that inhabits the islands around New Zealand). Impregnation in reptiles is internal. The majority of them lay eggs that possess a mechanism for water maintenance, which was of crucial importance for inhabiting land and abandoning water environment, and there are also species that give birth to live young. What is characteristic of reptiles is that they can be of various dimensions. Their size ranges from 3 centimeters (some geckos) until over 9 meters (some pythons). The greatest diversity of species is present in the tropical and subtropical regions, while a part of the species inhabits moderate regions too. The reptile skin is covered by corneal plates or flakes, which serve to prevent an excessive loss of water from the body of these animals. The reptiles sometimes change these corneal creations, the so-called "dress over", whereby the snake throws it away in a single piece (dress off), while the other groups throw it away in parts. What prevents additional water loss in reptiles is their physiology; the reptiles do not form liquid urine, and besides that have a considerably lower metabolism rate.

In the course of our research on the territory of the rivers Sutjeska and Hrčavka, the representative of the rank of scaled reptiles were recorded: lizards and snakes.

LIZARDS (Lacertilia) possess an extended body with an extremely huge tail, which is of the same length and in the majority of cases longer than the very body of the animal. The majority of lizards possess two pairs of feet with five toes each, on which there are claws; however, there are some species in which these extremities are absent. The body of the lizards is covered in scales that are relatively small and in our species, the scales on the lower side of the body are larger in relation to the dorsal. Lizards can receive sound signals that are transmitted via air. They have even copulatory organs (hemipenes and hemiclitorises) located in the tail root. Impregnation is internal, hence some species lay eggs, while other give birth to live hatchlings. The majority of our species of lizard possess the capability of throwing the tail away in the case of danger. After some time, the tail is completely regenerated.

SNAKES (Serpentes) are reptiles with an extended body and completely reduced extremities and tail that is considerably shorter than the body. In contrast to the lizards, snakes cannot receive sound signals that are transmitted by air. Bones that represent auditory small bones in mammals are part of the jaw in reptiles, so that reptiles sense the soil vibrations and very low frequencies via the jaw bones. The snake tongue is long and pronged, and they use it to collect fragrant molecules such as pheromons, traces of prey and other, and transfer them to the pits of Jacobsen's organ that is found on the palate. Snakes feed exclusively on animal food. They possess numerous small teeth that are found on the edges of the jaws, as well as in two rows on the palate. Some groups of snakes also have poisonous teeth, connected with glands that exude toxic secretion. The poison serves to incapacitate, that is, kill or

to some extent digest the prey. The snake body is covered with two types of scales; on the back side they are small and rhomboid-like, while on the belly side there is a series of wide scales. Snakes just like lizards possess even copulatory organs. A large number of snakes lay eggs, but there are also those that give birth to live hatchlings.

Except for when they are hunting, snakes, like other animals, attack exclusively in self-defense, in case of encounter with potential predator (such as man very often is); some species remain still, counting on their camouflage coloration, while others try to escape: if they fail to escape and hide, that is, if they get caught, or, for example, stepped over, they try to defend themselves and make a hissing sound, fold and if nothing helps, bite.

On the territory of the rivers Sutjeska and Hrčavka the species from the families of Colubridae as well as Viperidae were recorded.

In the course of the research we conducted during 2014 and 2015, we established a total of 20 species of amphibians and reptiles that were classified into the ranks of Anura (8), Caudata (2) and Squamata (10). The following species of frogs were found: *Bufo bufo* – common toad, *Bufotes viridis* – green toad, *Bombina variegata* – the yellow-bellied toad, *Hyla arborea* – the European tree frog, *Pelophylax ridibundus* – the marsh frog, *Rana dalmatina* – the agile frog, *Rana greaca* – Greek frog and *Rana temporaria* – the common frog. When it comes to tailed amphibians, the following were found: *Salamandra salamandra* – the fire salamander and the alpine newt. When reptiles are concerned, the following species of lizard were found: *Anguis fragilis* – slow worm, *Podarcis muralis* – the common wall lizard, *Lacerta viridis* – the European green lizard, *Lacerta agilis* – the sand lizard, *Dinarolacerta mosorensis* – the Mosor rock lizard, whereas, when it comes to snakes, the following were discovered: *Natrix natrix* – the European grass snake, *Natrix tessellata* – the dice snake, *Zamenis longissimus* – the Aesculapian snake, *Coronella austriaca* – Smooth snake, and *Vipera ammodytes* – Long nosed viper.

One of the most interesting discoveries is that of the alpine newt in the very canyon of Hrčavka, given that this species prefers calmer water surfaces, such as swamps and puddles. However, due to almost vertical sides that surround the canyon, such habitats are not present. The

TABLE I ENDANGERED AND PROTECTED SPECIES OF AMPHIBIANS AND REPTILES OF SUTJESKA AND HRČAVKA

Valid scientific name of the taxon	Common name	Global threat (IUCN)	Threat according to EU Directives	Regional threat
Salamandra salamandra (Linnaeus, 1758)	Fire salamander	LC	Bern: Appendix III	Red list of RS; RL FBiH (LC)
Ichthyosaura alpestris (Laurenti, 1768)	Alpine newt	LC	Bern: Appendix III	Red list of RS; RL FBiH (LC)
Bufo bufo (Linnaeus, 1758)	Common toad	LC	Bern: Appendix III	Red list of RS; RL FBiH (LC)
Bufotes viridis (Laurenti, 1768)	Green toad	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Bombina variegata (Linnaeus, 1758)	The yellow-bellied toad	LC	Habitats Directive: Annex II, IV; Bern: Appendix II	Red list of RS; RL FBiH (NT)
Hyla arborea (Linnaeus, 1758)	The European tree frog	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Pelophylax ridibundus / P. kl. esculentus (Pallas, 1771) / (Linnaeus, 1758)	The marsh frog	LC	Habitats Directive: Annex V; Bern: Appendix III	Red list of RS; RL FBiH (LC)
Rana dalmatina Bonaparte, 1840	The agile frog	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Rana graeca Boulenger, 1891	Greek frog	LC	Habitats Directive: Annex IV, Bern: Appendix III	Red list of RS; RL FBiH (NT)
Rana temporaria Linnaeus, 1758	Slow worm	LC	Habitats Directive: Annex V; Bern: Appendix III	Red list of RS; RL FBiH (NT)

Valid scientific name of the taxon	Common name	Global threat (IUCN)	Threat according to EU Directives	Regional threat
Anguis fragilis Linnaeus, 1758	The common wall lizard	/	Bern: Appendix III	Red list of RS; RL FBiH (LC)
Podarcis muralis (Laurenti, 1768)	The European green lizard	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Lacerta viridis (Laurenti, 1768)	The sand lizard	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Lacerta agilis Linnaeus, 1758	The Mosor rock lizard	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Dinolacerta mosorensis (Kolombatović, 1886)	The European grass snake	VU	Bern: Appendix III	Red list of RS; RL FBiH (VU)
Natrix natrix (Linnaeus, 1758)	The dice snake	LC	Bern: Appendix III	Red list of RS; RL FBiH (LC)
Natrix tessellata (Laurenti, 1768)	The Aesculapian snake	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Zamenis longissimus (Laurenti, 1768)	Smooth snake	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Coronella austriaca Laurenti, 1768	Long nosed viper	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)
Vipera ammodytes (Linnaeus, 1758)	Poskok	LC	Habitats Directive: Annex IV; Bern: Appendix II	Red list of RS; RL FBiH (LC)

discovery of the sand lizard in the upper course of Hrčavka is also interesting data, considering that this species prefers the more open habitats, and not thick beech and boreal forests that surround this part of Hrčavka. Along the main road, as well as next to other roads for motor vehicles, a large number of snakes was observed, and it wasn't rare for us to find 15 snakes of different species at one location due to movement for the sake of nutrition and arrival to the place for sunbathing. It has been noticed that a huge number gets killed on the road by the motor vehicles. A certain number of Mosor rock lizards were observed too, next to the very main road that passes through the National park Sutjeska. And even besides a huge load of the road due to the tourist season, these lizards were not scared and tolerated being approached at the distance of only few centimeters.

Rana graeca

SPECIES

THE FIRE SALAMANDER - SALAMANDRA SALAMANDRA (LINNAEUS, 1758)

Salamandra salamandra

Fire salamander belongs to the group of tailed amphibians and is one of several representatives of this group that can be encountered on the territory of the National park Sutjeska. The body of the fire salamander is principally of black color with characteristic yellow frets or stripes, and sometimes individuals with orange or red frets and stripes can be seen too. These frets represent a warning to predators, and besides that fire salamanders possess glands that exude poison (Salamandrine poison), which irritates the mucous and affects the central nervous system of the predators. Poisonous glands are also surrounded by muscles so that fire salamanders are capable of ejecting poisonous secretion under pressure to the distance of about 40 to 200 cm. The male and female specimens look identical. Adult fire salamanders are usually 25 cm long, less frequently 30 cm, of which a third belongs to the tail. Fire salamanders inhabit mainly deciduous forests, where they hide on wet places during the day. They are active at dawn and over the night, and during rainy days even throughout the day. Fire salamanders feed on invertebrates such as worms, snails and arthropods. Courting and mating happens on land; this species is ovoviparius, the female specimen give birth to about 10 to 70 larvae, the length of 2.5 to 3.5 cm. These larvae live in water, in which they undergo metamorphoses (transformation) to a young individual after 5 to 7 months, and during this period their whole organism goes through huge changes. Fire salamander is not dangerous to man, and folk beliefs that one can become deaf from its “hiss” are absolutely incorrect.

COMMON TOAD - BUFO BUFO (LINNAEUS, 1758)

Bufo bufo

They are 15 cm long; the female specimens are larger than the male ones. These are the biggest European frogs. In nature they live up to 12 years, but when imprisoned they can live up to the age of 40. The body color is brown or yellowish. The ventral side is a lot brighter and usually of light gray or yellowish color with small black spots. Their extremities are short, and body plump, so that they are slow and sluggish – make very short jumps. In the back skin they possess numerous individuals grain-like glands, as well as parotid (ear) glands (more precisely,

groups of separate glands) that exude secretion of an unpleasant smell, which repels potential predators. They have a horizontal pupil. The back feet toes with swimming skins are connected only at the base; the toes of both feet pairs have corneal thickenings resembling nails on top. They inhabit various, often relatively dry habitats. They are active at dawn and through the night, when they feed on various invertebrates, even though it is not rare for them to feed on small vertebrates (e.g. mice). They mate in water from March to June; females lay eggs in bands. Given they are plump and inert, and hence slow-moving, they often die on roads.

THE YELLOW-BELLIED TOAD - BOMBINA VARIEGATA (LINNAEUS, 1758)

Bombina variegata

The body length does not exceed 5 centimeters. It possesses warts that are found on the whole dorsal body surface, which is usually of gray, grown, olive or yellowish color. Thus colored and structured back perfectly fits into the environment – muddy swamps in which these animals spend the most of their time. Ventrally, this toad is gray-bluish with huge, flamboyant yellow-orange areas. When it senses danger, it manifests "unken" reflex, showing its starkly colored belly: this "flash" of yellow color is a strong contrast to the up to then practically invisible coloration, and can confuse potential predators. They have a heart-like pupil. These toads inhabit lakes, swamps, rivers and springs of hilly and mountain regions. They are very tied to water (and rarely abandon it): even in very small water basins one can find a huge number of these frogs. These toads feed on invertebrates. They mate from the spring and all the way up to the summer. Females lay from 50 to 120 eggs. On the territory of the National park Sutjeska lives a subspecies, *Bombina variegata scabra*, which is an endemic species for the region of the Balkans.

GREEK FROG - RANA GRAECA BOULENGER, 1891

Rana graeca

Greek frog is a species that represents an endemic species of the Balkan peninsula (lives only on the Balkan peninsula). The body length of these frogs is usually from 7 to 8 cm. The body is relatively wide and flattened; the top of the head (muzzle) is short and rounded. Body color can vary from gray to brown, reddish, yellowish or olive, and

dark frets or spots are often present too. The ventral side of the head (gullet) is usually a lot darker than the belly, with a characteristic bright line that passes through the middle. The belly is of whitish color and mainly without frets. In the mating season the males get the characteristic black-brown color, and their skin takes on a gelatinous appearance due to subcutaneous lymph accumulation. Greek frogs have a horizontal pupil. They inhabit mainly fast, clear and cold running waters that are tied to the canyon valleys; they are rather tied to waters and practically live next to the very water or in water the whole period except for the winter. They feed mainly on small invertebrates. These frogs mate from March, April and all the way up to July, depending on the year and weather conditions. They lay from 200 to 2000 eggs in calmer parts of the watercourse, and it is not rare for the males of this species to guard eggs from other small predators.

THE DICE SNAKE - NATRIX TESSELLATA (LAURENTI, 1768)

Natrix tessellata

The dice snake is a snake from the family of Aescalupius snakes (Colubridae). The length that they can attain is mainly up to 130 cm, and that mostly holds for female specimens, while the male counterparts are smaller and shorter. The coloration varies from brown, gray-green to olive color with four or more rows of dark brown or black squares or frets. Sometimes once can encounter totally black (melanic) individuals and individuals without frets. The belly side of the body is white, and the distribution similar to that on the chessboard, whereby white fields can sometimes be orange or reddish. Due to the described coloration people often confuse this harmless snake with the viper and think it is poisonous. This is a species that is closely tied to water surfaces, and on the territory of the National park Sutjeska it can be seen next to Sutjeska and Hrčavka rivers and their tributaries. This species feeds on fish in the majority of cases; however, it has been recorded that it can feed on amphibians too, primarily frogs and their tadpoles. When it senses danger, it can often pretend to be dead, releasing an unpleasant smell from cloacal glands, and there are cases known when it releases blood from the mouth. This species will practically never bite man and is completely harmless; in rare cases it will emit sounds like hissing in order to warn the potential predator. During the mating season, which usually takes place from March to May, they can gather in larger groups. They lay eggs during June and July, usually from 5 to 30 pieces. Young snakes hatch during August and September. They look the same as the adult individuals, the length of 10 to 20 cm.

MOSOR ROCK LIZARD - DINAROLACERTA MOSORENSIS (KOLOMBATOVIĆ, 1886)

Dinarolacerta mosorensis

The Mosor rock lizard represents a steno-endemic species of the Dinarides and the Balkan peninsula (lives only on the territory of Bosnia and Herzegovina, Montenegro and Croatia). This lizard has a flattened appearance with markedly sharp head and long and thin tail, which enables them to hide and move through the narrow cracks that are found in the rocks. The body length is about 7 cm, not including the tail. The dorsal side of the body is brown, gray-brown or olive – brown color with darker frets and spots. The ventral side of the body is without frets and spots and is usually yellow colored. The Mosor rock inhabits wetter, open, stony, Karst regions of the Dinarides, at the altitudes of 500 to 2000 meters. The habitats it inhabits are under the influence of a wide spectrum of climate conditions with long winters, wet spring and autumn, as well as with very warm and dry summer. This species of lizard mainly feeds on insects. Mating takes place in May and June, after which females lay from four to eight eggs in which there are already partly developed embryos. All this characterizes this species as one with the fastest period of incubation among the lizards (Lacertidae), which lasts from 23 to 26 days. We found this species on the mentioned habitats on the researched region in the canyons of the river Sutjeska at the altitude of 550 to 750 meters, which are also the lowest findings of this species at the National park Sutjeska.

THE NEGATIVE IMPACTS OF SMALL HYDRO POWER PLANTS

All the stated species are directly or indirectly tied to the rivers Sutjeska and Hrčavka as well as their canyons, be it next to the very water or the banks, slopes or rocks of the canyon.

SHPP „HRČAVKA I (S-H-2), 2 (S-H-1), 3 (S-H-3)"

Significant discovered species of amphibians that would be directly influenced by SHPP planned on rivers Hrčavka are Greek frog (*Rana graeca*), the agile frog (*Rana dalmatina*), the common frog (*Rana temporaria*), the common toad (*Bufo bufo*), the green toad (*Bufotes viridis*), the yellow-bellied toad (*Bombina variegata*) and the alpine newt (*Ichthyosaura alpestris*). All five species of frog were discovered along the researched course of the river Hrčavka, while the alpine newt (*Ichthyosaura alpestris*) was found in the canyon of the river Hrčavka, and the common frog (*Rana temporaria*) was found only in the upper course of the same river.

The Greek frog (*Rana graeca*), the endemic species of the Balkan peninsula, whose natural habitats are fast and cold rivers and mountain brooks, would certainly feel the negative impacts. This species is tied exclusively to water habitats, where it multiplies. That said, it is clear that the tadpoles directly depend on the existence and fluidity of the water flow. Given the low temperature of water (9.5-12.5 °C), tadpoles suffer a slower process of metamor-

phoses, which means that it is necessary to preserve the current flow in the summer months, when the water level is generally much lower in relation to the spring period. The construction of small hydro power plants in certain shallow parts would lead to the drying up of the river bed, and this in turn would cause the death of tadpoles and lead to drastic reduction in the population.

Along the course before the very canyon and after the canyon, tadpoles, juvenile and adult individuals of the common toad (*Bufo bufo*), green frog (*Bufotes viridis*) and yellow-bellied toad (*Bombina variegata*) were found. These species also use calmer parts of the course of the river Hrčavka for multiplication, and preservation of the natural flow of the river is essential for the survival of the populations of these frogs.

Fire salamander (*Salamandra salamandra*) was discovered next to the bank below rocks where moisture is preserved owing to the presence of the river. Fire salamanders, like other amphibians, depend on the bigger amount of moisture, so that in order to survive their skin has to be constantly hydrant. This they achieve by hiding below the rocks, rotten logs, leaves or moss that have kept moisture. In the multiplication season they lay their larvae into the springs, brooks, calmer parts of the mountain rivers (such as Hrčavka), so that a continuous flow of water is necessary for the survival of this species on the researched region. Every drying up of parts of the course in which larvae are present will lead to their death, given that the process of metamorphoses takes one to three months in colder waters.

The alpine newt (*Ichthyosaura alpestris*) as well as its larvae were found in the course of research in the very canyon of Hrčavka in the running water, even though this species prefers calmer water surfaces such as ponds and puddles. This phenomenon is above all manifested in the very flow of the river Hrčavka being surrounded in this part by vertical cliffs on which there are no possibility of forming temporary or permanent ponds, which is why any kind of disturbance of the Hrčavka's course is lethal for the larvae of the alpine newt, which need water during the metamorphosis from the larvae stage to adulthood.

The greatest impact of the construction of SHPP „Hrčavka 1 (S-H-2), 2 (S-H-1), 3 (S-H-3)" on the reptiles will be reflected in the water species of snakes, the European grass snake (*Natrix natrix*) and the dice snake (*Natrix tessellata*). The life of these species is directly tied to water where they feed, and they use the banks for going out and sunbathing, considering they are poikilothermic organisms. As it has already been stated, a huge negative impact on the amphibians would be transferred to the European grass snake that mostly feeds on amphibians, while the disappearance of fish or the reduction of their population would have negative impacts on the tessellated water snake, to which fish represent the only food in those habitats.

In conclusion, the stated species and their juvenile forms-larvae would be afflicted by the construction of SHPP „Hrčavka 1 (S-H-2), 2 (S-H-1), 3 (S-H-3)" in a negative sense in certain parts of the course. Even though the construction of SHPP requires a free flow of part of the water and facilitates the potential biological minimum, an explained and monitored flow and the characteristics of the course of the river Hrčavka is nowhere to be found, in order to be able to safely determine the same. The processed data from 1983/84 for the speed of the flow of the river Hrčavka cannot be valid in such as evaluation given current changes such as climate changes, greater droughts and various frequencies of the yearly water flow monitored in a longer time period.

By mining and pipe installation into the bank as well as above the canyon along the old Austro-Hungarian railway, the habitats of reptiles that were found in the canyon of the river Hrčavka would be devastated. The very process of pipe transportation and the equipment above the Hrčavka canyon (the route of the old Austro-Hungarian railway) would erode the forest cover, the surrounding rocks and rockery which represent the habitats to a larger number of reptiles discovered in the course of exploration. The noise that would be generated by the machines would cause withdrawal of the species from the given habitats as well as the habitats in the immediate vicinity. The construction material such as cement that would be used in the works would have a negative impact exclusively on the amphib-

ians due to its toxicity, and on the basis of that the impact on other aquatic species should be checked. Each potential unloading of fuel, motor oils and other side products of the machines driven by fuel would also have a negative impact both on the very habitat and on the amphibians and reptiles that inhabit it. Any kind of coarse works in the period of X to III month would have a negative impact on the winter residencies (hibernacula) of amphibians and reptiles which would lead to death of the representatives of the given group of organisms.

SHPP „SUTJESKA 2A I 2B"

All the discovered species of amphibians that would be negatively affected by the small hydro power plants planned on the river Sutjeska are important. At the transect between the estuaries of the river Jabušnica, as well as downwards to Vratar, a sub-species of the yellow-bellied toad, *Bombina variegata scabra*, the endemic species of the Balkan peninsula, which uses for the process of multiplication the very flow or puddles next to Sutjeska's flow. Such areas could not be flooded by the construction of SHPP and counting on the biological minimum, and lacking water they would be dried up, which in turn would cause the species to withdraw from the discovered locations.

Greek frog (*Rana graeca*) represents a species directly related to the mountain watercourse, where it spends most of the time and where it multiplies. It is an endemic species of the Balkan peninsula. Greek frog was found across the whole course of the researched part of the river Sutjeska, which ecologically (the mountain river type: low water temperature, clean water, canyon landscape) and biologically suits it very much. At the end of the month of June, given the area's climate, it is still possible to find tadpoles in water that undergo a gradual process of metamorphosis. Considering the low water temperature (10.5-12.5 °C), tadpoles sustain a slower process of metamorphosis which means it is necessary to preserve the current course in the summer months, when the water level is generally considerably lower in relation to the spring period. The construction of SHPP in certain shallow parts would lead to the drying up of the river bed, causing death to the tadpoles and leading to drastic reduction in the population.

In the very watercourse of the river Sutjeska green frog was also found (*Pelophylax ridibundus*). This species is also directly related to the water body and every change in terms of the reduction of the amount of water flow would lead to the withdrawal of the species. Owing to anthropogenic action, which includes the current issues as well, the number of the populations of green frogs is in decline, and the impact is seen in the surrounding countries too (e.g. Serbia, Montenegro).

Next to the very watercourse of the river Sutjeska, on the section between the estuary of the river Jabušnica and downwards, still water bodies were found, which are created by the formation of a strong current of the main river. There is a high probability that the reduction in the amount of water that will be carried through the pipes of the planned SHPP will lead to the drying up of such water bodies, where you can also find big green frogs that use such places to multiply.

In the canyon of the river Sutjeska, in the shallow parts, tadpoles of the common toad (*Bufo bufo*) were also found, this toad using this type of the water body during multiplication.

The European tree frog (*Hyla arborea*) was found on the coastal region of the river Sutjeska, where permanent or temporary puddles are formed, and in the vicinity of which there is flood vegetation that represents the protection and the habitat of this species, which is arboreal. Regulation of the watercourse of the river Sutjeska and reclamation of the right bank with the aim of setting the pipes will lead to the degradation of the habitat, the potential disappearance of the puddles due to the reduction in the water course (destruction of the water habitat for multiplication) and the very population of the European tree frogs.

The greatest impact of the construction of SHPP „Sutjeska 2a and 2b" on reptiles will be manifested with the water species of snakes, the European grass snake *Natrix natrix*

and the dice snake *Natrix tessellata*. The life of these species is directly related to water, where they feed and multiply, while using the stony banks and slopes of the canyon for going out and sunbathing, given they are poikilothermic organisms.

The Mosor rock lizard (*Dinolacerta mosorensis*), which represents a relict and steno-endemic species of the Dinarides, should also be singled out of the discovered species. This species is found on the Red list of the RS, as well as in FBiH where it has been classified into vulnerable species (VU). It prefers Karst regions with the influence of the Mediterranean climate with relatively moist and fresh habitats with the presence of the vegetation that creates the shadow. The species was also found on rockery grounds above the very course of the river Sutjeska, and all disturbances such as mining, machine work, soil shaking and the reduction of the moisture will endanger the populations above the very canyon.

In conclusion, the stated species and their juvenile forms/larvae will be negatively affected by the construction of SHPPs „Sutjeska 2a and 2b". Even though the construction of SHPP requires a free flow of part of the water and enables the potential biological minimum, an explained and monitored flow and the characteristics of the flow of the river Sutjeska can nowhere be found, in order to be able to safely determine the same. The processed data from 1983/84 for the speed of flow of the river Sutjeska cannot be valid in such an evaluation given the current changes such as climate changes, higher droughts and varying frequency of the yearly flow of water monitored in a longer period.

The construction of these SHPPs on the rivers Sutjeska and Hrčavka has as its part a planned intervention with the sedimentation tank, which would collect water from the bottom of the flow, and before the very entrance there would be a bar which would collect all the bigger deposits. This tank would also prevent the entrance of smaller deposits and have the possibility to separate all the particles from the water, whose diameter would be bigger than 0,5 mm. Considering that there would be a bar which would collect and direct water into this water catchment, this whole water catchment would create a problem to herpetofauna, exclusively to frogs and their tadpoles for which there are great chances to become isolated or sedimented in the water catchment. Likewise, the organisms that enter the food chain of amphibians would be exposed to the influence of SHPP, which would erode the whole food chain of the given region.


LACERTA VIRIDIS

DINAROLACERTA MOSORENSIS

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BIRDS

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BIRDS

Around 150 million years ago, birds (Aves) developed from reptiles, learned to fly and spread across the world in all types of habitats. Apart from the fact that they can fly, birds can walk, and some are also good swimmers or divers. The complete construction of the bird's body is adapted to flying and that is the reason why their skeleton is so light that their feathers are twice or thrice heavier than the skeleton.

It is owing to the same reason that the bones of the skull are very thin, while much larger bones are hollow. Birds sing in order to reveal their presence to their partners, to let other birds know where their territory is and let each other know what is important. Birds' song consists of a series of sound motives that the bird intermittently repeats from start and it represents the most important method of communication among birds.

In relation to other vertebrates, birds have a series of characteristics specific just for them, or features that occur for the first time in this group of animals:

- Body covered in feathers
- Bones adapted to flying (hollow bones)
- Existence of beak
- Heart made of two pre-ventricles and two ventricles
- Homeothermy
- High degree of metabolism
- Muscular stomach
- Laying eggs in the nest

Today birds include about 10 000 species. However, according to the data of the BirdLife International 1.111 species is currently marked by some of the categories of threat. Out of 526 regularly recorded species in Europe, 226 (43%) species are considered as not having a satisfactory protection status.

This is why birds stand out as the most important indicators of the state of the environment, thus, studying, monitoring and protection of their habitats today represent one of the most important components in the environmental protection system.

According to current indicators, close to 13% of the world's area is covered by a certain degree of protection. At the same time, there is the tendency to increase the total area of the protected regions to 17% at the world level until 2020. The current percentage of the protected areas includes about 150 000 identified regions. Out of the number stated, about 49% identified as IBA regions (Important Bird Areas) are not protected.

The majority of birds are migratory due to nesting, food and bringing up the young. The area where they mate and multiply represents the primary place of their residence, and they go to warmer areas during the winter, crossing a long path in order to return the next spring.

In forests and on agricultural cultures birds are considered to be natural regulators of the population of many insects, which, in large numbers, would cause massive devastation of forests and destruction of crops.

Many birds are very sensitive to changes in the environment, such as pollution, so that we consider them as very reliable bio-indicators. Current changes in bird migrations (the period of departure and arrival, as well as the change of locations) have given very important data on the impact of climate changes on the nature.

Birds have been a significant part of nature for men from the earliest civilizations. They are an integrative part of many mythologies and generally of the cultural heritage of the human civilization. In the modern age, the importance of birds in regulating the number of insects and rodents, agriculture, and all the more in tourism has been acknowledged.

For many birds our regions are extremely important corridors during the migration, and we have the duty to ensure them a calm and safe place for rest and feeding. There is a long process for preserving birds that nest in Bosnia and Herzegovina, during which we should secure them safe habitats and an adequate protection, given the current management of habitats that are of particular importance for birds – such as swamp areas, river banks, forest complexes, high mountain regions etc.

RESEARCH OF BIRDS IN THE NATIONAL PARK SUTJESKA

According to available literary sources, the first known research on the territory of the National park Sutjeska was conducted by the then curator of the National Museum of Bosnia and Herzegovina in Sarajevo, Otmar Rajzer in the period from 1888 to 1914. After that, the subsequent researchers were Rucner and Obratil (1973), and finally once again Obratil (1987). The only available, relatively newer research, has been conducted by Grubac and Gašić (2001). The analysis of the results of the stated researches shows that the same were mainly faunistic, and to a lesser degree population-directed. Earlier researchers mainly dealt with ornithocenosis of forest and high mountain habitats, while much weaker treated areas were those of the water courses of the rivers Sutjeska and Hrčavka with their canyons.

Rucner and Obratil (1973) pointed out that the researched area is characterized by diversity and specificity of vegetation, which represents one of the significant preconditions for the diversity of the bird fauna. The same authors adapted the research into the birds to phyto-cenological criteria, so that they ecologically divided the territory of the whole National park on: the forest biotopes (hill, pre-mountain and mountain range), biotopes of the mountain meadows and mountain glades, rocks, as well as mountain brooks, rivers and mountain lakes and areas. However, in this research the researched locations represent only the rivers Sutjeska and Hrčavka and their surrounding, and they included some of the following habitats: oak forests, hilly beech forests, beech and fir forests, coppice, forest cuttings, meadows, rocks, rivers and lakes, willow and alder forests, as well as partly human neighborhoods and the accompanying infrastructure. It is important to note that all the stated habitats represent the very water course and its surrounding which has a certain ecological connections with the river ecosystem.

In the course of our research on all the locations, a total of 55 birds species were recorded. The majority of taxons were registered next to the watercourses of Sutjeska and Hrčavka and their surrounding. Field research of the river Hrčavka determined seven territories of the white throated dipper (*Cinclus Cinclus*), who are directly tied to the river water courses because of their lifestyle. At least 10 white throated dippers were registered along the river Sutjeska, from the estuary of Jabučica to Tjentište. A family of the common sandpiper (*Actitis hypoleucos*) was registered in the river Sutjeska, in the immediate vicinity of Tjentište. Apart from them, the territories of the grey wagtail (*Motacilla cinerea*), which also nest and feed next to the water, were recorded on both rivers. Due to inaccessibility and mining of the field it was not possible to realize a field trip of all the sections of the water course of Sutjeska, so that the recorded number of pairs does not reflect the real state in the sense of numbers, that is, there is probably a larger number of territories along the water course on the sections not researched.

Out of the total of registered 55 bird species, a different number of species was recorded by locations (from 3 to 30 species by transect – location), depending on the ecological and other conditions prevailing in the habitats on the researched transect – location. Out of all the

registered species on the subject region of the water course and their surrounding, all the recorded species are recent nesting birds of Bosnia and Herzegovina, whereby the booted eagle (*Aquila pennata*) is a species for which it has been determined that it no longer nests in Bosnia and Herzegovina.

In terms of the numbers of populations of birds registered in BiH, it can be stated that several species that are considered at the state level as rare nesting birds, above all the species of daily birds of prey (*Pernis apivorus, A. pennata, Aquila chrysaetos*), then the Corn Crake (*Crex crex*), the common sand piper (*A. hypoleucos*), Eurasian eagle owl (Bubo bubo), and when it comes to wood peckers it is the white-backed woodpecker (*Dendrocopus leucotos*). Speaking of singing birds, the most significant nesting bird of rocks, rockery grounds and coppice in the canyons is the rock bunting (*Emberiza cia*). All the stated species are tied to the canyons of Sutjeska and Hrčavka, due to the choice of the place of nesting or feeding next to water or in the water. For the common sand piper this is perhaps the first discovered nest on the territory of Bosnia and Herzegovina.

TABLE I SOME ENDANGERED AND PROTECTED BIRD SPECIES

NO	Species	Common name	Regulation on the Red list of Protected Species of Republic of Srpska	EU Birds Directive	IUCN Red list of European Species
1.	*Pernis apivorus* (Linnaeus, 1758)	The European Honey Buzzard	+	I	LC
2.	*Aquila chrysaetos* (Linnaeus, 1758)	The Golden Eagle	+	I	LC
3.	*Aquila pennata* (J. V. Gmelin, 1788)	The Booted Eagle	+	I	LC
4.	*Crex crex* (Linnaeus, 1758)	The Corn Crake	+	I	LC
5.	*Actitis hypoleucos* (Linnaeus, 1758)	The Common Sandpiper	+		LC
6.	*Dendrocopos leucotos* (Bechstein, 1803)	White Backed Woodpecker	+	I	LC
7.	*Bubo bubo* (Linnaeus, 1758)	The Eurasian Eagle Owl	+	I	LC
8.	*Motacilla cinerea* Tunstall, 1771	The Grey Wagtail	+		LC
9.	*Cinclus cinclus* (Linnaeus, 1758)	The White-Throated Dipper	+		LC
10.	*Emberiza cia* Linnaeus, 1766	The Rock Bunting	+		LC

THE MOST THREATENED SPECIES OF THE WATERCOURSES OF THE RIVERS SUTJESKA AND HRČAVKA

THE WHITE-THROATED DIPPER (CINCLUS CINCLUS)

It inhabits fast, running, clean waters, mountain brooks, stony rivers rich in water invertebrates. It lays eggs from March to May, and makes the nest from moss and leaves in rocks, or below bridges, sometimes behind the waterfall or among the trees next to water. The survival of this species is related to the quality of water and the structure of the habitat. The white throated dippers are unique birds among the singing birds that dive in fast-running waters in order to feed. Young white throated dippers are specialized for hunting small stationary prey such as the larvae of Simulidae (Diptera) and avoid diving, while the adult specimen eat larger scoop and seek food more actively in deeper water. The nutrition of the white throated dipper consists of shrimps *Gammarus sp*., freshwater snails, the larvae of Coleoptera and Trichoptera and other water invertebrates. Mayflies (Ephemeroptera) are important food during the period of nesting, while in the later period the nutrition consists of caddis flies predominantly. It is important to note that the species of insects from both ranks are very sensitive to water pollution. The research into the impact of water pollution to the number of this population has shown that the number of the young is connected with alkality, pH, the amount of calcium, conductivity of water and the density of the population of prey.

Cinclus cinclus

The research carried out in the French Pyrenees show that all the categories of behaviour of the white-throated dipper are related to the variation of the water levels in the rivers on the studied habitats. Pollution, electro-energetics, the creation of water catchment, the drying up of the water courses and similar effects have a negative impact on the prey of the white throated dipper, and hence cause the reduction in the number of this species in the water courses.

THE GREY WAGTAIL (MOTACILLA CINEREA)

It nests from March to early August, and lays eggs mainly from April to May. The nest is largely found among the

Motacilla cinerea

rocks or in the cracks of river banks. It feeds on insects, shrimps (Gammarus spp.), land snails and spiders. The grey wagtail is closely connected with water in relation to the white wagtail, hence it can solely be met next to rivers or even more frequently next to hilly and mountain brooks. This species seems somewhat more flattened and stands out by its yellow colour of chest, belly and anal part, while the hips are white. The back and the wings are almost identical in color just like in the white wagtail, that is, grey and black and white.

THE COMMON SANDPIPER (ACTITIS HYPOLEUCOS)

It feeds on larvae and adults of the insects from the ranks of Coleoptera and Diptera, spiders, mollusks, crabs, annelids, and rarely eats frogs, tadpoles, small fish and plant materials (seeds). It nests in the shallow niches, among the bushes and trees. Besides using the waterside zone and shallow waters, the common sandpiper uses deeper and lacustrine parts of the water course for hiding from predators. The greatest death rate of the young is 3-5 days after hatching. Merely hatched young are weaker, less capable of running and hiding and are more vulnerable than the adults.

Actitis hypoleucos

THE IMPACT OF THE PLANNED HYDRO POWER PLANTS ON THE BIRD DIVERSITY

From the point of view of threat and protection, all the registered species are present in the Republic of Srpska too, and are found on the Regulation on the Red list of the protected species of flora and fauna of the Republic of Srpska. According to the IUCN categorization, all the recorded species have the category LC (least concern), while in the Annex I of the EU Birds Directive there are 16 registered species.

According to the quotes and explanation of Kotrošan et al (2012), the whole region of the National park Sutjeska was proposed for an IBA (Important Bird Area) region.

Oscillations of the water levels of these fast mountain rivers are sudden, and ecosystems of the mountain water courses are very sensitive and change their structure and dynamics quickly. Redirecting water reduces the available amount of water necessary for an optimal functioning of the ecosystem. The reduction of the total biodiversity and distribution of species down water, but also upwards from SHPP, the disturbance of fauna and the number of fish species, the community of water invertebrates and other water organisms will lead to the disappearance of certain bird species from the waterside zone, the loss of coastal vegetation and the conversion of the habitat.
The negative impacts on the hydro-morphological process and many other unpredictable effects are only some of the negative impacts of the construction of the SHPP on this region. The erection of the water catchment, pipelines and machine house as part of the SHPP imply significant works that would consequently erode the stability of the

river ecosystem both in the construction and exploitation phase. The threatening factors could be divided into these two criteria: the factor type and consequences, that is, effects on avifauna.

The threatening factors for avifauna according to type and origin:
• Physical partitioning of the water course and creation of the water catchment
• The reduction of the water level and disturbances in the water regime
• Disturbance of the sediment and other physical changes in the water ecosystem elements
• Eutrophication and chemical pollution of the river by pollutants
• Disturbance and erosion of the life cycle

Threatening factors according to the **effect on avifauna:**
• Direct effects on bird species that inhabit the water course and its close surrounding
• Indirect effects on bird species that inhabit the surrounding areas

The species that were particularly processed were those that due to nesting, ecological requirements and life cycle are directly tied to water, so that their choice of nesting and nutrition directly depend on the water level, sedimentation, position and composition of river banks, vegetation next to the water course or the composition of communities of water invertebrates that inhabit the river. The interventions that would be conducted during the construction of the exploitation of the SHPP have a potential negative impact on the nesting of these species, the reduction of the number of territories or the reproductive success or even disappearance of these species. In that sense, the white-throated dipper (*C. cinclus*), otherwise poorly incident nesting bird in BiH, which is closely tied for water invertebrates it feeds on, is the most endangered. Given that among the caddis flies and mayflies that live in Sutjeska and Hrčavka there are more species that are unique for this region (endemic species), the white-throated dipper is something invaluable that could be lost together with them if SHPP were constructed on these rivers. Our estimate is that the construction of the SHPP would lead to the disappearance of 20 to 30 territories of this significant bird species, otherwise an indicator of clean waters. Given that a large number of unique, endemic water insects would disappear together with the white-throated dippers, Sutjeska and Hrčavka being perhaps the only habitat of the said species, it is clear how great a loss that would be for BiH, as well as for the world's biodiversity.

Besides the mentioned species, the ones that inhabit the habitats ecologically connected with the water ecosystem were also processed. Those species of the neighboring habitats indirectly depend on rivers, and were analyzed under the assumption that the erosion of stability of the river ecosystems in the phases of construction and exploitation could lead to the disturbance in their life cycles. These birds largely imply species to whom the water course is a significant hunting area, the greater part of the hunting territory, regular rest resort, observatory and the like.

PHYSICAL PARTITIONING OF THE WATER COURSE AND THE CREATION OF THE WATER CATHCMENTS DIRECTLY OR INDIRECTLY WOULD HAVE CONSEQUENCES ON THE FOLLOWING:

Direct effects on the species that inhabit the water course and its close surroundings

Water catchment and pipelines have an impact on the reduction of the level of disappearance of water in the dry part of the season, change the composition of the communities of phytobenthos and water invertebrates that are the principal food to the white-throated dipper, white wagtail and the common sandpipers.

The interventions that disturb the river banks change the structure of the waterside zone and destroy places for nesting to these species and can possibly lead to the decrease in their number or vanishing from the subject region.

CINCLUS CINCLUS

Indirect effects on the species that inhabit the surrounding regions

Fragmentation and conversion of the habitats negatively influences the vegetation cover and at the same time ornithocenosis, because it changes the structure of ecotone (river banks and the like) that are the contact zone between the river surroundings and water course and represent the places for nesting and feeding to many species of singing birds (robin, subalpine warbler, ortolan and other). Deepening of the river bed pulls underground waters to a greater depth and makes them inaccessible to the plants, by means of which it negatively influences the coastal vegetation.

REDUCTION IN THE WATER LEVEL AND DISTURBANCES OF THE WATER REGIME WOULD DIRECTLY OR INDIRECTLY HAVE CONSEQUENCES ON:

Direct effects on the species that inhabit the water flow and its close surrounding

Changes in the hydro-morphological dynamics and micro-climate conditions lead to the changes in the coastal vegetation and disturbances in the species composition and the number of water invertebrates that the white-throated dipper, stream wagtail and the common sandpiper, as well as other species, feed on.
Slowing down the speed of the water course and the reduction of the water level leads to the increase in water temperature and causes thermal pollution. The water species of plants and animals are extremely sensitive to the temperature changes, and especially the water invertebrates that are the natural food to birds.

Indirect effects on the species that inhabit the surrounding regions

The negative impact on the disappearance of flooding zones in certain parts of the courses of both rivers where they naturally burst their banks in the periods of the possibility of occurrence of huge amounts of water disables the creation of key spots for multiplication, feeding, rest and generally the survival of endangered and unique species on the region of the National park. At the same time, the disappearance of water side plant communities reduces the retention capacity of these regions and attenuates the flooding wave during the torrential deposits and flooding.

Even small changes in the quantity and the term of flow influence the aquatic and coastal ecosystems, and therefore can significantly erode the ecological network and the links of the food chain of the river system.

DISTURBANCES IN THE SEDIMENTATION AND OTHER PHYSICAL CHANGES IN THE RIVER ECOSYSTEM ELEMENTS WOULD DIRECTLY OF INDIRECTLY HAVE CONSEQUENCES ON:

Direct effects on the species that inhabit the water course and its close surrounding

Disturbance in the inflow of the sedimentation has a negative impact on the composition of the communities of the bottom of fauna and thereby the food source for the white throated dipper, the common sandpiper and stream wagtail. The reduction of sedimentation in the water course increases the lateral erosion and gradually destroys the bank. This disturbance in the inflow of the sedimentation and construction works can lead to the disappearance of the natural river banks and sandbanks that are the habitats of the common sandpiper.

Indirect effects on the species that inhabit the surrounding areas

The works on the construction of pipelines and other direct interventions in the water course cause the degradation of the river bed, influence the river hydromorphology, longitudinal and lateral hydrological connectedness, which has as its consequence the devastation of the river ecosystem and the reduction of the total biodiversity.

EUTROPHICATION AND CHEMICAL POLLUTION OF THE RIVER WOULD HAVE DIRECT OR INDIRECT CONSEQUENCE ON:

Direct effects on the species that inhabit the water course and its close surrounding

Disturbance in the water course influences the accumulation of mud, heavy metals and other pollutants that stem from the work of SHPP, and reduces the potential of self-cleaning of the river. Various operations with the work of SHPP can cause a low level of oxygen saturation or even oversaturation, which in both cases causes serious damage for the metabolism of the water organisms and reduces the number of prey to the birds that feed next to water.

Indirect effects on the species that inhabit the surrounding areas

Low or medium impact.

DISTURBANCE DURING THE CONSTRUCTION AND EXPLOITATION, DISTURBANCES IN THE LIFE CYCLE WOULD HAVE DIRECT OR INDIRECT CONSEQUENCES ON:

Direct effects on the species that inhabit the water course and its close surroundings

Construction works and disturbances have a direct negative impact on all the species in the close surrounding in the nesting season. For some species, they destroy the habitat and irretrievably remove the nesting spots.

Indirect effects on the species that inhabit the surrounding areas

Disappearance or the reduction of the nesting spots of the species population (eagles, falcons, owls, some singing birds) that inhabit the canyon rocks, and hunt in the open part of the canyon.

SOME OF THE CONCLUSIONS AND PROPOSALS FOR THE FURTHER PLANNING AND ACTIVITIES:

- It is necessary to determine more precisely the state of bird populations through all the seasonal aspects. It is also necessary to process the surrounding areas, next to the very water courses, and to pay special attention to the species that inhabit the waterside regions of Sutjeska and Hrčavka, as well as to birds of prey.
- The stated construction works would change the qualitative and quantitative composition of the avifauna on the subject region.
- We do not recommend the construction of the SHPPs on the territory of the National park Sutjeska, on the water courses of the rivers Sutjeska and Hrčavka because they would irretrievably lead to the disturbance of the habitat of the white-throated dipper, the common sandpiper and hilly wagtail, as well as their prey that represents a group of unique species of water insects specific for this region and Bosnia and Herzegovina. The construction of the same would have a negative impact on other species of birds too, and above all, the drying up of the river bed and probable disappearance of water during the dry period of the year would have greater consequences for ornithofauna of a wider area of these water courses.
- On the contrary, we think that the preservation of the birds' populations should be one of the imperatives of the development of the National park Sutjeska. All the more popular in the world is birdwatching, which can bring more benefits to the very park and local communities on itself than the construction of small hydro power plants can do. Speaking long-term, by means of the inclusion of such activities into the tourist offer of the national park we would contribute to the popularization of scientific activities, expand the tourist offer and ensure a better understanding and protection of these important species.
- On the region of the National park Sutjeska it is necessary to ensure long-term undisturbed natural processes along the rivers with the maintenance and improvement of hydro-morphological processes and the maintenance of a favorable state of biodiversity in the rivers and next to them.

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BATS

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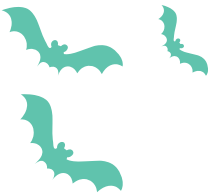

BATS

They are the only actively flying mammals and after rodents, they represent the largest rank with over 1 100 described species that inhabit all the continents except Antarctic. Bats live in various habitats: forest, meadow, moist, mountain and other, as well as in human settlements. For the purpose of hide shelters in which they live during the day and during the period of hibernation they use speleological objects, trees, natural cracks and holes in stones and rocks, buildings and other constructions (e.g. churches, bridges and the like). Certain species form colonies, while other live individually. The individuals of the same species can live in various shelters during one and the same year, depending on the part of the life cycle in which they are. Bats have a complex life cycle; they spend the winter in hibernation, and form family colonies in the summer; in autumn they mate and during the spring they move from winter to summer shelters.

The species that live in Europe and feed on insects and represent from the point of view of importance for men and its economic activity significant natural regulators of the number of insect species that are marked as agricultural and forest-wise harmful organisms. Bearing in mind their complex life cycle, the specialization in feeding on insects, that is, special requirements for certain habitats, bats have been recognized as significant bioindicator species that indicate changes in the state of ecosystems in which they live.

The main threatening factors for the survival of bats are the following: the disappearance of shelters and hunting territories due to fragmentation and loss of habitats, above all the forest ones; the arrangement of caves that represent significant shelters for a large number of bats; demolition and inadequate reconstruction of old buildings and churches that bats use as their shelters; an increased use of insecticides that causes the disappearance of the insects they feed on; direct disturbance and killing of individuals. That is why today all the European species of bats are endangered and classified at various degrees of protection, both at the European and the national level.

All the European species of bats are found in the Anex II of the Bern Convention (strictly protected species) except for the species *Pipistrellus pipistrellus* that is found on Annex III (protected species). The implementation mechanism of the Bern Convention for the European Union is the Directive of the European Union on the preservation of natural habitats and wild fauna and flora, better known as the Habitats Directive (Official Journal of the European Union [92/43/EEC]), in which all the species of bats are found in Annex II, and 13 species also on the Annex IV, and on the basis of which the best known and the most significant network of protected habitats in Europe – Natura 2000 – was created. Likewise, all the European populations of bats are found in the Annex II of the Bonn Convention which has a special implementation instrument in the form of the Agreement on the preservation of the populations of the European bats (EUROBATS). Unfortunately, this agreement has not been ratified only by Serbia, Bosnia and Herzegovina and Greece, when it comes to South and South Eastern Europe.

29 species of bats and 126 shelters that are represented mainly by caves have been recorded on the territory of Bosnia and Herzegovina so far. Despite the research efforts made up to now, a larger part of the country has remained insufficiently and unsystematically researched in the sense of fauna and ecology of bats.

As part of the described research the activity of the representatives of at least 14 species of bats was registered by ultrasound audio-detection. Given the very limited research period and the restrictions of the method used – on the one hand, and the wealth and preservation of the natural resources of the researched area, on the other, it can be expected that the number of bats is even greater.

The location with the biggest minimal diversity of species registered by the method of ultrasound audio-detection is the canyon of Hrčavka with nine registered species, after which comes the canyon of Sutjeska with the minimal number of seven species, and Donje Bare, that is, the river

Sutjeska in the region of the area of Tjentište with five registered species each.

Within the boundaries of the National park Sutjeska the domination of forests is pronounced (with perceived old trees and dead trunks with many cracks and holes) as the most widely distributed habitat, as well as the wealth of water courses and general presence of water surfaces. Both types of habitat (forest and water) are extremely important for bats as shelters, that is, hunting territories. Likewise, numerous favorable forms of Karst landscape (cracks in rocks) that represent potential habitats for various species of bats. Also, when the weather conditions were favorable a high number and diversity of flying and non-flying insects was observed and recorded, and these are potential scoop for bats. The discoveries of colonies and natural shelters, that is, an expressed wealth of the fauna of bats on a wider territory of the researched area can be considered expected in the future chiropterological research.

TABLE I

LIST OF BATS OF THE RESEARCHED AREA WITH THE STATUS IN THE INTERNATIONAL LEGISLATION AND THE LEGISLATION OF THE REPUBLIC OF SRPSKA AS WELL AS THE GLOBAL IUCN STATUS OF THREAT

Species	Bern Convention Annex	Bonn Convention Appendix	EU Directive Annex	EURO BATS	Global IUCN status	Red list of Republic of Srpska
Rhinolophus euryale (Blasius, 1853)	II	II	II, IV	+	NT	+
Rhinolophus hipposideros (Bechstein, 1800)	II	II	II, IV	+	LC	+
Barbastella barbastellus (Schreber, 1774)	II	II	II, IV	+	NT	+
Eptesicus serotinus (Schreber, 1774)	II	II	IV	+	LC	-
Myotis blythii (Tomes, 1857)	II	II	II, IV	+	LC	+
Myotis capaccinii (Bonaparte, 1837)	II	II	II,IV	+	VU	+
Myotis daubentonii (Kuhl, 1817)	II	II	IV	+	LC	+
Myotis myotis (Borkhausen, 1797)	II	II	II, IV	+	LC	+
Myotis mystacinus (Kuhl, 1817)	II	II	IV	+	LC	+
Nyctalus noctula (Schreber, 1774)	II	II	IV	+	LC	+
Hypsugo savii (Bonaparte, 1837)	II	II	IV	+	LC	+
Pipistrellus kuhlii (Kuhl, 1817)	II	II	IV	+	LC	+
Pipistrellus nathusii (Keyserling & Blasius, 1839)	II	II	IV	+	LC	-
Pipistrellus pipistrellus (Schreber, 1774)	II	II	IV	+	LC	+
Pipistrellus pygmaeus (Leach, 1825)	II	II	IV	+	LC	-
Plecotus auritus (Linnaeus, 1758)	II	II	IV	+	LC	+
Plecotus austriacus (Fischer, 1829)	II	II	IV	+	LC	+
Miniopterus schreibersii (Kuhl, 1817)	II	II	II, IV	+	NT	+

INTERESTING SPECIES OF THE RESEARCHED AREA

THE LESSER HORSESHOE BAT - RHINOLOPHUS HIPPOSIDEROS (BECHSTEIN, 1800)

The lesser horseshoe bat is the smallest bat from the family of horseshoe bats (Rhinolophidae) – bats that have characteristic skin folds in the form of a shoe which surround the nasal cavities. The total weight of this bat does not exceed 4-7 grams. The fur on the back is of brown to yellow-brown color, and on the belly it is of light gray color. Flying membranes and ears are of brown color. During the hibernation, the lesser horseshoe completely covers itself with wings and flying membranes, so that it has a very characteristic and recognizable appearance. The species is incident in Europe, and it reaches to the north all the way to Ireland and Southwestern England, which is at the same time the farthest northeast boundary of the incidence of the lesser horseshoe in Europe.

It inhabits the regions up to 2 000 m high. Hedges, forests and water habitats, villages with orchards and pastures represent the habitats which are of particular importance as hunting territories. They use the most diverse habitat types – from attics of churches and old buildings, to tunnels, abandoned mines, bridges and caves. Family colonies are made of 10 to 200 individuals. The young start flying when they are three weeks old, abandon the shelter for the first time when they are four weeks old and are completely independent a month and a half after birth.

Males and females reach sexual maturity in the second year of life. Mating takes place in underground or winter shelters. They catch their prey while flying, and they are skilful hunters even in the habitats with dense vegetation. It is a sedentary species, and seasonal migrations are registered at the distance of up to 50 km. The results of radio-telemetric research have shown that individuals hunt during the night in the radius which is not bigger than 4-6.4 km in relation to the shelter, as well as that they feed on several hunting territories during one night. What is very important are the linear regional elements such as the boundaries or hedges of forests, which connect the hunting territories of this species. The maximal age of individuals is 21. Like all the other species of horseshoe bats, the small horseshoe bat is found on the Annexes II and IV of the EU Habitats Directive. According to the IUCN Red list of endangered species, it is found in the category "least concern" (LC). The populations of these species were drastically reduced in the countries of the northern and western Europe in the seventies due to the use of pesticides in agriculture and forestry, the negative impact of which is still present as threatening factors, including the anthropogenic changes of the region and the fragmentation and loss of habitat.

In order to protect the species from further decrease in the number of population, it is necessary to protect all the known habitats from disturbances, sustainable managing of the regions within the areal of activity, good connectedness with the linear regional elements of the hunting territories, especially forests, as well as the prevention of fragmentation and further loss of important habitats.

THE BARBASTELLE - BARBASTELLA BARBASTELLUS (SCHREBER 1774)

The barbastelle is a bat of a middle-sized body, and dense, dark brown fur. The hair tops on the back are of white color. The flying membranes and the skin on the face and extremities are of dark, black-brown color. Wide ears are joined at the base on the front side of the head. They are the only representative of this species in Europe, being incident all the way to England and Sweden on the north. The species is closely tied to forest habitats in which the shelters and the main hunting territories are found. During flight, they use the tree bark as the shelter, while

RHINOLOPHUS HIPPOSIDEROS

inhabiting caves, tunnels, cracks in the rocks and old buildings in the winter time. The colony consists of usually 10-20 females in the trees during the summer, while they can form much bigger colonies in other types of shelters during the winter, frequently with the representatives of other species of bats. They reach sexual maturity in the first year of life. The young are completely independent when they are six weeks old. They are very skilful flyers in the vicinity of vegetation. The representatives of this species live up to the registered 22 years of age. It does not migrate to larger distances, mainly up to 40 km. The hunting territories are found in the radius of up to 4-5 km distance from the shelter, using up to several hunting territories for a single night. The species is found on the Annexes II and IV of the EU Habitats Directive, and according to the IUCN Red list of endangered species it has been classified as "nearly threatened" (NT). The main factors of threat are presented in the form of the use of pesticides in agriculture and forestry, cutting and removing of old and dead trees, fragmentation and loss of forest habitats.

Barbastella barbastellus

THE COMMON BENT-WING BAT - MINIOPTERUS SCHREIBERSII (KUHL 1817)

The common bent-wing bat is a bat of a middle-sized body, short and widely spread ears that do not exceed the length of fur on the head. This species has long wings, the tops of which are folded towards the inner side of the body when resting. The fur on the back is brown-gray to dark gray color, while the belly is of somewhat lighter color. The species is widely distributed in the Mediterranean region, and the northern boundary of the areal reaches to the central France and Ukraine.

It prefers forest habitats as the hunting territories, even though it uses a wide spectrum of the same. Family colonies have been registered at the altitude of above 1 200 m, and some groups of individuals have been found even at higher altitudes. The shelters have been registered mainly in caves, but also in abandoned mines, cellars and other underground shelters. Family colonies comprise up to several thousand individuals. Very numerous family colonies have been registered in Portugal, up to 20 000 individuals, and in Bulgaria they have been recorded in even greater number. The colonies are of high density (the individuals are found in immediate contact) and are formed during the summer and winter. The females are sexually mature in the second year of life. The maximal age of individuals is registered as 16 years of age. They undertake seasonal migration at the distance of 40 to 100 km between shelters on average; however, migrations of individuals even over 800 km have been registered in France and Spain. The species is found on Annexes II and IV of the EU Habitats Directive, and on the IUCN Red list of endangered species it is classified as "nearly threatened" (NT). The populations of this species across Europe are endangered by the loss and fragmentation of habitats, the use of pesticides, disturbance and direct loss of habitat.

THE IMPACT OF THE CONSTRUCTION OF HYDRO POWER PLANTS ON BATS

Due to objective limitations, the presented results of the research are not sufficient in order to assess the negative impact of the construction of hydro power plants on the bats of the researched area, but they can serve as good basis for further research in order to accommodate for such a need.

In order to obtain a precise evaluation of the impact of the project for the construction of hydro power plant on the fauna of the bats of researched region, it is necessary to conduct a detailed monitoring of the activity, seasonal dynamics and the fauna of the bats of the research that is defined as being under the direct or indirect influence of the project. It is of particular importance to identify the shelters, the territories on which the bats feed, as well as the flying corridors. At the same time, it is necessary to possess concrete information about technical-technological aspects of the projects for the construction of hydro power plants. It is necessary to make the field research at least one year long, in order to include all the phases of the life cycle of species that inhabit the region on which one can expect a certain impact of the hydro power plants.

Generally speaking, the activities that accompany the realization of the projects of the construction of hydro power plants can have a negative impact and consequences on the survival of bats. These consequences include the following: changes in the hydrological regime, microclimate, changes in the composition of the fauna of the insects that the bats feed on, destruction of the wooden vegetation and linear regional elements, removal of vegetation from the banks and the like. If it were determined through a detailed analysis that the stated negative consequences significantly influence the existing habitats, the nutritional areas or flying corridors, the realization of the construction of the hydro power plant should not be allowed.

Miniopterus schreibersii

ANALYSIS OF A BAT INDIVIDUAL

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SMALL MAMMALS

DEJAN RADOŠEVIĆ

As part of the research into the small mammals, which was conducted on the region of influence of the planned small hydro power plants on the rivers Sutjeska and Hrčavka, two ranks were processed (insect eaters and rodents) within the scope of the National park Sutjeska.

RODENTS

Rodents got their name from the Latin word "rodere" which means to mill. They belong to the rank of animals that stand out by their front teeth, incisors and the type of food they eat – they are all plant eaters, except for some types of rats that eat everything.
Rodents are otherwise the largest rank among the mammals, with a huge number of genera including mice, rats, guinea pigs, beavers, chinchilla, coypu and others, and the group counts 2 270 species, which makes up for 42% of all the mammal species.

The majorities of rodents are night animals, or are active at dawn, but they can, of course, be met during the day too. They live in all living conditions, from desert regions of Africa and Australia, to the tropical forests of Amazonia. Rodents live underground, on earth, or even in the high treetops which, for example, are home to the squirrel.

Rodents receive a lot of information from the surrounding via sharp sense of smell and hearing, as well as over long dense moustache which are sensitive to touch. The night species have larger eyes than those that are active during the day, so that the amount of light that falls on the iris and creates a brighter and clearer picture is increased. Rodents communicate by smell that they release from the glands on the body, as well as using various sounds.

The nutrition of many rodents is based on plant food, such as leaves, fruits, seeds and roots. However, some species have a different type of nutrition, for example, the forest mouse eats snails. In the large appendix rodents have bacteria that disintegrate celluloses, which is the main ingredient of the plant cell walls, into digestible carbon hydrates. That is how they receive more energy from the food. The high speed of multiplication enables rodents to maintain stability of populations in unfavorable conditions. That means that the birds of prey and some human activities, such as poisoning, do not have a significant impact on the species survival. In favorable conditions, the number of animals largely and rapidly increases. Some species of voles can have more than 13 breeds per year. Small species of rodents have bigger broods than the larger species, and therefore become the prey of many birds of prey.

INCIDENCE IN BOSNIA AND HERZEGOVINA

The rank of rodents in Bosnia and Herzegovina in Bosnia and Herzegovina is incident with five families and 29 species. Within the family of mice (*Muridae*) the species known as "mouse-like" rodents are incident. One of the representatives is the endemic-relict Balkan Snow Vole (*Dinaromys bogdanovi*). In the biome spectrum, the representatives of the South Europe, mainly deciduous forests and sub-Mediterranean, mainly deciduous forests and shrubberies, are dominant. In the rodent fauna, two species of water habitats are present, and these are the European water vole (*Arvicola terrestris*) and the common muskrat (*Ondatra zibethica*), as well as four synanthropic species (those that live in houses, flats): the black rat (*Rattus rattus*), the brown rat (*Rattus norvegicus*) and the common mouse (*Mus domesticus* and *Mus musculus*). In the sub-family *Arvicolinae*, the majority of representatives belong to the category of hemisynanthropic species, given that they mainly occur in agrobiocenoses or other types of anthropogenic habitats. Ecological preferences are dominantly tied to the open type of habitat, with an equal preference in relation to the moisture of such habitats and a pronounced preference for the land medium. Within closed habitats, the preference for moist or dry, as well as the land and solid media is equally distributed.

THREATENING FACTORS AND MEASURES OF PROTECTION

The basis for the protection of rodents is their ecological status in agrobiocenosis, where they occur as consumers of the plant mass (underground organs, weed parts and grains) and where measures of suppression (poisoning and trap hunting) are applied to them. They are sensitive to the application of chemical devices in agriculture, which they intake in large concentrations by consuming the plant mass. They are also sensitive to the degradation of the medium by means of which underground halls and lairs of the species tied to the land layer are destroyed, and so are they sensitive to disturbance. Even though rodents, above all "the mouse-like rodents", are species that have a high growth rate and that manage to maintain high numbers of their populations, there is the danger of being afflicted, when in low numbers, by negative phenomena and processes and of disappearing from a certain region, due to expressed oscillations in numbers. Changes of the structure of forest habitats and disturbance of animals in the course of exploitation and execution of construction works also eliminate the predators of "mouse-like rodents, which are an extremely important regulator of their numbers. Integral measures of the protection of forests, land and the legal regulations of using the chemical devices are one of the measures for their protection.

INSECT-EATERS

Insect-eaters are small mammals that are mainly active during the night. Their anatomy differs from species to species and depends on their lifestyle, while the common features of all insect-eaters are small eyes, small ears and pronounced muzzle. Some species, such as hedgehog, live on the land, while others, such as moles, are adapted to digging underground halls, and there are also species like the water shrewmouse that live both on land and in water.

They mainly feed on invertebrates, such as insects, spiders and worms. However, some species feed on other species of animals and parts of different species of plants. For instance, water shrew mice eat small fish, frogs and crawfish. Even though they have small ears and very small eyes, insect-eaters easily find prey by means of a sharp sense of smell. For example, moles have a muzzle covered in numerous sensory hairs, very sensitive to touch and by means of it they can recognize various smells. On the other hand, hedgehogs mainly rely on the sense of hearing. There are indications that some species of shrews have the capacity of echolocation, as is the case with bats, and that they register obstacles and prey in that manner.

Generally speaking, individuals stay alone during the whole year, except in the period of mating season and upbringing the young. Depending on the species, insect-eaters can have young once a year with more hatchlings or more times a year, realizing offspring with a fewer number of individuals that way.

A very interesting phenomenon is that the female specimens of some species of shrews take the young in the so-called caravan with the young that hold the top of the mother's tail in their teeth; in such a manner up to seven individuals can move.

INCIDENCE IN BOSNIA AND HERZEGOVINA

In Bosnia and Herzegovina, the rank is present with three families and 11 species. There are no endemic or relict representatives at the level of the species. Two representatives are tied to the water type of habitat, and namely the Eurasian water shrew (*Neomys fodiens*) and Southern Water Shrew (*Neomys anomalus*). The alpine shrew (*Sorex alpinus*) is the representative of high mountain habitats. The Ecological preference of the habitat is towards denser habitat structures, except for the European mole (*Talpa europea*) and the blind mole (*Talpa caeca*) that appear in open habitats.

They equally prefer moist and dry habitats.

THREATENING FACTORS AND MEASURES OF PROTECTION

The basis for the protection is their trophic status as carnivorous animals of the first rank, their importance as the regulators of the populations of insects in the complex of pedofauna, as well as in the processes of circulation of organic substances in land and pedogenesis. The principal threatening factors of their survival are measures of chemicalization in agriculture (pesticides), change of the structure of habitat as a consequence of water regime changes, as well as the change of the structure of the medium and the earth level of forests and ecotone. As animals with extremely rapid metabolism, insect-eaters almost immediately react to changes in the composition of the pedofauna they feed on.

RESULTS OF THE RESEARCH OF THE SMALL MAMMALS FAUNA IN THE REGION OF THE IMPACT OF THE PLANNED SMALL HYDRO POWER PLANTS ON THE RIVERS SUTJESKA AND HRČAVKA

In the course of the research, 20 individuals, 18 of which have been determined to the level of species, and two to the level of genus, were registered. A total of 11 species was recorded. When it comes to the species that are exclusively tied to water, above all by their manner of life and the construction of nest, the Eurasian water shrew (*Nemys sp.*) was registered. Bushes and dense waterside vegetation are inhabited by the shrews, bicolored shrew (*Crocidura leucodon*) and the common shrew (*Sorex araneus*). Likewise, on that type of habitat the white-breasted hedgehog (*Erinaceus concolor*) and the wood mouse (*Apodemus sylvaticus*) were registered.

In deciduous forests and old orchards two species of dormouse were recorded: the fat dormouse (*Glis glis*) and the forest dormouse (*Dryomys nitedula*), as well as the squirrel (*Sciurus vulgaris*). On the grass habitats the moles (*Talpa caeca* and *Talpa europaea*) were recorded, while in the vicinity of the inhabited part an alochtonous species was found, namely the rat (*Rattus rattus*).

TABLE I LIST OF REGISTERED SPECIES IN THE AREA OF RESEARCH

Taxon	Common name	Red list of Republic of Srpska
Sorex sp.	-	Sorex alpinus is on the list
Neomys sp.	The Eurasian water shrew	Neomys fodiens and N.anomalus are on the list
Crocidura leucodon (Hermann, 1780)	Bicoloured shrew	+
Talpa caeca Savi, 1822	Blind more	+
Apodemus sylvaticus (Linnaeus, 1758)	The wood mouse	+
Glis glis (Linnaeus, 1766)	The fat dormouse	+
Dryomys nitedula (Pallas, 1778)	The Forest dormouse	+

TABLE 2 PREVIOUSLY REGISTERED SPECIES OF SMALL MAMMALS IN THE NATIONAL PARK

Species	Location	Author	Year of collection	Red list of Republic of Srpska
Sorex minutus Linnaeus, 1766	Zelengora – Orlovačko jezero	Petrov (1992)	1984	+
Sorex alpinus Schinz	Perućica	Petrov (1992)	/	+
Talpa caeca *Savi,* 1822	Čemerno	Todorović (1965)	/	+
Dinaromys bogdanovi (Martino, 1922)	Zelengora – Orlovačko jezero, Orlovac	Petrov (1992)	1984	+
Dinaromys bogdanovi (Martino, 1922)	Maglić - Prijevor 1750 mnv	Petrov (1979)	/	+
Chionomys nivalis (Martins, 1842)	Maglić	Petrov (1992)	1970	+
Apodemus flavicollis (Melchior, 1834)	Zelengora - Orlovac	Petrov (1992)	1984	-
Apodemus flavicollis (Melchior, 1834)	Maglić - 1550 mnv	Petrov (1992)	1970	-
Apodemus sylvaticus (Linnaeus, 1758)	Zelengora - Orlovac	Petrov (1992)	1984	+
Dryomys nitedula (Pallas, 1778)	Maglić	Kryštufek (1985)	/	+
Dryomys nitedula (Pallas, 1778)	Zelengora	Kryštufek (1985)	/	+

THE SPECIES OF THE RESEARCHED REGION

THE BALKAN SNOW VOLE - DINAROMYS BOGDANOVI

The Balkan Snow vole - *Dinaromys bogdanovi* (Martino, 1922) was discovered in 1922 and was described as a member of the genus *Chionomys* (snow voles); in 1926 it was transferred to the genus *Dolomys*, and then in 1955 it was classified into a new, separate genus *Dinaromys*. On the grounds of morphology eight sub-species have been described: *D. b. bogdanovi*, *D. b. coeruleus*, *D. b. grebenscikovi*, *D. b. korabensis*, *D. b. longipedis*, *D. b. marakovici*, *D. b. preniensis* and *D. b. trebevicensis*. On the basis of the differences in the morphology of the first lower molars, the sub-species can be divided in two groups whose main representatives are *D. b. bogdanovi* and *D. b. grebenscik*

Dinaromys bogdanovi

ovi. Three main lines were established by the analysis of the gene of cytochrome b of mitochondrial DNA, and namely the following ones: northwestern line to the north of the river Neretva, the central line between the rivers Neretva and Drim and the southern line to the south of the river Drim. The Balkan snow vole is in the category "vulnerable species" (VU), according to the classification of the International Union for the Protection of Nature (IUCN).

The biology of the species is relatively unknown due to specific choice of habitats and low density. It is a specialist in choosing the habitat, is tied to the wreck and appears on the accumulations of stone blocks, cracks in rocks, caves, faults and ditches. The reproduction of the female specimens starts in the second year of life. The sizes of broods, established on the number of embryo and scars, vary between one and three in the second year of life, and between two and four in the third and fourth year of life. The reproductive period of the Balkan snow vole is not continuous. This species is the Balkan endemic-relict species. The areal of the species crosses the territories of Croatia, Bosnia and Herzegovina, Kosovo, Montenegro, western Macedonia, Albany and part of the Northern Greece. It is tied to the Karst habitat type, independently of the altitude. It has been found at the altitudes from 10 all the way up to 2 200 meters, but 70% of findings has been recorded below the altitude of 1 400 m.

It was not registered during the research in the region of the National park Sutjeska, but it was recorded in earlier research on Zelengora in the vicinity of Orlovačko lake and on Prijevor.

VODENA ROVČICA - THE EURASIAN WATER SHREW

The Eurasian water shrew - *Neomys fodiens* (Pennant, 1771) is classified among the bigger species of the European water shrews, the total length of 12 cm. A dense and soft fur is black on the upper part of the body, and grayish-white or whitish on the belly. The hair is dense in order to protect the skin from water. Apart from the Eurasian water shrew, the Miller's water shrew - *Neomys anomalus Cabrera*, 1907, which is similar in its morphological characteristics to the Eurasian water shrew, also occurs in Bosnia and Herzegovina.

It prefers life in the mountain region waters and more precisely regions with living springs where the water does not freeze. Its most frequent habitats are brooks in the mountain, forest areas with clean water and sandy or gravelly bottom. In the loose soil next to the water, the Eurasian water shrews dig hallways, but also use the mouse hallways and mole holes in the vicinity of its habitat. The dwellings have several exits, out of which one goes out to water, and the others lead above the water surface onto the land or end deeply in the soil. It is an excellent swimmer and diver. This species multiplies in April or May. During the mating they make intermittent hissing sounds, and that is the time when more individuals make this sound, making it a real boom. It mainly feeds on water

Neomys fodiens

insects, worms, small mollusks, and it can also attack and feed on amphibians, small fish, birds and mammals.

The Eurasian water shrew is present in almost all Europe and one part of Asia. The northern boundary of distribution is England and the Baltic countries, while the southern boundary is in Spain and Italy. In the Republic of Srpska there are findings from the region of Mrkonjić Grad, Jahorina, Vlasenica, Foča, Gacko and Čemerno.

THE BLIND MOLE - TALPA CAECA

The blind mole - *Talpa caeca Savi*, 1822 – taxonomic studies from the end of the sixties and the beginning of the seventies, about the moles inhabiting the Balkan peninsula resulted in the recognition of three taxons: *Talpa europaea, T. caeca* and *T. romana stankovici*.

It inhabits the regions of deciduous forests, meadows and pastures of the hilly and mountain regions. This species requires deeper soils that are not too dry, which explains the sporadic distribution of the species in the Karst regions. The research conducted on the Balkan Peninsula shows the tendency of a competitive suppression of the blind mole to the marginal habitats by the common mole *T. europaea*. A similar case is in Italy where it has been suppressed by the species *T. romana*, on the regions where those two species are found as sympatric. It leads an exclusively underground manner of life, digging underground hallways and throwing out bunches of earth onto the surface. It has a well developed sense of smell, hearing, touch, while the sight is not good. It mainly feeds on worms, larvae of beetles, snails and centipede. The female digs the chamber for the nest in which it gives birth to three or four young.

The species is distributed in the southern parts of French Alps, Italy, Switzerland, Apennines, the mountain region of the Western Balkans, between the river Neretva and the mountain Olimp. The findings of the blind mole below the altitude of 100 meters are rare (18% of all the findings). Apart from the findings in the catchment of the National park Sutjeska, in the Republic of Srpska, there are findings from the region of Gacko, Čemerno, on Lebršnik and Magrop.

Talpa caeca

THE POTENTIAL IMPACT OF THE CONSTRUCTION AND WORK OF THE SMALL HYDRO POWER PLANTS ON THE SMALL MAMMALS FAUNA

Changes in the habitat caused by the construction and work of the small hydro power plants can cause the destruction of the nest, food and habitats of the small mammals, which are an important link in the food chain. When small mammals, afflicted by direct or indirect impacts of the hydro power plant, leave their habitats due to degradation, they are more exposed to predators and it is possible that they may not be able to adjust to new microclimate conditions and start their own chain reaction in the new habitat to which they moved. In that manner they become endangered. The truth is, some species are more adaptable to changes than others; however, there is no doubt that the construction and work of the hydro power plant has a significant negative impact on their habitats.

This impact is reflected through the following phenomena and processes:

- Direct degradation of the habitat due to cutting-in of new roads and the construction of pipelines, water catchments and machine building
- change of water regime
- changes in pH and water temperature
- changes in the physical conditions of the habitat
- changes in the intensity of the erosion processes
- noise pollution

Dramatic changes in the water levels caused by the work of the hydro power plant degrade the banks, destroy the habitats of aquatic organisms, and organisms closely tied to the bank. The direct impact mostly afflicts the species of shrew, which is closely tied to the river and its coast.

The species is well adapted to diving and searches for food mainly underwater. Every unnatural fluctuation of water or a permanent reduction of the flow can lead to the decrease in the number of prey this species feeds on and to the destruction of its nests.

The other species are endangered indirectly, via the impact on their prey (different plant species and invertebrates that participate in the nutrition). Given that the practice is such that no monitoring is conducted for the biological minimum on the constructed hydro power plants in BiH, and that it is often not even respected, the negative consequences are frequently more pronounced. The very concept of the biological minimum is not defined, so that speculations about it are possible. As a rule, it implies the amount of water that enables protection and the sustainable development of the water course's living world, even though the idea of percentile unit measure for water that should be used for the needs of the hydro power plants in a given period is intertwined with it, which is certainly wrong and would enable numerous abuses. For the purpose of determining the biological minimum it is necessary to firstly establish the starting "zero" state, which implies the engagement of specialist experts.

This is particularly important for the facilities that are in the areas protected by the law, as is the case with the National Park Sutjeska. Therefore, it is not sufficient to determine *ad hoc* the minimal amount of water in the water flow as the biological minimum, given that this depends of the biodiversity of a certain watercourse.

Likewise, it is important to point out that according to Petrov (1992), the most endangered species among the representatives of the rank of insect-eaters, and taking into consideration only those species that we recorded during the research in the period from 25 June to 2 July,

are *Talpa caeca*, *Erinaceus concolor* and *Neomys sp*. First and foremost we have the *Talpa caeca*, because the areal of this species is not huge and given that it does not have a numerous population on almost all the places where it lives. On certain places it is a real rarity. For the species *Neomys fodiens* Petrov maintains that it is endangered due to a widely spread pollution of the fresh waters and running waters. Today we can add another factor to the threat factors, and that is the change of water regime for energetic purposes. When it comes to the species from the rank of rodents, taking into consideration only those species we recorded on the researched area, Petrov finds the species *Dryomys nitedula* to be the most endangered one.

Neomys fodiens

NEOMYS FODIENS

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LARGE CARNIVORES

SLAVEN RELJIĆ, ĐURO HUBER & JOSIP KUSAK

PARTICULARY INTER-ESTING SPECIES

THE BROWN BEAR (URSUS ARCTOS)

The brown bear is a mammal from the rank of large carnivores (Carnivora), the family of bears (Ursidae), genus of bear (Ursus) and species of brown bear (*Ursus arctos*). The brown bear that lives in Bosnia and Herzegovina is part of a bigger Dinaric-Pindos population that is distributed on the territory of Dinaric and Pindos Mountains, from Slovenia to Greece and counts about 3 070 individuals in total. The population of the brown bear in Bosnia and Herzegovina is estimated differently. In the report for the European Union from 2012, the number is estimated at 555 individuals, and depending on the authors it ranges from 400 to 12 000 individuals. The brown bear is recorded on the northwestern, western, central and eastern mountain regions of Bosnia and Herzegovina. The locations on which this species lives are Plješevica, Šipovo, Koprivnica, Maglić, Perućica, Igman, Bjelašnica, Romanija, Vlašić, Ivan Sedlo, Prenj, Čvrsnica, Čabulja, Raduša, Vukovsko polje, Prijevor, Snježnica, Nevesinje, Lipovac and other.

Bears are the biggest land carnivores. In Croatia, for example, the female specimens weigh 120 kg on average, and the male ones 210 kg, though sometimes some bears weigh more than 300 kg. During the year, the mass of the same adult individual can vary by more than a third: it is the biggest in late autumn before denning, and it is the smallest at the beginning of the summer, that is, the end of the mating season. The teeth have all the characteristics of carnivores, with characteristic incisors, fangs and carnassials. The tooth formula is I 3/3, C 1/1, P 4/4, M 2/3, that is, it has 42 teeth in total. The digestive tract is short and simple like in other carnivores, with a simple belly, and long thin intestine, small appendix and short colon. The bear's excretion takes on very different forms, consistency and color, depending on the food consumed.

Beech fruit. The most important bear food in the autumn period for the creation of fat reserves prior to denning.

A sign of bear presence in the habitat. Nutrition consisting of various kinds of herb in the summer.

However, the size and most often aromatic smell easily distinguish it from the excretion of other animals. Due to short and simple digestive tract, a large part of the eaten plant mass goes through the whole tract poorly processed or not processed at all.

Even though their body structure makes them real carnivores, bears satisfy about 95% of their nutritive needs by plant food. When it comes to plant food, the most important species during the spring are the following: ramsons (*Allium ursinum L.*) and the wild arum (*Arum maculatum L.*), the poaceae (*Graminae sp.*), clover (*Trifolium sp.*) and dock (*Rumex sp.*); during the summer it most often feeds on wild angelica (*Angelica silvestris L.*), early spring wild

Ursos arctos

food (*Aposeris foetida L.*) and strawberry fruit (*Fragaria sp.*), raspberry fruit (*Rubus idaeus L.*), blackberries (*R. fructicosus L.*), buckthorn (*Rhamuns catharitica L.*) and blueberries (*Vaccinium myrtillus L.*). In winter, certainly the most important food is the beech fruit (*Fagus syilvatica L.*) as the main food for collecting winter reserves of the sub-skin fat, but it also feeds on the European crab apple (*Malus sylvestris Mill.*) and the European pear (*Pyrus communis L.*).

Likewise, it likes to feed on the fruits of hazel (*Corylus avellana L.*), fruits of Rowan (*Sorbus aucuparia L.*), sweet chestnut (*Castanea sativa Mill.*), European cornel (*Cornus mas L.*) and various kinds of oak nut (*Quercus sp.*). In the fields it feeds on all species of cereal crops, and particularly on oats and corn, especially when the fruit is milky. It visits orchards and vineyards where it eats plums, apples, pears, peaches, cherries, grapes and other fruits. It also likes to eat the larvae of bees and honey, so he breaks into the beehives. In this manner it causes damage in agriculture. When it comes to animal food, it most often feeds on the carcasses he finds in the woods. Moreover, it feeds on invertebrates, especially the larvae of ants and other insects, as well as other offspring of wild animals. Speaking about home animals, it most often attacks sheep, sometimes cows, donkeys and horses. In terms of wild animals, it feeds only on very young, and wounded and sick animals it can catch.

The ingredients of huge-seed leaved trees (beech, chestnut, oak) play the crucial role in satisfying the bear's life needs.

The bear spends the winter in the den, without eating or drinking anything. The majority of dens in our regions are found in smaller rock cracks. Only about 10% of dens are found among the huge tree root tendons, and the same percentage is found in the open, that is, under the treetops of coniferous trees.

Bears mate in the period from April to mid-July. The male specimens then cross large distances, fight each other if they find themselves next to the one and the same female specimen, and each makes efforts to impregnate more females. The same is true of the female bear, which can mate with many male specimens in a single season, so that it is possible for all the young from a single brood not to have come from the same father. Embryo in the womb has a deferred implantation, so that the greatest part of its development takes place in the last three months of pregnancy, which lasts about seven months in total. Little baby bears are born in the den at the end of January. One to four younglings are born (on average 2,39) with the mass of around 350 g. They are born blind and with no hair. They largely depend on the she-bear's milk that contains about 22% of the fat and 12% of proteins, and in this respect it is only comparable in the animal world with the seal's milk. Little bears spend the whole first year of life with their mother and the next winter in the den, and they separate at the age of about 1,5 years, when the mother mates again. Our bears reach their sexual maturity at the age of three to four years. In nature they can live from 10 to 20 years, whereas in imprisonment they can live over 30 years.

In order for the habitats to satisfy the animal needs of the bear, they have to consist of different types of forests, the main role being played by the ingredients of the huge seed broadleaved trees (beech, chestnut, oak). The existence of thickets and meadows is also necessary for the purpose of shelter and pasture. Peace in the habitat is particularly

crucial in the winter due to newborn little bears in the den. It is estimated that during its life the bear uses the area of about 250 km^2 (25 000 hectares) during its life in the habitats of Croatia.

STATUS OF THREAT

According to the IUCN Red list of endangered species the brown beat is marked as LC (Least Concern) category of threat. Generally speaking, the world populations of the brown bear are huge and are not significantly endangered with the exception of certain isolated populations. It is found in the Appendix I (for the Central Asia), Appendix II of the CITES Convention, Annex II of the Bern Convention and Annexes II and IV of EU Habitats Directive. It has been listed in the Regulation on the Red list of the protected species of the Republic of Srpska. The brown bear is a species protected by close season, according to the laws on hunting of the Federation of Bosnia and Herzegovina and the Republic of Srpska.

Given the mentioned number of the populations, it is considered that the brown bear is not an endangered species in Bosnia and Herzegovina.

THE GRAY WOLF (CANIS LUPUS)

The gray wolf (Canis lupus) is a mammal from the rank of carnivores (Carnivora), the family of dogs (Canidae). Besides the species *gray wolf*, two more free-living species of wolves are known: Red wolf (*C. rufus*) and Ethiopian wolf (*C. simensis*). All today's dog breeds have been created by domesticating the wolf in the process that was started around 100 000 years ago, but it has to be said that there were occasional cross-breedings with the wolf later too. Thus today we consider the dog (*C. lupus familiaris*) and the wolf one and the same species. Canis also includes the coyote and two species of jackal. The gray wolf occupies the ecological niche of large mammal predators of the northern hemisphere and historically it inhabited all the habitats of the northern hemisphere (from about 20° of the northern latitude up to the polar cap), in which huge even-toed arciodactyls lived. The gray wolf in Bosnia and Herzegovina belongs to the large Dinaric-Balkan population with the estimated number of 3 900 individuals in total. On the territory of Bosnia and Herzegovina the wolf is widely spread species recorded from the Karst landscapes to the mountain regions. The number is estimated to about 650 wolves.

The gray wolf is the largest member of the family of dogs. The largest wolves live on the north (average mass = 41 kg – Alaska, North West Territory in Canada), while the representatives of the southern populations (India, Pakistan, Afghanistan) are twice as small. The average mass of an adult wolf from the region of Croatia is 31 kg. From the nose top to the tail top they are on average 170 cm long (tail = 42 cm), and the average height in 70 cm. The color of the fur depends on the partake of black, gray and brown top coat. In the region the fur is gray, and the back and tail are somewhat darker in color, which fades into a lighter gray towards the belly and legs. On the front side, the forearms most often have a dark stripe, although specimens without it have also been found.

The wolf's body construction is adapted to running, and particularly to long-term trot. The chest is narrow, and the elbows are indented toward inside, while the paws are turned outwards. This makes it possible for the front and back leg to move in the same line. It has four fingers on the back, and five on the front feet, whereby it does not rest on the first finger of the front leg (the thumb, the inner side of the leg). The footprint of the front paw is 11-12 cm long and 7-8 cm wide. On the basis of only one paw footprint it cannot be determined whether it was made by a wolf or a dog of the same size.

If the circumstances allow (snow), the trace should be followed long enough so that by the behavior (almost straight-line movement without many turnings, stopping) and other signs (marking the territory by excretion, urine, scraping or the findings of the prey remains) it can be determined more reliably whether it was a wolf or a dog that passed there. The presence of wolves can be concluded on the basis of their howling, which has multiple purposes. By howling wolves inform other wolves of their presence and so defend the territory of the caught prey.

CANIS LUPUS

The wolf feeds exclusively on meat, bones and other parts of the bodies of animals it is hunting. Its massive jaws provide the basis to which strong chewing muscles are fixed, as well as 42 specialized teeth. The tooth formula is I3/3, C1/1, P4/4, M2/3.

In order to hunt huge prey, predators either have to be almost as big as the prey (the examples are carnivores from the family of cats), or, if they are smaller, they have to hunt in groups (wolves, African wild dogs), which is the reason of their evolutionary success. Besides being able to catch a bigger prey, due to hunting in groups, they can immediately eat it, that is, use it completely. The group in which they live is called a pack. The core of the pack is comprised of a reproductive pair of wolves, while all the other members of the pack, baby wolves and their older brothers, are the offspring of that parent couple. In order to conduct all this successfully, there is a relatively complex social structure in the pack. The wolf pack is hierarchically structured: the parent couple has the dominant position, while the other members of the pack build among themselves the relationships of superiority and subordination, by male and female line. Thus only one she-wolf can have the younglings, which is one of the mechanisms of self-regulation of the size of the population of that excellent predator. At the same time, mating within kinship is prevented. The impossibility of mating and the lack of food force the subordinated wolves to leave the parent pack and their territory. This most often happens in the second and third year of life of young wolves and is called dispersion.

Wolves are expressly territorial, in the sense that they mark the region in which they live by using urine, excretion, and scrapings on the ground and howling. By defending their life space from other wolves, they ensure their prey. The size of the territory of the wolf pack in the southern part of Croatia is about 150 km^2.

If a foreign wolf enters into the pack's territory, and if it is discovered, it will almost certainly be killed, and maybe even eaten. Thus even 65% to 70% percent of the wolves' deaths in the populations that are not eroded by human action are caused by other wolves. This is another mecha-

Canis lupus

nism of the self-regulation of the wolf population.

The she-wolf feels the need to mate once a year, in the period from the end of January to the end of April – later in the more northern regions, sooner in the southern parts. This oestrus lasts three weeks, and the very mating happens in the third week. Pregnancy lasts 63 days, and baby wolves are born in the lair that the she-wolf had dug earlier. If the lair is not upset, the wolves use it for several years in a row. In the brood there are most often 4-7 younglings, which are blind and deaf in the first 11 to 15 days of life. They suckle until the age of six to eight months, and in the meantime they gradually move on the food brought to them by all the other members of the pack. The spot on which the little wolves live during the period of growing up and to which the adult wolves from the pack come back every day is called the gathering point. Already by the time of the first winter, the little wolves grow up to the size of the adult wolf and then they start travelling with the pack. They reach their sexual maturity at the age of 22 months, after which they can even leave their pack. Wolves can live in every habitat in which there is enough prey and that secures them shelter. Thus for example, the domestic animals (sheep, goat, and less often large cattle and dogs) have an incidence of 84% in the wolf's nutrition in the region of Dalmatia, in contrast to the Gorski kotar, where the wild ungulates (roe deer, deer, and to a lesser extent wild boar) make 77% of the wolf's main prey. It has long been known that wolves in hunt choose the prey that is easier to catch at the given

moment, which changes during the year. Thus in the ecosystem where there are more kinds of prey, they will more often hunt those species which are larger in number and hence more easily accessible, and even then they will select those animals that are weaker due to age, illness, starvation or are younglings.

This is how wolves have a positive impact on the health of the prey's population, and contribute to the stability of the whole ecosystem.

STATUS OF THREAT

According to the IUCN Red list of endangered species the gray wolf has been marked as LC (Least Concern) category of threat. Generally speaking, the world's populations of wolves are stabile, but in certain countries of the western Europe, Mexico and the United States of America its number is extremely low or it has even disappeared. It is found on the Appendix II of the CITES Convention (except for the populations in Bhutan, India, Nepal and Pakistan, which are in Appendix I), Annex II of the Bern Convention and Annexes II and IV of the EU Habitats Directive.

It has not been stated in the Regulation on the Red list of the protected species of the Republic of Srpska. The wolf is a species protected by close season, according to the Law on Hunting of the Federation of Bosnia and Herzegovina, while in the Republic of Srpska it is not protected. Given the satisfactory number, the wolf is not considered an endangered species in Bosnia and Herzegovina.

THE EURASIAN LYNX (LYNX LYNX)

By systematization, cats (Felidae) are classified into the suborder of the catlike carnivores (Feloidea), and they belong to the species of carnivores (Carnivora). Four species of lynx that belong to the genus of Lynx are known in the world. Two species live on the region of the Nothern America, and namely the Canadian Lynx (*Lynx canadensis*) and the bobcat (*Lynx rufus*). Other two species live on the European continent, and those are the Iberian lynx (*Lynx pardinus*), from the region of Pyrenean peninsula and the Eurasian lynx (*Lynx lynx*). Within the nominal sub-species, the sub-species such as *L. lynx balcanica* and *L. lynx carpathica* are mentioned. The lynx inhabits the hilly and mountain regions, gorges and poorly wooded and rocky habitats at the altitudes of 800 to 1 400 meters. It is mostly tied to the mixed woods. The most recent data indicates a small number of individuals recorded in the region of the mountains of the northwest, west and central Bosnia and Herzegovina on the locations: Loskun, Plješevica, Prometnica, Cincar, Kamenica, Crni Vrh, Staretina, Priluma, Vitorog, Vranica, Vlašić, Vran, Čvrsnica, Raduša, Čučkovine, Jaram-Kurkalj, Šator, Semešnica and Igman. It is estimated that about 70 individuals of the Eurasian lynx live in Bosnia and Herzegovina today.

The Eurasian lynx is bigger than the other species of lynx; the average mass of adult males is 21 kg (though it can reach the weight of 38 kg too), while the females are somewhat lighter, their average mass amounting to 18 kg. The body length is from 0,8 to 1,3 meters, while the short tail is 15 do 20 cm long and is covered in black hair on the top. The height at the level of shoulder amounts to 60 cm. The body is covered by thick reddish-gray fur on which there are more or less visible frets. On the top of spiky ears grows a wisp of black hairs the length of up to 4 cm. In their denture there are 28 teeth P3/3, I1/1, PM2/2, M1/1. On the front feet they have five, and on the back ones four toes with sharp claws they can pull in.

Lynx mate from the middle of February to the end of March, but mating can also start already in January and last even into part of the April. The females are sexually

LYNX LYNX

mature after 20 to 24 months of life, and males after 30 months, that is, after the third winter. Pregnancy lasts on average 73 days, that is, from 65 to 74. The size of the brood varies from 1 to 5 younglings, most often 2. The younglings weigh 250 to 360 grams at the moment of brooding. The gender ratio is 1:1. They start to see at the age of 7 to 17 days.

The younglings suckle up to 5 months, and start taking hard food when they are between 35 to 40 days of age. They get a completely permanent denture when they are approximately 8-10 months old. At the beginning of the next mating season they separate from their mother and leave her territory. If they lose their mother in the last months before the dissolution of the family group, the young lynx are incapable of surviving, the death rate is then big and it is the time when they often come close to human areas (settlements). The life cycle of the Eurasian lynx in nature amounts to 12 to 15 years, and in imprisonment even over 20 years.

Lynx lynx

Lynx is a territorial species. The size of the territory depends on the amount of prey and the density of the population and differs significantly in males and females. By using the method of telemetric tracking, in Switzerland they discovered that the territory of the males in the region of established population is from 71 to 209 km^2 big (on average, 159 km^2), and the one of females from 45 to 210 km^2 (on average 106 km^2). It is possible to find up to three territories of females on one territory of males.

The daily movement on average amounts from 3 to 30 km. Animals defend their territory more by marking by means of secretion of fragrant glands, urine and scraping than by direct conflict with neighbors. Sometimes they undertake long trips outside their territory. Lynx are the most active in the morning and evening hours, while they mostly rest during the day and night.

The main food for lynx are ungulates and bigger rodents. During the winter they more often hunt bigger prey, since it is then easier to catch. When they catch prey, as a rule of thumb, they return in the next 2 to 7 days to the prey until they have eaten it completely.

The data from Switzerland show that the incidence of a certain species of prey is as follows: 70% roe deer, 21% chamois, 6% foxes, 2% rabbits. In Croatia and Slovenia it can be concluded on the basis of researched samples that roe deer and deer make 80% of the lynx nutrition, which is by and large the only food of males, while the remaining 8 animal species eaten were found in the belly and excretion of female and immature specimens only.

Lynx eat 1,0 to 2,5 kg of meat per day. At the mass of the whole prey, this amounts to 3,3 kg a day, measured as an average reduction of the mass of carcass remaining after every night meal. A single family of lynx (mother with two younglings on average) needs up to 4,4, kg of prey per day.

What poses a more frequent problem for the lynx is that the prey it has caught gets eaten, partly or fully, by other carnivores (bear) or vultures. Given that it does not eat the whole prey at once, but returns to the remaining in the following days, lynx tries to protect it from the competitive species by digging it and hiding it in other ways (like taking it under the rocks). In a large number of cases this is not successful, as the competitors find the remaining via smell or coincidence. This is why the lynx is often forced to go hunting more often than it would be required by the amount of food it had obtained. We conclude that the competitor species represent a bigger problem in taking the prey than in the total reduction of the nutritive base. For the total nutritive base its greatest competitor is man, who influences the density of the population of these ungulates to the largest extent.

STATUS OF THREAT

According to the IUCN Red list of endangered species, the lynx has been marked as LC (Least Concern) category of threat. The world species of lynx are generally stable, except in certain countries where it is considered as a really endangered species. It is found on the Appendix II of the CITES Convention, Annex III of the Bern Convention and Annexes II and IV of the EU Habitats Directive.

Like the bear it has been listed in the Regulation on the Red list of protected species of the Republic of Srpska. Lynx is a permanently protected species according to the laws on hunting of the Federation of the Bosnia and Herzegovina and the Republic of Srpska. Given the markedly low numbers, lynx should be marked as critically endangered species (CR) in Bosnia and Herzegovina.

RESEARCH AND FINDINGS OF THE SIGNS OF PRESENCE IN THE NATIONAL PARK SUTJESKA

In the period from 25 June to 01 July 2015, in the region of the National park Sutjeska, in the canyons of the rivers Sutjeska and Hrčavka, an intensive research of the presence of large carnivores (bear, wolf and lynx), as well as their prey species and plant species that are part of their nutrition was conducted. The aim of this research was to confirm that is establish the presence of the stated species and to assess the potential impact of the construction of 5 SHPPs in the canyons of Sutjeska and Hrčavka on large carnivores.

During the stated period of seven days, the transects in the region of 74.5 km^2 (Picture 1) in total, that is, in the region of the canyons of both rivers and the surroundings were researched, and so was the region of the rainforest Perućica. Due to the size of the living regions used by the bear, wolf and lynx, the area covered by the research was much larger than the narrow band next to the watercourses.

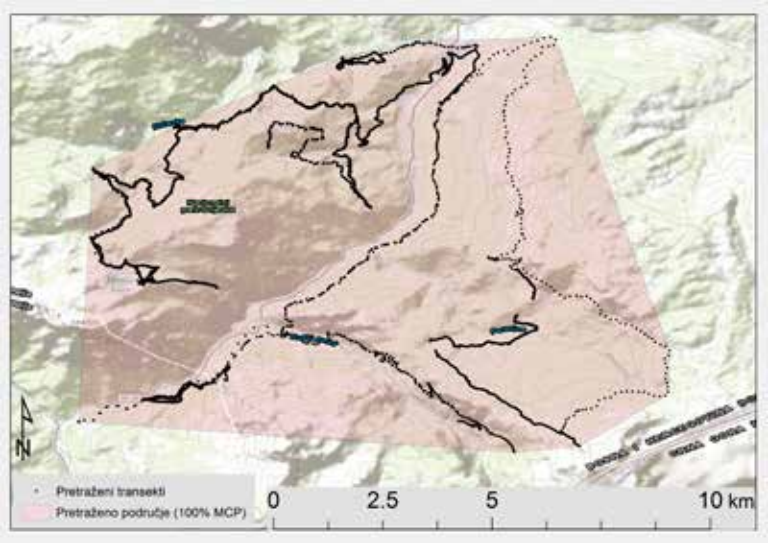
TABLE I

SUMMATIVE OVERVIEW OF THE FINDINGS OF SIGNS OF PRESENCE BY ANIMAL SPECIES IN THE CANYONS OF THE RIVERS SUTJESKA AND HRČAVKA IN THE PERIOD FROM 25.06. TO 01.07.2015.

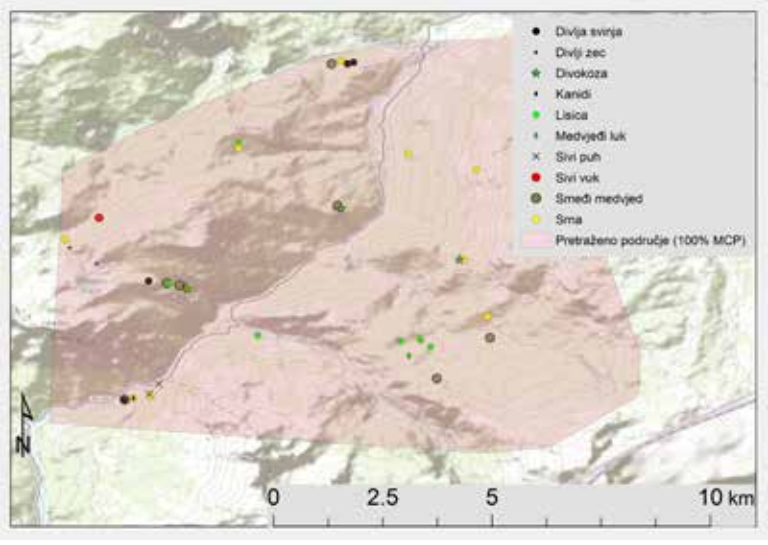
Species	Number of signs found
Chamois	13
Roe deer	12
Fox	11
Brown bear	8
Wild hog	7
Wild rabbit	2
Dormouse	2
Canids	2
Gray wolf	1
TOTAL	**58**

Ursos arctos

PICTURE 1 THE RESEARCHED REGION OF THE CANYON OF THE RIVERS SUTJESKA AND HRČAVKA WITH THE RESEARCHED TRANSECTS THE SIZE OF 74.5 KM², RESEARCHED AS 100% MCP POLIGON



PICTURE 2 RESEARCHED REGION WITH NOTICED SIGNS OF PRESENCE OF LARGE CARNIVORES (BEAR, WOLF), THEIR PREY SPECIES AND SOME PLANT SPECIES




CANIS LUPUS

PLANNED WORKS ON THE CONSTRUCTION OF SHPPS IN THE CANYONS OF THE RIVERS SUTJESKA AND HRČAVKA

For the purpose of construction of certain facilities of SHPPs on the rivers Sutjeska and Hrčavka, areas that will be utilized permanently in the course of the whole period of exploitation will be used, and so will those areas that will be used temporarily, only in the period of the construction of SHPPs. The bottom of the land in the river bed will be used permanently for the placement of the water catchment with tank sedimentation, then the bottom of the land in the river bed and waterside zone next to the river for the placement of pipelines that will be dug into the earth with partial concretion of the bank, the bottom of the areas next to the rivers for the plant (machine) building and the bottom of the land surface for access roads. The land next to the banks will be used temporarily for the purpose of disposing construction materials and the earth excavations until another filling up. Due to relatively small heights of the partitioning dams there would be no flooding of the land outside the present riverbed.

On the planned SHPPs Sutjeska 2a and 2b pipelines would be laid on along the right bank of the river Sutjeska (2b and the initial part of 2a); in the canyon Vratar the pipeline would be laid into the stony bank-establishment, and would cross onto the left bank below the existing bridge. In the last 262 meters it would be laid across the bottom of the tunnel, with the diameter of 4,5 meters. The pipeline dimensions would be the following: for 2a 2,4 meters, and for 2b 1,6 meters. The pipelines on Hrčavka 1, 2 and 3 would be laid across the whole length of the section of the old forest road, for the larger part next to the watercourse of the river, and partly across the section of the former railroad. On several places the pipeline would pass below the beds of several brooks. The pipe diameter would range from 0,7 to 1,4 meters. The total length of the pipeline for the river Sutjeska would amount about 7 093 meters, and the pipelines in all 3 SHPPs on the river Hrčavka would be of the total length of about 8 903 meters, which in total amounts to about 15 995 meters.

The plant buildings would occupy the space outside the riverbed up to about 450 m^2 each for Sutjeska, and about 150 m^2 by building for the river Hrčavka. The total area outside the beds of the rivers for the plant buildings would thereby amount to about 1350 m^2. Another 2,8 km of access roads would be built next to the canyon of Sutjeska and 3,7 km next to the canyon of Hrčavka, which in total would amount to 6,5 km of access roads.

(BAD) EXPERIENCES FROM PREVIOUS SIMILAR INTERVENTIONS IN BOSNIA AND HERZEGOVINA

In 2002, the SHPP "Divič" was constructed in the upper part of the course of the river Vrbanja. Due to special natural values this region was singled out as part of the hunting field intended for an intensive breeding of wild animals. It was primarily singled out due to protection and insurance of peace for brown bears that liked staying and actually did stay in the region all the time. Also known were the dens "winter homes" of this species. In the course of the construction of SHPP this region got devastated. The work of SHPP requires that the water from all springs and brooks be directed to the collective pipelines leading to the SHPP, which creates an unbearable noise and causes the disappearance of water in the watercourses. The movements of motor vehicles are frequent too. Due to the all stated above, the bears left that region forever and found their peace on the slopes of Vlašić. What used to be the best bear habitat in this region turned into a devastated region.

CONCLUSION

The National park Sutjeska (175 km^2) with the surrounding region represents a significant habitat for many animal and plant species. Of particular importance are mature forest contents, as well as the rainforest contents in the region of Perućica, and the permanent watercourses of the rivers Sutjeska and Hrčavka that ensure a permanent water source. The presence of many species has already been described by various authors, and this research confirmed the presence of two large carnivores (brown bear and gray wolf), their prey species and certain plant species that serve above all as food for bears.

Brown bear (Ursus arctos)

It is important to stress that part of the population of bears that live in the National park Sutjeska and the surrounding region belongs to the Dinaric-Pindos population that stretches from Slovenia on the northwest to Pindos hills in Greece on the southeast. On the territory of Albania and Montenegro, the corridor that makes the population complete is the longest. The National park Sutjeska with described plant and animal species represents a very important habitat and a really significant corridor in connecting the Dinaric-Pindos population, from the point of view of the quality of the habitat for the life of brown bear. When it comes to the plant and animal species, we will list only the most important ones that feature largely in the bear's nutrition. Speaking about the plant species, we should certainly emphasize the beech forests, whose fruit serves the bear as the source of energy for creating reserves of fat before the winter dream. There are also buckrams, blackberries and other berries. When it comes to the animal species, this researched proved the presence of roe deer, wild boar, chamois and wild rabbit.

Wolf (Canis lupus)

The Dinaric-Balkan population that is shared by 10 countries and which reaches up to the Old Mountain in Bulgaria lives in this region. It is important that there exists and should continue to exist a passable corridor for a constant flow of individuals and their genes.

Lynx (Lynx lynx)

The National park Sutjeska is a potential habitat for the Eurasian lynx too. The presence of lynx in this region is not currently confirmed, which can be ascribed to partly hidden manner of life of this species, and partly to the lack of continuous monitoring. The National park Sutjeska is found between the Dinaric population that lives in Slovenia, Croatia and the western part of BiH, as well as the population of critically endangered Balkan lynx in Macedonia, Albania and Kosovo.

The preservation of the superior quality of the habitat in the eastern part of Bosnia and Herzegovina and the north western part of Greece enables a certain number of individuals to enter the corridor and for at least some animals to transfer their genes to the other side. It is considered that the spreading and exchange of genes requires at least one successful migrant by generation. Even more so than in the case of bear and wolf, every disturbance and fragmentation of habitats in the region of the eastern part of BiH (National park Sutjeska) will largely reduce the chances for finding as well as returning of the lynx and its stay on these regions.

Taking into consideration the scope of the planned works for the five SHPPs in the canyons of Sutjeska and Hrčavka and comparing them with the experiences from the constructed SHPPs Divič, we can conclude that the construction would significantly affect the ecosystems, habitat and the animal species in the course of the construction, since it would cause real disturbance (noise, constant movement of motor vehicles, mining). Once constructed, SHPP might lead to the reduction in the size and quality of the habitat, as well as to the reduction of passage of that part of the corridor that is expected to be permanently protected and of supreme quality and consequential fragmentation. If the partitioning (fragmentation) of the population occurs, its viability and sustainability will be significantly weakened.

All three large carnivores are protected by numerous international agreements and conventions and have a high

degree of international protection (Bern Convention, CITES, Habitats Directive). The management and protection is expected at the level of populations, as well as the level of certain states. The connectedness of the habitats and the protection of quality habitats are the key elements of the protection. Large carnivores are found on the top of the food pyramid and are called "keystone" species (which stabilize the whole ecosystem in the manner of blocking stone), as well as the "umbrella" species that are as such the most demanding for the protection. By satisfying their needs bigger regions are protected too, and in that manner also the relative habitats and less well-known, but ecologically equally significant species that are found in those regions. It is therefore important not to endanger the systems, especially in those regions that already have the highest category of legal protection in their own right. The construction of the infrastructural facilities outside the protected zones should satisfy the conditions from the stated documents, while the construction within a certain national park is absurd and should by no means be allowed. The category of the national park is simply incompatible with the intervention of the construction of dams on rivers and the hydro power plants installations. In order for the interventions to be conducted, we should firstly cancel the status of the National park Sutjeska. We truly hope this will not happen.

Ursos arctos

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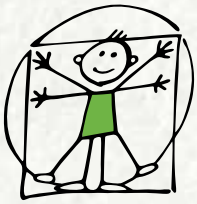

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