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# Rivers: lifelines of the Dinaric Arc

Conservation of the most valuable rivers of  
South-Eastern Europe

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WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by: conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.



# Rivers: lifelines of the Dinaric Arc

Conservation of the most valuable rivers of South-Eastern Europe

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Skadar Lake, Montenegro © Andrija Vrdoljak WWF-Canon



## *”Balkans freshwater biodiversity is globally outstanding”*

Scientists are unanimous when talking about the amazing biodiversity of the Dinaric Arc,<sup>1</sup> especially its freshwater life — endemic fish, snails and other invertebrates, and below our feet, in the darkness of caves and underground tunnels, thrives a magnificent, yet unexplored cosmos of life. This is a very special part of our planet.

As we struggle towards more resource-efficient economies, humanity’s demand for more power is driving investments in hydropower developments in our region at an exponential rate. By modifying water flows, hydropower developments are impacting known (and unknown) life forms dependent on these age-old patterns, modifying our landscapes and our local climate. How to balance the need for power with wise stewardship of our own, unique, piece of life on Earth? The answer to this dilemma will require that we find in ourselves the will and wisdom to make the right choices.

WWF believes that these choices can be made through an open and transparent analysis of costs and benefits of hydropower developments. This publication is our contribution to improving the quality of dialogue. It does not offer definite answers. We make an appeal to scientists, decision makers, investors and interested public to examine it, discuss it and improve it. Doing so will help us appreciate the difficulty and complexity of factors we have to consider when deciding for or against hydropower developments. We hope that this reflection will convince everyone concerned that these decisions cannot be made in isolation, but through a broad societal consensus and, therefore, serve as an encouragement to engage in a productive dialogue.

### **Deni Porej, PhD**

Director of Conservation Programmes,  
WWF Mediterranean



Deni Porej

# INTRODUCTION

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Francesca Antonelli

## *“Hydropower is not a green energy by default”*

With its long, deep, unspoiled, crystal clear waters, the river network of the Dinaric Arc region is its heart, the foundation of well being for people, animals and plants. Nature has provided this abundant and high quality resource for free for millennia but today it is used and misused without concern. The rhythm of development is increasing and the region is experiencing the boom of hydropower development, with hundreds of new dams in the pipeline or under construction.

Hydropower is an excellent source of energy and in some cases the right choice to meet energy needs. Nevertheless there is a myth to dispel: hydropower is not a green energy source by default. A decade ago the World Commission on Dams,<sup>II</sup> initiated by the World Bank<sup>III</sup> and the International Union for Conservation of Nature (IUCN),<sup>IV</sup> demonstrated that often dams were being built without adequate concern for local communities and nature, resulting in damage rather than benefit. Too often dams have been planned and built looking mostly at the economic angle.

The good news is that civil society, investors, financiers, national and regional decision makers are becoming aware that a dam should be planned and built only when a win-win situation exists. More and more they are taking into account social, environmental and economic aspects.

WWF (the Mediterranean Programme in collaboration with the Danube Carpathian Programme) has developed this publication as a contribution to more responsible decision making in dam planning, highlighting the river ecosystems of the Dinaric Arc region which are outstanding for their biodiversity or their singularity. This assessment was carried out in collaboration with the most important environmental institutions from Albania, Bosnia and Herzegovina, Croatia and Montenegro<sup>1</sup> to make sure that the information and approach used are in line with their knowledge and experience. The hope is that those involved in the conception, planning and construction of dams in the Dinaric Arc region will make the best use of this information.

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<sup>1</sup> Albania: General Directorate of Water of the Ministry of Environment, Faculty of Natural Sciences of Tirana University. Bosnia and Herzegovina: Institute for Protection of Cultural, Historical and Natural Heritage of Republika Srpska; Ministry of Environment and Tourism of the Federation of Bosnia and Herzegovina. Croatia: State Institute for Nature Protection. Montenegro: Environmental Protection Agency.





The Neretva River delta in Croatia © Andrija Vrdoljak WWF-Canon

## SUMMARY

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In 2011, WWF Mediterranean launched the WWF Dinaric Arc Sustainable Hydropower Initiative (DASHI) which aims at improving the way decisions about future hydropower infrastructures are made and existing plants are operated, since the viability of freshwater ecosystems is at stake. WWF, with the most important environmental institutions from the countries of the Dinaric Arc, carried out an analysis of rivers to identify which are still intact and rich in biodiversity. 296 rivers were analysed for a total length of about 13,278 km and a total basin surface of around 165,000 km<sup>2</sup>.

The analysis took into consideration the condition of rivers (based on their hydrology, channel morphology, riparian vegetation, water quality and land use in the sub-basin) and their biological condition using the distribution of freshwater fish species and the existence of Protected Areas.

Two additional analyses identified all the habitat types typical of the region (representation analysis) and the river reaches important for connectivity (connectivity analysis), highlighting a wide variety of different habitats, and therefore species, many of which are endemic, that are present in the four countries. This enabled the production of a map of the most valuable reaches of rivers (see pages 10-11).

The outcome of the analysis is the discovery that the level of integrity of the Dinaric Arc river network is very high with many of the rivers still in high or good condition. The total length of outstanding river reaches is in fact 8,739 km, accounting for 66 % of the total river length analysed. The country with the highest percentage of preserved rivers is Montenegro with 76 % of outstanding rivers (898 km), followed by Croatia with 73% (3,301 km), Bosnia and Herzegovina with 60% (2,632 km) and Albania also with 60% (1,907 km).

# METHODOLOGY

The process envisaged first the development of a methodology followed by data collection (provided by national institutions or publicly available on internet) and a GIS analysis. A final consultation with the partner institutions completed the process. The methodology and the GIS analysis were performed by Krešimir Žganec, PhD, Associate Professor at the University of Zadar in Croatia.

The assessment took a bit more than one year and covered four countries (Albania, Bosnia and Herzegovina, Croatia and Montenegro).

Rivers were first classified by river types<sup>2</sup> and then divided into river reaches, the main units of the analysis. Evaluated river reaches (ERR) were classified based on river type, habitat type and their condition.

<sup>2</sup> According to the: I) size of their sub-basin, II) altitudinal range, III) geology and IV) hydrology

<sup>3</sup> Maximum value of TBI index is 100

\* The hydromorphology data used was taken from report „Balkan Rivers – The Blue Heart of Europe; Hydromorphological Status and Dam Projects”, EuroNatur, Riverwatch, FLUVIUS, Vienna, March 2012





\*River condition was calculated by combining the value of five indicators: hydrology, water quality, channel morphology, riparian vegetation and land use. Each of the indicators was assigned a numerical value, and based on their sum the condition of river reaches was classified as high, good, moderate, poor or bad. All river reaches with high and good condition are considered the “most outstanding river reaches”. The main assumption of this approach is that river reaches in high or good condition are able to maintain biodiversity characteristic of that river and habitat type. Data on the distribution of IUCN Red List fish species, endemic fish species and protected areas were used at this stage to calculate the total biological importance (TBI) index<sup>3</sup> for each ERR. All ERRs with a score between 80 and 100 in the TBI index became candidate priority river reaches of very high and high conservation priority.

Two additional parameters were analysed in order to provide a complete overview: representation and connectivity analyses. The representation analysis increases the value of an ERR in moderate or poor condition because it is the only habitat of this type left in the region (i.e. the Neretva delta in the Adriatic Sea or Mirna in Istria), while the connectivity analysis looks at the longitudinal connectivity between candidate priority reaches and the rest of the river network.

More details on the approach adopted, data used and results obtained are available upon request.



Eurasian coot (*Fulica atra*) © Andrija Vrdoljak WWF-Canon



Kravice waterfall on Trebižat River, Bosnia and Herzegovina © Andrija Vrdoljak WWF-Canon



Common duck (*Anser anser*) in the Neretva River delta in Croatia © Andrija Vrdoljak WWF-Canon







## REGIONAL MAP

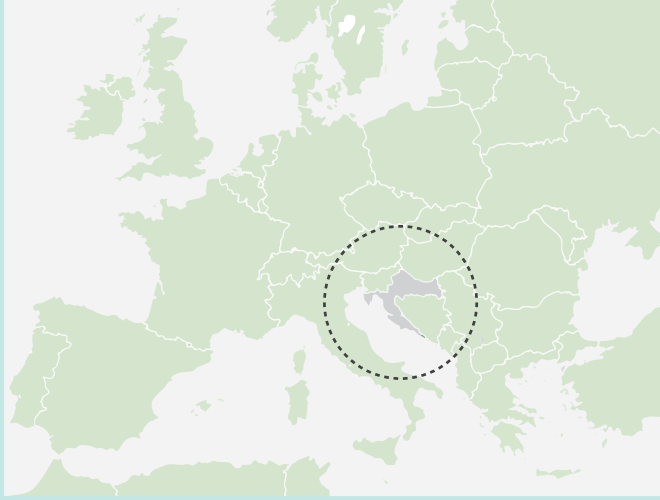
### RIVERS AND RIVER REACHES MOST IMPORTANT FOR THE DINARIC ARC

#### IN A SNAPSHOT:

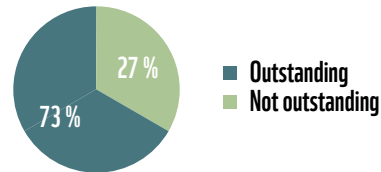
- 296 rivers analysed
- Total length of 13,278km
- Total basin surface of around 165,000km<sup>2</sup>
- 66 % of the total river length analysed is outstanding (8,739km)
- The country with most preserved rivers is Montenegro with 76 % of outstanding rivers (898km), followed by Croatia with 73% (3,301km), Bosnia and Herzegovina with 60% (2,632km) and Albania also with 60% (1,907km)

# CROATIA

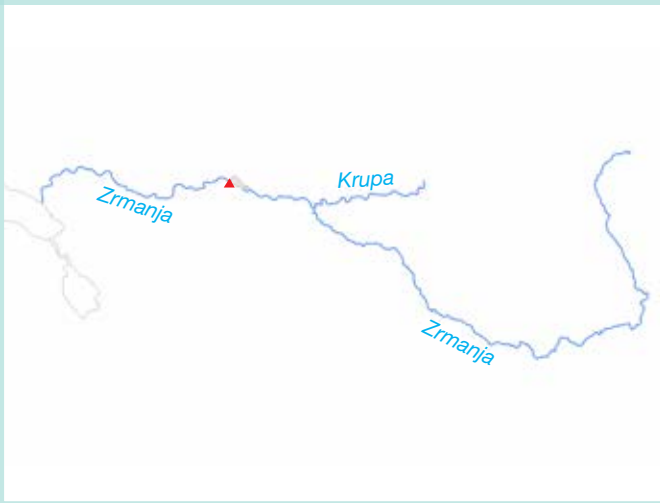
## Croatia (Europe)



A total of 4,522km was analysed 73 % of which resulted to be outstanding (3,301km). Of these rivers 998km are included for habitat representation purposes and 69km for connectivity purposes. The Zrmanja River is presented in this publication as a case of extreme biological and landscape diversity concentrated in a very small area and of rich underground freshwater fauna.



## Focus: The Zrmanja River



## LEGEND

- Most outstanding river reaches
- River reaches important for connectivity
- Other evaluated river reaches
- Existing dams

## WWF RECOMMENDATIONS FOR THE ZRMANJA RIVER

The Zrmanja River canyon (the lower part of the Zrmanja) is protected as a significant landscape and the other part of the Zrmanja together with its tributary the Krupa are protected as part of Velebit Nature Park by the national Nature Protection Act (both belong to IUCN category V). Furthermore, both rivers are part of the Natura 2000 network. As such, any development plan should be scrutinized according to the Croatian Nature Protection Act and Natura 2000 procedures. Croatian water legislation aligned with the Water Framework Directive, additionally protects these rivers.



# MOST IMPORTANT RIVERS AND RIVER REACHES IN CROATIA



# THE ZRMANJA RIVER

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## MAIN CHARACTERISTICS

With a length of 69km, the Zrmanja River is among the shortest rivers within the Adriatic river basin. It is located at the junction of a number of ecosystems and is exceptionally rich in biodiversity. The Zrmanja connects the south eastern slopes of the Velebit Mountains with the Velebit Nature Park. It is a typical karstic river, which has formed a 7km-long valley in its upper course where it plunges into a 200m-deep canyon. The most significant tributary of the Zrmanja River is the Krupa River, rich in travertine structures. After the confluence with the Krupa, the Zrmanja also forms travertine barriers, like the 11m-high waterfall called Visoki buk, which is the biggest waterfall on the river. Further downstream we find Janković buk, the last waterfall on the Zrmanja River, which marks the border between fresh and brackish water as well as different biotic communities. Other tributaries are the Krnjeza, Ričica and Otuča. The middle part of the

Zrmanja River is partially a seasonal river, and it dries out near Mokro field where the waters of Zrmanja submerge, to finally emerge about 15km downstream as the permanent flow of the lower Zrmanja.

## MAIN BIODIVERSITY DATA

The Zrmanja River flows entirely within the Natura 2000 network. The characteristic species in the upstream parts of the river are similar to those found in other karstic rivers, while further downstream from Jankovića buk to the estuary, because of salt water intrusion, brackish and marine species prevail. A total of 49 fish species were recorded in the river, 15 within the freshwater part, 8 of which are species endemic to the Adriatic river basin, and the rest in the estuary part. The European eel (*Anguilla anguilla*), critically endangered all over the world, and the olm (*Proteus anguinus*), the only



“Croatia, as the newest EU member, is faced with the challenge between EU efforts to preserve the rivers and nature on the one hand, and to use hydropower as renewable energy source on the other. Most of the rivers, which are in this project recognized as the most outstanding, are also included in the Natura 2000 network in Croatia. This publication further highlights the importance and the need to preserve our natural heritage.”

**Daniela Schneider, State Institute for Nature Protection, Croatia**





The Zrmanja River, Croatia © Goran Šafarek WWF-Canon

cave amphibian in Europe found in the underground flow of Zrmanja with a large population, are common in the Zrmanja river. A combination of freshwater habitats with extensive farming is suitable for amphibians (8 species) and reptiles (20 species), and they are abundant. Many of the molluscs present are endemic, protected or threatened species or subspecies. The canyons of Zrmanja are also home to the otter (*Lutra lutra*) and to endangered birds like the golden eagle (*Aquila chrysaetos*) and the short-toed snake eagle (*Circaetus gallicus*).

## MAJOR THREATS

The waters in the lower part of the Zrmanja are used by the reversible HPP Velebit (pumping storage) and Razovac reservoir, both built in 1984. Tunnels and pipes were also built to connect Zrmanja to the Ričica River because of the Velebit pumped-storage power plant. Changes to the hydrologic regime of the river pose a major threat to the survival and stability of fish fauna, a threat made more significant by the possibility of an upgrade to the existing system of hydropower production. Other major threats to the biodiversity of the Zrmanja are water pollution, poaching and intrusion of



Golden eagle (*Aquila chrysaetos*) © Wild Wonders of Europe Sven Zacek WWF

alien species. Recently there have also been plans to build river regulation infrastructure to protect the lower river from flooding.

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## ZRMANJA IN NUMBERS

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- 49 Fish species
  - 8 Endemic fish species
  - 20 Reptile species
  - 8 Amphibian species
- 



### ENDANGERED BIRDS:

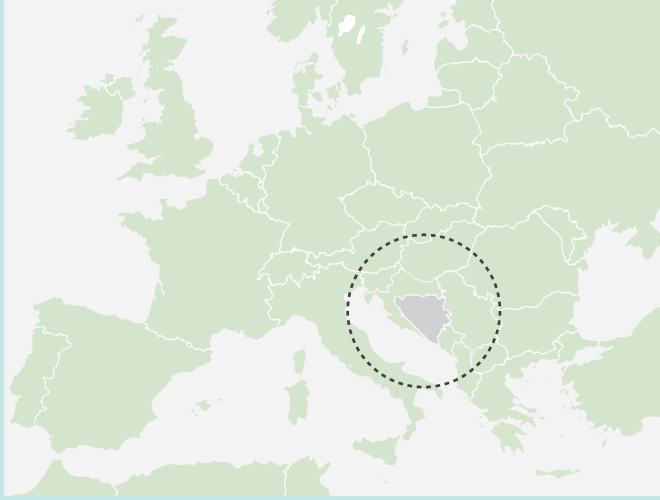
Golden eagle (*Aquila chrysaetos*)

Short-toed snake eagle (*Circaetus gallicus*)

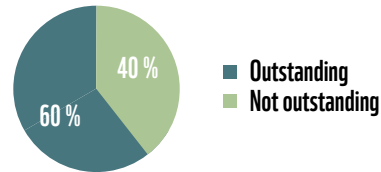


# BOSNIA AND HERZEGOVINA

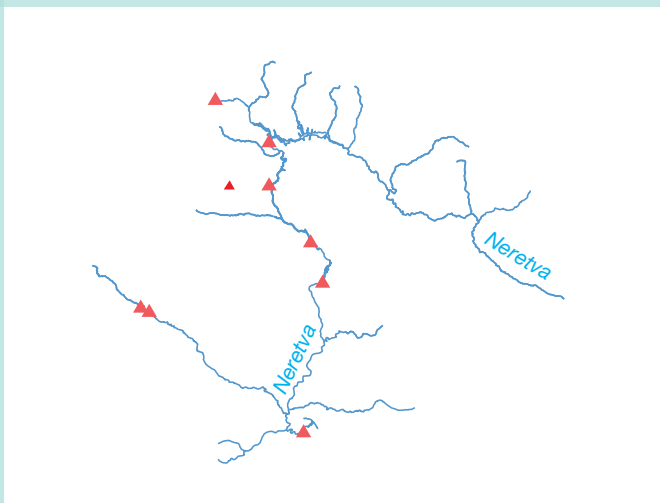
## Bosnia and Herzegovina (Europe)



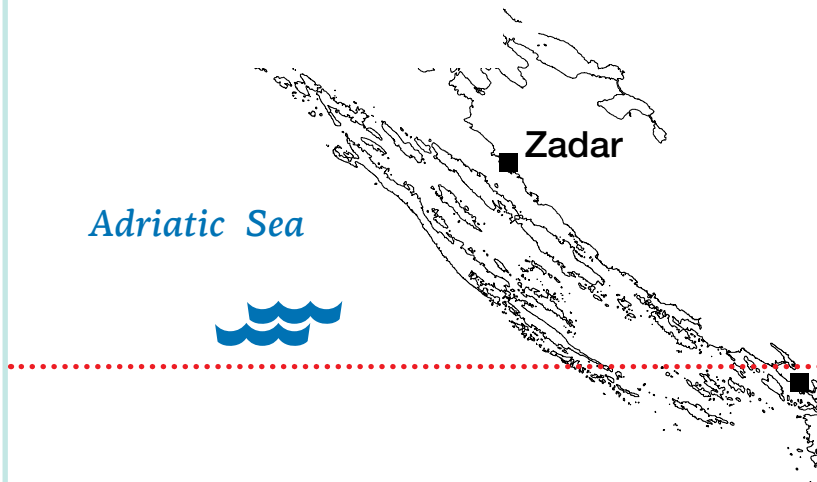
A total of 4,408km was analysed, 60% of which resulted to be outstanding (2,632km). Of these rivers 486km are included for habitat representation purposes and 762km for connectivity purposes. The Neretva River is presented in this publication as remarkable for its strong fish endemism and intricate underground hydrology which enriches an outstanding network of wetlands in its lower course.







## Focus: The Neretva River



Adriatic Sea



## LEGEND

-  Most outstanding river reaches
-  River reaches important for connectivity
-  Other evaluated river reaches
-  Existing dams

## WWF RECOMMENDATIONS FOR THE NERETVA RIVER

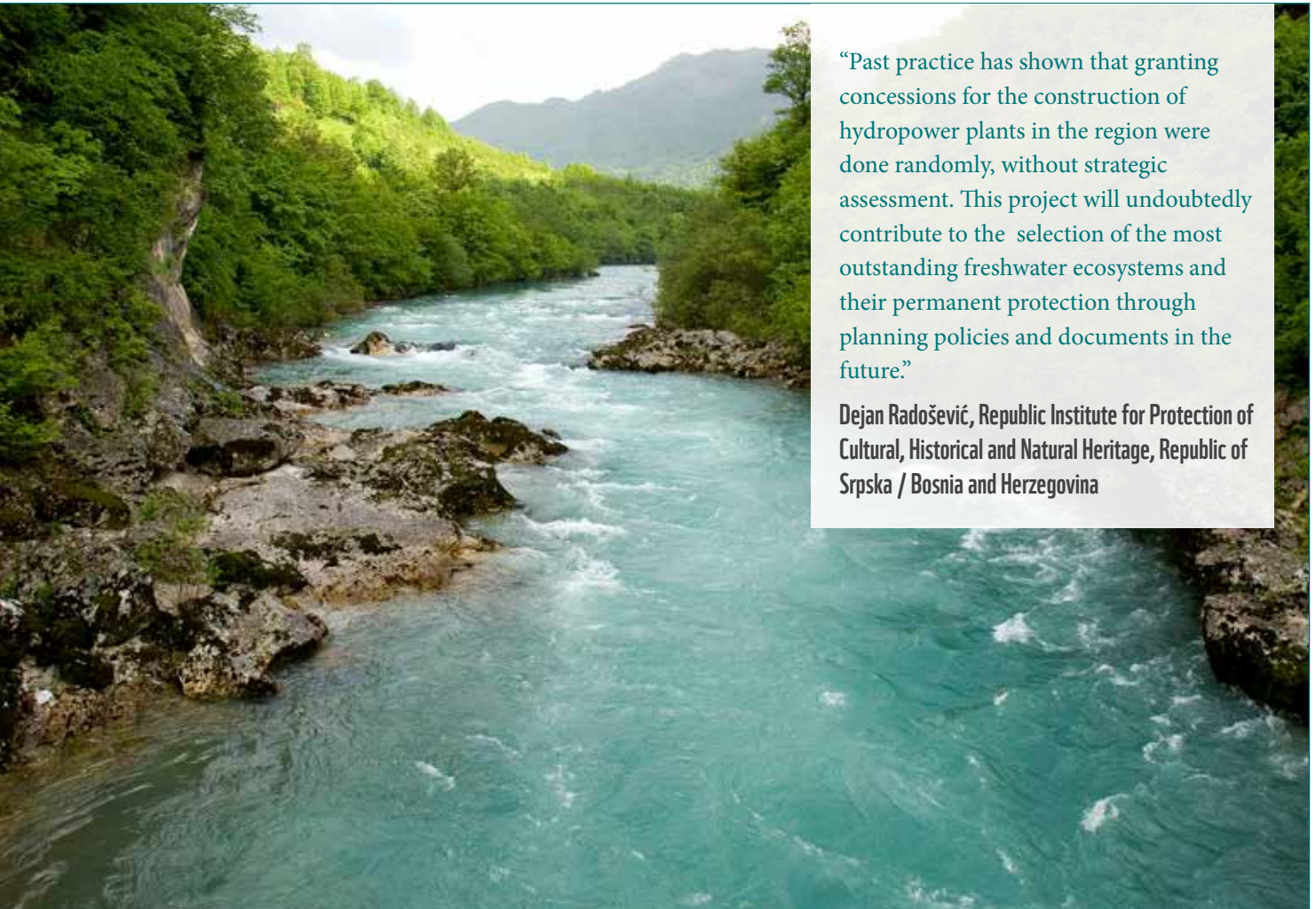
It is crucial to integrate nature conservation aspects into the existing hydropower system and apply the relevant EU directives and modern standards before further hydropower development on the Neretva River.



# MOST IMPORTANT RIVERS AND RIVER REACHES IN BOSNIA AND HERZEGOVINA



# THE NERETVA RIVER



“Past practice has shown that granting concessions for the construction of hydropower plants in the region were done randomly, without strategic assessment. This project will undoubtedly contribute to the selection of the most outstanding freshwater ecosystems and their permanent protection through planning policies and documents in the future.”

**Dejan Radošević, Republic Institute for Protection of Cultural, Historical and Natural Heritage, Republic of Srpska / Bosnia and Herzegovina**

Upper Neretva River, Bosnia and Herzegovina © Michel Gunther WWF-Canon

## MAIN CHARACTERISTICS

The Neretva River is the largest river in the Eastern Adriatic river basin, flowing through Bosnia and Herzegovina for 203km, with a final 22km in Croatia. Along the upper course of the Neretva numerous streams and springs form headwaters that run in undisturbed rapids and waterfalls, carving steep gorges reaching depths of up to 800 metres. In the last 30 kilometres of its flow, downstream from the confluence of its tributaries the Trebižat, Bregava and Trebišnjica Rivers, and just before entering the Adriatic Sea, the valley spreads into the biggest alluvial delta in the Adriatic. The upper part, with 7,411 hectares in Bosnia and Herzegovina, formed by the tributaries Krupa and Skrka, is a wetland called Hutovo Blato. The delta of the Neretva and Hutovo Blato form one of the three key migratory stops for birds in the Adriatic Flyway.

## MAIN BIODIVERSITY DATA

The Neretva and its numerous tributaries provide many different habitats for a diverse collection of plants and animals and several endemic species, recognised by official nature conservation bodies at both the national and international level. While the Neretva delta is a Ramsar site and in the process of becoming a Natura 2000 site, Hutovo Blato wetland is protected as a nature park (IUCN category V) and a Ramsar site. In the Neretva River we can find 75 species of freshwater fish, among which several are endemic and on the IUCN red list: the marble trout (*Salmo marmoratus*), the softmouth trout (*Salmo obtusirostris*), the Dalmatian barbelgudgeon (*Aulopyge huegelii*), the Dalmatian soiffe (*Chondrostoma knerii*), the Neretvan roach (*Rutilus basak*), the Neretvan rudd (*Scardinius*



*plotizza*) and the Neretvan bleak (*Alburnus neretvae*). Furthermore six species of minnows (*Telestes dabar*, *Telestes metohiensis*, *Phoxinellus pseudalepidotus*, *Phoxinellus alepidotus*, *Delminichthys adpersus* and *Delminichthys ghetaldii*), well known for migrating into the underground waters during dry summer conditions, are endemic to specific areas of the Neretva watershed. The literature data for Bosnia and Herzegovina also contains confirmation of the presence of fish species *Phoxinellus alepidotus*, in the basin of the river Neretva.

At least 115 bird species regularly nest in the area, but the total number of bird species using the area amounts to more than 300. The area is also important as a European resting place for migratory birds, and as a wintering ground.

## MAJOR THREATS

The lower reaches of the Neretva were significantly altered in the second part of the twentieth century, mainly by land reclamation works and hydropower development. As a result of land reclamation only a few fragments of the formerly large Mediterranean wetlands remained, most of which is now cultivated land. The Neretva has also been one of the most important sources of electricity produced from hydropower in the former state. In the middle and lower part of the Neretva watershed there are 12 hydropower plants and storage lakes operating while an additional 9 are planned. This has had a tremendous impact on river connectivity and has seriously disrupted the water regime, meaning a drastic decline in fish and bird populations throughout the river basin.



The Krupa River, Nature park Hutovo blato © Andrija Vrdoljak WWF-Canon



Eurasian oyster catcher (*Haematopus ostralegus*) © Goran Šafarek WWF-Canon



Eurasian curlew (*Numenius arquata*) © Goran Šafarek WWF-Canon

## NERETVA IN NUMBERS

**75** Fish species

**7** Endemic fish species

**300** Bird species

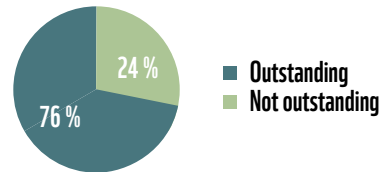
**115** Bird species regularly nesting in the area

# MONTENEGRO

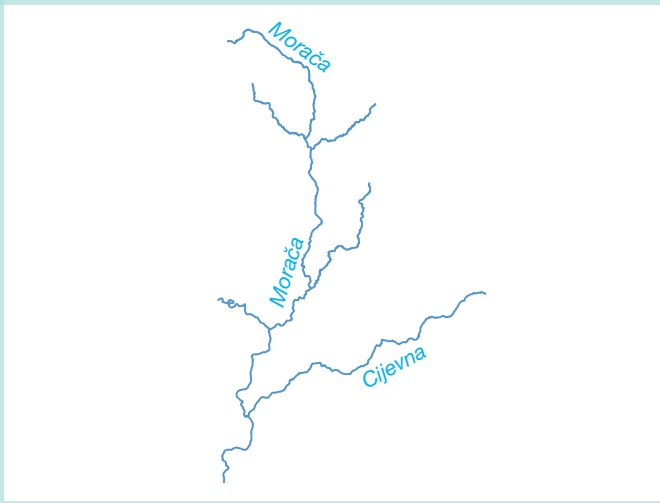
## Montenegro (Europe)



A total of 1,184km was analysed, 76 % of which resulted to be outstanding (899km). Of these rivers 110km are included for connectivity purposes and none are included for habitat representation purposes. The Morača River in this publication is presented as having high diversity of fauna and flora and for its importance to the ecology of Skadar Lake, a Ramsar site and the biggest lake in the Balkans.







## Focus: The Morača River



Adriatic Sea

## LEGEND

-  Most outstanding river reaches
-  River reaches important for connectivity
-  Other evaluated river reaches
-  Existing dams

## WWF RECOMMENDATIONS FOR THE MORAČA RIVER

The Morača River is one of the few free-flowing rivers remaining in Europe and a biodiversity hotspot. It is most strongly recommended not to disrupt it with new infrastructure, the impact of which is almost certain to be irreversible.

# MOST IMPORTANT RIVERS AND RIVER REACHES IN MONTENEGRO



\* This designation is without prejudice to positions on status, and is in line with UNSC 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.



# THE MORAČA RIVER

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The Morača River canyon, Montenegro © Andrija Vrdoljak WWF-Canon

## MAIN CHARACTERISTICS

The Morača River is part of the Adriatic basin and has a watershed of 2,970km<sup>2</sup>. With a total length of 97km it is the biggest tributary of Skadar Lake (national park and Ramsar site), accounting for 62% of the total water discharge to the lake. It originates in northern Montenegro, under the Rzača mountains. Its source is found at an altitude of almost 1000m, and it rapidly assumes the characteristics of a fast-flowing mountain river, winding through the beautiful Platije Canyon near Montenegro's capital Podgorica. It is the second most important river in Montenegro and is one of the few free-flowing rivers left in Europe.

## MAIN BIODIVERSITY DATA

The main tributaries of the Morača are the Mrtvica and Mala rijeka, both Emerald sites with wonderful biodiversity. The Morača is home to several protected fish species: the critically endangered European eel (*Anguilla anguilla*), the endangered endemic species Skadar gudgeon (*Gobio skadarensis*) found only in the Skadar Lake basin and lower Morača, and the endangered softmouth trout (*Salmo obtusirostris*), a species endemic to the Adriatic river basin.

The Morača canyon fulfils Important Bird Area (IBA) standards thanks to 29 different bird species living in this area. Platije Canyon hosts 42% of the total national breeding population of the globally endangered pygmy cormorant (*Phalacrocorax pygmeus*). In terms of plant diversity, 1,600 plant species have been registered in the Morača Canyon, of which 60 plant species are endemic to the Balkan Peninsula and more than 85 species are protected at a national level.

Skadar Lake hosts one of the most important bird and fish habitats in the Mediterranean region, providing more than 90% of freshwater fish consumed in Montenegro, and is a winter home to some 150,000 migratory birds.

## MAJOR THREATS

The biggest threat to the Morača is the Montenegro Government's plan to build a series of four hydropower



plants. The construction of dams and reservoirs along the Morača would flood large upstream areas and impact the water inflow to Skadar Lake. This would jeopardize local and migratory bird and fish species, as well as the whole spectrum of species of international importance and would threaten one of the three major resting areas for birds in the Adriatic Flyway.

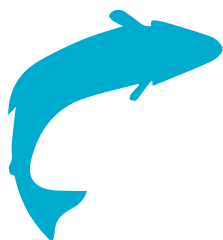
## MORAČA AND SKADAR LAKE IN NUMBERS

**54** Fish species

**31** Endemic fish species

**282** Bird species

**150,000** Migratory birds



### ENDANGERED FISH:

European eel (*Anguilla anguilla*)

Skadar gudgeon (*Gobio skadarensis*)

Softmouth trout (*Salmo obtusirostris*)



Whiskered terns (*Chelidonias hybrida*) © Wild Wonders of Europe Milan Radisics WWF



Great white pelican (*Pelecanus onocrotalus*) © Andrija Vrdoljak WWF-Canon

“This publication is a very important tool for decision makers and for those engaged in the protection of the environment in Montenegro. Rivers, river basins and aquatic ecosystems are the biological engine of the planet. They play a very important role not only in maintaining the natural balance, but also for provisioning services that support life. Therefore it is necessary to protect certain parts of aquatic ecosystems from any kind of disruption.”

Milica Vukčević, Environmental Protection Agency,  
Montenegro



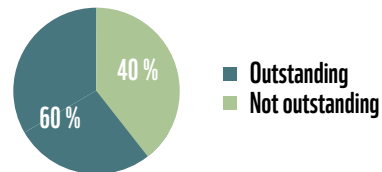
Boat on Skadar Lake, Montenegro © Wild Wonders of Europe Milan Radisics WWF

# ALBANIA

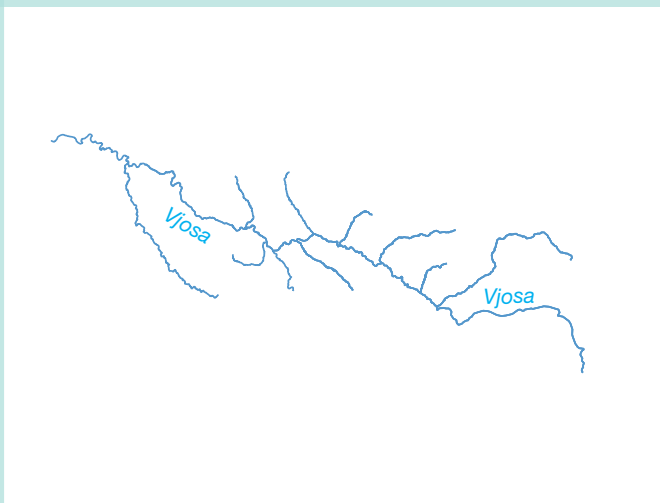
## Albania (Europe)







A total of 3,164km was analysed, 60% of which resulted as outstanding (1,907km). Of these rivers 223km are included for habitat representation purposes and 748km for connectivity purposes. The river Vjosa is presented in this publication as one of the few free-flowing rivers in Albania with extremely valuable biodiversity and good or high ecological status.



## Focus: The Vjosa River



## LEGEND

-  Most outstanding river reaches
-  River reaches important for connectivity
-  Other evaluated river reaches
-  Existing dams

## WWF RECOMMENDATIONS FOR THE VJOSA RIVER

The Vjosa River is one of the few remaining free-flowing rivers in Europe and one of the most important for biodiversity in Albania. The river should remain pristine, safe from human interference and hydropower development. Due to the natural and biological values of the upper part of the Vjosa watershed, from Tepelena to the Pindos Mountains in Greece, the entire watershed should be declared an International Protected Area, similar to the existing trans-boundary Park of Prespa.



# MOST IMPORTANT RIVERS AND RIVER REACHES IN ALBANIA



\* This designation is without prejudice to positions on status, and is in line with UNSC 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

# THE VJOSA RIVER

## MAIN CHARACTERISTICS

The Vjosa River is one of the biggest rivers in Albania, with a total length of 272km and a water basin of 6,700km<sup>2</sup>, of which 4,365km<sup>2</sup> in Albania and the rest in Greece. The river's source is in the Pindos Mountains in Greece. As it flows the Vjosa collects water from the aquifers of the Albanian mountains, flowing through several Albanian districts (Permeti, Tepelena, Gjirokastra, Fieri, Vlora) and ending in the Adriatic Sea near Vlora. The main tributaries are Sarandoporo (Greece), Drinos and Shushica (Albania), but there are many other small tributaries.

## MAIN BIODIVERSITY DATA

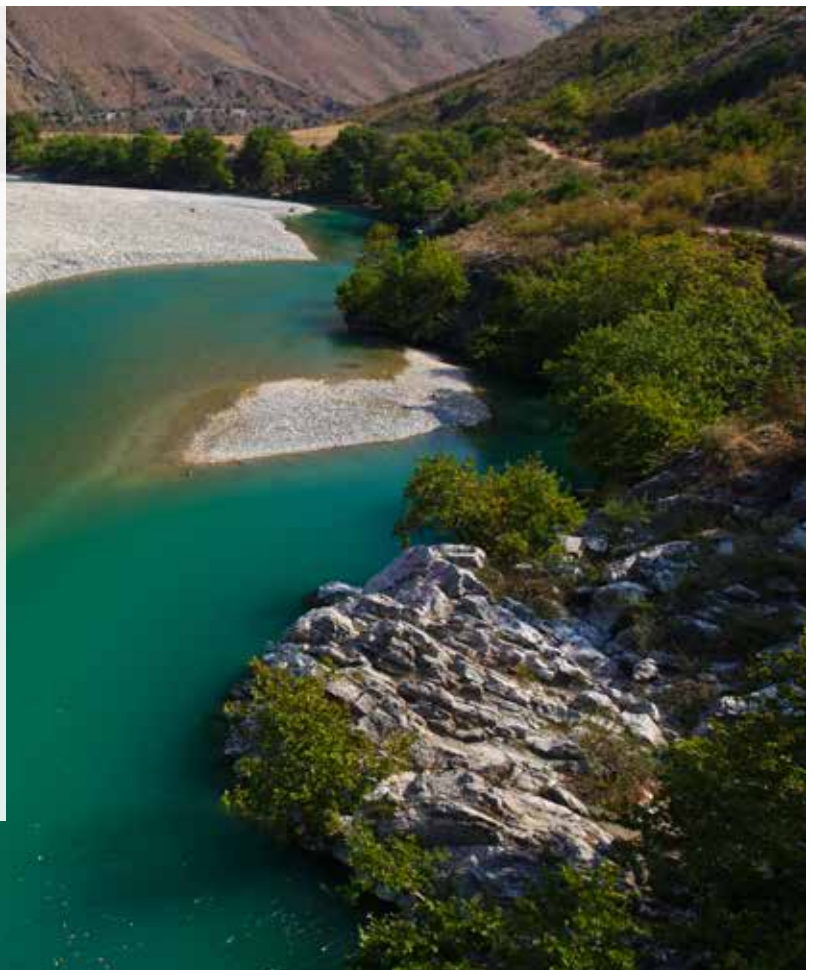
The Vjosa River has had a stable and continuous freshwater ecosystem and hydrological regime for thousands of years. The river area has high diversity of habitats and species,

while its delta (the Narta Lagoon) and its belt of coastal dunes were declared a Landscape Protected Area in 2004. The Vjosa River valley represents a biodiversity hotspot of Albania hosting ideal aquatic habitats for various migratory fish species like the critically endangered European eel (*Anguilla anguilla*).

The Vjosa River also hosts sub-endemic fish species like the Ohrid loach (*Cobitis ohridana*) and the Pindus stone loach (*Oxy noemacheilus pindus*). Two globally very rare species get shelter in Vjosa, the Adriatic sturgeon (*Acipenser naccari*) and the European river lamprey (*Lampetra fluviatilis*). The river is also home to the threatened European otter (*Lutra lutra*). Rare, endemic or relict species can be found throughout the watershed of Vjosa and especially in its sandy dunes and wetlands, where we can

“Albania is a country with a rich and interesting hydrological network, which is not used properly either for the conservation of water resources or for the benefit of the community. The country currently produces 95% of its energy from hydropower plants and is exploring the possibility of increasing the production of hydro energy. In this regard I will share my concern and call for the implementation of environmental standards for the construction of hydropower plants and for the strategic assessment of needs and impacts, to make the use of water resources more sustainable and the protection of our beautiful “blue arterial system” a reality.”

**Pellumb Abeshi, General Director of Environment,  
Ministry of Environment, Albania**





The Vjosa River, Albania © Goran Safarek WWF-Canon

find relict or rare plant species like the aquatic fern four leaf clover (*Marsilea quadrifolia*), several species of orchids, the catchfly (*Heliosperma intonsum*) and the crocus (*Crocus hadriaticus*), while in the upper part of the river we can find the Greek strawberry tree (*Arbutus andrachne*) and populations of cephalonia catchfly (*Silenece phallenia*). The Vjosa-Narta coastal zone is listed as the second most important site for birds in Albania, after the Karavasta area, with about 80 species recorded. The zone is known as the main wintering site for several globally endangered bird species like the greater flamingo (*Phoenicopterus roseus*) and Audouin's gull (*Ichthyaetus audouinii*). The Dalmatian pelican (*Pelecanus crispus*) is also present. The mountainous parts of the Vjosa watershed offer habitat to endangered bird species including several species of vulture (e.g. *Gypaetus barbatus*, *Neophron percnopterus*, *Gyps fulvus*).

## MAJOR THREATS

The main threat facing the Vjosa is the construction of eight hydropower plants. This process has intensified in the last four years with the policy of past governments for promoting hydropower construction on Albanian rivers. The hydropower plant Kalivaçi is the first one under



European eel (*Anguilla anguilla*) © Erling Svensen WWF-Canon

construction (since 2007) and there has been increased gravel extraction in the lower part of the Vjosa River, as well as in its tributaries Drino and Shushica. Construction of all hydropower plants and continuation of gravel extraction will have a big impact on the river connectivity that could lead to a decline in fish and bird populations throughout the river basin.

## VJOSA IN NUMBERS

80 Birds species

2 Sub-endemic fish species



### ENDANGERED FISH:

European eel (*Anguilla anguilla*)

Mullet (*Mugil cephalus*)

Sturgeon (*Acipenser*)

European river lamprey (*Lampetra fluviatilis*)



# CONCLUSION

The analysis of 296 rivers in Albania, Bosnia and Herzegovina, Croatia and Montenegro casts light on the level of integrity of the Dinaric Arc river network, making evident that many of the rivers are in good or high condition. The total length of outstanding river reaches (taking into account both representation and connectivity) is, in fact, 8,739km, accounting for 66 % of the total river length analysed.

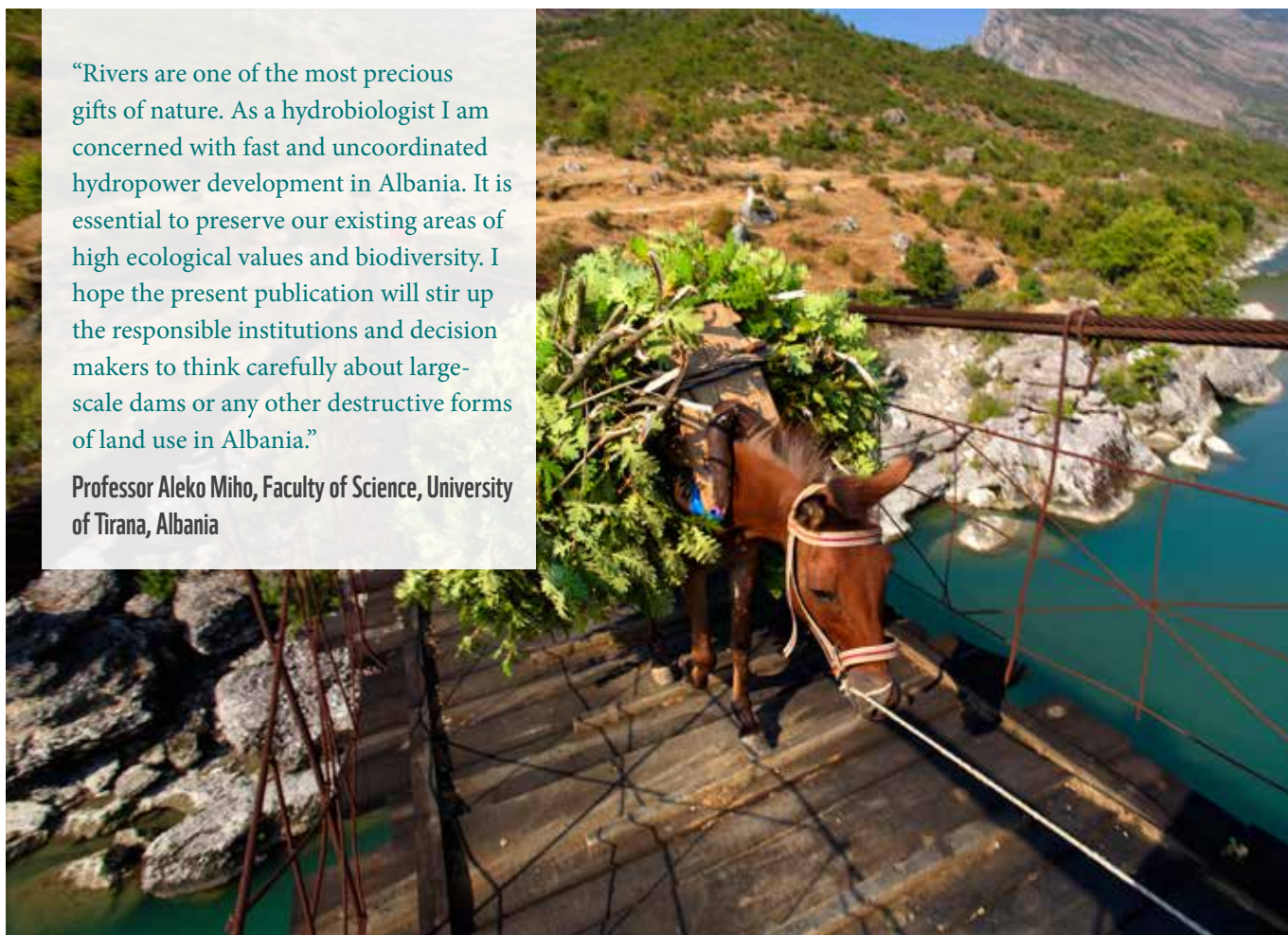
Well preserved rivers are an important asset for these countries and should be seen as an opportunity for reflection and wise future planning. Instead there is the danger that these countries will rush to exploit the potential for further hydropower development. Mistakes made by other European countries which, in some cases, have overexploited their river networks, should not be repeated. In many cases these countries have national programmes for river restoration and are spending

significant amounts to restore the degraded ecosystems which have lost the capacity to provide important services (e.g. clean drinking water, flood protection) for free. Dams are currently being decommissioned on rivers in several European countries, such as the Duero in Spain or the Loire in France.

Dinaric Arc countries should take advantage of the lessons learned elsewhere and identify which of their rivers it is wise to maintain unspoiled for future generations and adopt very stringent standards for the planning, building and operation of dams. As Nelson Mandela said in his speech in 2000 for the launch of the World Commission on Dams report, dams are “one of the battlegrounds in the sustainable development arena”. Our hope is that this publication contributes to the best possible decisions being made in the context of such a complex battleground.

“Rivers are one of the most precious gifts of nature. As a hydrobiologist I am concerned with fast and uncoordinated hydropower development in Albania. It is essential to preserve our existing areas of high ecological values and biodiversity. I hope the present publication will stir up the responsible institutions and decision makers to think carefully about large-scale dams or any other destructive forms of land use in Albania.”

**Professor Aleko Miho, Faculty of Science, University of Tirana, Albania**

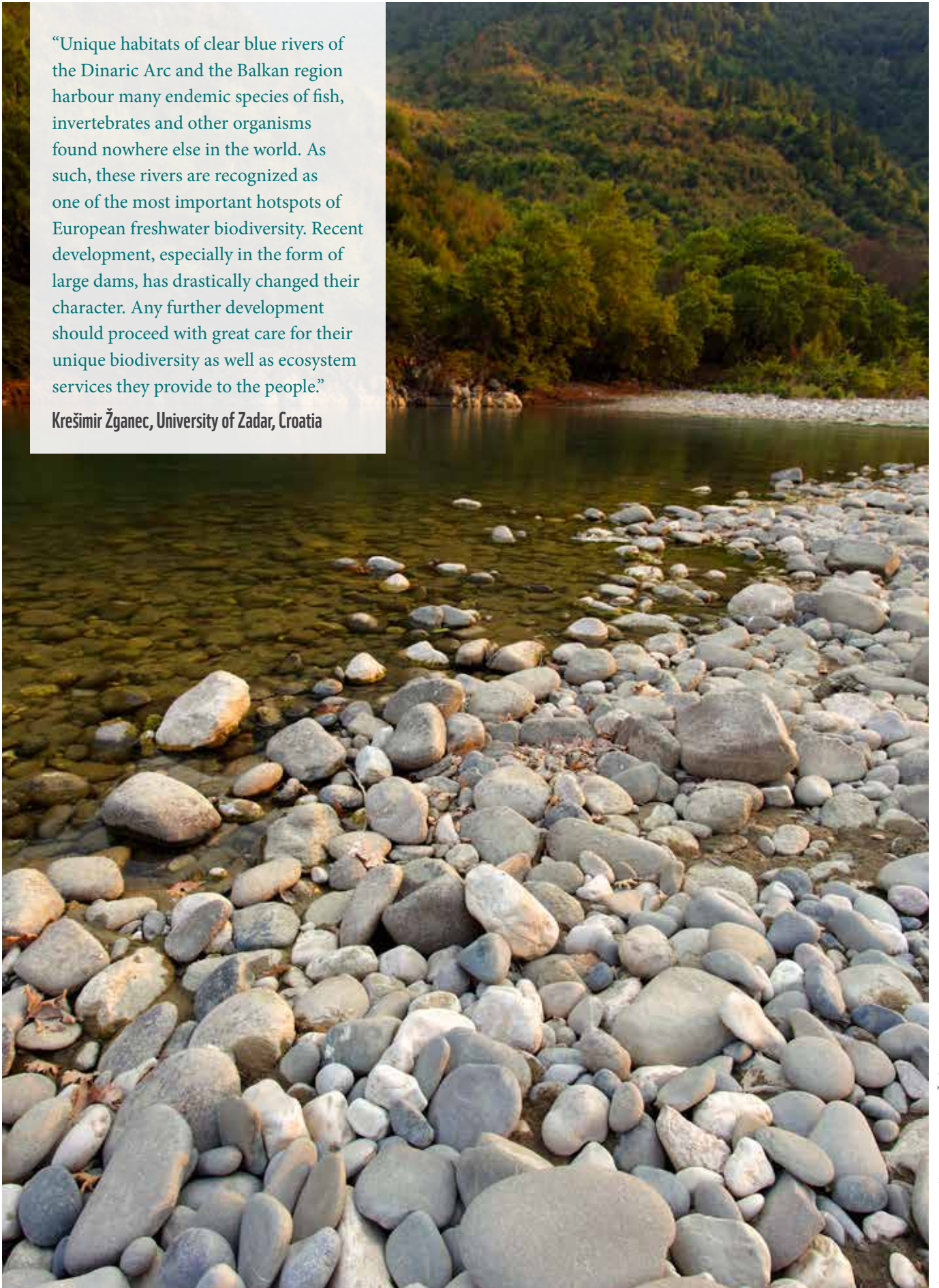


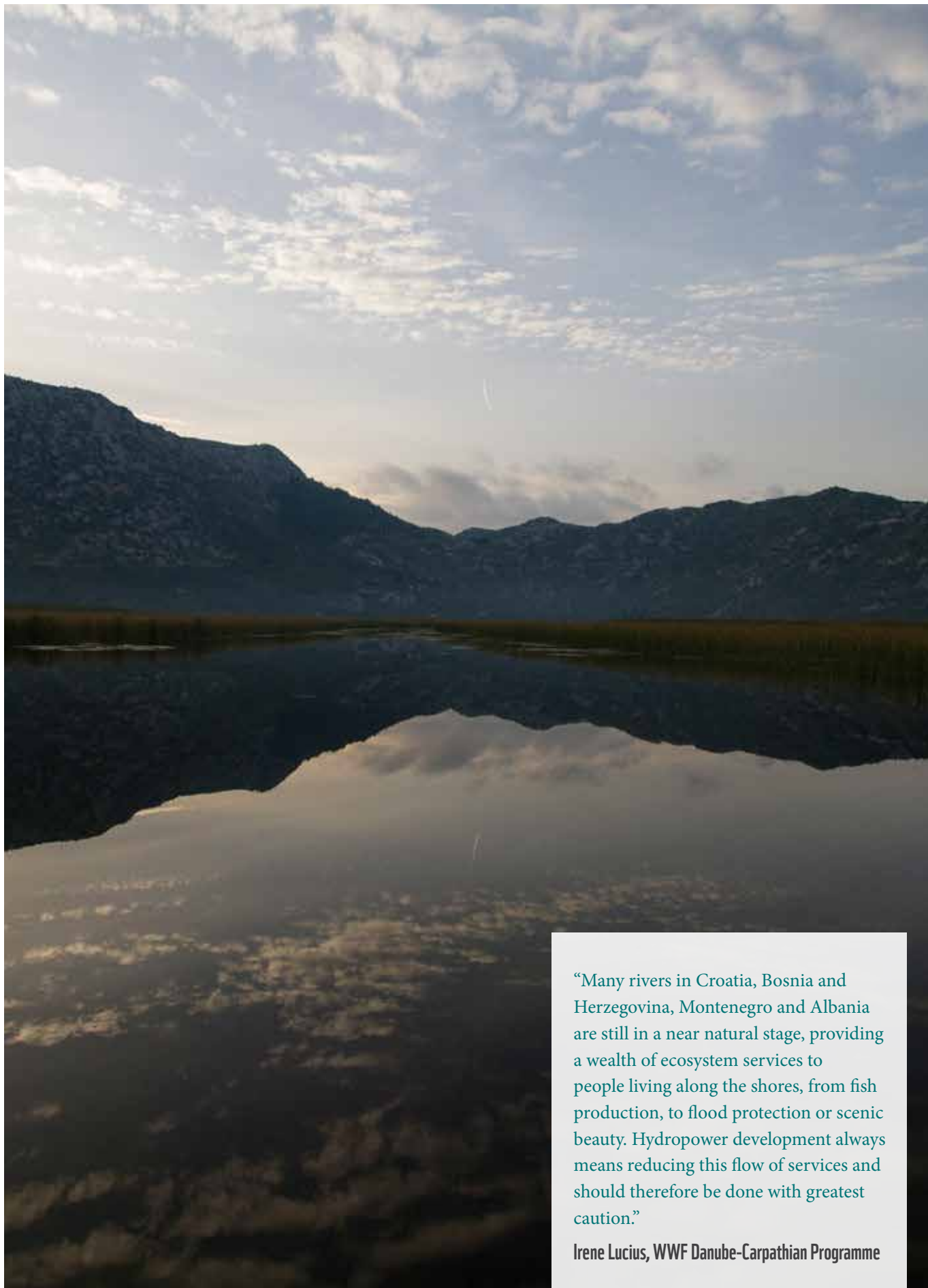
The Vjosa River, Albania © Goran Šafarek WWF-Canon



“Unique habitats of clear blue rivers of the Dinaric Arc and the Balkan region harbour many endemic species of fish, invertebrates and other organisms found nowhere else in the world. As such, these rivers are recognized as one of the most important hotspots of European freshwater biodiversity. Recent development, especially in the form of large dams, has drastically changed their character. Any further development should proceed with great care for their unique biodiversity as well as ecosystem services they provide to the people.”

**Krešimir Žganec, University of Zadar, Croatia**





“Many rivers in Croatia, Bosnia and Herzegovina, Montenegro and Albania are still in a near natural stage, providing a wealth of ecosystem services to people living along the shores, from fish production, to flood protection or scenic beauty. Hydropower development always means reducing this flow of services and should therefore be done with greatest caution.”

**Irene Lucius, WWF Danube-Carpathian Programme**



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Državni zavod  
za zaštitu prirode



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<sup>i</sup> The Dinaric Arc is an area in south-eastern Europe covering approximately 100,000km<sup>2</sup> and with more than 6,000km of coastline, which stretches from Trieste in Italy to Tirana in Albania. It includes parts of Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro and Albania.

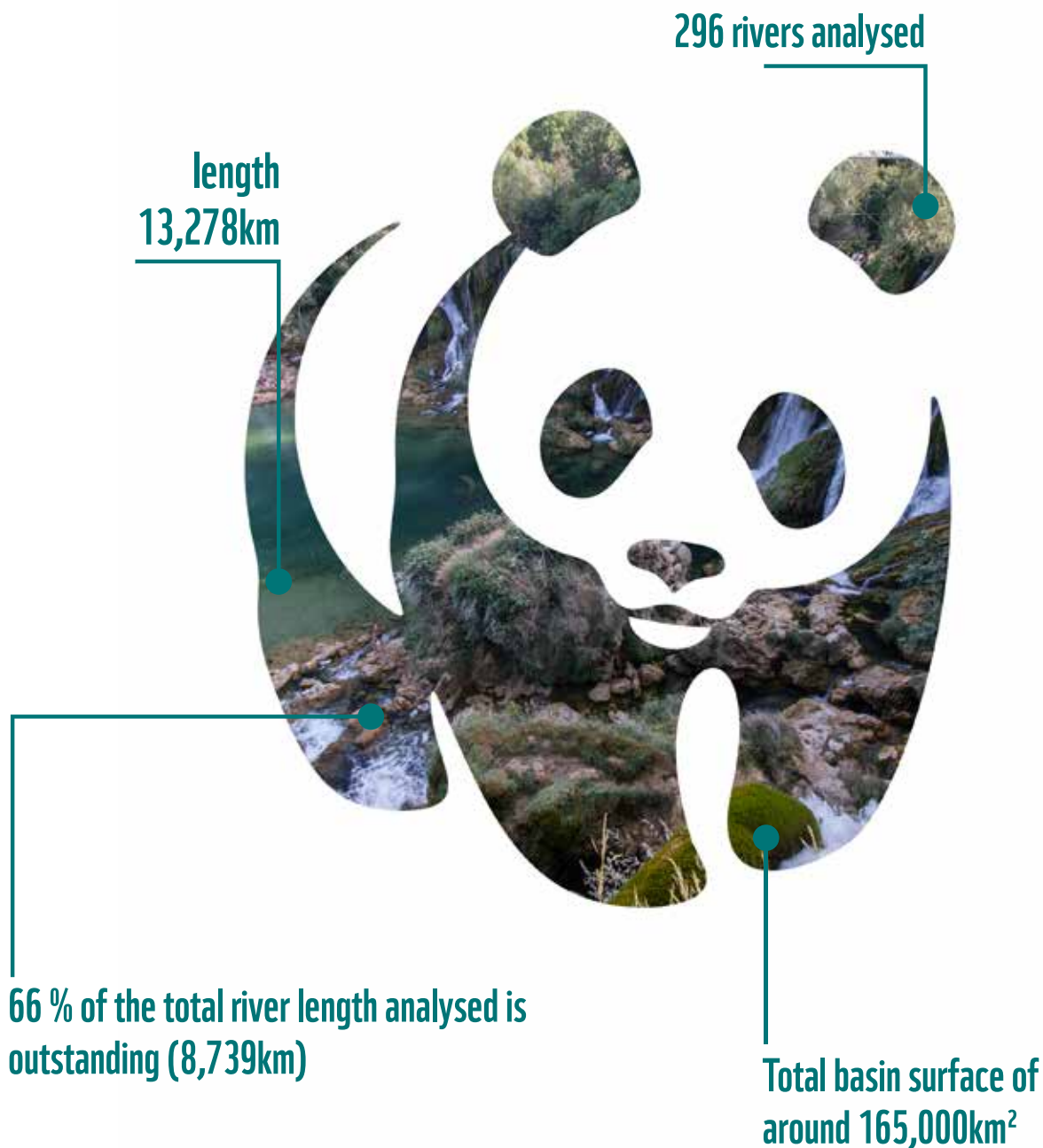
<sup>ii</sup> [www.internationalrivers.org/campaigns/the-world-commission-on-dams](http://www.internationalrivers.org/campaigns/the-world-commission-on-dams)

<sup>iii</sup> [www.worldbank.org/](http://www.worldbank.org/)

<sup>iv</sup> [www.iucn.org/](http://www.iucn.org/)

# Rivers: lifelines of the Dinaric Arc

Conservation of the most valuable rivers of South-Eastern Europe



**Why we are here.**

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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