Balkan Rivers - The Blue Heart of Europe

Hydromorphological Status and Dam Projects

Report

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Cover images: Upper Morača, Montenegro (Mathias Dieckmann) and Ashta dam construction on lower Drin river, Albania (Goran Safarek)

Preface:

The Balkan region is famous for its outstanding natural beauty and diversity, featuring coastal Mediterranean plains and alpine meadows, estuaries and deltas, rigid karst formations and open plains, vast lakes and many of the last wild rivers of Europe with a very high number of rare and endemic species. In particular the pristine river systems and natural lakes are rich in endemic fish and mollusc species. Therefore they have been identified by WWF as one of the key places (Global 200 ecoregions) for biodiversity conservation globally. This extraordinary biodiversity is massive capital the region´s future can build on. Wise and forward looking planning is needed to ensure that economic development goes hand in hand with maintaining this natural treasure.

Maybe the most imminent conflict to be avoided is the one between a high number of planned hydropower stations and the goal to maintain the high ecological value of Balkan river systems. The authors of this study believe that this time bomb can be defused if there is political will and sufficient information on which to base informed decisions. The study aims at contributing to this information base and guiding decisions. In particular, it wants to support the identification of “no-go areas” as demanded by European Water Directors at their meeting in Segovia on 27 and 28 May 2010: “Pre-planning mechanisms allocating “no-go” areas for new hydro-power projects should be developed”.

Sooner or later, all countries in the Balkan region will be members of the European Union and will have to comply fully with the Water Framework and Habitats Directives. Preventing damage to river systems today will save future costs of measures to improve the ecological status and will preserve the last “river jewels” of the continent for generations to come.

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List of Acronyms

AL	Albania
AT	Austria
BA	Bosnia and Herzegovina
BG	Bulgaria
CEN	European Committee for Standardization
DEM	Digital Elevation Model
EIA	Environmental Impact Assessment
FD	Floods Directive
FFH-D	Flora Fauna Habitat Directive (Natura 2000 network)
GIS	Geographical Information Systems
GR	Greece
GWh	Gig watt hour
HR	Croatia
HU	Hungary
ICPDR	International Commission for Protection of the Danube River
IT	Italy
ME	Montenegro
MK	Macedonia
MW	Megawatt (installed power)
rkm	River Kilometer
RO	Romania
RS	Serbia (Kosovo has still no own Iso-Code)
SI	Slovenia
TR	Turkey
WFD	EU Water Framework Directive
WWF	World Wide Fund for Nature

Glossary of selected terms

Hydromorphology	The science of the physical characterisation and assessment of riverine habitats based on hydrologic, hydraulic and morphologic parameters for channel, banks and floodplain. In the meantime extended assessments also for lakes and estuaries.
Channel incision	River bed deepening by missing sediment supply from upstream (dams) and river regulation (concentration of erosion forces on the channel bottom) causing disconnection of river and floodplain and lowering of the groundwater level.
Natura 2000	It is an EU-wide network of nature protection areas established under the 1992 Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by member states under the Flora-Fauna-Habitat Directive, and also incorporates Special Protection Areas (SPAs) which they designate under the 1979 Birds Directive.

Executive Summary

Among the biggest current threats to the natural heritage of the Balkan region is a wave of planned hydropower stations. Hydropower dams have a significant impact on the river ecosystem and the longitudinal continuum for living organisms and sediments. They can also negatively impact wild terrestrial animals including large carnivores living in mountain fringes within the Dinaric Arc. This leads to a loss of ecological integrity, river degradation, and consequently a decrease in biodiversity. The study aims at providing a reliable information base to exclude ecologically valuable river stretches from harmful developments. In particular, it wants to support the identification of such “no-go areas” as demanded by European Water Directors and serve as a first step towards a “masterplan” as in preparation e.g. for Austria and Slovenia.

Methodology and range

This study is the first comprehensive attempt to provide a large-scale overview of Balkan rivers assessed by a harmonized methodology according to European standards. It analyses and ranks the hydromorphological intactness of rivers with the help of remote sensing and integrates the results with data on protected areas and major floodplains as well as information on ecology, hydropower dams, and river regulation activities. Intactness as analysed with this methodology is a good indicator for the ecological integrity and status of river systems.

The geographical area covered by the study has a length of approximately 1,300 km and a width of some 250 km and includes all countries of former Yugoslavia, Albania, and the trans-boundary catchment areas in the trilateral-region of Bulgaria, Greece and Turkey. All rivers with catchments larger than about 500 km² as well as karst poljes/floodplain areas larger than about 100 ha/500 ha respectively were included.

The following classification was applied:

	Hydro-morphological assessment class	**Conservation value** (assessment as result of overlay of hydromorphological assessment + protected areas + floodplains)
Class 1	Near-natural	**Very high**
Class 2-3	Slightly to moderately modified	**High** (river stretches crossing important floodplains/poljes/estuaries/deltas **or** overlapping with protected areas **or** both belonging to the “Very high” conservation value stretches)
Class 4	Extensively modified	**Low, but important for longitudinal continuum** (river stretches crossing important floodplains/poljes/estuaries/deltas **or** overlapping with protected areas **or** both belonging to the “High” conservation value stretches)
Class 5 Impoundments	Severely modified	**Not assessed**

Figure ES 1: Assessment and colour scheme for hydromorphology and conservation value

Hydropower dams larger than 1 MW were collected and categorised as “existing”, “under implementation” and “planned” as well as divided into three size classes (1-10 MW, 10-50 MW and > 50 MW).

Results

In total 34,468 rkm in 224 sub-catchments were assessed covering an area of 449.480 km² (larger than the size of Germany with 357.112 km²).

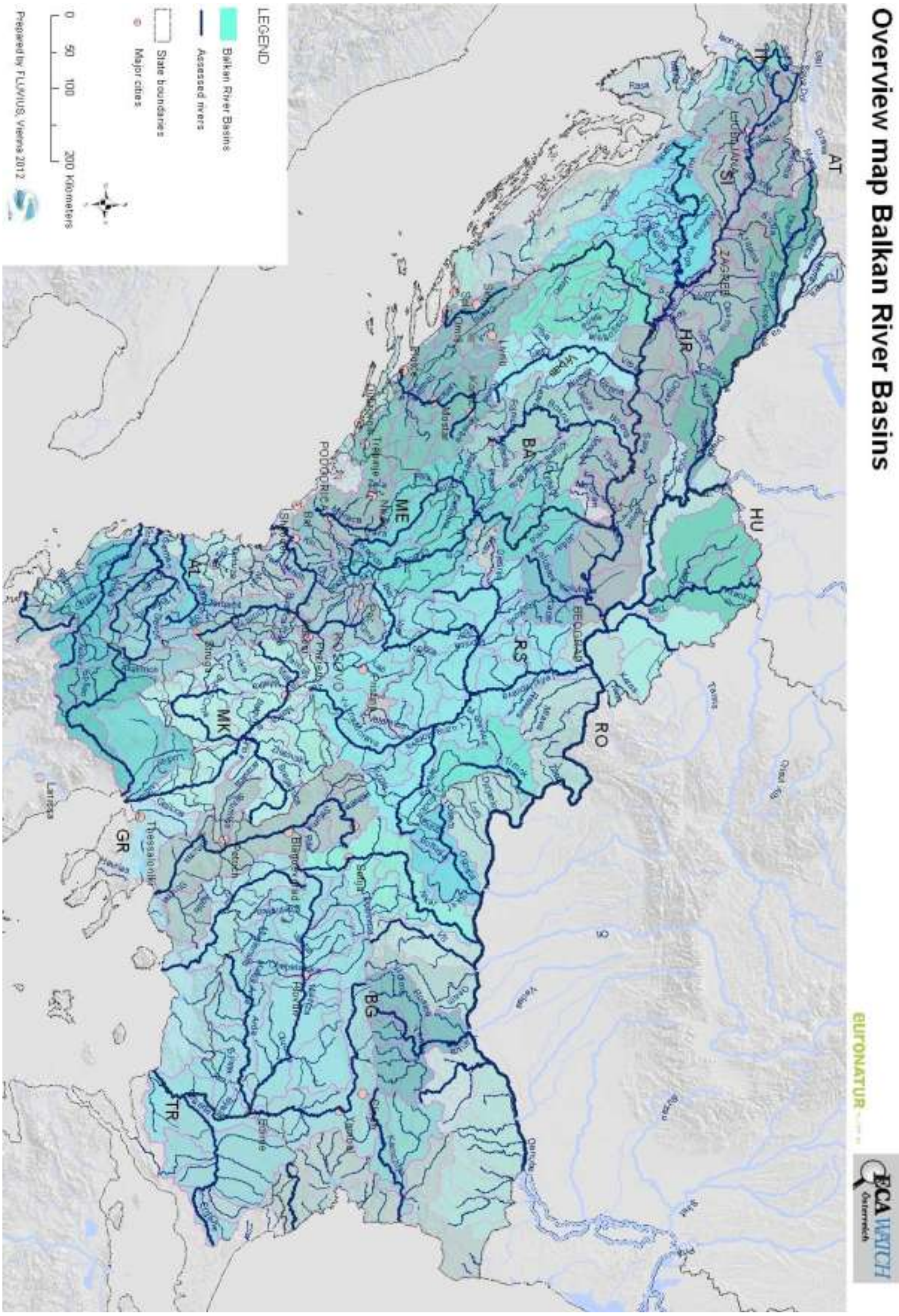


Figure ES 2: Project area (major rivers and different basins in blue colours).

Hydromorphological intactness
Overall, regions and catchments of the Balkans have retained many more largely intact river landscapes than western and central European river basins. Up to 30% of large rivers are still near-natural some even pristine and of very high conservation value, in Albania and Montenegro over 60%, while in Germany only 10%, in Switzerland 7% and in Austria 6% of the rivers are in such high state. Almost 50% of Balkan rivers are only slightly or moderately altered – in Germany, for comparison, this is the case for only 30%.

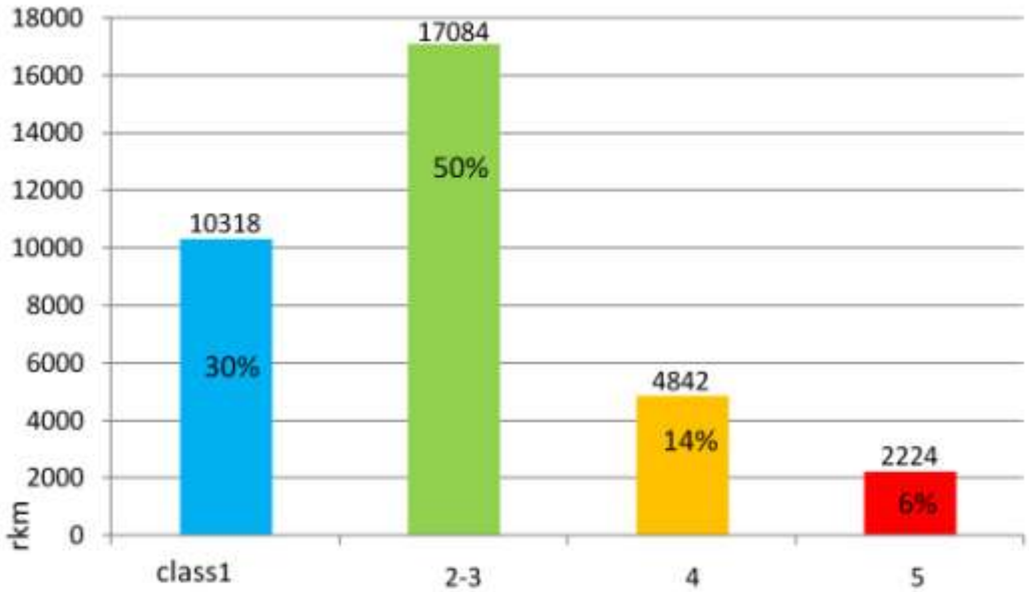


Figure ES 3: Hydromorphological assessment in rkm and percentage.

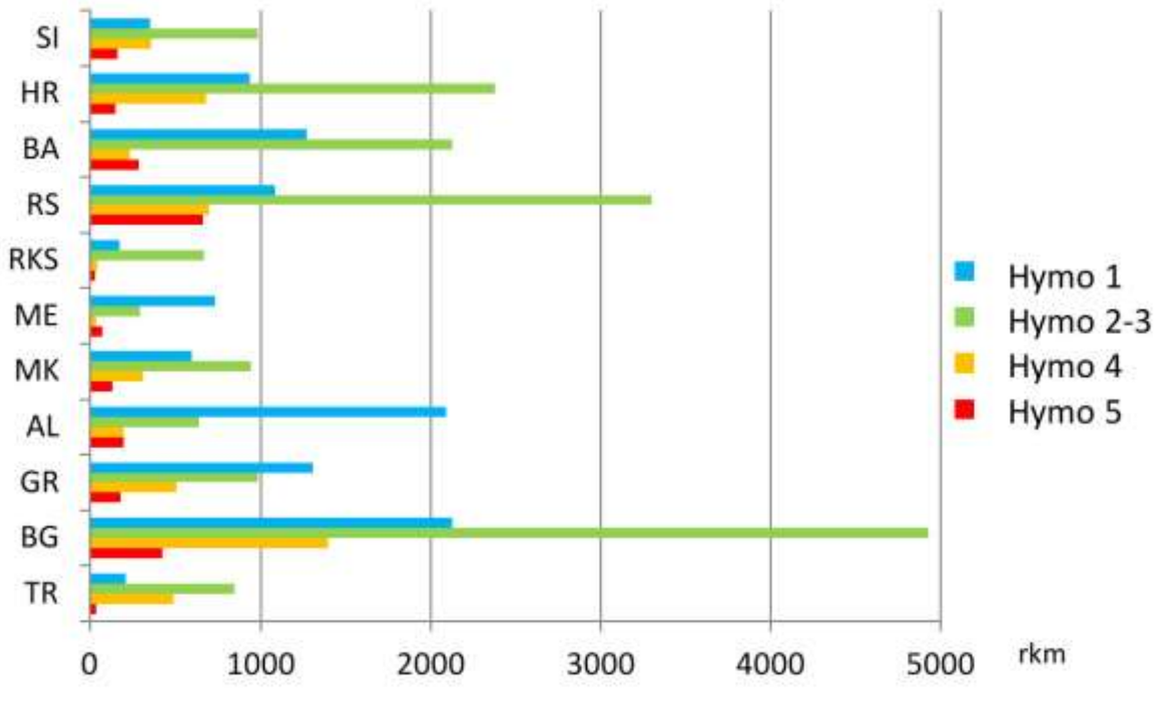


Figure ES 4: Country distribution of hydromorphological classes (for GR only the northern country part and for TR only the European part of the country, compare ES 2).

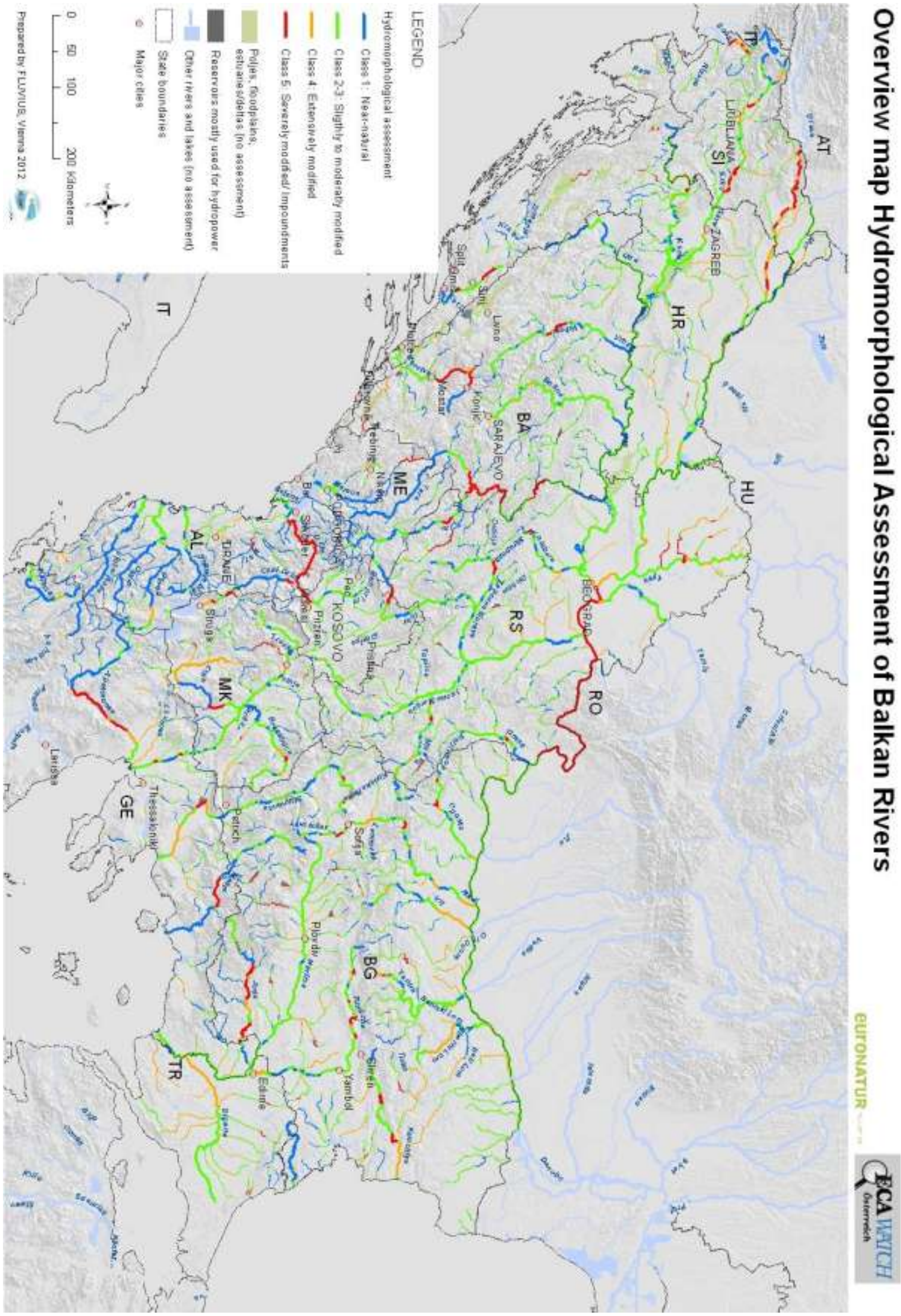


Figure ES 5: Overview map of hydromorphological assessment.

Conservation value

More than 50% of all rivers fall into the very high conservation value class. These are composed of 30% hydromorphologically intact rivers and 21% of the second class (Hydromorphology class 2-3) rivers within protected areas. 33% belong to the “high” class, 10% to the “low” class and the remaining stretches (6%) are impoundments without assessment.

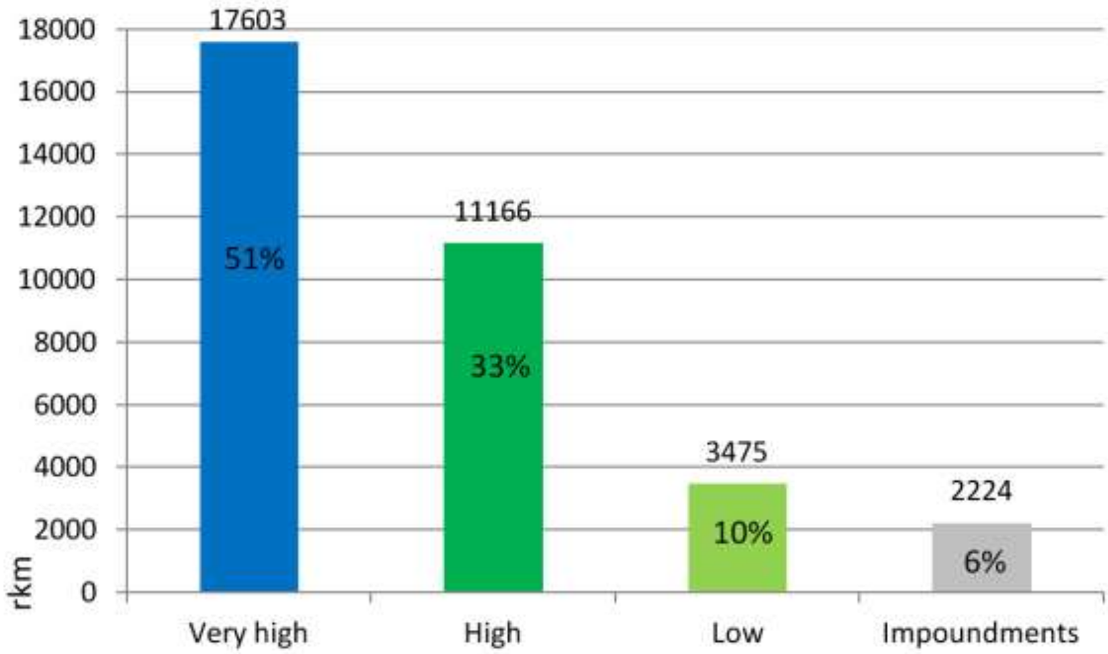


Figure ES 6: Percentage of rivers of very high, high, low conservation value and those with impoundments.

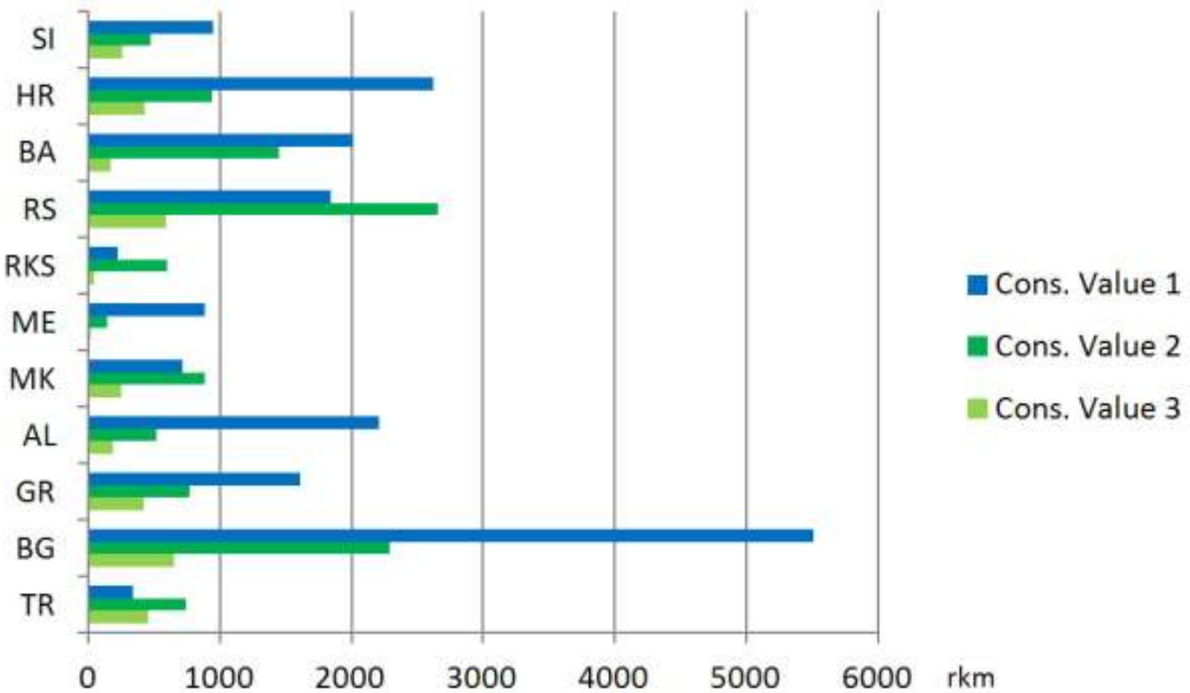


Figure ES 7: Country distribution of conservation value.

Hydropower plants
Of 861 hydropower plants with a capacity over 1 MW and sufficient information, 573 are currently planned and would impact many rivers. The remaining ones are under implementation or already in operation.

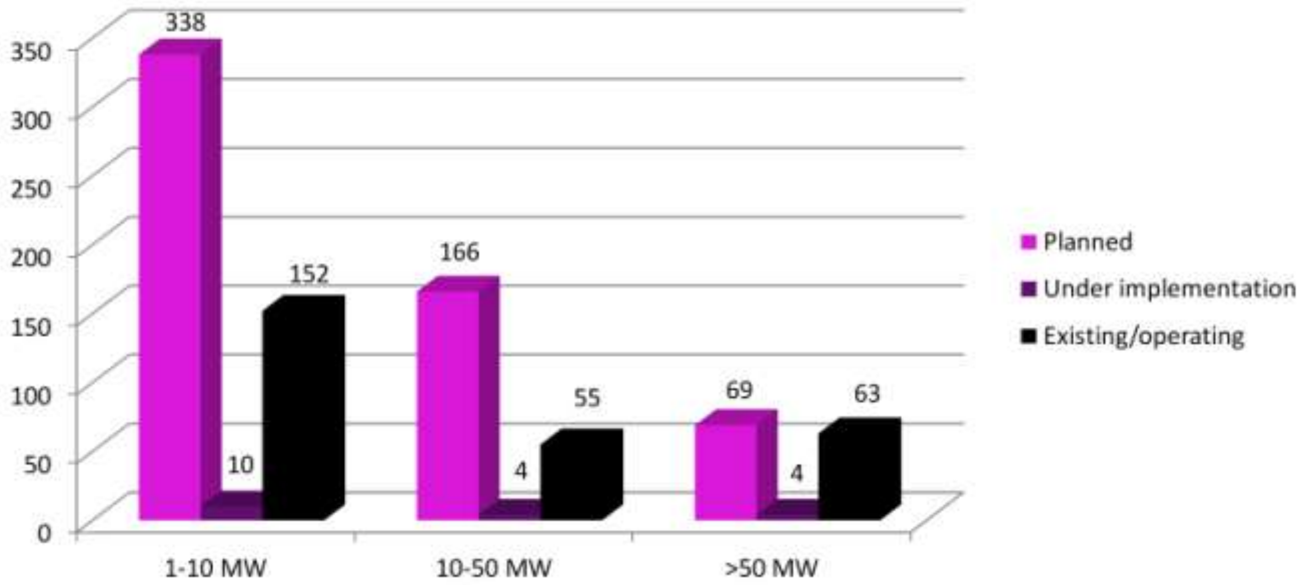


Figure ES 8: Distribution of hydropower plants.

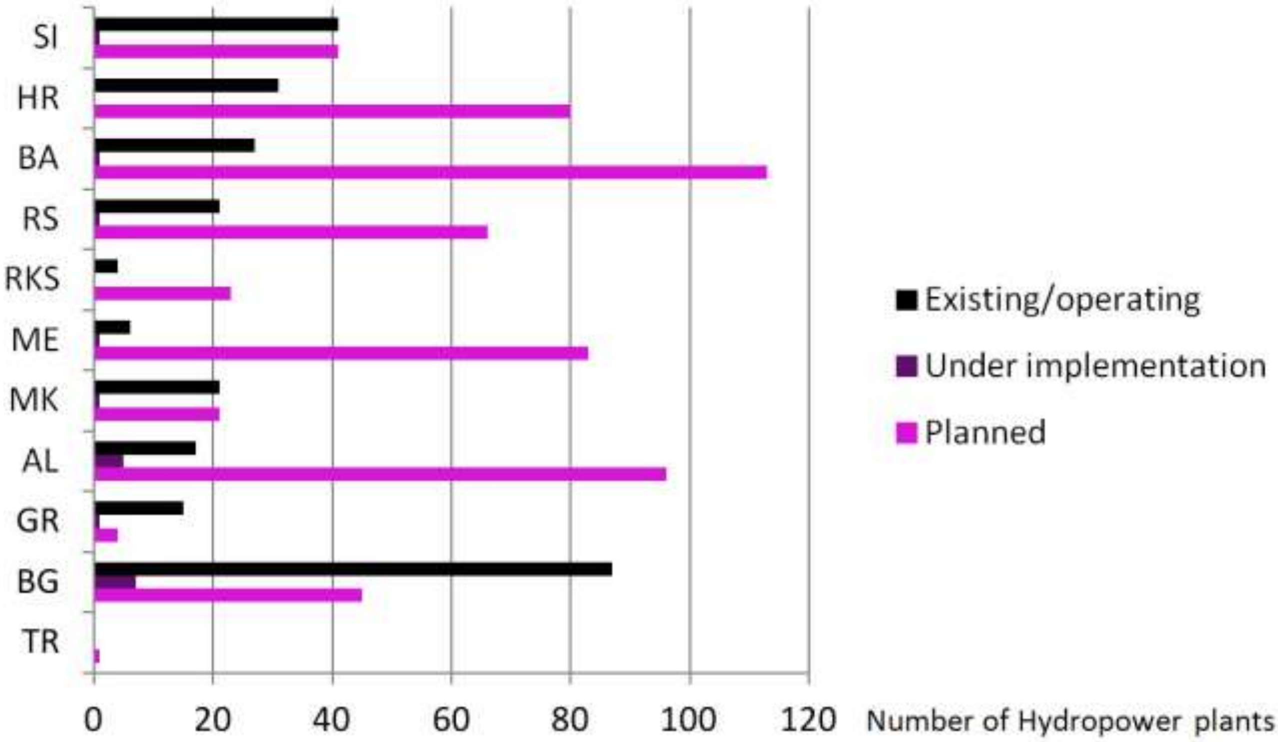


Figure ES 9: Country distribution of hydropower plants.

Planned hydropower plants and conservation value

The overlay of assessed rivers and hydropower developments show that many of the planned hydropower plants will be located in ecologically valuable areas: 71 % in river stretches of “very high” and 23% in “high” conservation value. The expected damage to river ecosystems is consequently particularly high. This threat appears to be highest in Albania and Montenegro, in particular regarding the fragmentation of currently still entirely free flowing rivers.

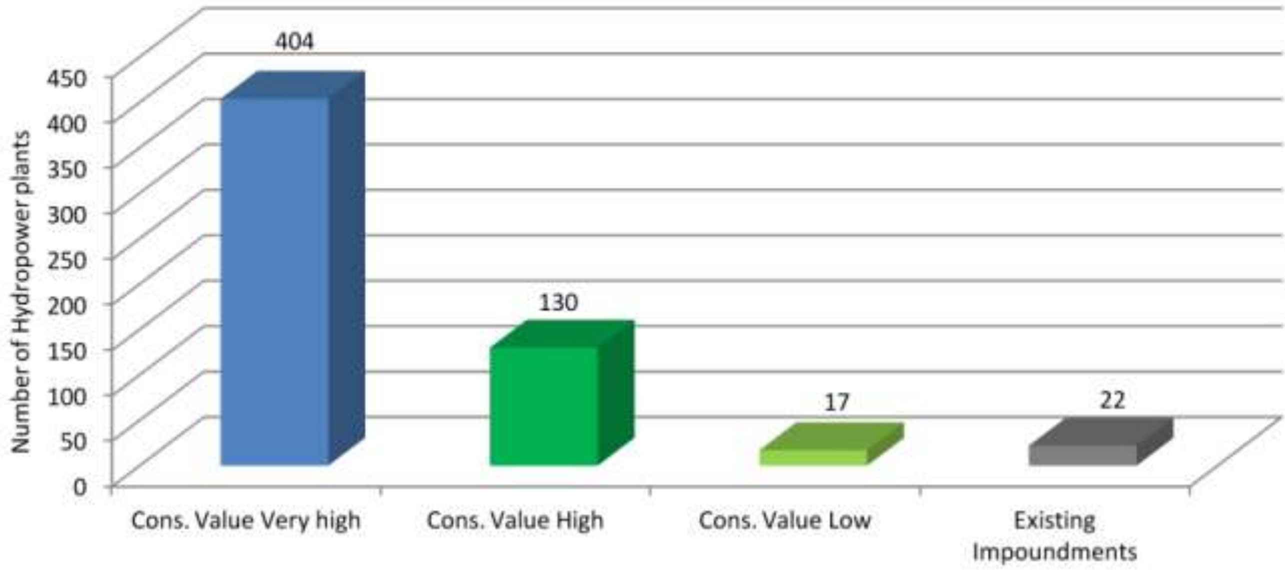


Figure ES 10: Number of planned hydropower plants that would affect very high, high and low conservation stretches.

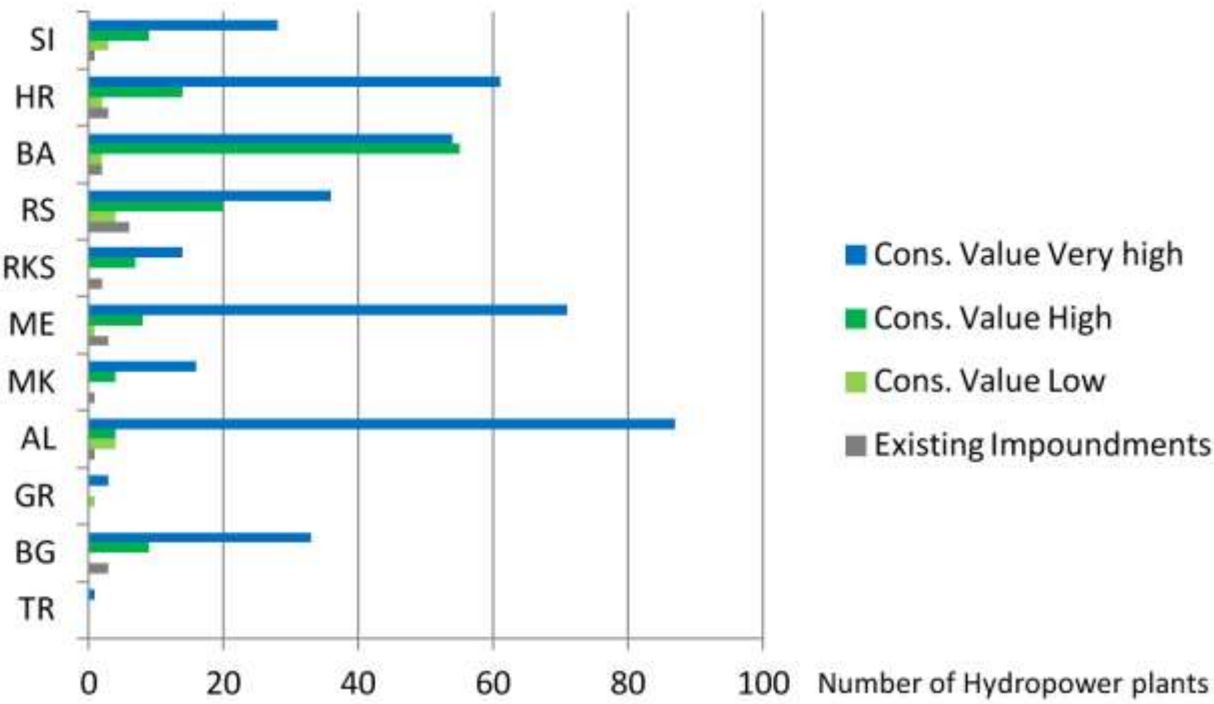


Figure ES 11: Country comparison highlights the high number of hydropower plants affecting pristine rivers in ME and AL.

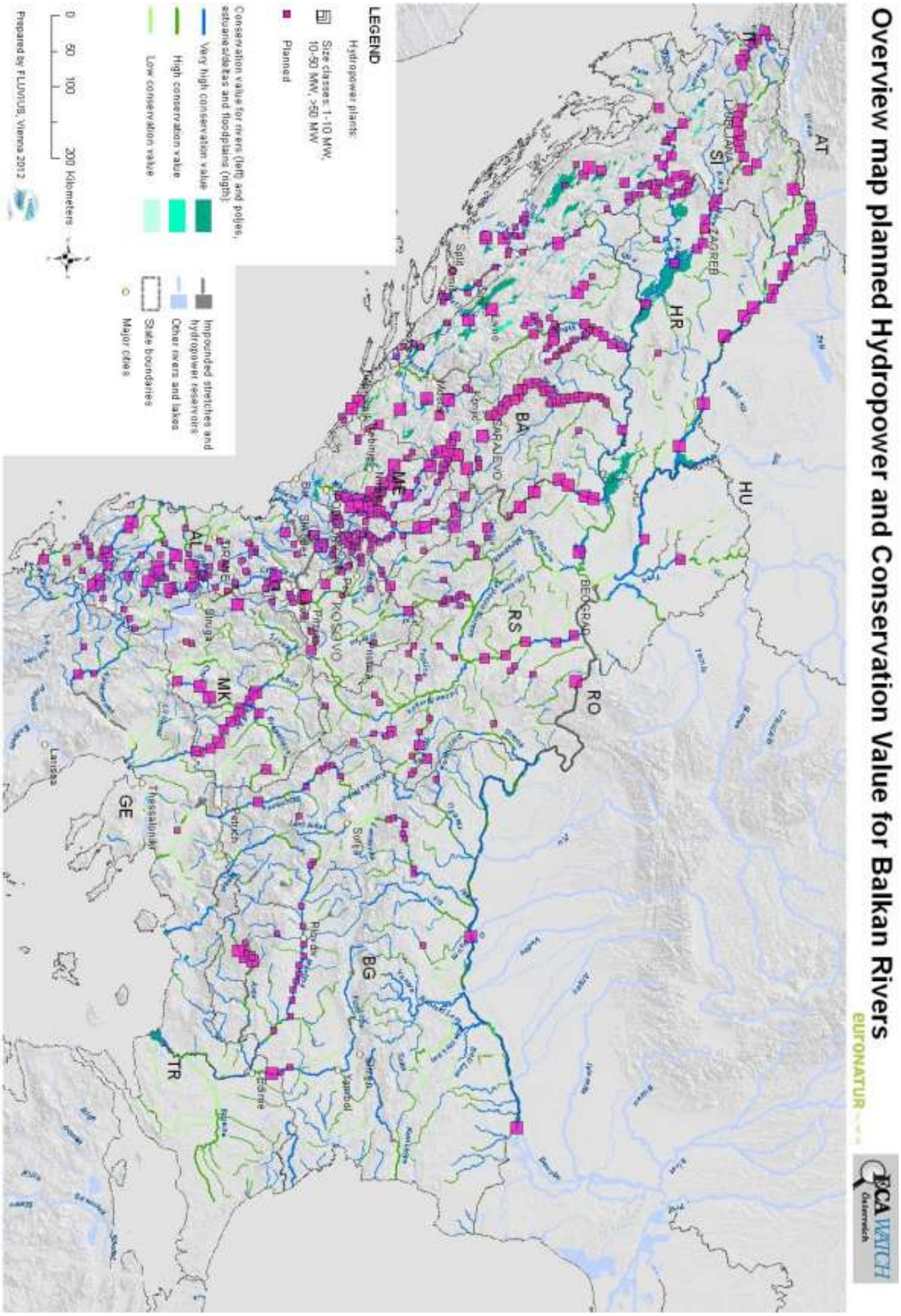


Figure ES 12: Affected very high and high conservation stretches by planned hydropower plants for the entire project area.

The enormous richness of karst waters and river systems provide home to a unique and globally endangered endemic fish and molluscs fauna (e.g. Softmouth trout, Marble Trout, Dalmatian barbel gudgeon, Greek brook lamprey). In some river basins more than 50 % of the fish species are endemic. This makes the region one of the densest areas of fish endemism in overall Europe and therefore one of the priority ecoregions for biodiversity conservation globally.
The numerous planned hydropower plants would severely impact these rivers. So far number and locations of new dams are concentrated on maximum energy exploitation not following ecological planning principles. Intact river landscapes are not "renewable" and ecological compensation measures can never fully balance the loss of biodiversity. Therefore priority should not be given to building new hydropower dams, but upgrading existing ones and lowering increasing energy demand by raising energy efficiency, for which the potential in the Balkan region is huge. Developing and using ecologically sustainable alternative sources such as solar power is particularly high in this part of Europe. Existing dams should mitigate impacts, e.g. by being made passable at least for fish, better also for sediment. While river landscapes of highest conservation value should not be developed at all, those of lesser value are not necessarily recommendable for development.

Most threatened major rivers
In Slovenia and Croatia on the lower Mura and Drava Rivers, in total 17 new dams are planned and would be in contradiction to a planned trans-boundary biosphere reserve. Furthermore, Slovenia wants to develop many more power stations on the upper Sava and together with Croatia along the upper Kolpa/Kupa. For the lower Sava in Croatia several new large dams are planned partially in conjunction with navigation. In Bosnia the Vrbas and Bosna rivers, are expected to be turned into canalized chains of hydropower plants. The lower Drina in Serbia - a unique remnant of a meandering large gravel dominated river - might be developed for hydropower exploitation. Many narrow river valleys such as along Ibar in Serbia would be turned into chains of hydropower plants. The nearly untouched upper courses of Moraca and Tara in Montenegro are subject of ambitious plans which would disconnect the upper river systems of Moraca towards Scutari Lake and Adriatic Sea. Two large braided rivers in Albania, the Vijosa and Devoll Rivers, will be interrupted by major dams. The still free-flowing Vardar River in Macedonia would be turned into a hydropower cascade. In Bulgaria the Struma could be disconnected systematically by new dams. Lower Danube is threatened by two mega projects impounding some 500 rkm. Dams on lower Veliki Morava in Serbia and one on lower Tundzha River on the Bulgarian-Turkish border will interrupt large river systems.

Conclusions
Balkan rivers can be rightly called as "Blue Heart of Europe" still offering a tremendous ecological value with its specific endemic biodiversity unique for Europe, grown over millenniums. Now in 2012, these river lifelines are faced with a rapid development of hydropower plants, interrupting the river continuum, impounding free-flowing rivers and impacting nearly all remaining free-flowing stretches and karst underground waters within only one decade of construction. If all construction plans will be realised the Balkan rivers will definitely lose its prominent position among Europe Rivers.
This study can only provide the basis for complex political decisions that need to be reached with stakeholder involvement. It hopes to give momentum to the important identification of "no-go" areas.

1. Introduction

This study is the first comprehensive attempt to provide a large-scale overview of Balkan rivers assessed by a harmonized methodology according to European standards. It analyses and ranks the hydromorphological intactness of rivers with the help of remote sensing and integrates the results with data on protected areas and major floodplains as well as information on ecology, hydropower dams, and water management activities. Intactness as analysed with this methodology is a good indicator for the ecological integrity and status of river systems.

The geographical area covered by the study (see figure 1 on next page) includes the Western Dinarides adjacent to the Julian Alps in Slovenia, the Central and Eastern Dinarides, the Albanian mountains, which rise up to 2,754 m, the Šar-Planina-Pindos-Systems, the Western and Eastern Balkan mountains (up to 2,276 m) and in the south the Rila and Pirin mountains as well as the Rhodops. The total area thereby has a length of approximately 1,300 km and a width of some 250 km and includes Slovenia, Croatia, Bosnia & Herzegovina, Serbia, Montenegro, Kosovo, Macedonia, Albania, and the trans-boundary catchment areas in the trilateral-region of Bulgaria, Greece and Turkey.

The number of covered bioregions is high: Alpine, Western and Eastern Dinaric, and Eastern Balkan bioregions, the Mediterranean bioregion along the coast, and the Pannonic and Illyric regions to the north. The largest river catchments are those of the Sava (west) and the Maritza (east), which reaches into the territory of Turkey.

The largest part of the study area is covered by non-EU Member States, which do not have to collect and publish consistent and comprehensive data as prescribed by the Water Framework Directive and the Habitat Directive. The assessment of rivers in the Balkan region is therefore raw, but robust enough to provide reliable results.

The following chapter 2 of this study outlines in detail the applied assessment methodology. Chapter 3 presents results. It gives an overview of surveyed rivers, shows the hydromorphological status and provides information on protected areas and major floodplains. The assessment of the conservation value is overlaid by an inventory of planned and constructed hydropower plants.

The last chapter concludes on the main threats and ecological status of the Balkan region and gives first management recommendations.

The annexes provide detailed information on river systems of high conservation value and hydropower plants.

The presentation of “River Jewels” and threats illustrated by images are collected in the separate “River Catalogue”.

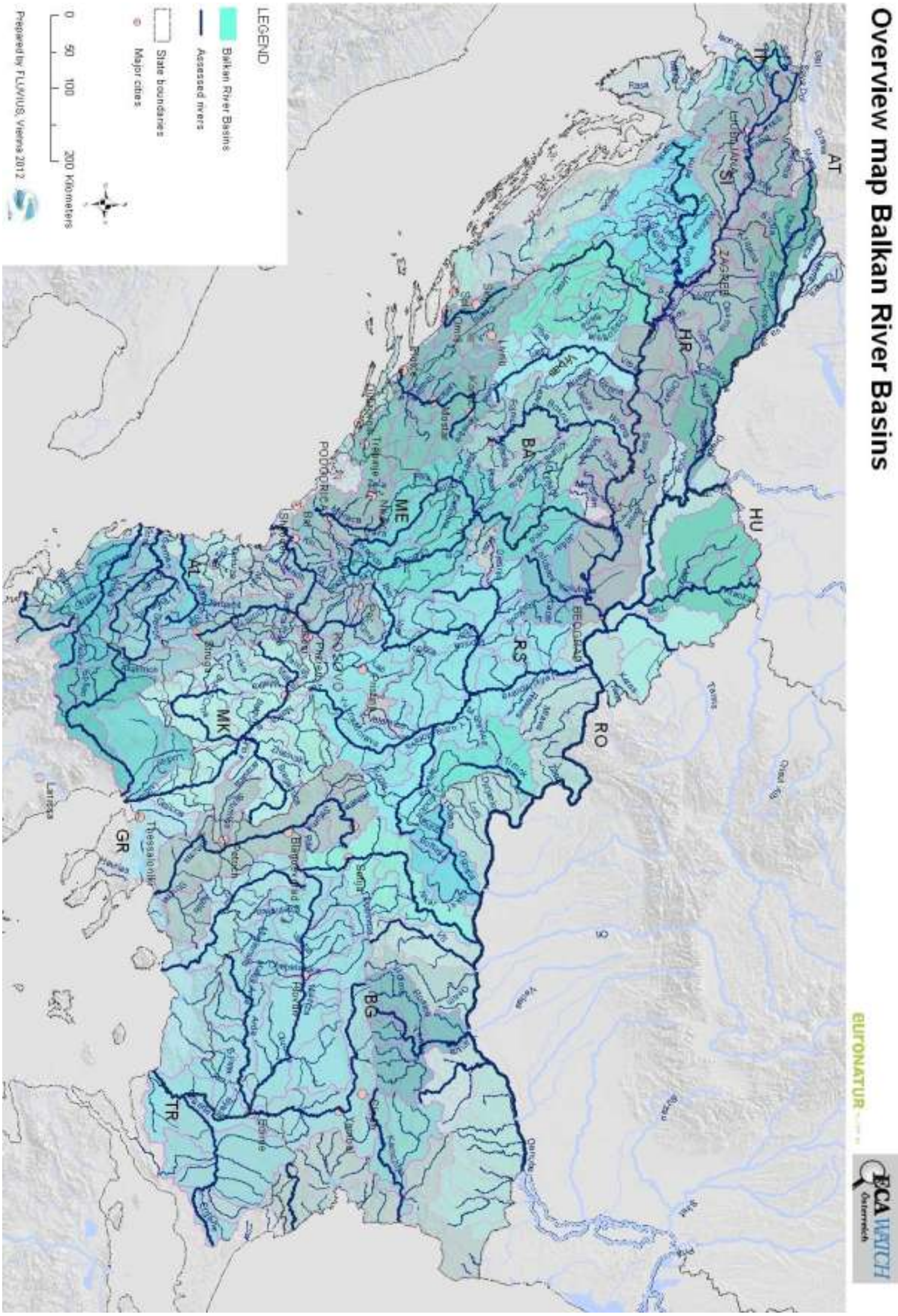


Figure 1: Overview map of covered area (major rivers and different catchments in blue colours).

2. Methodology and Assessment

2.1 Methodology

Regarding the survey and mapping of rivers in the Balkan countries, no commonly used tools and methods such as those based on the Habitat Directive and WFD have been applied until now. However, nature protection agencies and NGO's collect important data on different scale and level, e.g. for national nature conservation planning. The EMERALD network – largely in line with EU practices - covers most of the Balkan countries. Other examples are Ramsar sites and IBA (important bird areas of BirdLife). In the water sector hydromorphological assessments are still underdeveloped, detailed field survey data missing nearly at all. In most of the countries at least raw "risk assessments" about the hydromorphological pressures exist but with different methodology and without direct comparability. If rivers are trans-boundary national water management collaborate more or less e.g. through border commissions concerning hydropower plants, reservoirs, river regulation and sediment exploitation.

The aim of the assessment is therefore not to develop some completely new approaches but to base it on reliable robust indicators of hydromorphology overlaid by nature protection as well as important floodplains and deltas/estuaries as well as poljes to describe the "conservation value". Plenty of regional, national and international studies have been used to compare and calibrate the applied methodology and the results. The chosen approach cannot and will not substitute national inventories, river basin descriptions and assessments as required by WFD or the Habitat Directive, but it highlights the importance of spending more efforts on systematically assessing rivers, enlarging protected areas and improving their management.

The methodology is based on investigations and assessments concerning the hydromorphological and ecological intactness of rivers, estuaries/deltas, poljes (without underground karst river systems) as well as inventories of the existing and planned hydropower plants. The direct use of the ecological status (WFD) and water pollution was limited due to the lack of available data (only EU countries SI, BG and GR) and the limited evidence for terrestrial habitats such as divers wetlands as being part of this assessment. The results highlight among the entire drainage network those stretches of very high conservation values that are presently endangered by hydropower development and other hydromorphological pressures.

The geographical scope comprises the countries of Slovenia (SI), Croatia (HR), Bosnia & Herzegovina (BA), Serbia (RS), Montenegro (ME), Kosovo, Macedonia (MK) as well as parts of Bulgaria (BG), Greece (GR) and Turkey (TR) (compare figure 1).

All rivers with catchments larger than 500 km² and in some cases due to importance of river and new hydropower projects also smaller catchments (some 100 km²) were included. River stretches to be included are longer than 5 rkm and floodplain areas are larger than 500ha (surface karst water systems/flooded karst poljes must have 100 ha). Several significant smaller areas summing up to 5 rkm or 100 ha have been merged.

The final analysis results are visualised in maps by coloured river stretches indicating the respective information (hydromorphological intactness and conservation value) allowing the calculation of balances by rkm for each country (or catchment which can be implemented in a later stage/project).

The results of the assessment can provide the basis for defining “No Go Areas” for future hydropower and other developments and to propose new and better protection status for those stretches with the highest conservation value.

2.2 Assessment of rivers

2.2.1 Hydromorphological intactness

In the WFD, hydromorphology serves as additional supporting assessment to underline weak results of the BQE (biological quality elements) and should be monitored every 6 years. Basically the “hydrological regime” (quantity and dynamics of water flow, connection to groundwater bodies), the “river continuity” as well as the “morphological conditions” (river depth and width variation, structure and substrate of the river bed as well as structure of the riparian zone) are directly mentioned in the directive.

Since 2004 the CEN Framework standard for the survey of hydromorphological features (CEN 2004) has been in use. It is based on the long time experience and method developments in United Kingdom, France, Germany, Italy and Austria (compare also Schwarz 2007 and 2008 for method review and application, e.g. Schwarz 2010). This framework standard outlines the assessment of river channels, banks and floodplains. Floodplain assessments are not required by WFD, but are an important unquestionable integral part of hydromorphological assessments of the entire river-floodplain-system.

The formerly used seven class systems (compare figure 2 on next pages) of hydromorphological and synonym “ecomorphological” assessments in the German speaking countries as well as the scoring-based systems in UK and France, were adapted to the WFD five class systems (ecological status assessment):

Class 1=Pristine and near-natural (WFD: reference conditions, status “high”)
Class 2= Slightly altered (as derivation from class one by human interventions, valid for all following values; WFD: “good”)
Class 3= Moderately altered (WFD: “moderate”)
Class 4= Strongly altered (WFD: “poor”)
Class 5= Totally altered (as the worst conditions, e.g. if rivers a turned into impoundments; WFD: “bad”)

For this study a hydromorphological assessment was applied to free-flowing river stretches, based mostly on the visible (satellite and ground images) hydromorphological intactness supplemented by different technical and local information, e.g. on dams, river regulation, water abstraction and landuse such as dense settlements, infrastructure etc. The evaluation is based mostly on

a) visual interpretation of available high resolution satellite and field images (channel with planform and in-channel features such as bars and islands as well as floodplain (landuse) characteristics; banks cannot be easily assessed based on this resolution or if they are covered by tree canopies)

b) expert judgments relying on the supplementary technical information for each river (over 15 years many field visits in most of the countries underline the assessment)

Based on the 5-class system the following simplified classification is used:

Class 1: The attention of this study was set to identify river stretches with still pristine conditions (only headwaters and some selected smaller catchments) but in particular of near-natural local conditions. “Near-natural” characteristics imply remote human changes e.g. of sediment and hydro regime in upper stretches but they usually provide all natural habitats in sufficient quantity and quality.

Class 2-3: Characterises slightly and moderately altered river reaches by river regulation, e.g. passable longitudinal continuum interruptions such as small ground sill in upper courses, or long reaches without dams in lower reaches, altered river planform (braiding or meandering characteristics), bank reinforcements only partially and riparian zone reduced only by some flood protection dikes. The reason to merge the second and third class is the difficult determination in detail (in particular for banks), which would require more field work. However, many third class stretches would have a great restoration potential and are the first to be subject of measures under the WFD.

Class 4: Strongly altered river stretches mostly in towns or between infrastructures; no specifically attention was set to this class in the inventory, however passable for migratory fish.

Class 5: Impoundments and in some specific cases diversion stretches and artificial canals.

Hydromorphological assessment class	Description
Class 1	Pristine and near-natural
Class 2-3	Slightly and moderately altered
Class 4	Strongly altered
Class 5 Impoundments	Totally altered

Figure 2: Hydromorphological assessment and examples as illustration

Rivers were subdivided into assessment stretches based on the overall geomorphology, slope and catchment characteristics as well as existing pressures e.g. impounded reaches or strongly altered “town”-reaches on the one hand and near-natural stretches on the other hand. The basic minimum length criterion was some 10 rkm.

For estuaries and deltas only a raw complementary hydromorphological assessment was done (visualisation like rivers). Main parameters are the degree of bank reinforcement, the longitudinal and lateral connectivity (in particular for lagoons and deltas) and the visible morphological activity, such as sediment bars towards the pro-deltaic zone, as well as the adjacent vegetation/landuse.

The hydromorphological intactness of karst poljes (assessment was skipped) is even more complicated due to missing data about duration and dynamics of flooding and can be estimated only based on typical landuse pattern (grasslands, water bodies, forests, landuse (in particular degree of drainage)).

The usage of remote sensing, even with very high resolution data is limited to visible hydromorphological features for rivers but well developed for wetlands in general. Therefore the usage of complementary data, in particularly regarding the hydrological intactness (water abstraction, hydro regime) as well as “ground data” such as images and reports are essential for the final assessment.

Regarding the ecological status (WFD) and the degree of pollution no further investigations or data intersection/comparisons were made as explained due to the limited data availability and evidence for the physical habitats, but also due to the fact that hydromorphological intact rivers have a great ability for self-purification and provide diverse habitats for respective biological indicator species and BQE assessed under the WFD. Finally, hydromorphology can be seen as limited but useful indicator to assess the overall status of rivers and that’s the task of this study. Wherever possible (Drava, Mura, Danube) existing hydromorphological inventories are used (Schwarz 2007, ICPDR 2008).

The European context

Methodology and results (chapter 3) can be compared to those of similar European studies. Figure 3 and 4 on next pages show the overview of the German hydromorphological assessment done about 10 years before in the formerly used seven class system. It shows the high number of severely altered rivers (classes 5-7) with about 60% (former western Germany would reach 75%) in total. The legend (Figure 2) includes also a short description of the classes. The class 1 corresponds directly with the WFD class 1 the class 2 (1-2) as well, the class 3 (2) and 4 (2-3) correspond to WFD class 2, the class 5 is the third WFD class, 6 is fourth and 7 is fifth WFD class.

The results for Germany corresponds with the very first published European wide overviews: Nearly 30% are designated as HMWB (heavily modified water bodies), meaning classes 4 and 5 WFD (respectively classes 6 and 7). An average of 40% of surface water bodies in the EU have been identified as being at risk and around 30% as not being at risk of failing to achieve the environmental objectives by 2015. For the rest of surface water bodies (around 30%), the result of the risk assessment is not conclusive due to insufficient data putting a spotlight on missing quality and methods

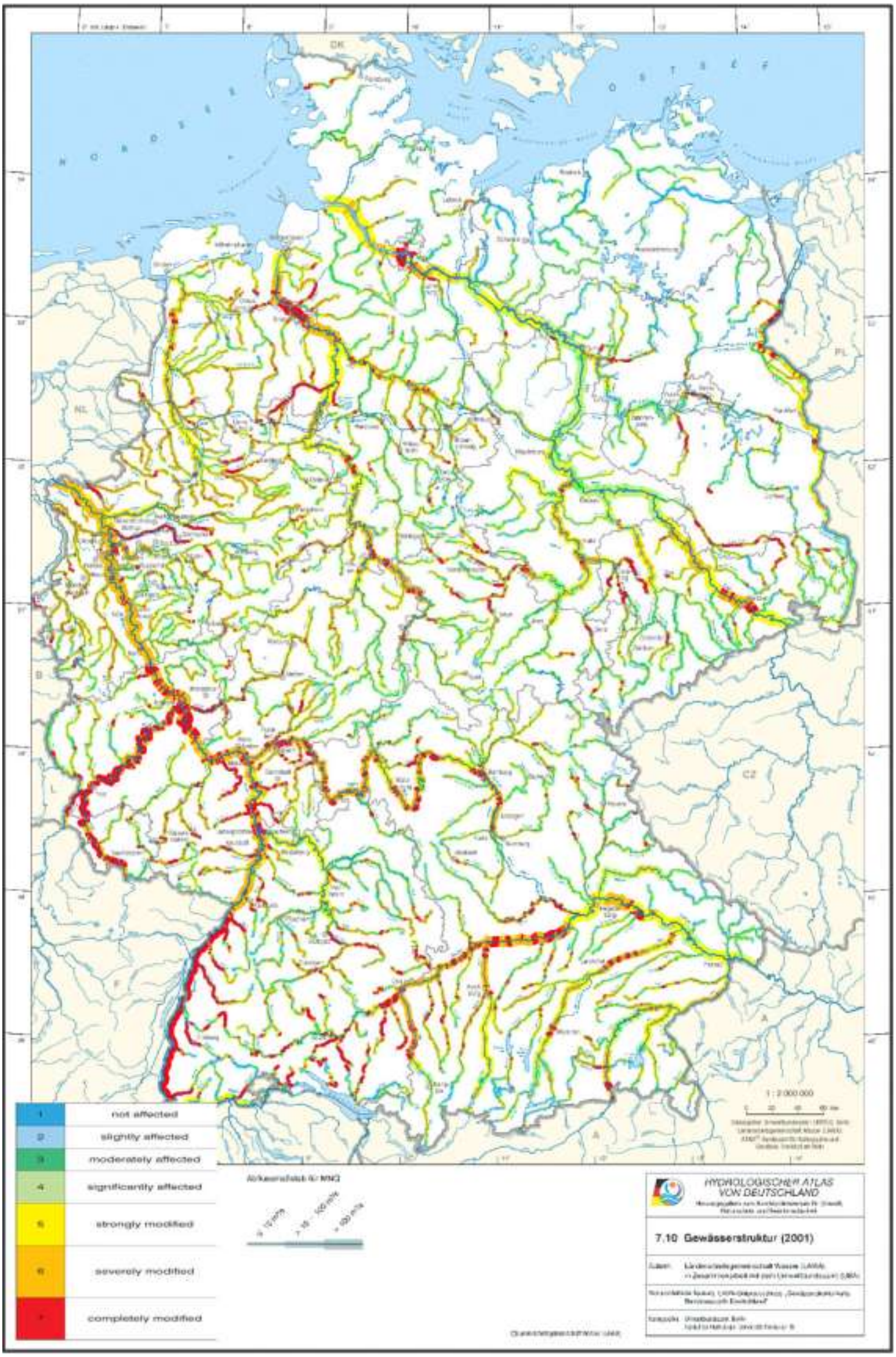


Figure 3: Hydromorphological inventory for Germany (as representative for most of the western European countries), assessed main river network is 33,000 rkm, HAD 2003.

class	classification of hydro-morphological features	short description	year 2001
1	not affected	The hydromorphological features are comparable to the potentially natural state.	2%
2	slightly affected	The hydromorphological features are slightly affected by singular, local influences.	8%
3	moderately affected	The hydromorphological features are moderately affected by several local influences.	11%
4	significantly affected	The hydromorphological features are significantly affected by several impacts, e.g. in bed, banks, by impoundments and/or uses in the floodplain.	19%
5	strongly modified	The hydromorphological features are modified by a combination of impacts, e.g. in course, by bank impairments, transverse bars, impoundments, flood protection measures and/or uses in the floodplain.	27%
6	severely modified	The hydromorphological features are severely changed by a combination of impacts e.g. in the course, bank impairments, transverse structures, impoundments, flood protection measures, and/or uses in the floodplain.	23%
7	completely modified	The hydromorphological features are completely modified by impacts on course, by bank impairments, transverse structures, impoundments, flood protection measures and/or uses in the floodplain.	10%

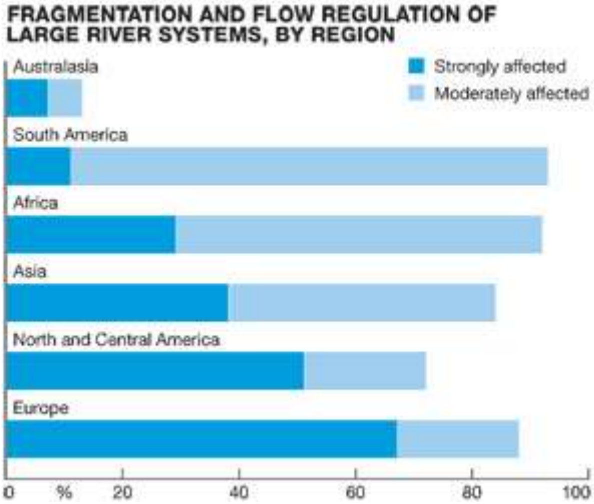
Figure 4: The formerly used seven class assessment schema (e.g. used in Germany and Austria): River stretches with very high conservation value fall mostly into the „blue“ classes meaning in total only some 10% of all rivers still provide the conditions for very high conservation values.

related to hydromorphology across Europe (EC 2007). A raw deficit analysis is e.g. given for HR by an EU Twinning Project (EU 2009). Transboundary comparisons of hydromorphological methods and results are very important (e.g. Weiß et al 2008) and basically show the compliance and their relation to the WFD, in particular to the BQE (fish, macrophytes and partially macrozoobenthos are highly correlated to hydromorphological conditions). International analysis such as ICPDR 2009 and 2010 at least underline the situation by hydromorphological risk assessments and longitudinal continuity as well as lateral connectivity summaries.

Regarding hydropower, several alpine countries such as Austria and Slovenia are working on so called master plans. In addition to purely technical and economical assessments, ecological analyses become more and more important. In 2009 WWF Austria published an eco-master plan based on the results of the ecological status assessed under the WFD and other criteria (conservation value). Regarding impacts of new hydropower plants recent studies show exemplary for the impact of impoundments how many rivers (rkm) would need to be impounded to realise the proposed potential for hydropower (Schmutz et al. 2010). This analysis initially didn't assess sufficiently hydropeaking, residual river stretches or the impact regarding sediment continuity. However the plans in Austria would need in most cases exemptions (overriding public interest after WFD) because the ecological status will be definitively lowered.

The worldwide context

Discussing the fragmentation and flow regulation by dams and impoundments on a worldwide level, Europe reaches a top position (see Figure 5). This is not surprising as Europe is populated densely and the development of hydropower has a long tradition.
The degree of decline of freshwater biodiversity is shown in Figure 5 since 1970 when a massive dam development period started. But the general decline of riparian habitats and its biodiversity originate also in river regulation, agricultural land reclamation and over-exploitation of resources (waste water, irrigation, and sediment extraction).



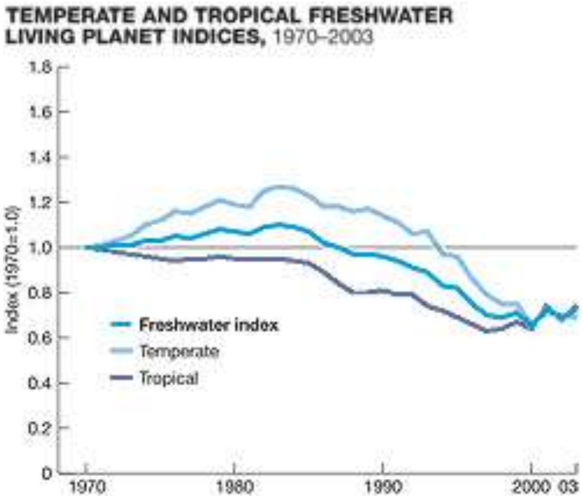


Figure 5: Fragmentation distributed by continents (left) showing already the highest fragmentation for Europe and global decline of freshwater living planet index an indicator for freshwater biodiversity (population of 344 representative freshwater species (287 in temperate zones and 51 in tropical zones) decline for some 30% from 1970-2003, WWF 2003 (until 2007 almost 35 %, WWF 2010).

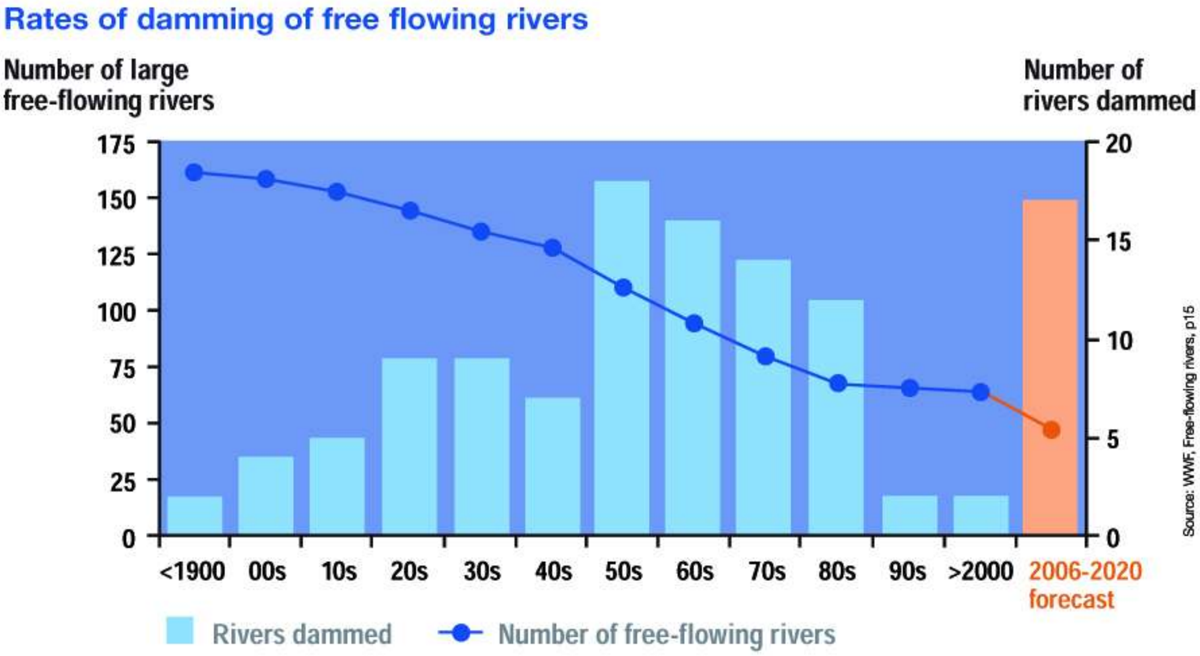


Figure 6: After the strong hydropower development of the 1950-1980ties and for the next 10 years a significant acceleration of construction can be observed (WWF 2006).

2.2.2 Important floodplains

Major and important floodplains along the rivers can be seen as another indicator for a high biodiversity in the riparian corridors and therefore raising the "conservation value" of adjacent river stretches. The main criterion is the type specific size, meaning naturally small intact floodplain areas along upper and middle courses have a similar importance than those large floodplains along lower courses. The minimum size is larger than 500 ha and for the karst poljes as special type some 100ha respectively 20 ha for those areas taken from Stumberger (Stumberger 2010).

As second criterion, qualitative aspects such as the occurrence of red list species and habitats based on literature sources were taken into account.

2.2.3 Protected areas

Protected areas are based for EU (SI, BG, GR) and accession (HR) countries on the existing Natura 2000 network, for all other countries on national inventories. The type and IUCN protection level as well as detailed area description and management plans were recorded where ever possible, however for the final assessment only the spatial overlay was used. The coverage is very heterogeneous and many river valleys are still not protected, although protected areas officially planned for protection are included.

2.2.4 Conservation value

The "conservation value" is focusing on the hydromorphological intactness of the ecosystems continuously overlaid by important floodplains and protected areas and finally supplemented by biological data. Biological data was not included in the assessment due to non-harmonised and missing data sources. However a parallel investigation by Freyhof 2012 on endemic fish and molluscs species improve the picture and highlight the tremendous importance on European even on worldwide scale. Stretches and areas with a resulting "very high" conservation value are of particular interest for nature protection but also "high" conservation value stretches and areas can be important and should be managed carefully and sustainably. Also entirely free-flowing catchments should be considered critically. The "low" value implies strongly altered stretches which have only limited ecological functions but can be also important as "free flowing" stretches for migratory species.

River stretches of highest conservation priority fall into the first class and are characterized by near-natural conditions (Figure 7). However, the situation is not always clear-cut. On the one hand, as for hydromorphology, areas upstream of dams sometimes are near-natural whereas the downstream reaches are often subject to substantial channel degradation. On the other hand, long- and middle range migrating fish species can be found downstream if no further dam is disturbing the longitudinal continuum, but upstream those species disappear even if hydromorphology is intact. Therefore, only the downstream effects can be captured directly by hydromorphology (see more details in the following chapter 3.2.2). The approach furthermore highlights catchments without barriers and includes biological data (e.g. IUCN Mediterranean Fish study 2006, Freyhof 2012) to underline the conservation value exemplarily.

Hydromorphology class	Conservation value
Class 1: Pristine and near-natural (>10 rkm)[1]	**Very high**
Class 2-3: slightly and moderately altered (>10 rkm free-flowing) [2]	**High with restoration potential** (river stretches crossing in **addition** important floodplains **or** overlap with protected areas **or** both will fall in the highest conservation value)
Class 4: Strongly altered	**Low, but important for longitudinal continuum and certain restoration potential** (can be rise to “”high” as previous class 2-3), e.g. the residual water stretches with strongly altered hydro regime falling into protected areas such as along the Drava hydropower plants in SI and HR raise to the second class the “high” conservation values)
Class 5: Impoundments	**Not assessed**

Figure 7: Assessment of the conservation value

Reservoirs (artificial lakes of hydropower plants) were not assessed; in most cases those artificial lakes destroyed river valleys, although for migratory birds they can have an important resting and feeding function, which gives some of them a certain conservation value, such as Buško Jezero in Bosnia, in the Livanjsko polje area. Another special case are salinas such as the Salina Ulcinj in Montenegro which have indeed often a very high conservation value for birds. De facto Salinas are artificial and cover former lagoon areas. Even those “exemptions” clearly underline the importance of wetlands for nature conservation on a European as well as worldwide level. In the coverage of protected areas those areas are included.

Data on poljes as typical karst landscape forms in particular in the western and central Balkan for continuous karst areas were taken from Stumberger (2010), who mapped and investigated poljes regarding their basic flooding dynamics. Often local karst streams or even larger rivers with extreme discharge dynamic - from nearly dry to some hundred m^3/s during flood season - strongly influence the surface flooding of karst poljes. For this study, only poljes with at least partial seasonal flooding were taken into account. Poljes with only partial flooding where included into the second class of high conservation value; if those areas are part of protected areas they fall in the very high class. Poljes, which are mostly flooded, fall directly into the very high class.

[1] Including underground karst river stretches (if no water will be abstracted for reservoirs and hydropower plants); for larger rivers > 500 km^2 a length of about 20 rkm was considered (10 rkm plus 10 rkm class 2-3 stretches down or upstream), for smaller rivers (< 500 km^2) the minimum size was reduced to some 5 rkm (class 1 stretches), also to cover short but water rich karst tributaries)
[2] Including underground karst river stretches (if no water will be abstracted for reservoirs and hydropower plants)

2.3 Assessment of hydropower dams and other impacts

Hydropower dams were collected in three basic categories: Existing, under implementation and planned. Many of the planned projects are already ratified by national and regional parliaments and planning work and EIAs are already ongoing.

Three size classes were distinguished (installed power 1-10 MW, 10 -50 MW and > 50 MW). HPP's smaller than 1 are not covered by this inventory. The initial detailed inventory shows many difficulties regarding localisation and verification in the maps; for some small hydropower plants it seems that maybe lists or approvals exist, but they were never built or are out of operation. The parameters in detail are described in the database chapter 3.2.3.2. Some of the small hydropower plants cannot be verified in the field, they are in official and unofficial lists, and therefore as no impact can be verified they were skipped. For some countries like Bulgaria, the impact of many very small plants (< 1MW) can exceed those by larger plants but was not investigated by this study and should be assessed based on national data and approaches.

Hydropower dams have a significant impact on the longitudinal river continuum for biota and sediments, leading to a loss of ecological integrity, which means lower biodiversity (e.g. migratory species) and species abundance, and serious river degradation processes downstream of dams (channel incision). Impacts can be assessed according to the size and location (upper or lower course) and the number of dams in catchments and sub-catchments. Besides the detailed dam information collected in the database, an exemplary assessment of the mentioned basic parameters (size, number, location of dams) was conducted initially for several catchments.

The study cannot predict the detailed impacts of specific dam projects. Also, downstream impacts of dams can be only assumed technically: The evidence of damaging, hydropeaking and the influence of changed hydro regimes, such as the elimination of ecologically important smaller floods occurring all one - five years and the degree/distance of channel degradation by bed incision, can be measured even 200 km downstream of larger rivers (e.g. Drava in Croatia). Therefore the assessment can be done only on the qualitative experience and expert judgement e.g. by analysing the existing dams along Drin or Neretva or water regime changes in karst systems such as Cetina or Trebišnijca catchements. In combination with the morphological situation (is the river flowing through a gorge (straight) or a plain (braiding) this leads to an assessment of those “dam downstream sections” of some 30-50 km covering the most evident impacts. The estimation influences the hydromorphological assessment - class one is definitely impossible downstream of dams. In particular residual water stretches downstream of large dams can lead to worse situations as estimated (even drying river beds). Almost all major rivers are modified (at least for hydrological and sediment regimes) by existing dams, however they provide further downstream along short stretches the full range of highly endangered habitats, therefore those remaining sections where classified as “hymo class 1 and conservation value very high”. National experts review the results (for dam inventory and hydromorphological assessment). The compliance of results was high and improvements were implemented.

Other major ongoing hydromorphological pressures with significant regional importance are recorded where available as additional point information, but not further analysed. Those are:

- Sediment exploitation
- River regulation
- Flood protection
- Water abstraction
- Irrigation
- Landuse development (agriculture, settlements, infrastructure)

2.4 Database and GIS application

2.4.1 Introduction

The data and GIS management for such a large project area is very important. The developed Access database is split into sub-modules for “Stretches with very high conservation value“, “Hydropower inventory” and “Catchment information” allowing fast and simple access to the entire data. The data base can directly link to the GIS data enabling the efficient analysis and visualization of spatial data.

GIS data and application

Besides base data layers such as administrative borders, settlements, rivers, lakes and catchments, main thematic layers were prepared such as the river assessment, the protected areas, poljes/floodplains/deltas/estuaries as well as hydropower plants.

- Base GIS data (vector layer for rivers/catchments derived from digital elevation model (SRTM, significantly improved for karst rivers and lowlands by available regional catchment maps from hydrological atlases) for a scale of approximately 1: 100,000. No canals or artificial rivers with exception of diversion stretches of hydropower plants were assessed; only hydropower reservoirs are separated, all other lakes and reservoirs for other purposes are not distinguished), protected areas, SRTM relief data)
- Google Earth, BingMaps and other most recent free available satellite data
- Literature, internet data mining, experts knowledge
- National and international protected areas
- Internet and expert knowledge about existing and planned hydropower dams
- WFD status and risk assessments (as far as available for non-EC countries)
- Assessments of biodiversity

The analysis were done in ArcGIS using plug-ins to embed GoogleEarth or Bing maps (having each time seamless high resolution satellite images in the background of the project).

Data validation

The GIS analysis was prepared after the validation of data using ArcGIS software by checking the:

· Structural integrity of the spatial data sets
· Spatial features and attributes (consistency)
· Database integrity
· Cartographic annotation

Data references

For the whole project area and for each country plenty of publically available data sources, documents and web pages were analysed. In the references of this report only a selection of the most important items per country is given. Furthermore, the database contains much more detailed references.

2.4.2 Inventory of river stretches with very high conservation value

In addition to the continuous overall hydromorphological assessment including simply the hydromorphological classes as discussed in chapter 2.2.1 (compare Figure 2 with identifiers for assessment segments), river stretches with very high conservation value were collected separately to allow a more detailed description (see Figure 7).

- Country
- Conservation value
- Name,
- Position, size, length
- Geomorphological characterisation
- Catchment info
- The four main habitats with percentages
- Biodiversity (text information only where available)
- Nature protection
- Important floodplain adjacent
- Affecting hydropower plants with identifiers (link within the database)
- Hydromorphological intactness
- Conservation value
- Description and data references

The Polje information for the western and central part of the project area (continuous karst of 72,000 km^2 in size) was taken from Stumberger (2010) and complemented by information for the eastern part (ME, RS) for the discontinuous karst area of 18,000 km^2.

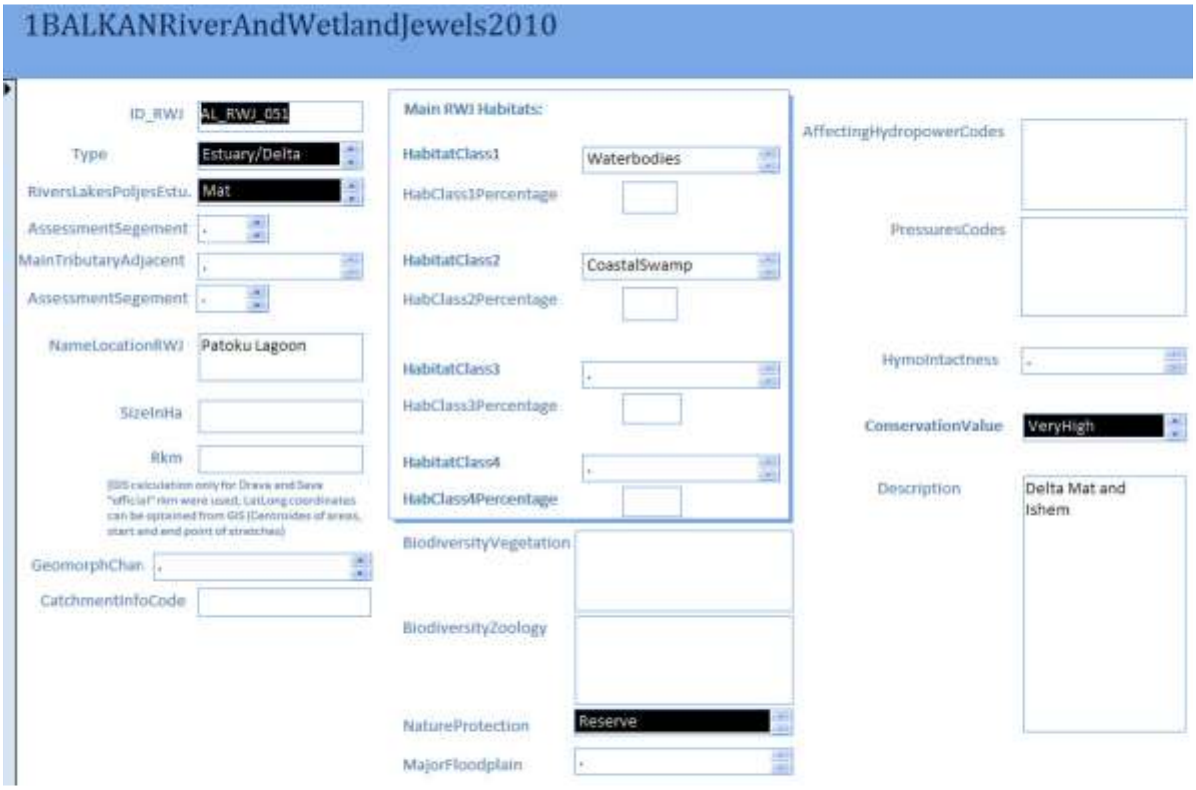
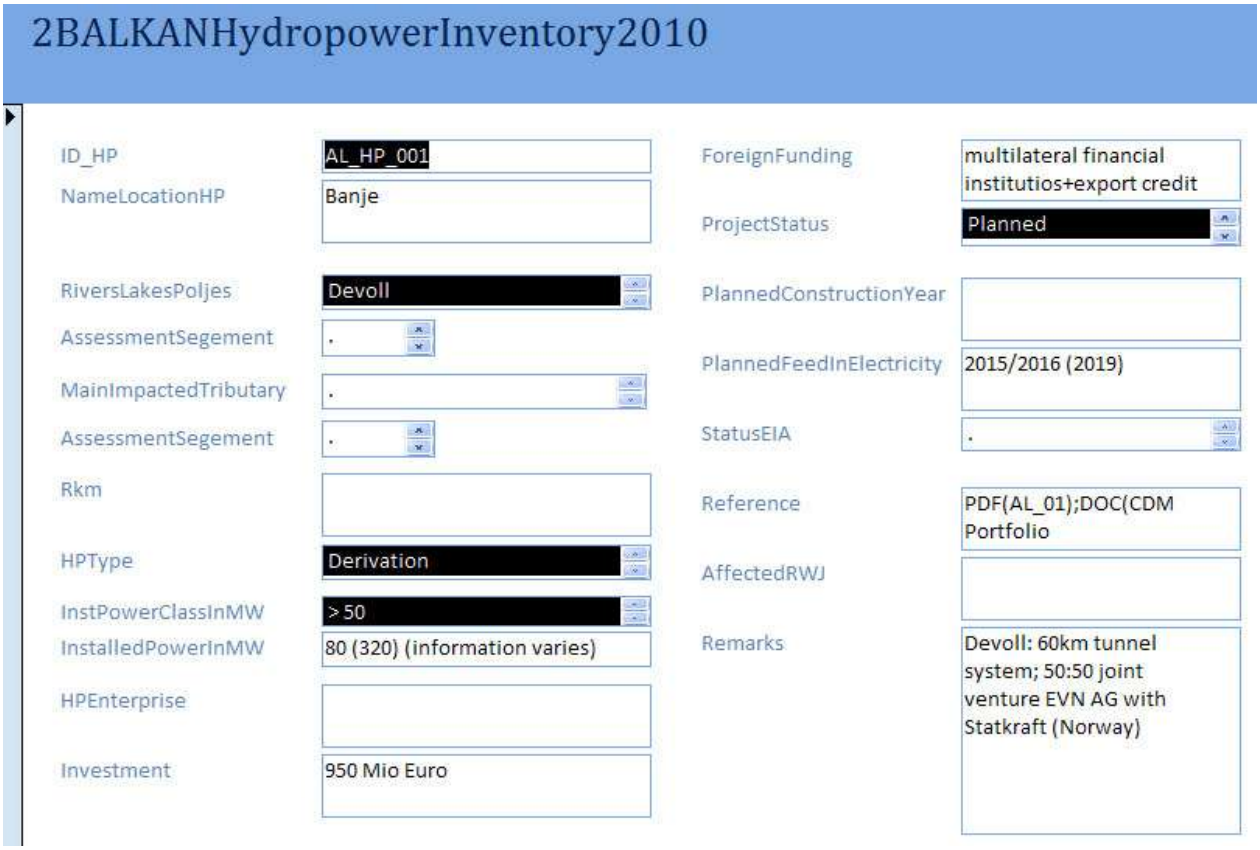


Figure 8: Access data form example for the river stretches with very high conservation value

2.4.3 Inventory of hydropower plants

The database will also list and provide key data to existing and planned hydropower dams and other major impacts (compare figure 9 on next page).

- Country
- River, Wetland
- Name of hydropower dam
- Type of hydropower dam (storage, run-off the river etc.)
- Operator/operating company
- Foreign funding/involvement (country, company, bank etc.)
- Costs
- Capacity (MW in classes 1-10 MW, 10-50 MW and > 50 MW; expected production in GWh)
- Status of implementation (planned, under implementation, existing/operating)
- Planned start and end
- Status EIA
- Protection status of affected river stretch
- Conservation value of affected river stretch
- Description and data references including information if new construction or upgrading)



2BALKANHydropowerInventory2010

ID_HP	AL_HP_001	ForeignFunding	multilateral financial institutios+export credit
NameLocationHP	Banje	ProjectStatus	Planned
RiversLakesPoljes	Devoll	PlannedConstructionYear	
AssessmentSegement	.	PlannedFeedInElectricity	2015/2016 (2019)
MainImpactedTributary	.	StatusEIA	.
AssessmentSegement	.	Reference	PDF(AL_01);DOC(CDM Portfolio
Rkm		AffectedRWJ	
HPType	Derivation	Remarks	Devoll: 60km tunnel system; 50:50 joint venture EVN AG with Statkraft (Norway)
InstPowerClassInMW	> 50		
InstalledPowerInMW	80 (320) (information varies)		
HPEnterprise			
Investment	950 Mio Euro		

Figure 9: Access data form for the hydropower plant inventory

2.4.4 Inventory of other pressures than hydropower

Other pressures were collected after their type and the (project) status (similar to hydropower plants). Only large scale significant pressures were recorded. Basically only planned (new) pressures were taken into account as continuous information about river regulation and flood protection dikes or landuse in general is integral part of the hydromorphological assessment (see 2.2.1.1.).

- Impoundment(s), e.g. as reservoirs for water supply or retention
- Water abstraction/ residual water
- Significant sediment deficit downstream of dams
- Sediment extraction
- River regulation
- Flood protection dikes
- Land reclamation, land use development
- Drainage/irrigation/agriculture
- Multiple pressures along town stretches

Sediment extraction and deficit downstream of dams were collected also for the current situation. The total data entries and heterogeneous data quality doesn't reach the level to use the data for analysis across the entire project area and was therefore skipped for overall analysis.

2.4.5 Inventory of protected areas

The inventory comprises the polygon layer of protected areas in the GIS as well as basic information and serves only as additional assessment layer for the conservation value:

- Name
- Size
- Type (Natura 2000, national park, biosphere reserve, Ramsar site, Emerald area, IBA, nature conservation, landscape conservation)
- Status (existing, planned)

For the EC Member states SI, BG and GR the detailed Natura 2000 data was available. For Croatia the preliminary Natura 2000 coverage (developed based on the Cro-nen project cofounded by EC) can be seen as comparable. For ME, AL, RS, BA and MK the coverage was compiled using existing nature protection areas and national parks and additionally highly proposed areas by Ramsar, IBA and the EMERALD network. Actually the preparation of Natura 2000 starts in BA and RS and will lead to a more comprehensive coverage of protected areas. Most problematic is the far western part of Turkey where only written lists of areas were available so far.

3. Results

The results are sorted by countries (from west to east) with a final overall presentation for each topic.

3.1 Covered rivers and catchments

34,468 rkm in 224 sub-catchments were assessed covering an area of 449.480 km² (larger than the size of Germany with 357.112 km²). The average length of river stretches, for which the hydromorphological assessment was done, is 10 rkm, ranging from 2 rkm e.g. along town stretches to 324 rkm at the impounded section between Beograd and the Iron Gate 2 hydropower plant.

All rivers with catchments larger than 500 km² are included, with the mean size of catchments being about 2,000 km², but smaller rivers were also considered, if they were of particular ecological value or subject to hydropower planning. The length of rivers ranged from 1 rkm for the Ombla “River” at the Coast near Dubrovnik to 945 rkm for the Sava with a catchment of 95,719 km². Some small coastal catchments were aggregated. Further about 50 connecting underground karst water stretches with a length of 656 rkm were simply indicated following straight dotted grey lines. In addition 38 estuaries/deltas with a size of about 42,000 ha, 51 major important floodplains with a total size of about 650,000 ha, 97 karst poljes with 280,000 ha and 10 wetlands (related to lakes but strongly influenced by rivers) with about 11,000 ha were assessed (compare Figure 1 on page 16).

The following country results for river stretches not summing up to the exact total values given in the summary and overall assessment. They sum up gradually higher as they include trans-boundary rivers for both countries to represent really entire single countries. Trans-boundary hydropower plants were counted only for one country, indicated by main usage and national company.

3.2 Hydromorphological intactness of rivers

There are four classes characterizing the different levels of hydromorphological intactness: Class 1 stands for high intactness (near-natural) and bears the blue colour code (lakes and rivers outside of the project areas are in light grey-blue). Class 2-3 is characterised by slightly to moderately modified status, indicated in light green (integrating the two original colours of dark green for class 2 and yellow for class 3). Class 4 for river stretches which are extensively altered are orange and class 4 (red) indicates stretches with severely modifications, in particular impoundments.

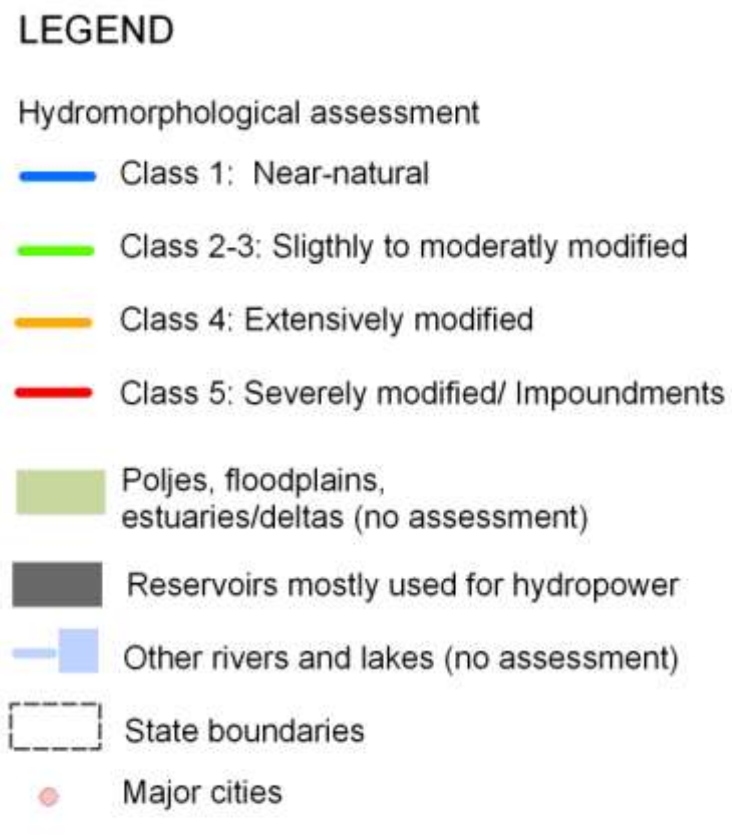


Figure 10: Legend for the following maps of chapter 3.2. To save space for country maps legend and title was not added to individual maps (river names outside the project area are incomplete).

3.2.1 Slovenia

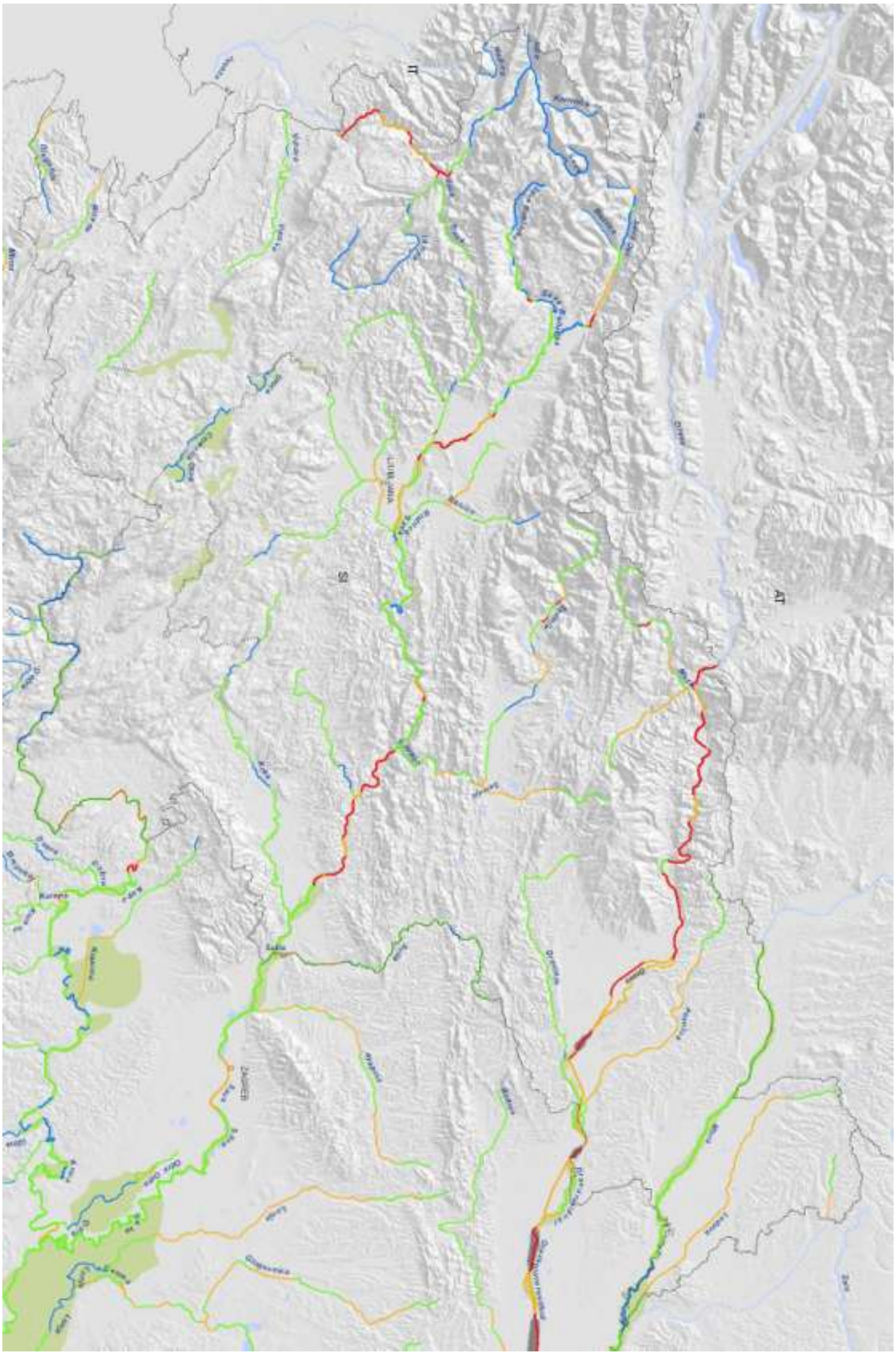


Figure 11: Hydromorphological assessment for SI.

Slovenia covers significant parts of the Alpine mountains. Major rivers are the Sava, Drava, Mura and Soča. Typical karst rivers in the south of the country are less modified than the main rivers in particular Drava is entirely used for hydropower. But also significant stretches of Sava and lower Soča are already strongly modified by impoundments and residual stretches for hydropower purposes. Hydromorphologically intact rivers can be find in the middle and upper Soča catchment, for most of the Sava headwaters and some Karst rivers. Due to the mountainous character of the country only along Mura and parts of the Drava as well as short stretches along inner Sava floodplains can be find. Additionally some regularly flooded poljes are typical and leads over to the karst systems of the Western Dinarides.

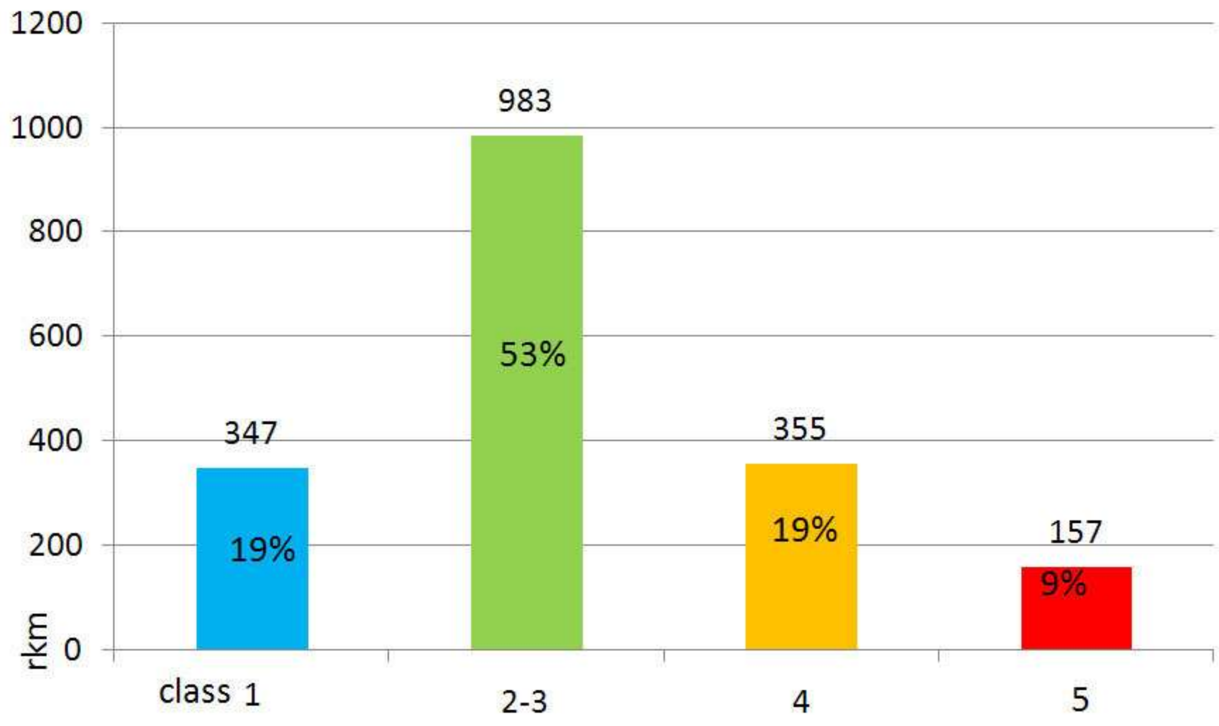


Figure 12: Hydromorphological assessment in rkm and percentage for SI.

3.2.2 Croatia

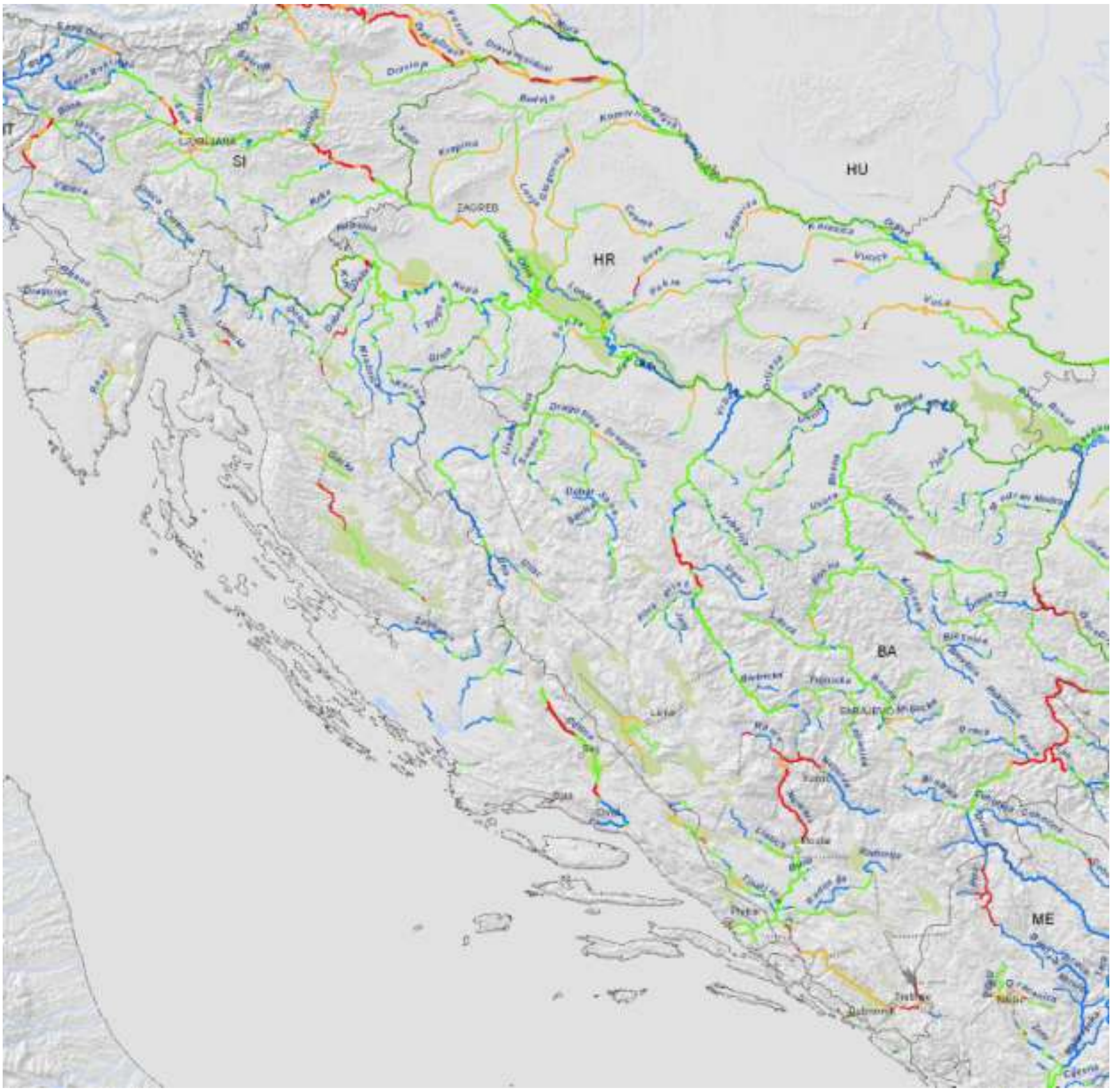


Figure 13: Hydromorphological assessment for HR.

Croatia can be mainly subdivided in the northern Illyric and even Pannonian influenced part with Drava and Sava and the karst and Mediterranean part in the south where the drainage network considerably decrease. The Drava river is modified just downstream of SI complementing the chain of hydropower plants in AT and SI. Further downstream the river still host valuable river stretches in particular in its middle course and upstream of Osijek, however peak power with daily changing water levels and regular sediment extraction (and retention of gravel in the chain of dams further upstream) leading to channel incision impacting the river as typical for most of the major Balkan rivers. The Sava hosts some of the largest floodplains in the Danube basin and some stretches with the typical meander morphology still exist.
The Karst influenced rivers are much larger and significant than in SI, aside of the famous world heritage site of Plitvice or the Krka waterfalls, several canyons (as such of lower Cetina) fall in the near-natural class of the hydromorphological assessment but are partially interrupted by hydropower facilities (dams, tunnels for hydropower, diversions). Only rivers of the Sava plain and close to the capital Zagreb are altered significantly by river regulation and technical flood defences.

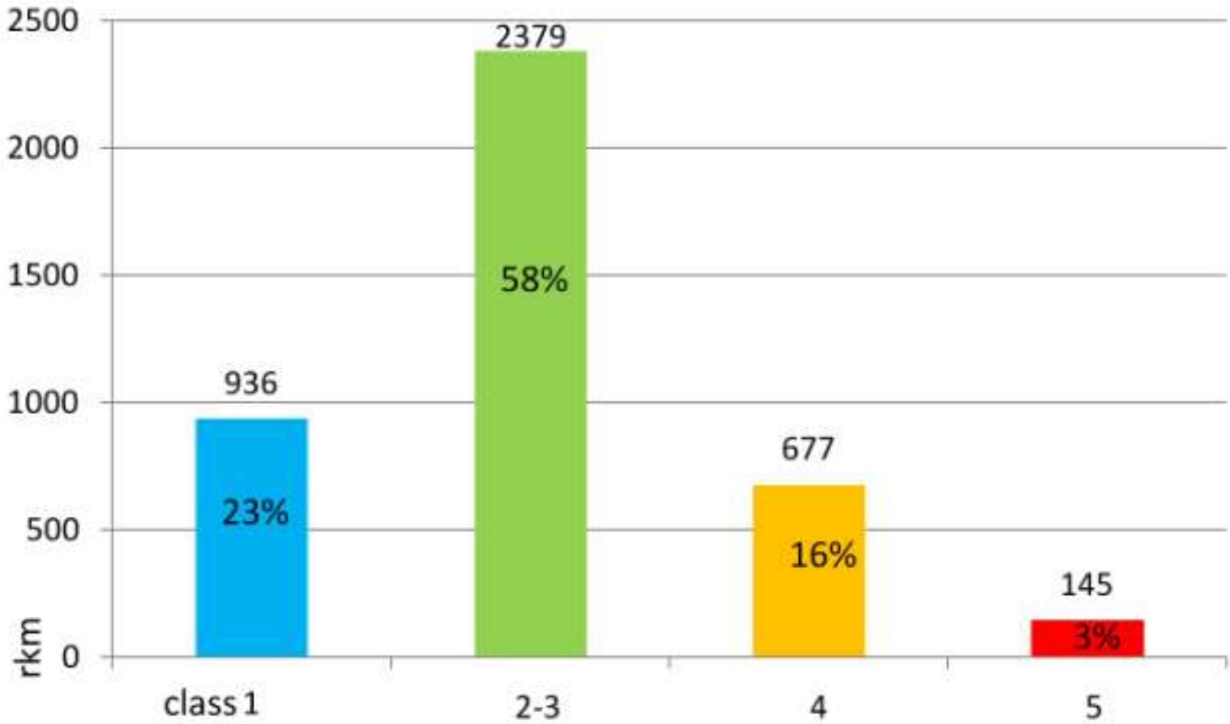


Figure 14: Hydromorphological assessment in rkm and percentage for HR.

3.2.3 Bosnia & Herzegovina

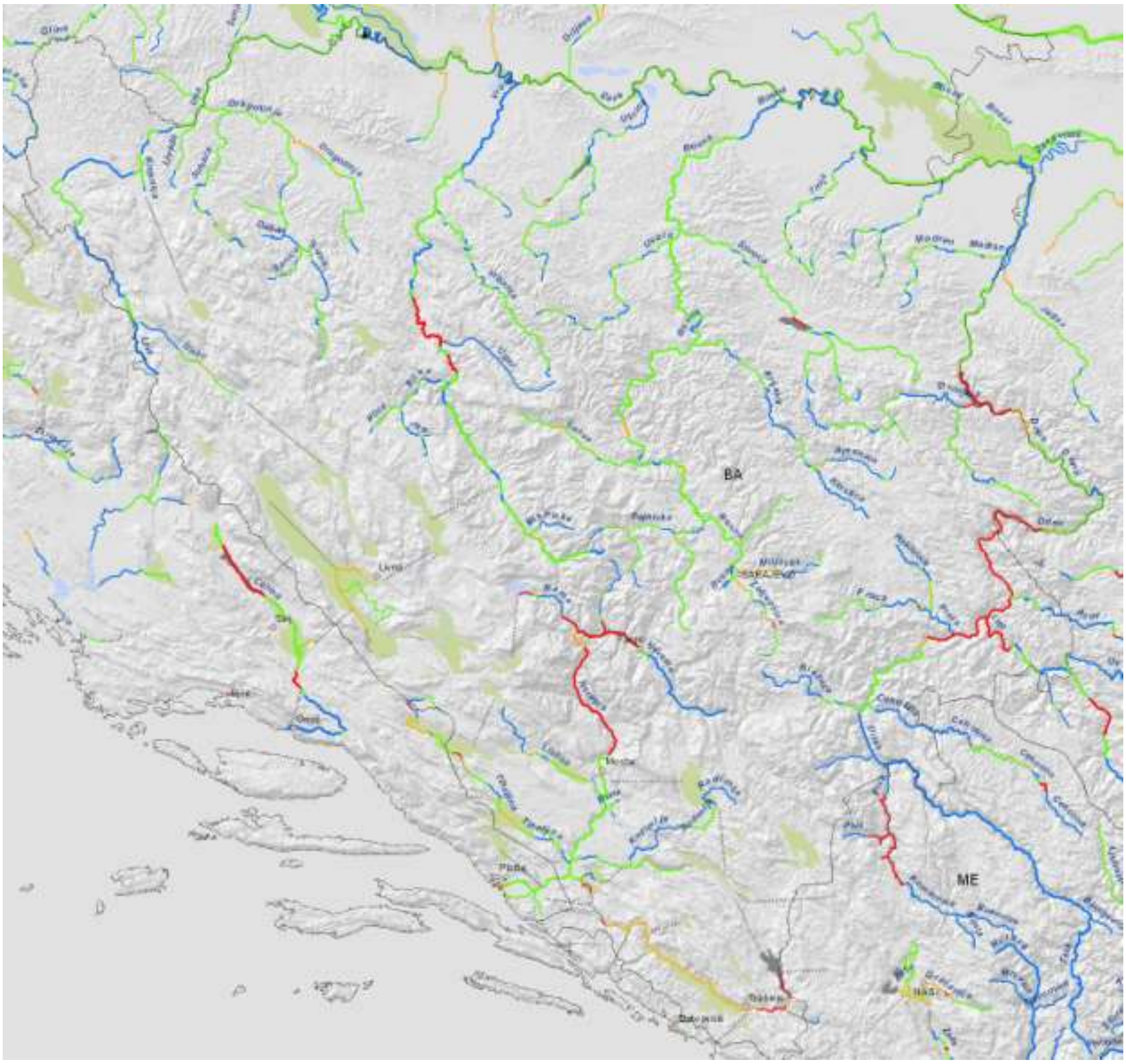


Figure 15: Hydromorphological assessment for BA.

Bosnia and Herzegovina is entirely within the geographical Balkan and hosts all major tributaries of Sava river. In particularly the upper Una and the lower Vrbas as well as lower Drina fall still in the highest class, which is remarkable as most of the lower courses of comparable rivers in Europe are subject of strong changes. The major karst and Mediterranean river, the Neretva is altered by a chain of major hydropower plants. On the other side the headwaters and some of the lower tributaries provides still very good hydromorphological conditions (compare e.g. the cover image, water falls on Kravica). Even the densely settled Bosna valley still provides good to moderate hydromorphological conditions (still entirely free flowing, which has significance for sturgeon and Danube salmon populations).

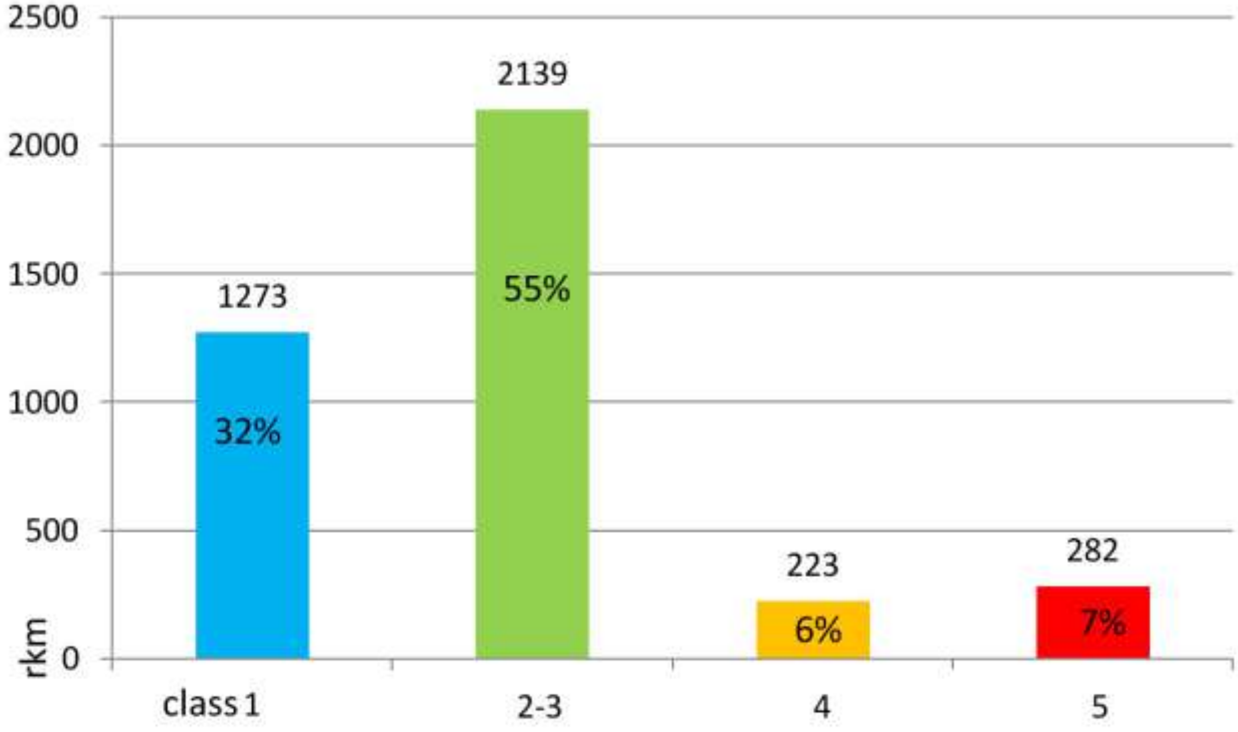


Figure 16: Hydromorphological assessment in rkm and percentage for BA.

4.2.4 Serbia

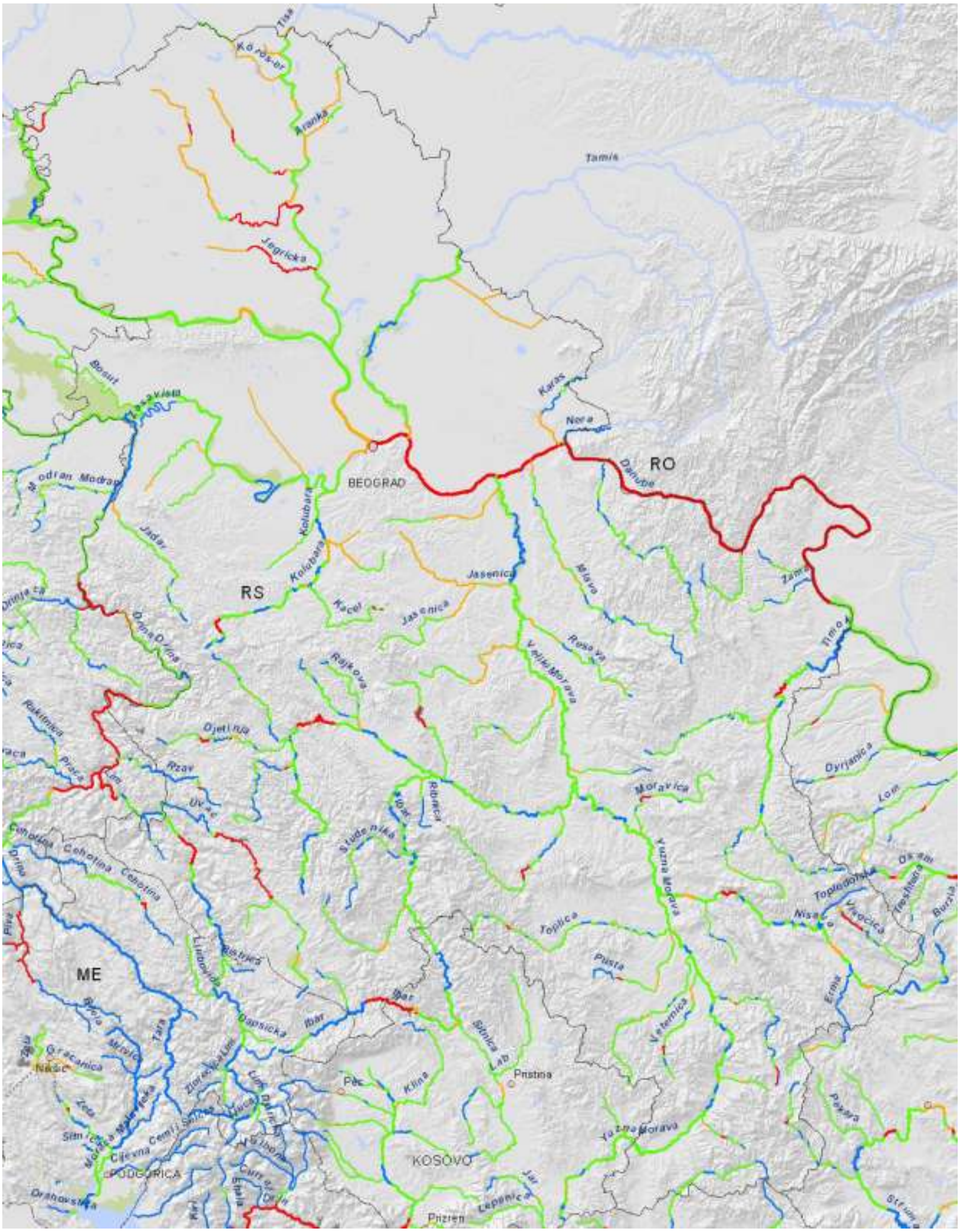


Figure 17: Hydromorphological assessment for RS.

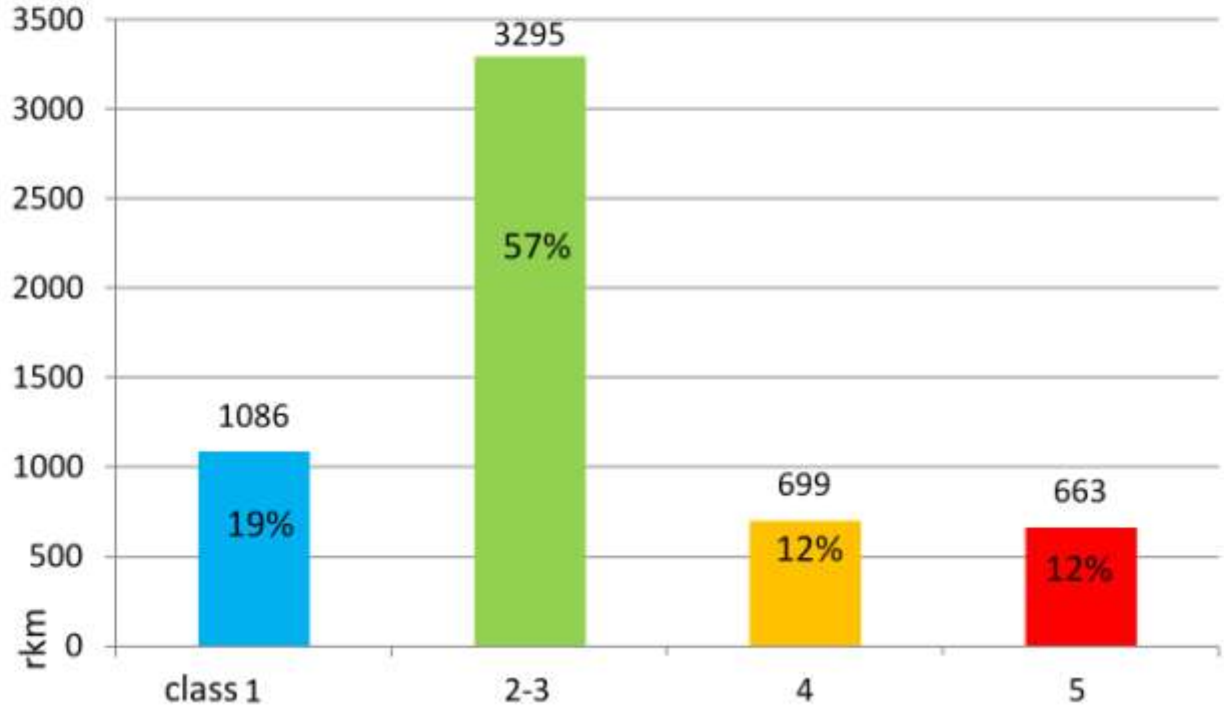


Figure 18: Hydromorphological assessment in rkm and percentage for RS

The northern part of the country (mainly Vojvodina) can be count to the Pannonian plain adjacent to Hungary. In Serbia major river systems of the Danube meet changing the hydrological regime of Danube from Alpine influenced to Pannonian and Balkan influenced river systems (Tisa and Sava influence). The construction of Iron gate 1 and 2 dams completely changed the breakthrough valley between Carpathian mountains in the north and the Balkan ridges in the southeast (class 5). The former gravel dominated cataract stretch turned into a huge hydropower lake. The impoundment reaches approximately the Tisa mouth but depending on discharge it spreads between Novi Sad (during very low water) and Beograd (very high water). Therefore lower Sava and Tisa are affected by backwater as well. Coming to the two main Balkan rivers the Drina and Veliki Morava systems large parts still provides good hydromorphological conditions (class 2-3), even on lower courses of both rivers stretches with very good conditions can be find (as well as on lower Timok). But the Drina continuum is interrupted by several major dams. On the other side the narrow Lim valley is similar as the well known Tara canyon in Montenegro a touristic attraction and partially untouched. Floodplains were widely spread in the northern part of the country, today only remaining sites can be find along the upper part of Serbian Danube, some places along Tisa and along the course of lower Tamiš.

3.2.5 Kosovo

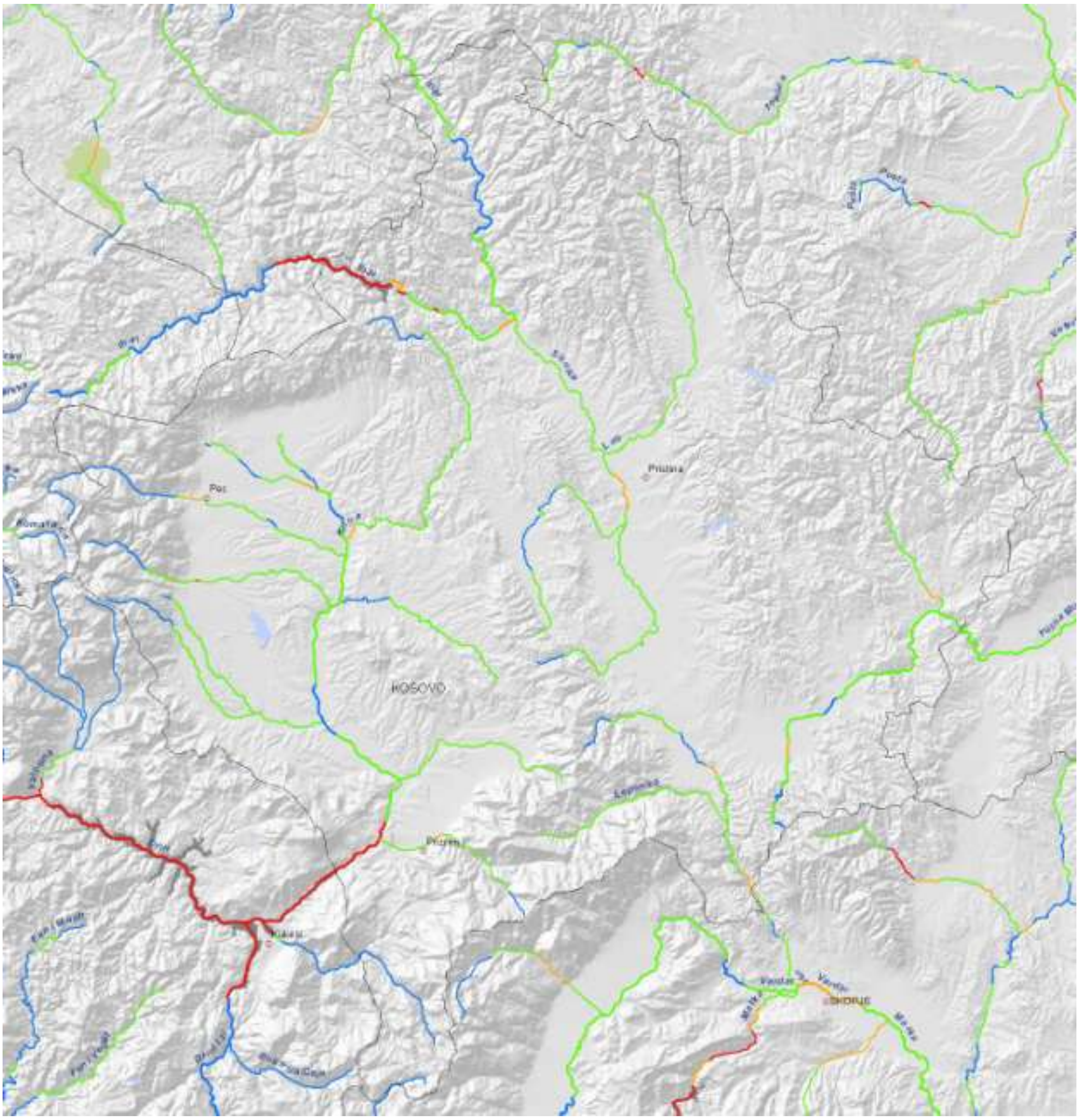


Figure 19: Hydromorphological assessment for Kosovo.

Rivers in the Kosovo are mostly but relatively moderately used, meaning aside of two impounded hydropower cascades on Ibar and Drin the rivers provide good to moderate hydromorphological conditions (class 2-3). Highlights are some breakthrough valleys and headwaters.

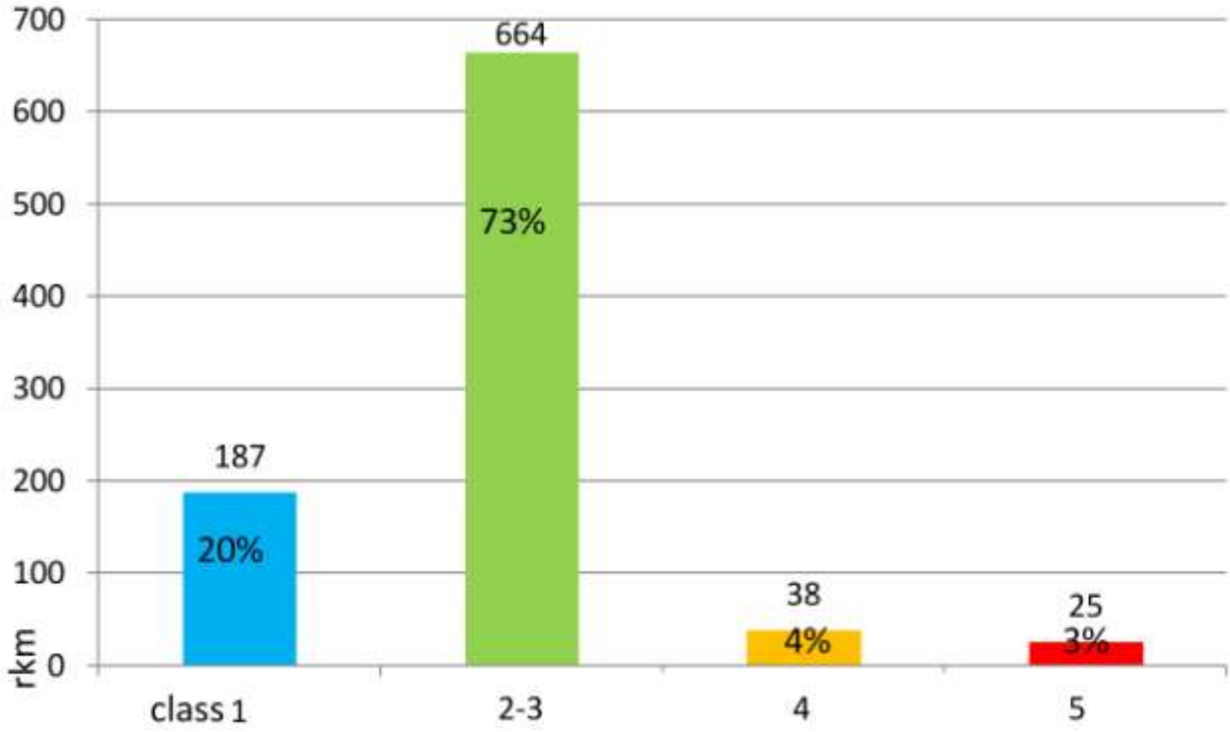


Figure 20: Hydromorphological assessment in rkm and percentage for Kosovo.

3.2.6 Montenegro

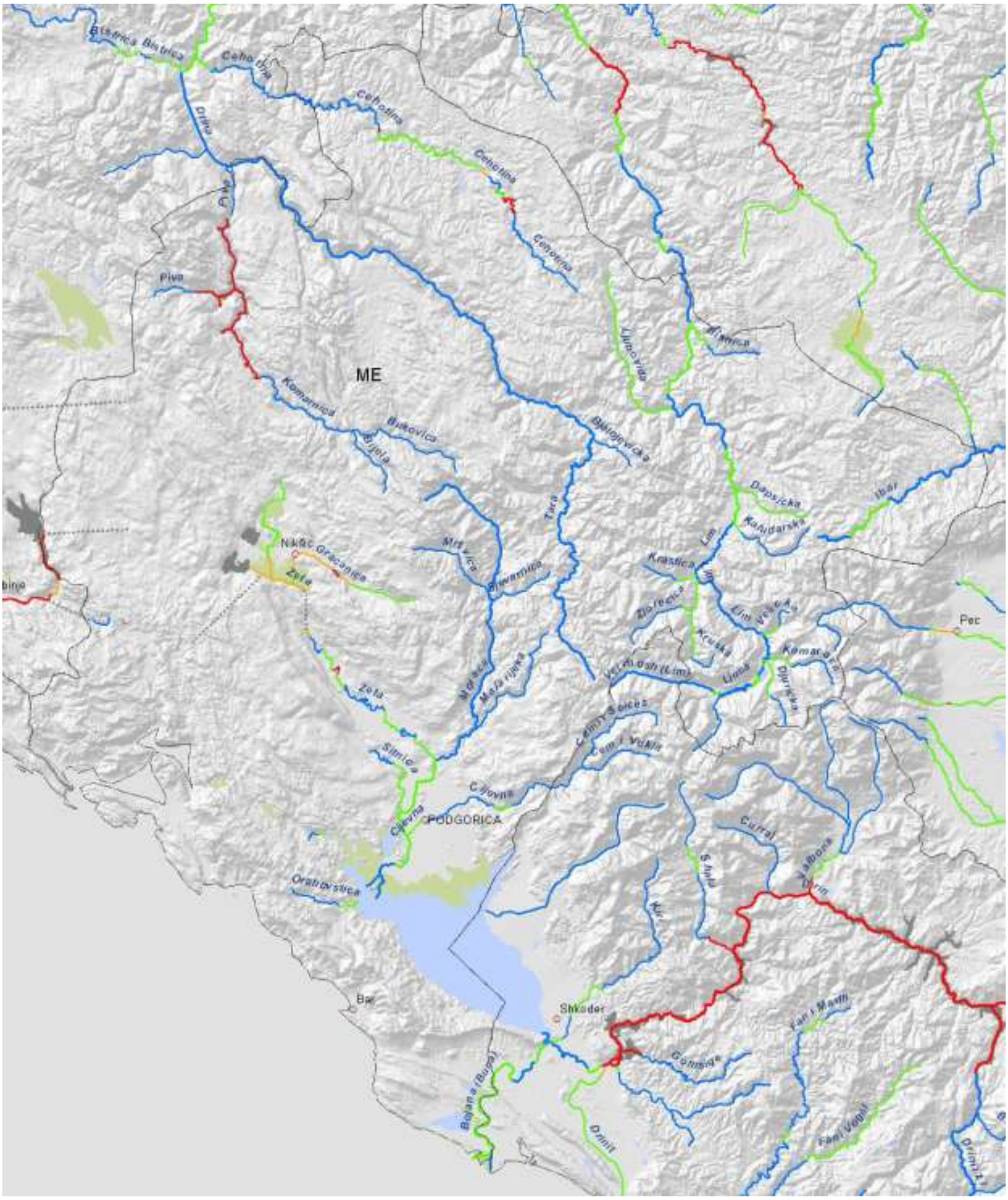


Figure 21: Hydromorphological assessment for ME.

Montenegro and Albania still have the most intact river network across the entire Balkan region. Only the upper and middle Zeta catchment near Nikšić is used for hydropower usage. The Morača as the main tributary to Lake Scutari (Scutari-Shkoder) is entirely free-flowing. The upper course is a nearly untouched narrow valley with canyon parts, the lower part is under pressure of excessive gravel exploitation before entering the tremendous floodplain belt surrounding the northern lake shore. The Tara canyon is a national park and most famous, but also the Bojana-Buna delta provides good conditions.

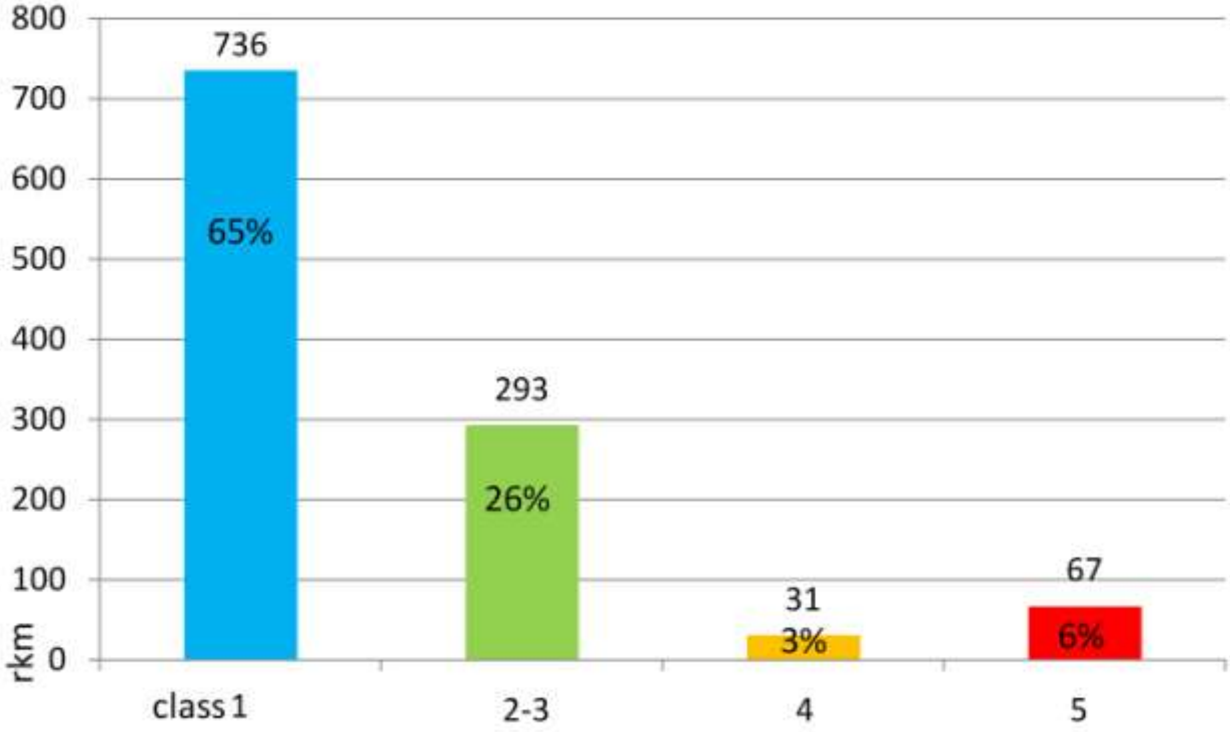


Figure 22: Hydromorphological assessment in rkm and percentage for ME.

3.2.7 Macedonia

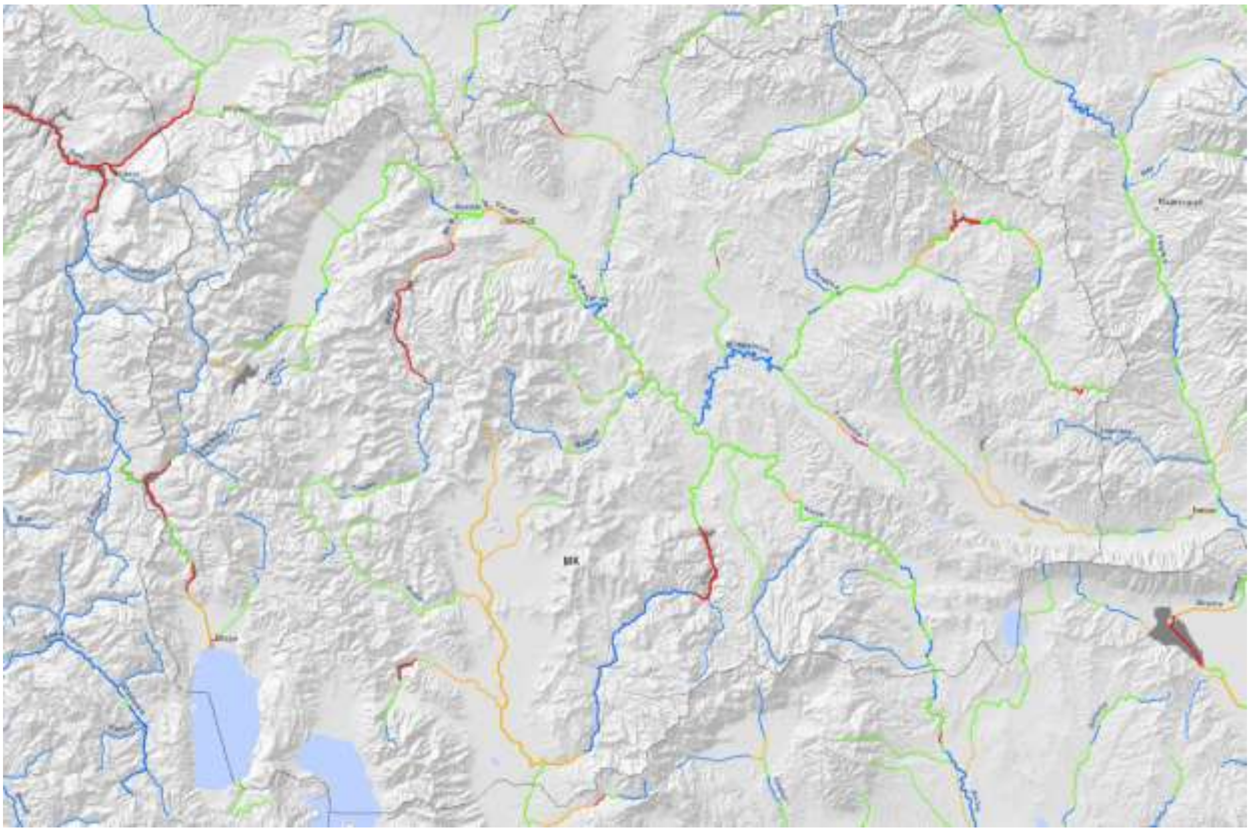


Figure 23: Hydromorphological assessment for MK.

Macedonia provides a great diversity of riverine landscapes from high mountain headwaters, over lake tributaries to tectonical lowlands (Pelagonia) in junction with a different degree of alteration (from large barrages and dams to pristine breakthrough stretches and valuable cultural river landscapes with meadows and floodplain forests). Crna Reka river is the best example turning from good to impounded and pristine stretches followed by the strongly regulated (class 4 orange) lowlands of Pelagonia which host a great potential for restoration.

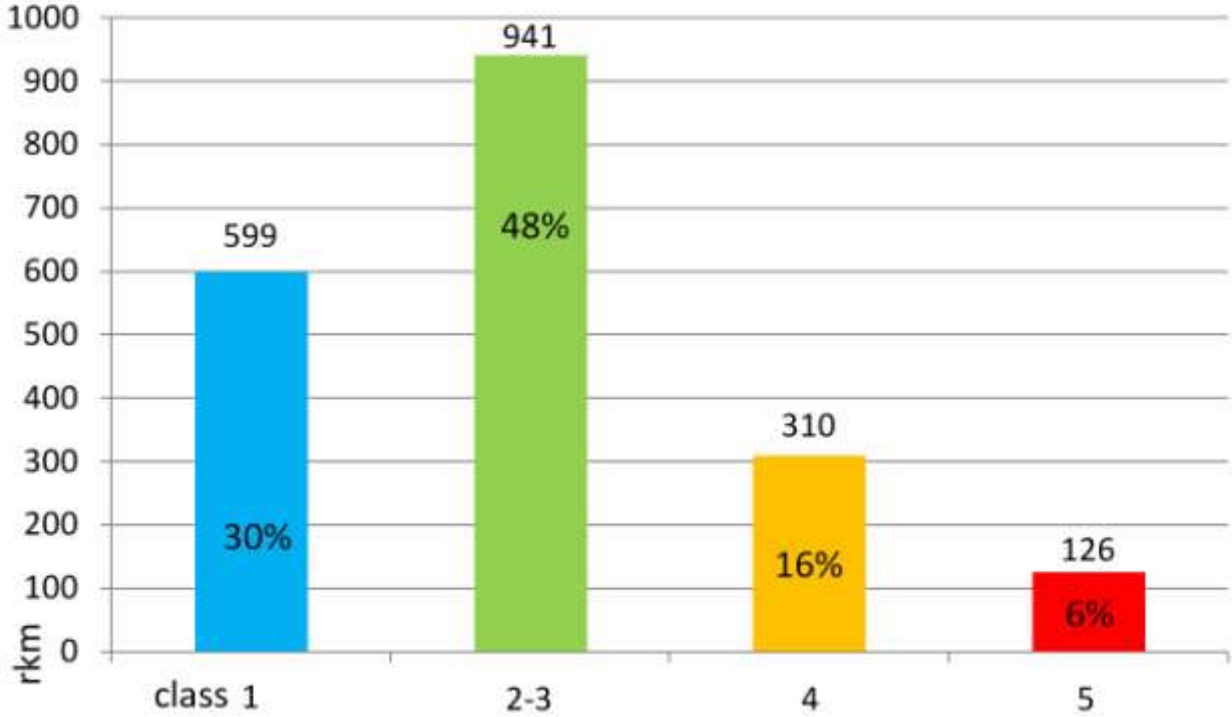


Figure 24: Hydromorphological assessment in rkm and percentage for MK.

3.2.8 Albania

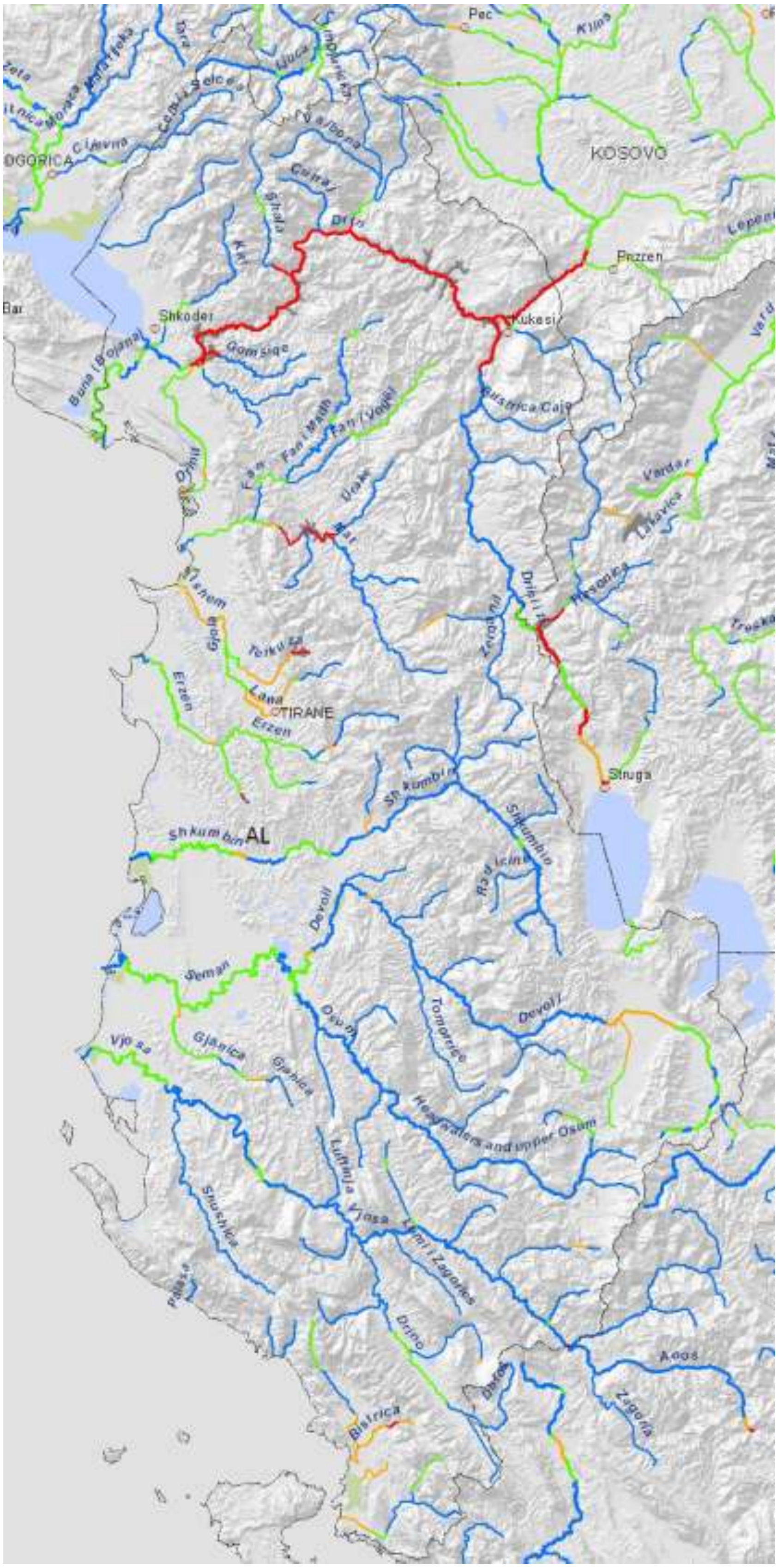


Figure 25: Hydromorphological assessment for AL.

As mentioned Albania has still together with Montenegro the largest free flowing and mostly untouched river stretches of all Balkan countries. Even large rivers like Vjosa, the Seman system with Devoll and Osam as well as Skumbin are still not interrupted by dams (Vjosa is interrupted by a major dam under construction). Only Drin river is mostly turned into a chain of hydropower reservoirs. But also many deltas and estuaries still provide excellent hydromorphological conditions.

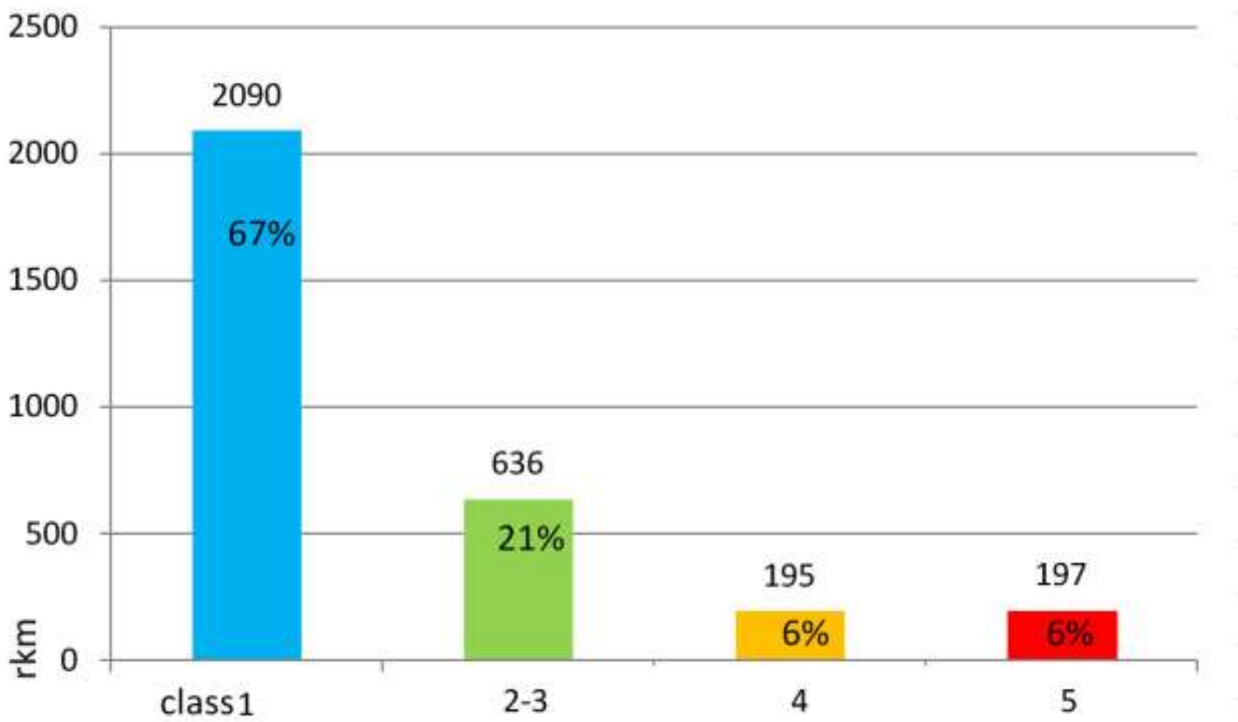


Figure 26: Hydromorphological assessment in rkm and percentage for AL.

3.2.9 Greece

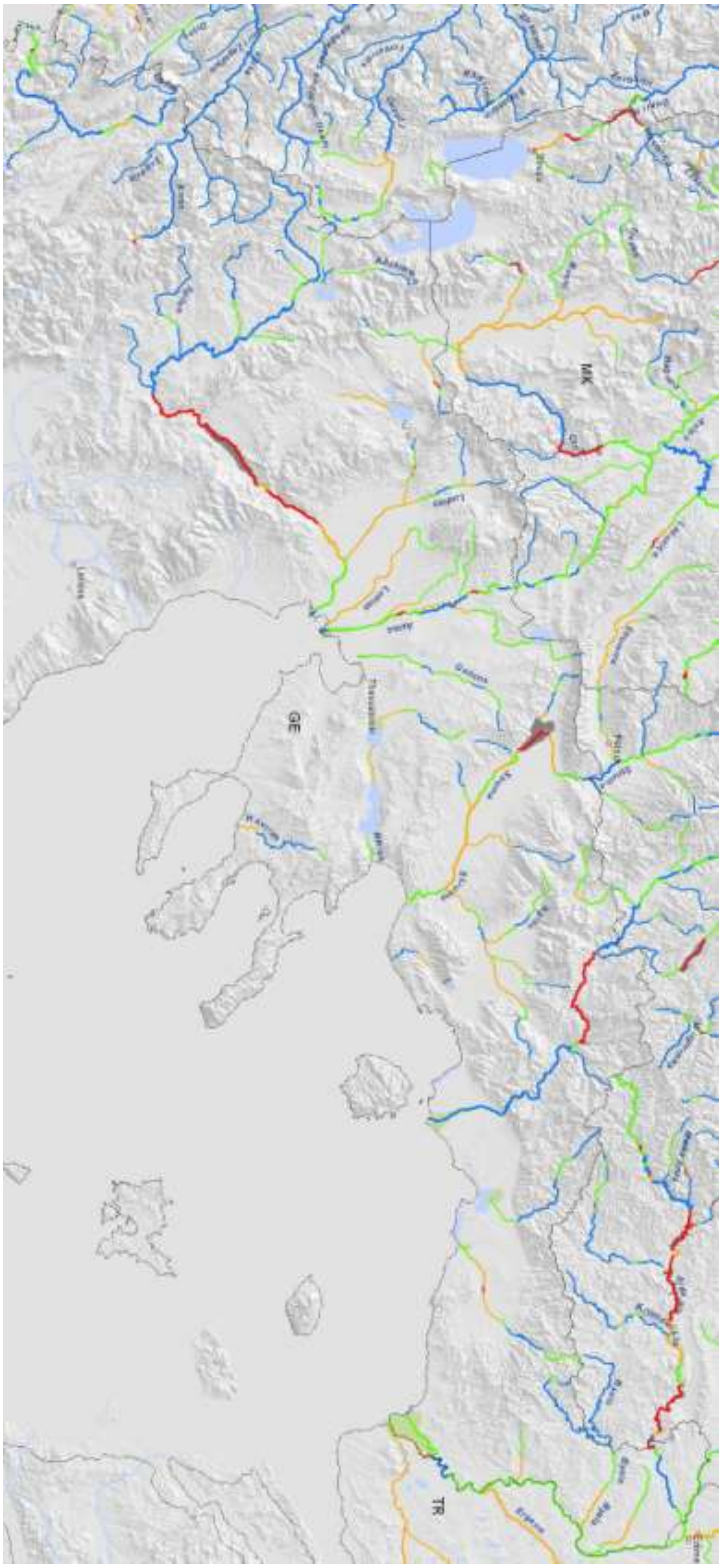


Figure 27: Hydromorphological assessment for GR.

The analyzed part of northern Greece is characterized by extremes: All headwaters and rivers close to the Albanian border still provide very high hydromorphological conditions. In addition upper Aliakmon as well as lower Nestos fall in this class, which lead to a very good overall evaluation regarding this part of Greece. Hydropower cascades can be find along lower Aliakmon, upper Nestos as well as middle Struma. Axios and in particular Struma are significantly altered. Regarding estuaries and deltas the hydromorphological conditions are less good as compared with Albania.

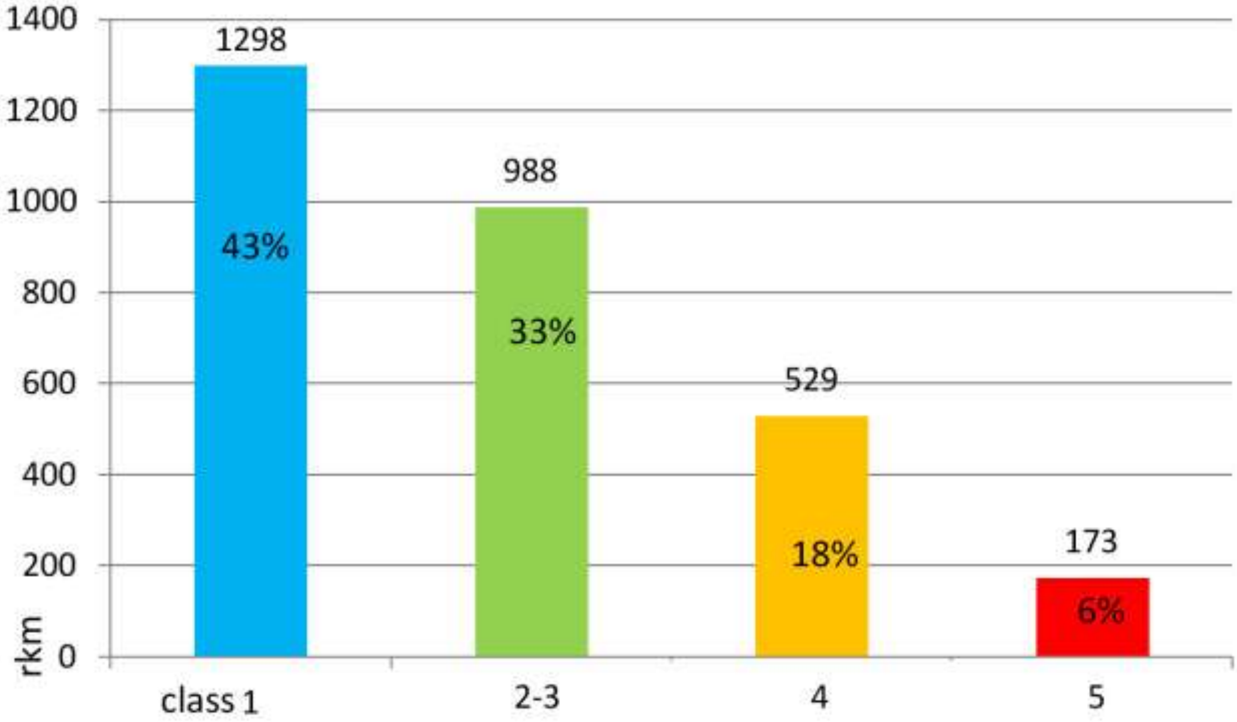


Figure 28: Hydromorphological assessment in rkm and percentage for GR (remark: as only some northern Greece catchment are covered the results are not representative for entire country).

3.2.10 Bulgaria

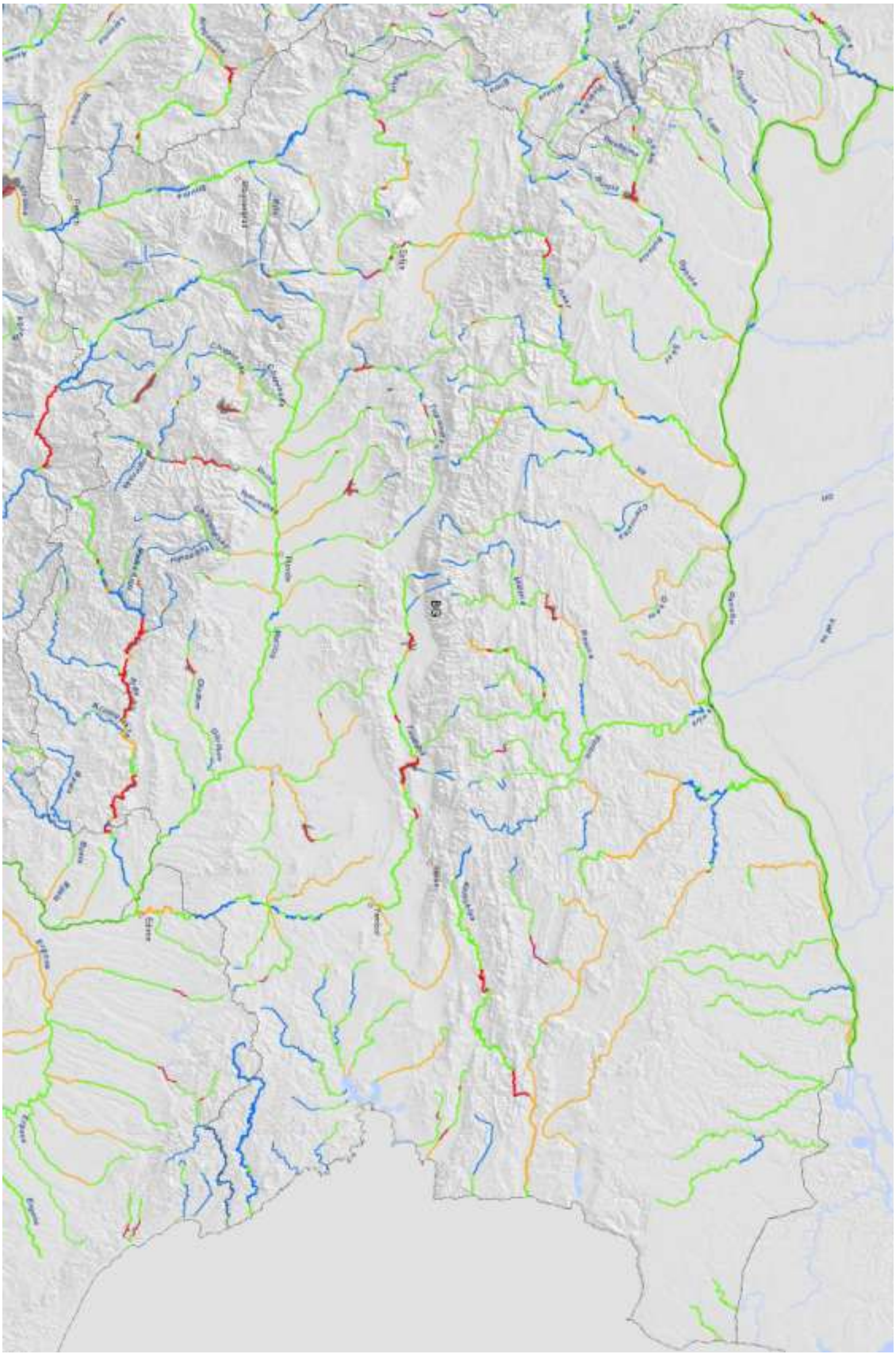


Figure 29: Hydromorphological assessment for BG.

Bulgaria fall mostly into the Balkan region, only the far northeastern Pontic part is significantly different (more steppe climate with temporal streams). The Danube itself as border between Romania and Bulgaria still provide many in-channel features such as bars, islands and over large stretches untouched banks including shallow point bars and steep banks along the Bulgarian terrace. On a couple of very shorter stretches the Danube fall still in the class one where floodplains are not totally cut of, such as for most of the Romanian site. Danube tributaries fall mostly in the second class, often the lower courses are strongly altered (class 4) but intersected by some canyon like breakthroughs (e.g. Russenski Lom) or imposing steep banks (lower Yantra). The southeastern catchment of Struma still has many river stretches in the second and first class. The Maritsa is still free flowing but moderately altered. The Black Sea catchments are differentiated by size, larger rivers are often intensively used, smaller rivers are nearly intact.

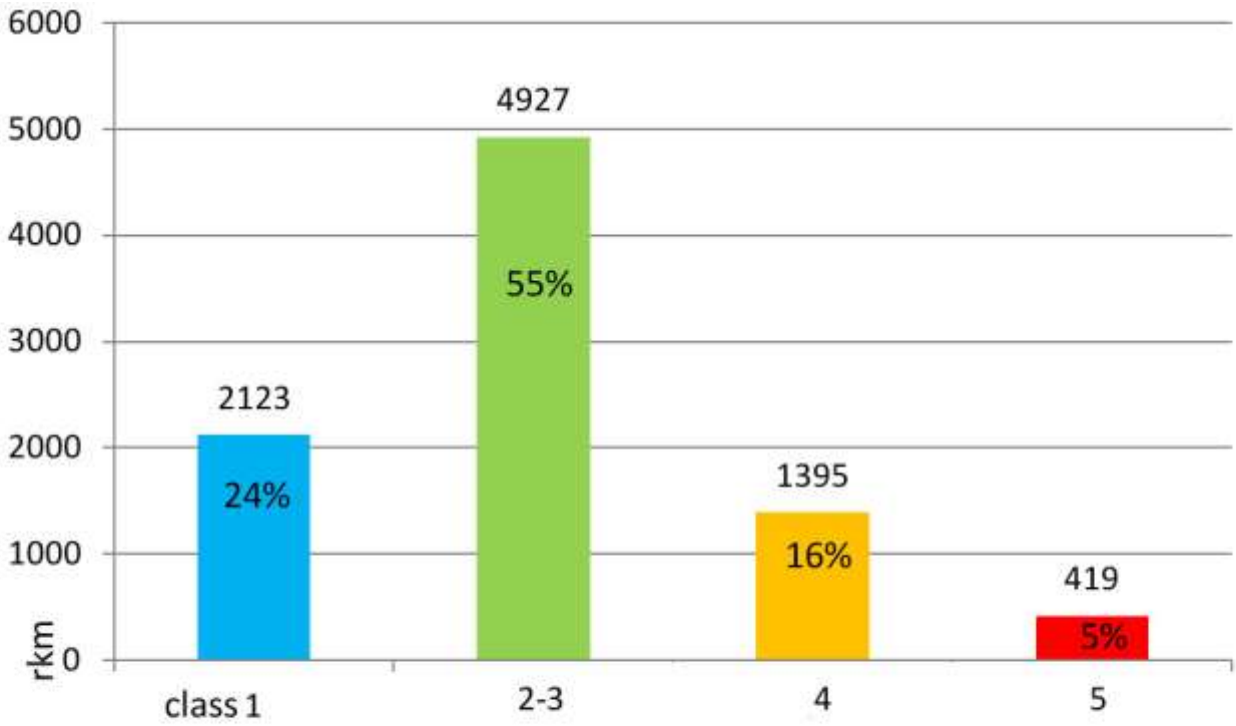


Figure 30: Hydromorphological assessment in rkm and percentage for BL.

3.2.11 Turkey

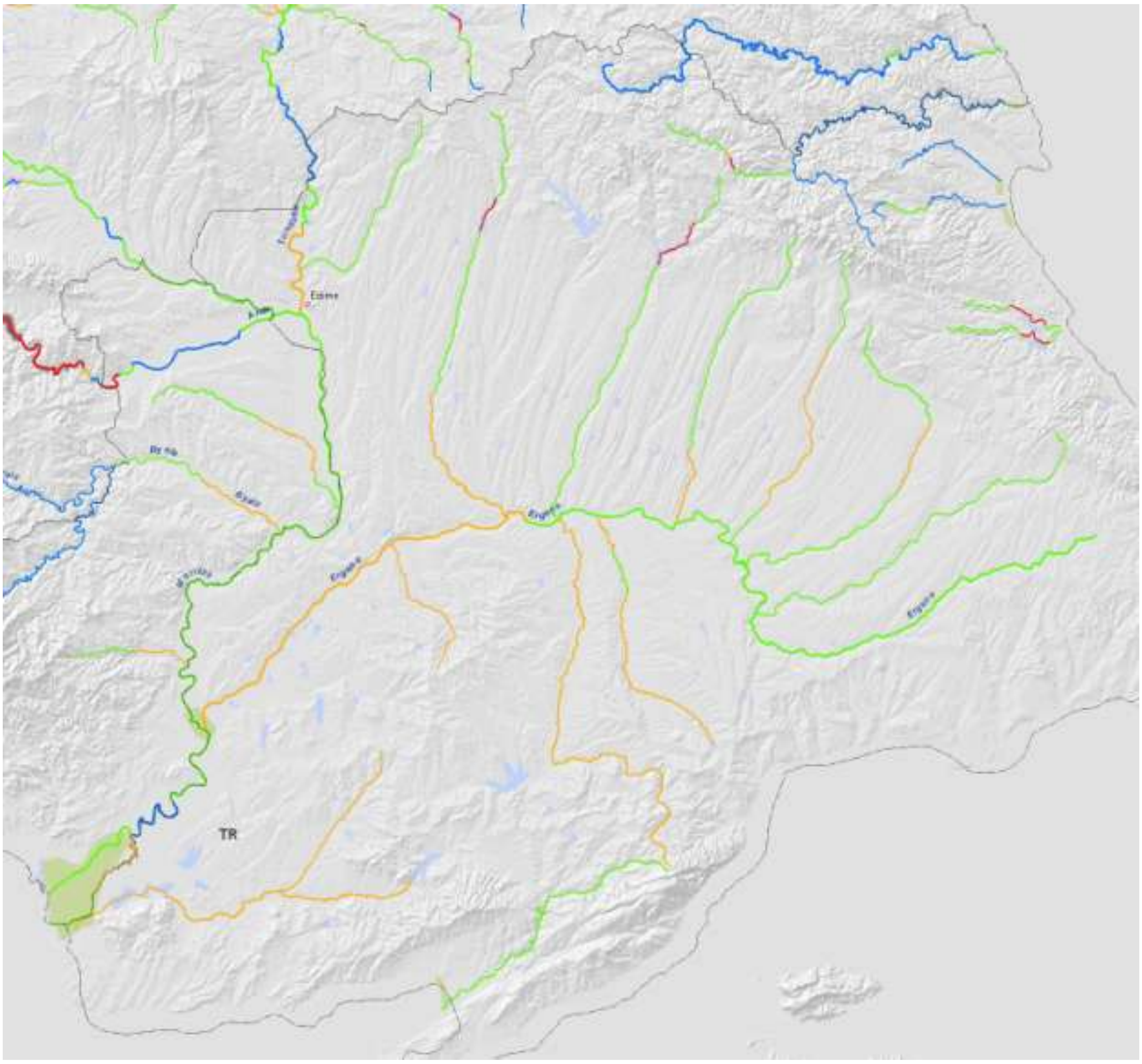


Figure 31: Hydromorphological assessment for TR.

Only the northeastern part of European Turkey was included in this study. Some rivers like the lower Ada and the Rezovo river contributing to Black sea and building the border between Bulgaria and Turkey fall in the first class and are important examples for eastern Balkan rivers. At Maritsa good hydromorphological conditions prevails but tributaries like Ergene in the lowlands are more or less altered (class 2 - 4).

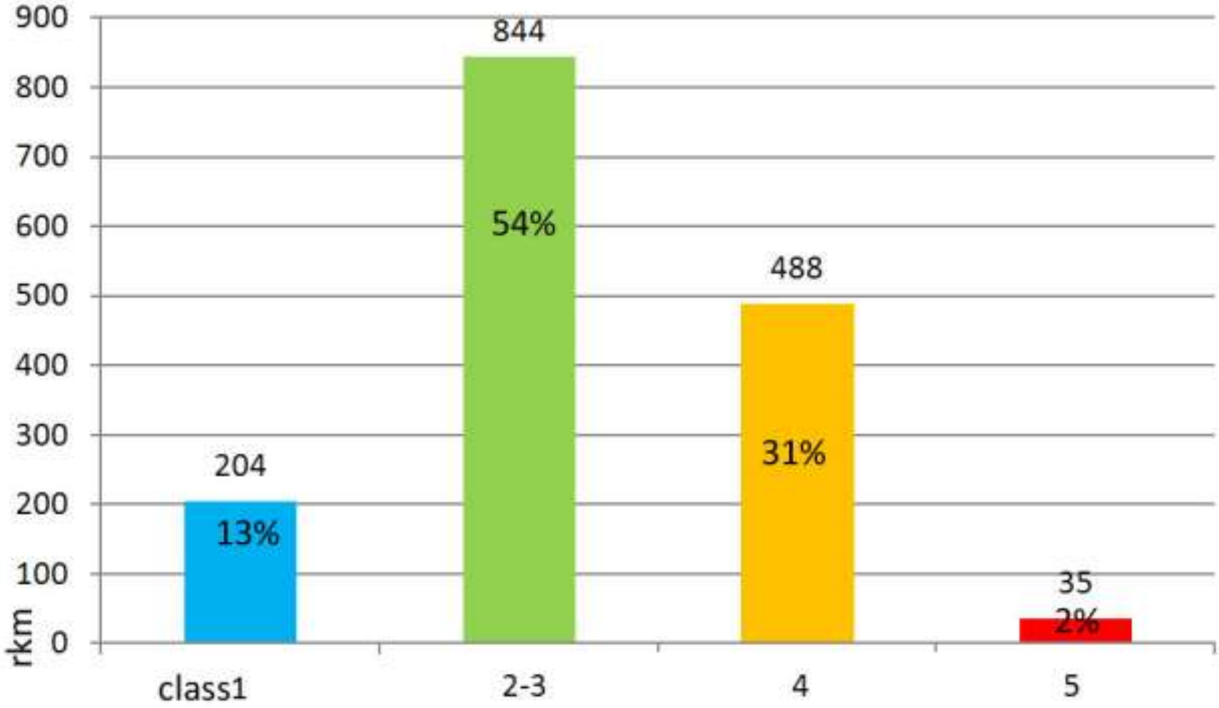


Figure 32: Hydromorphological assessment in rkm and percentage for TR (remark: as only some European parts of Turkey are covered the results are not representative for entire country).

3.2.12 Entire Balkan region

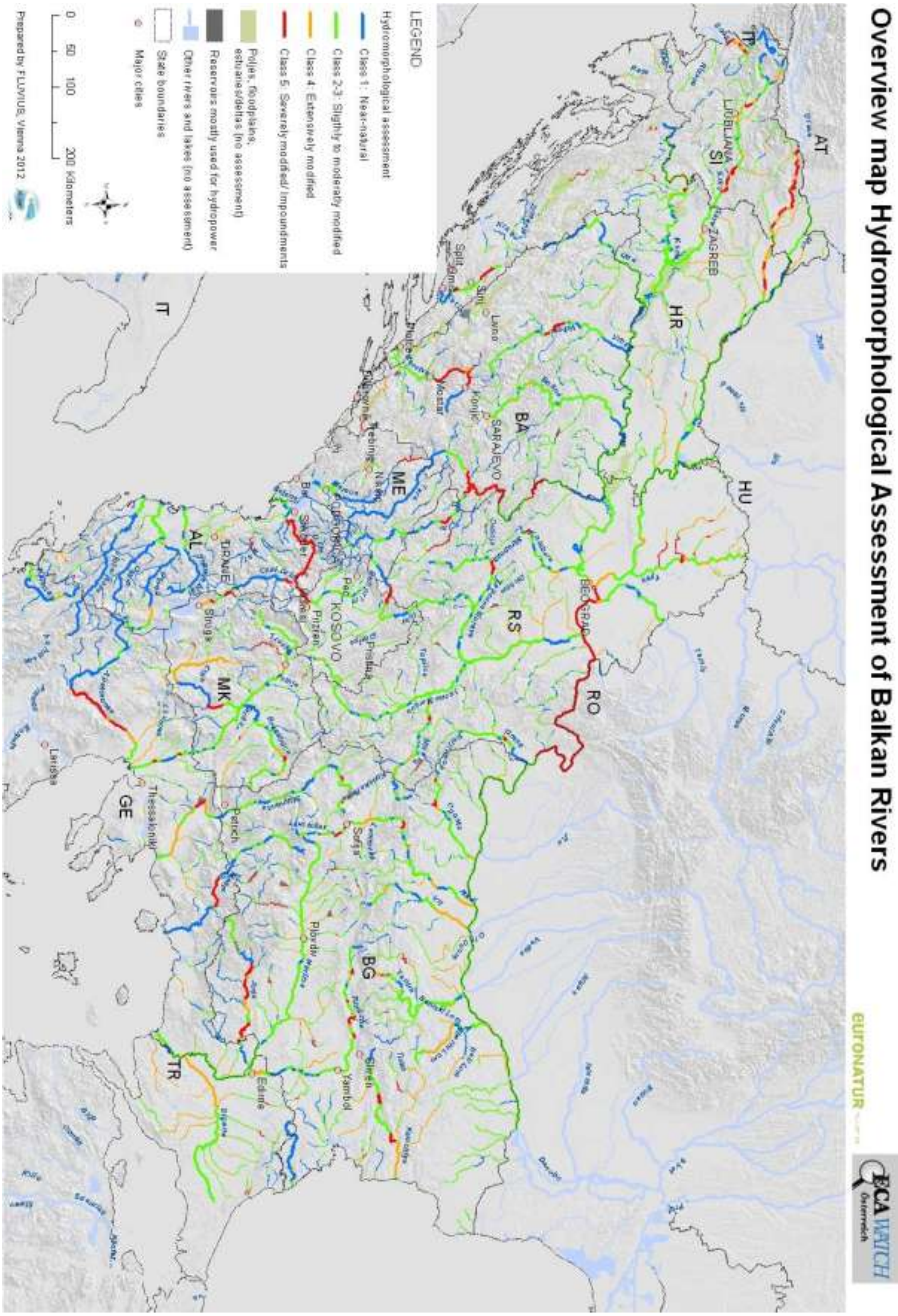


Figure 33: Hydromorphological assessment, overview for entire project area.

The overall picture underlines the still good hydromorphological conditions within the Balkan region regarding class 1 and 2-3. The about 30% of river stretches in the first class indicating the still great number of intact river stretches mainly in ME and AL but also distributed over all other countries. Also the representativeness regarding size and geomorphological river types in the first class must be positively considered (in many western European countries those rivers can be find only in mountainous headwaters as the lower courses are changed significantly). On the other side the length of impounded and therefore totally altered river stretches with some 7% of entire length is still low, but comparable to western European countries. The class 3 with strongly altered river stretches is significantly lower than in Western Europe, one reason could be the poorly developed water management and river regulation branches in some countries.

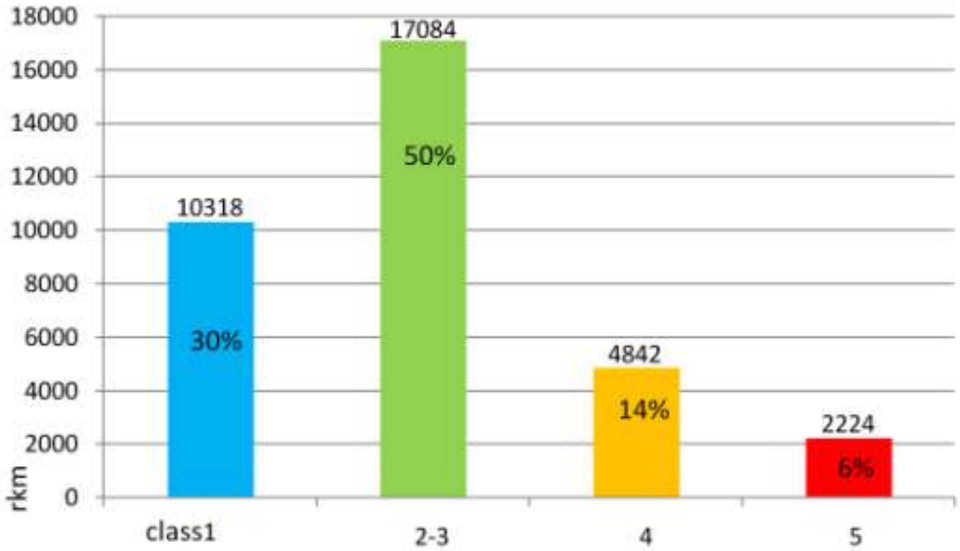


Figure 34: Hydromorphological assessment in rkm and percentage, overview for entire project area.

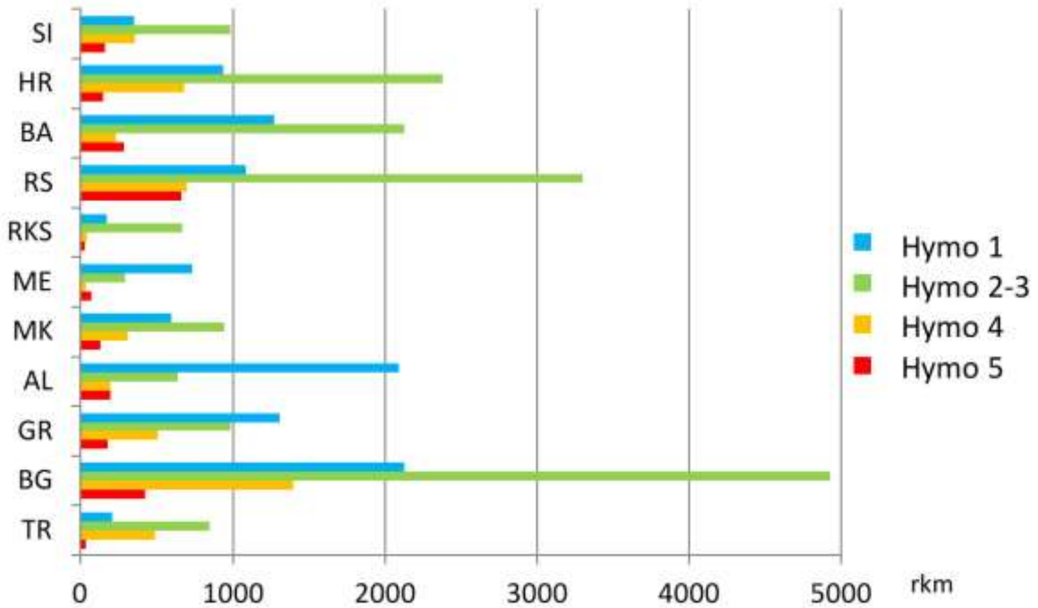


Figure 35: Country distribution indicating AL and BG with the longest river stretches falling in the first class.

3.3 Protected areas, karst poljes, estuaries/deltas and important floodplains

The overview map (Figure 36 on next page) shows major floodplains and protected areas, in particular, Natura 2000 for EU Member States (EC 2010) and Croatia (State Institute for Nature protection Croatia 2010), national parks, biosphere reserves, nature reserves, EMERALD network areas and Important Bird Areas (IBA) as well as Ramsar sites for other countries.

The protected areas for Bosnia and Herzegovina, Serbia and Macedonia still lack on detailed proposals/planning for a coherent network including many river valleys, while in Montenegro many huge national parks already include important river reaches (e.g. Tara canyon, Skadar Lake). The proposals for Albania also not fully cover all major river system as it would be in EU countries.

Major important floodplains were considered continuously, meaning for the large rivers such as Danube, Drava and Sava they are subdivided in upper, middle and lower parts. In addition the map includes all assessed karst poljes, estuaries/deltas as well as other wetlands (not lakes, only those strongly influenced by adjacent rivers).

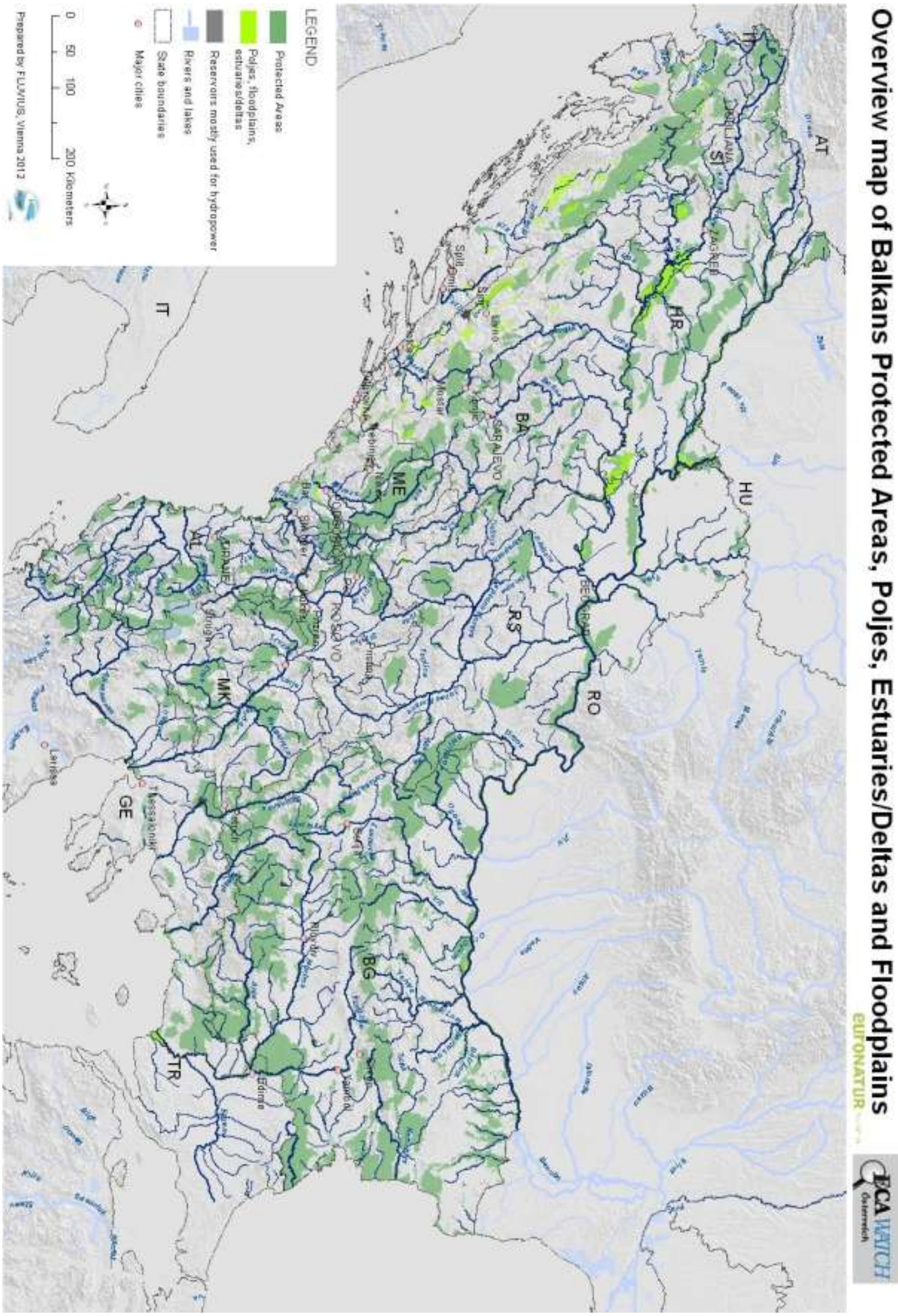


Figure 36: Protected areas within the project area.

3.4 Conservation value of rivers

The conservation value is assessed in three levels (compare chapter 3): Very high conservation value (in blue), high conservation value (in dark green) and low conservation value (in light green). Karst poljes, major floodplains as well as deltas and estuaries with very high conservation value are visualized in dark blue-green and high conservation value in light green and low in light turquoise. Karst poljes and deltas are from particular interest for nature protection, therefore nearly all fall in the first two conservation classes.

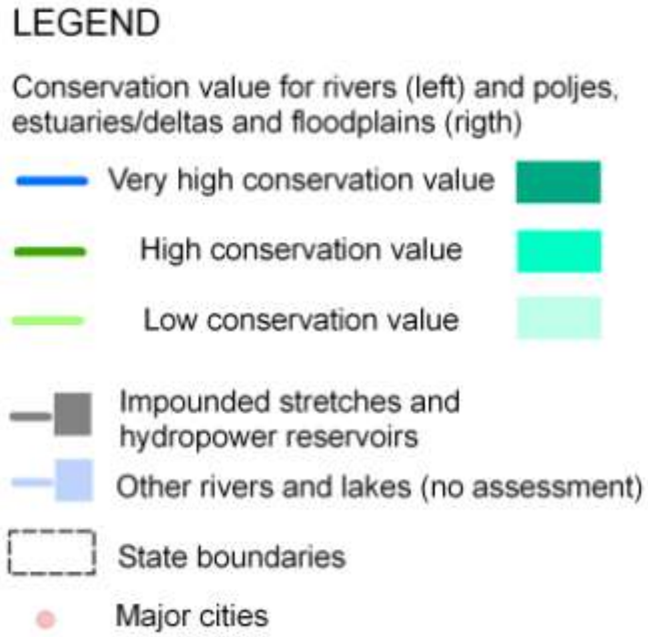


Figure 37: Legend for the following maps of chapter 3.4 To save space for country maps legend and title was not add to individual maps (river names outside the project area are incomplete).

3.4.1 Slovenia

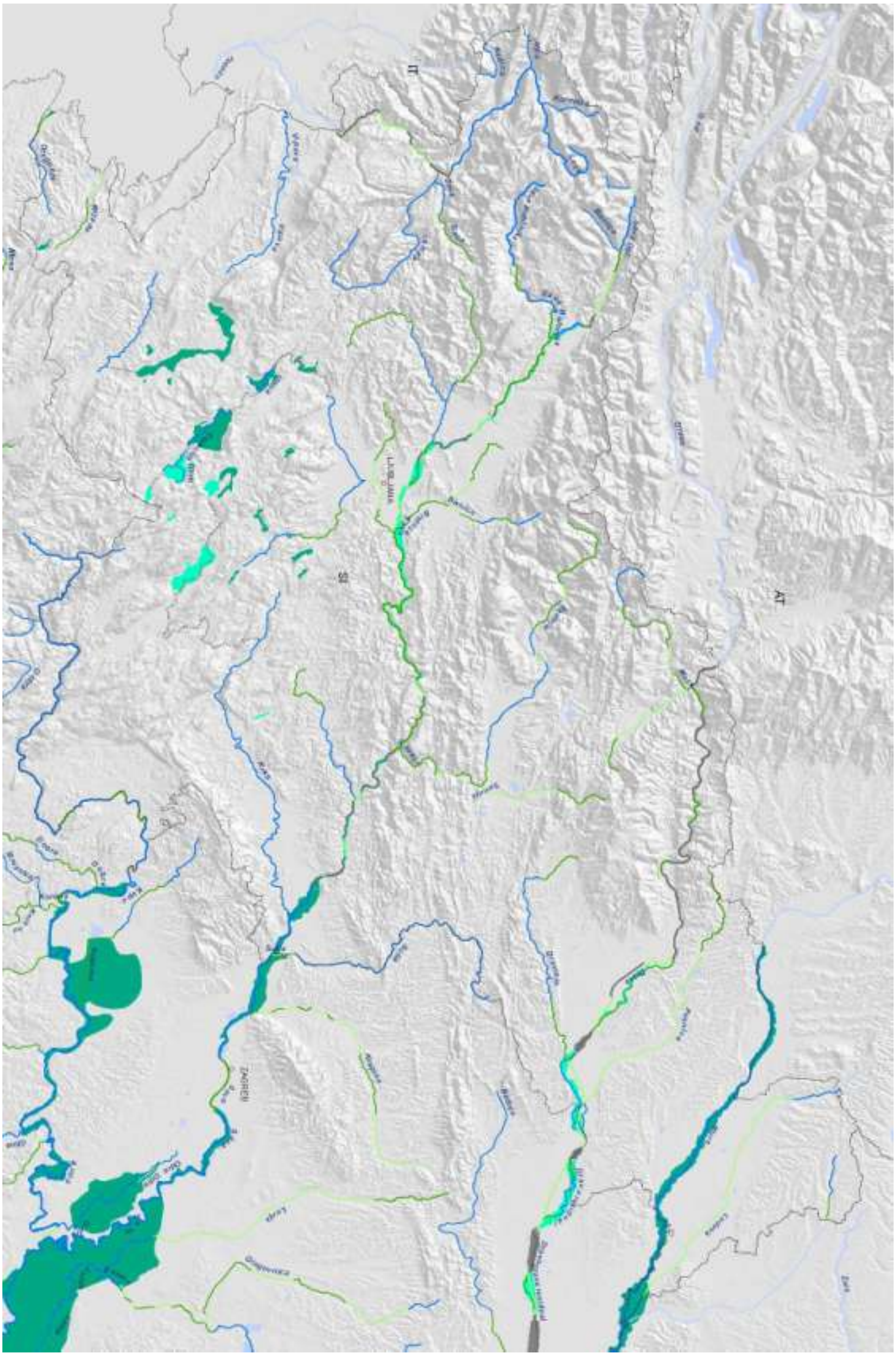


Figure 38: Conservation value for SI.

The very high conservation value covers the upper Sočia, Mura and many southern Karst rivers. The high conservation values along Drava are relevant for the residual water stretches of former river bed which are part of the Natura 2000 network (nevertheless hydrology is heavily damaged and the river and floodplains are degraded, but still in size significant for the region). Special attention should be given also to middle and upper Sava in SI still providing valuable river reaches. Most of the karst poljes fall into the very high class.

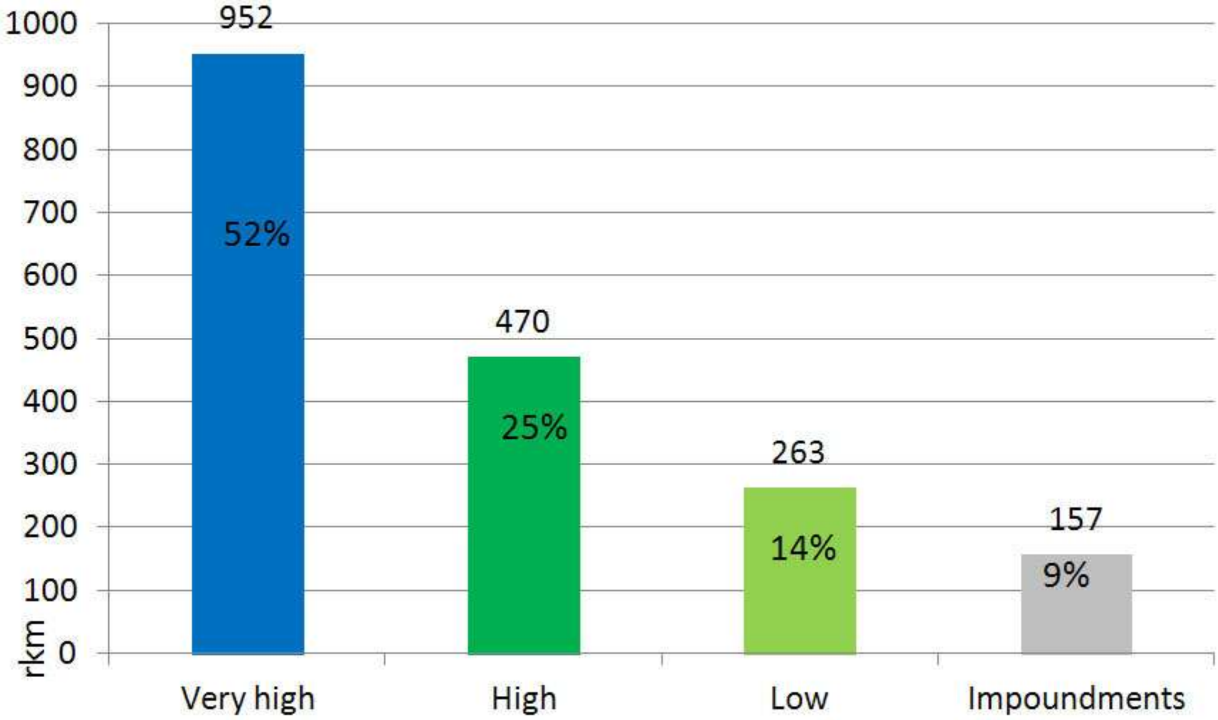


Figure 39: Conservation value in rkm for SI.

3.4.2 Croatia

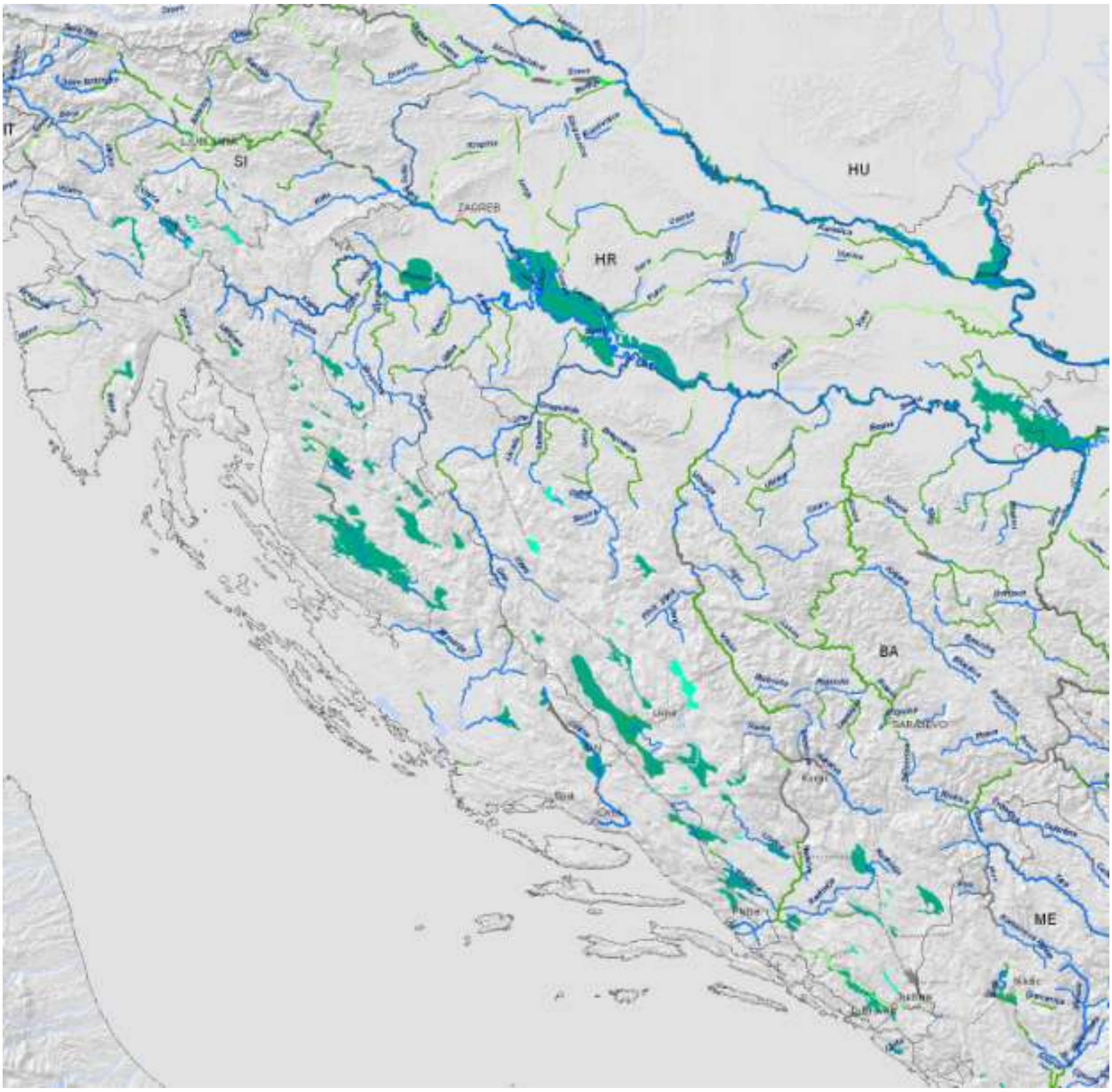


Figure 40: Conservation value for HR.

The figure 40 indicates the outstanding position of Croatia regarding high conservation values: Over 60% of the river stretches fall in the first category.

Croatia has already a preliminary Natura2000 coverage protecting many river corridors and raising several river reaches into the very high conservation value class due to their protection status (in particular on major rivers such as Sava, Drava, Danube and Kupa). But Sava, lower Drava and lower Kupa as well as Danube have additionally major floodplains. Great examples for still intact floodplains are the Kopački Rit nature park on Danube and Lonjsko Polje nature park on Sava. But also many Mediterranean rivers with impressive canyons fall without doubt into the very high conservation class such as river stretches hosting the Plitvice and Krka waterfalls. Low conservation value tributary stretches can be find on smaller streams between Drava and Sava.

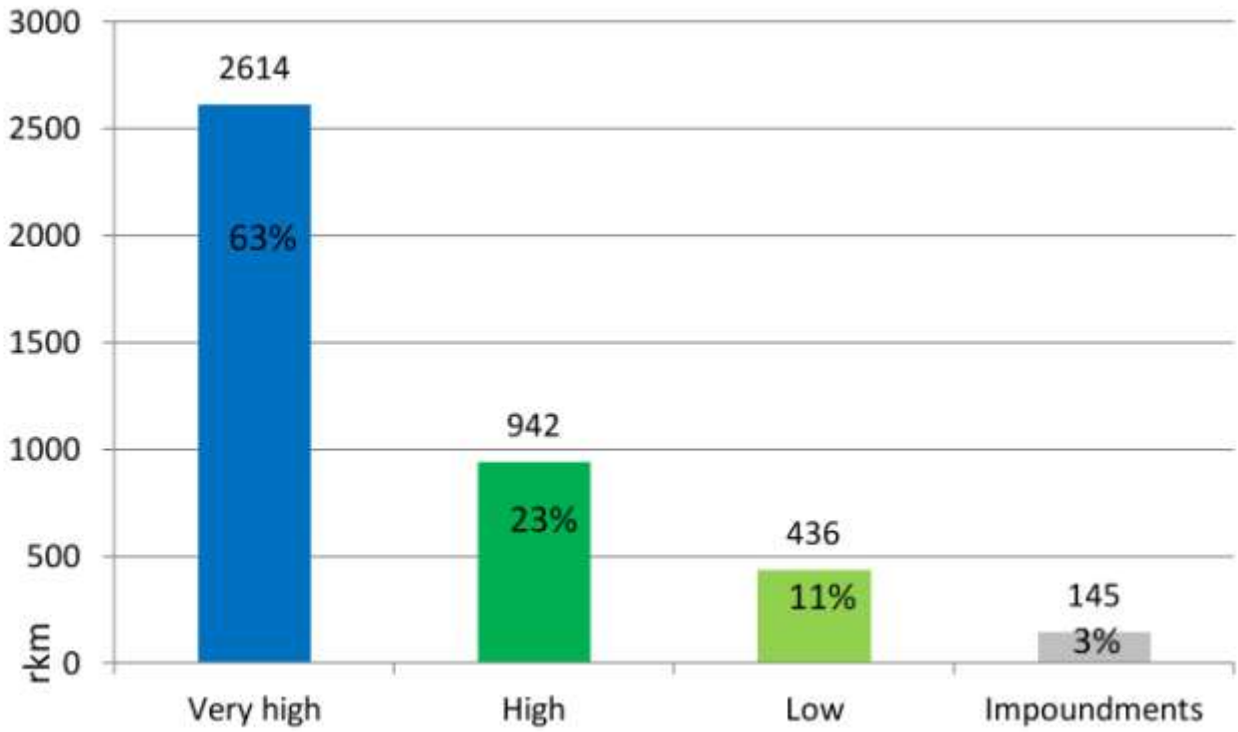


Figure 41: Conservation value in rkm for HR

3.4.3 Bosnia & Herzegovina

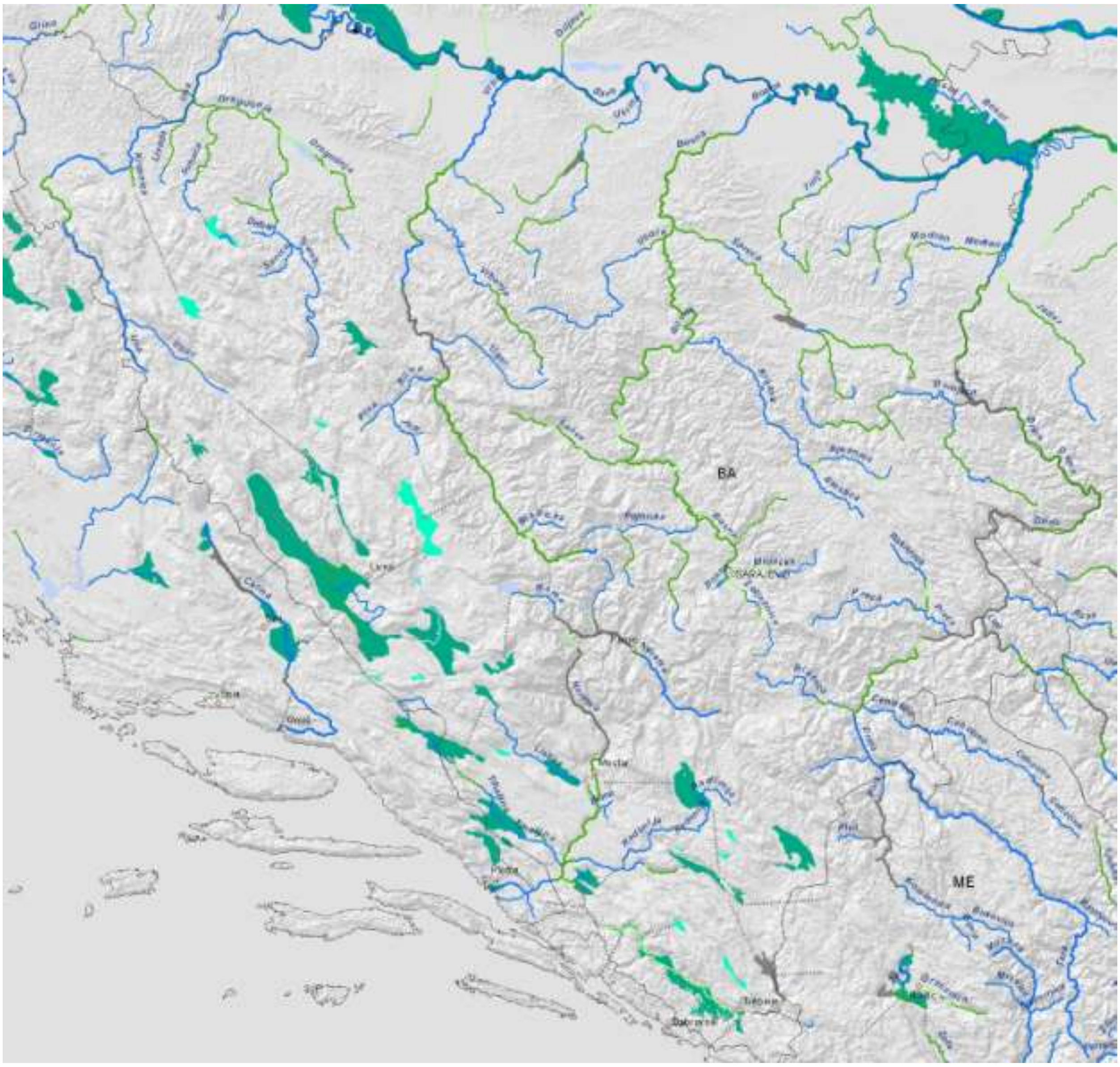


Figure 42: Conservation value for BA.

Regarding karst poljes Bonsine and Herzegowina has an outstanding importance. One of the largest karst polje worldwide is the Livanjsko Polje in the Cetina basin, keeping in larger parts its original characteristics of regular flooding it falls into the highest conservation value class.

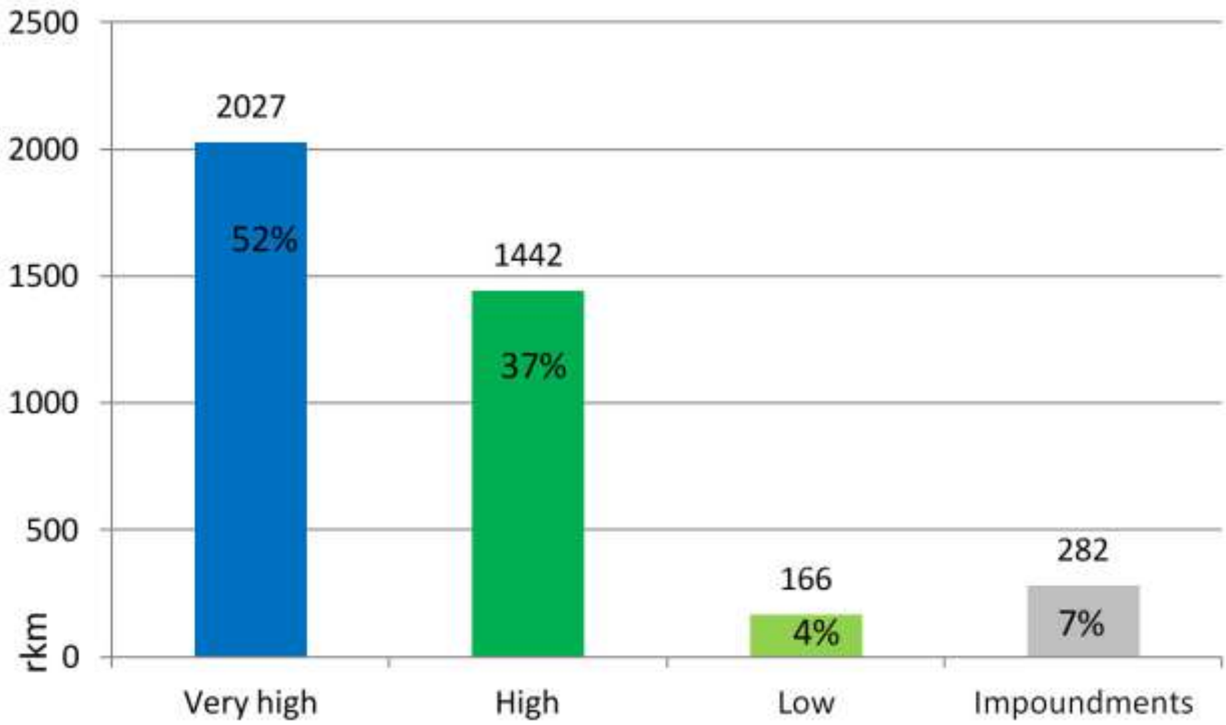


Figure 43: Conservation value in rkm for BA.

3.4.4 Serbia

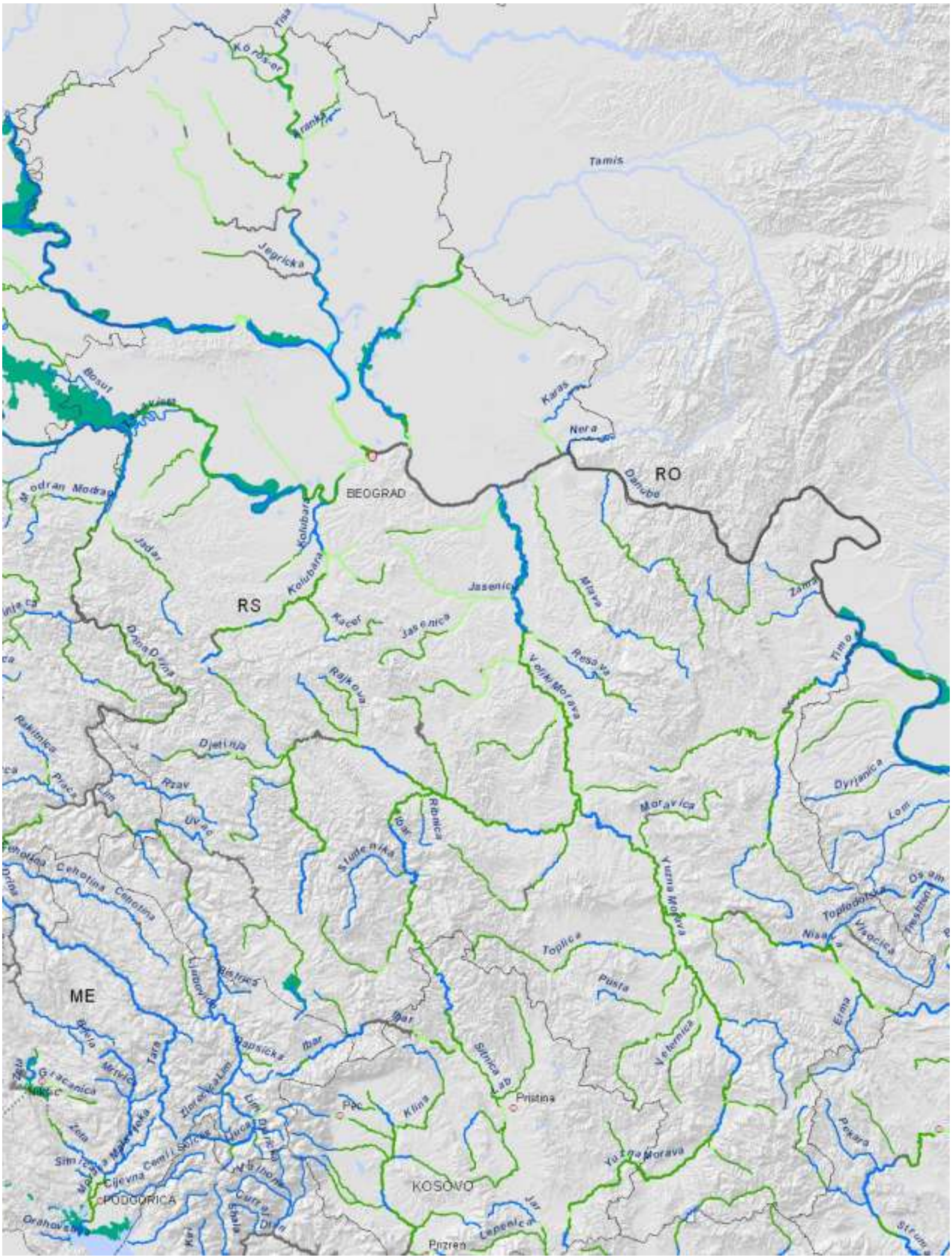


Figure 44: Conservation value for RS.

In Serbia several large river stretches fall into the highest class due to protected areas or significant adjacent floodplains. However most of the rivers are so far classified in the second class, which could change due to enlarged protection areas (e.g. by EMERALD/ Natura 2000 planning) including river corridors. The Danube in the Iron Gate was not assessed due to large impoundment.

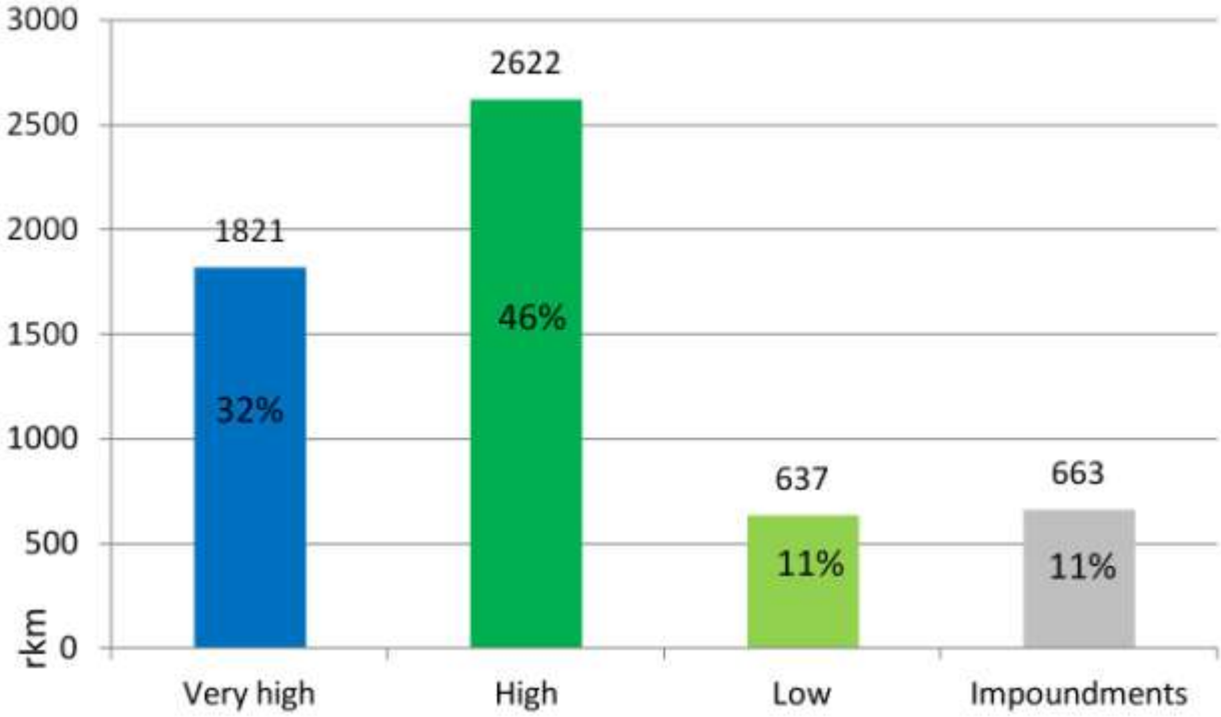


Figure 45: Conservation value in rkm for RS.

3.4.5 Kosovo

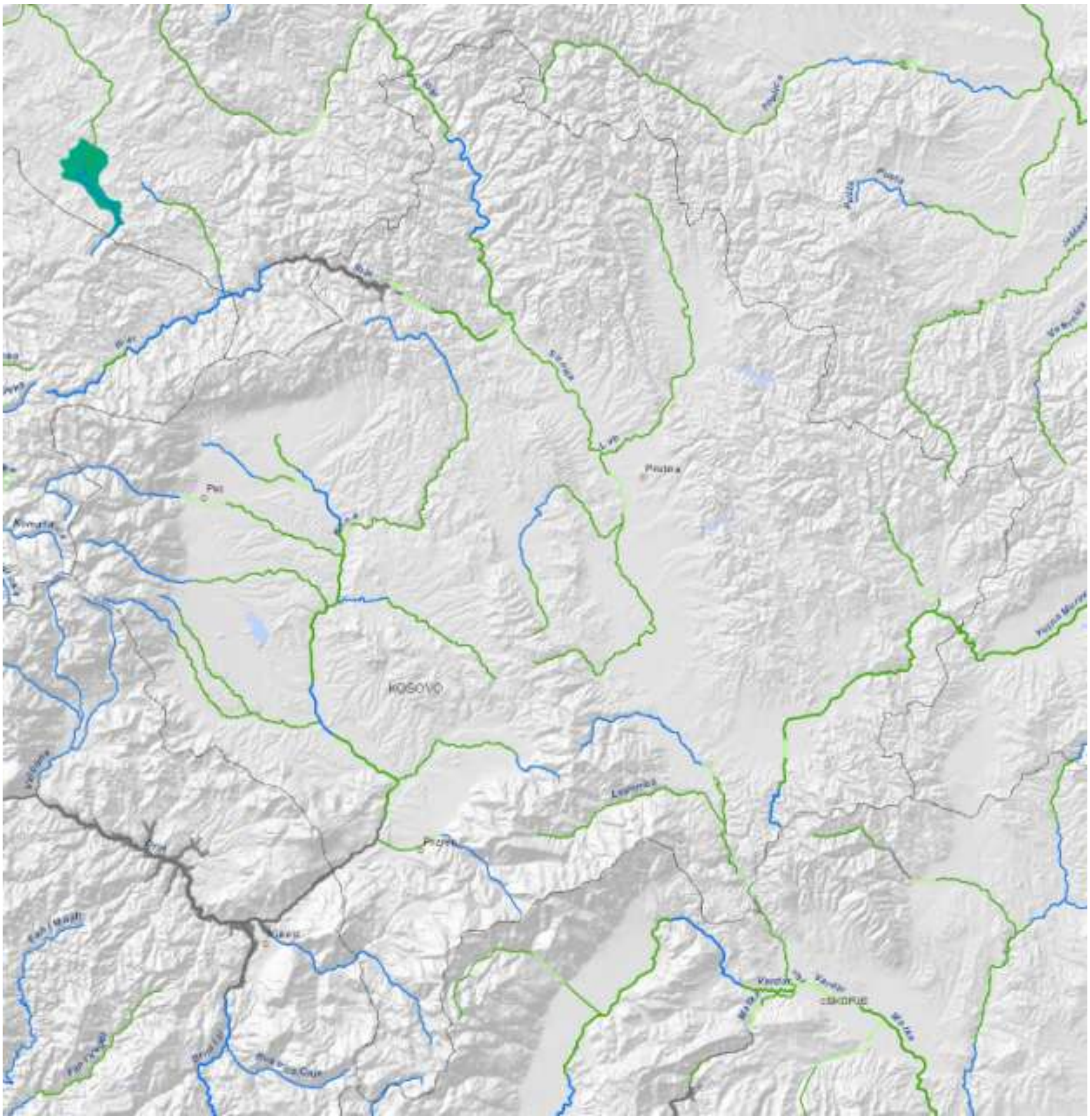


Figure 46: Conservation value for Kosovo.

Very high conservation values were reached in the Kosovo for some breakthrough stretches and headwaters. The protected area network is still incomplete.

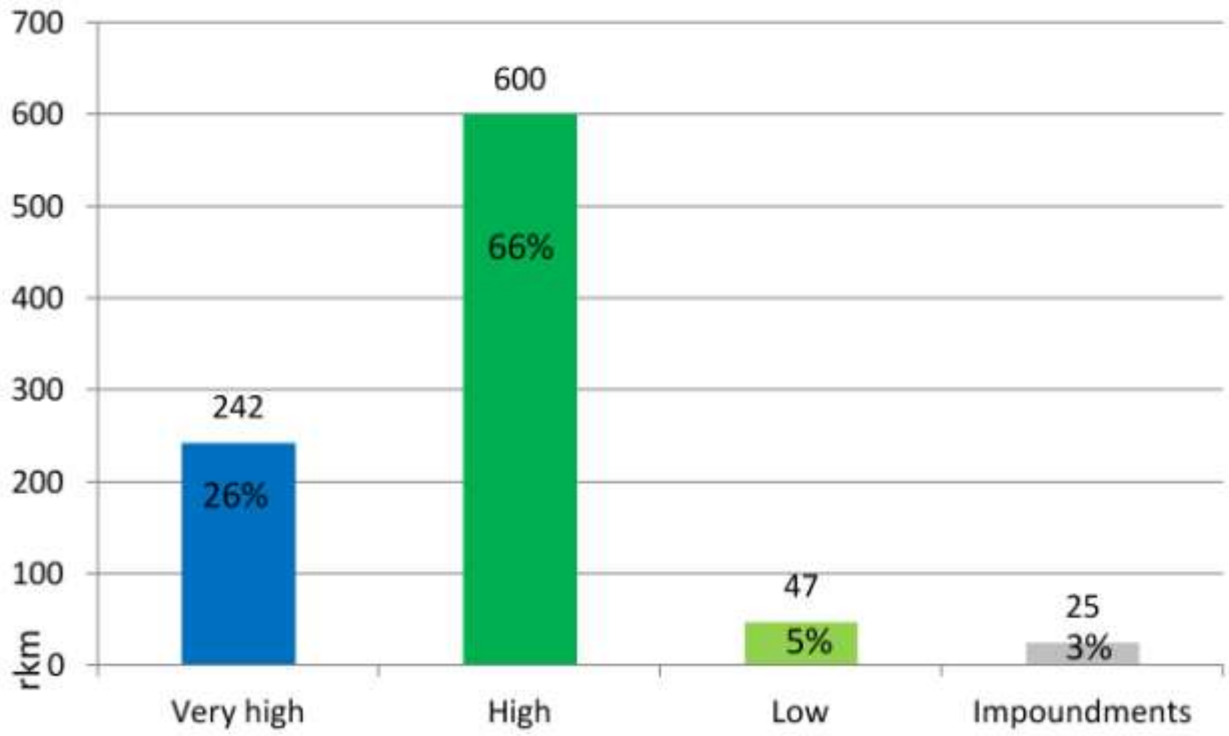


Figure 47: Conservation value in rkm for Kosovo.

3.4.6 Montenegro

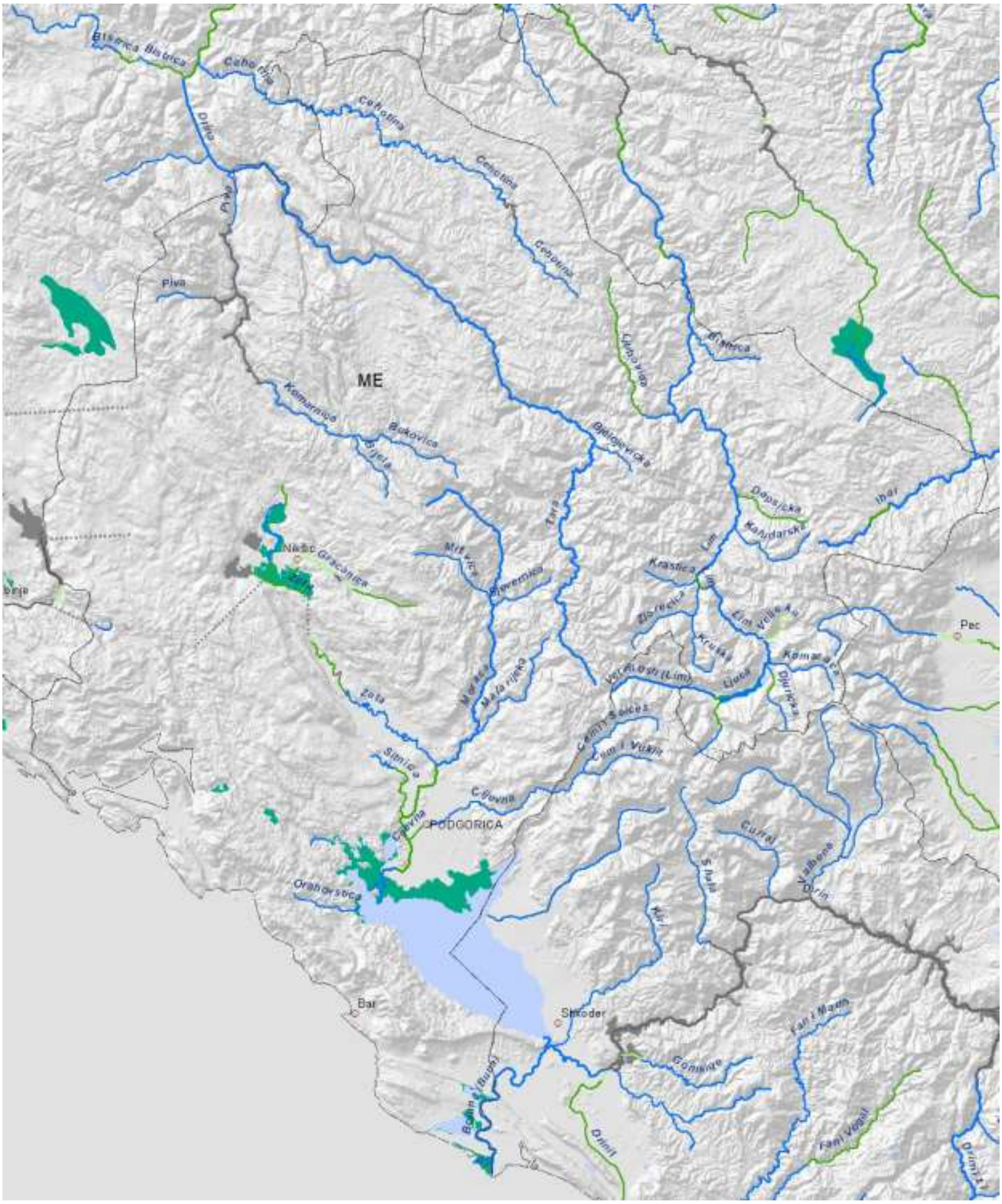


Figure 48: Conservation value for ME.

In Montenegro nearly 80% of all rivers still provide a very high conservation value, which is outstanding across entire project area. Skadar Lake would have a special role in the freshwater ecosystem of the country and is the continuum between the Adriatic Sea (Bojana-Buna) and Morača having the characteristics of a huge “floodplain lake” an a dynamic of 5 m of lake water level annually building a broad floodplain belt on its northern shore. The rather good developed system of national parks supports the very high conservation value assessment.

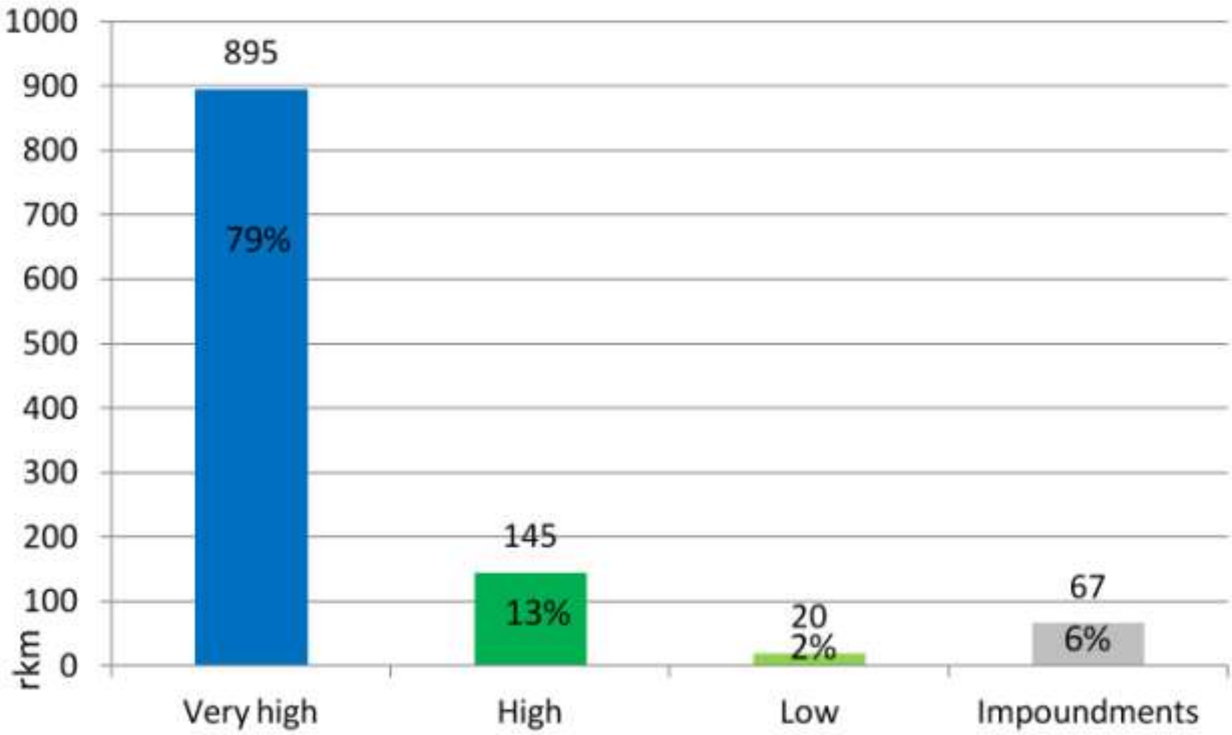


Figure 49: Conservation value in rkm for ME.

3.4.7 Macedonia

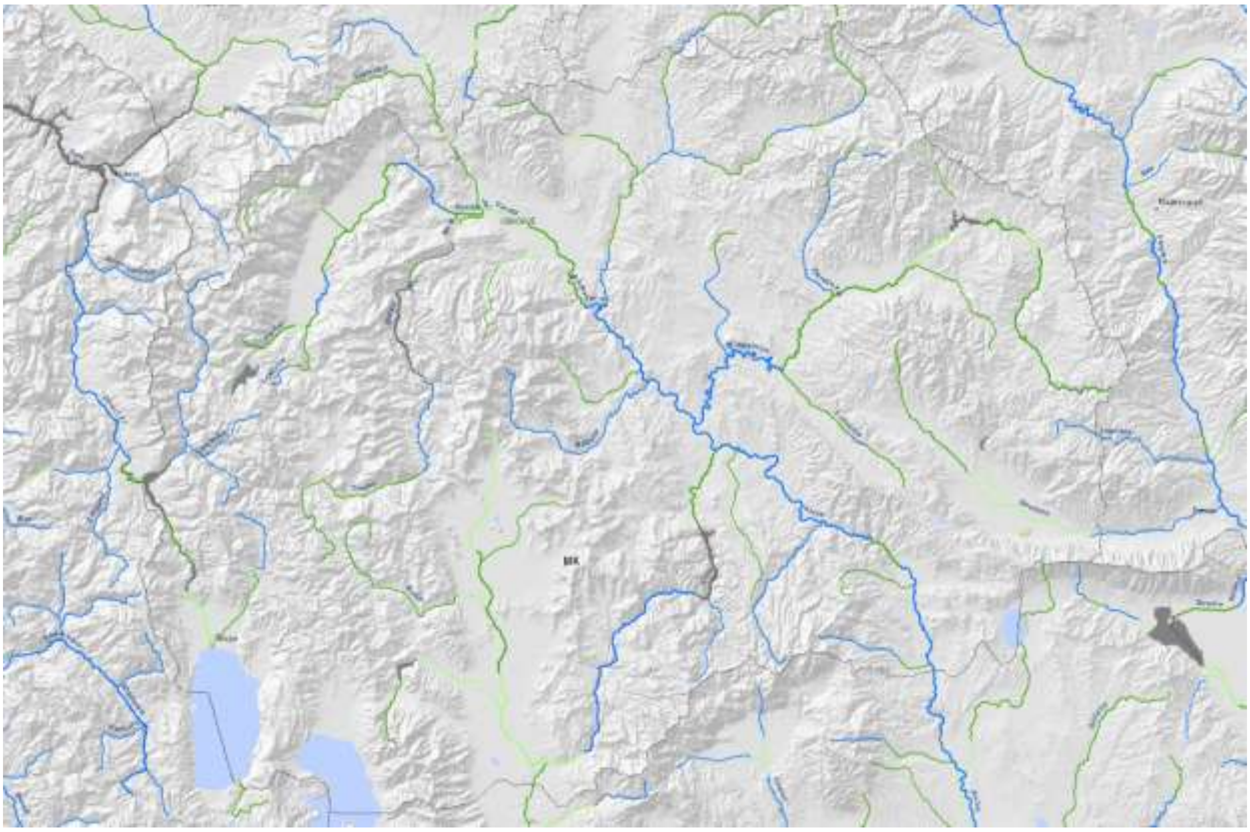


Figure 50: Conservation value for MK.

Macedonia still host many river stretches in the highest conservation value. Impressive are some breakthrough valleys and smaller tributaries as well as cultural landscapes with pastures and orchards along smaller rivers.

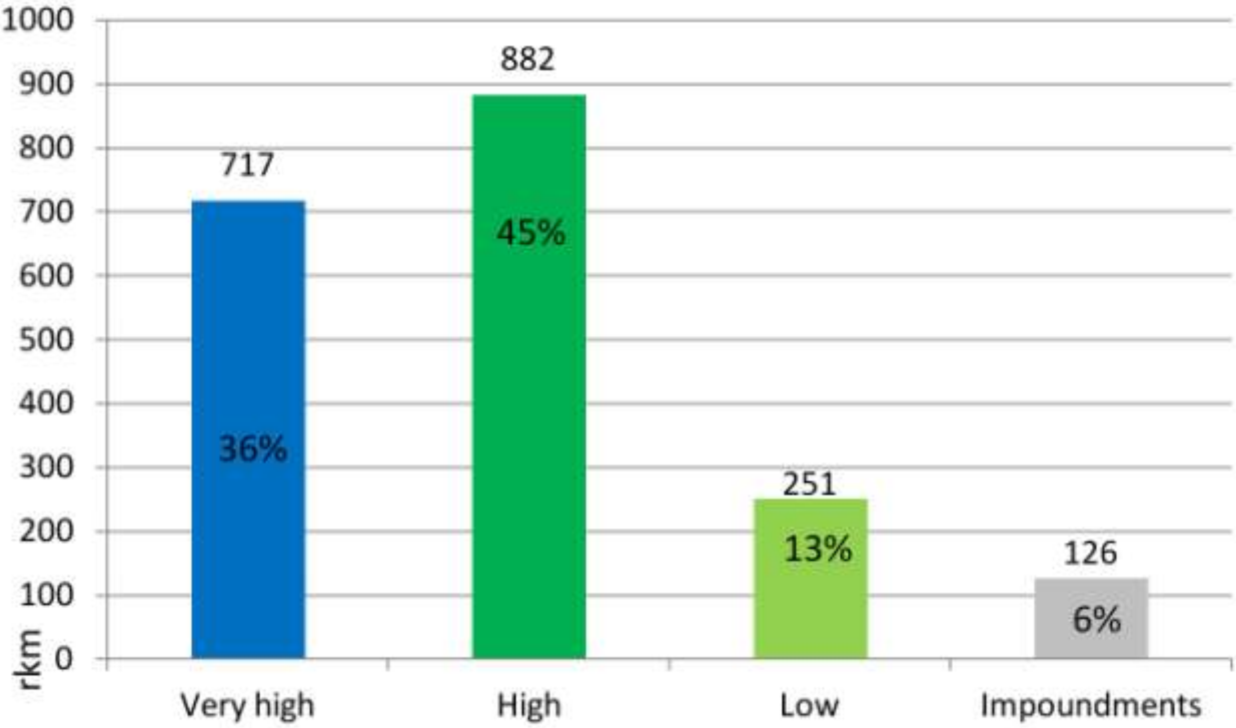


Figure 51: Conservation value in rkm for MK.

3.4.8 Albania

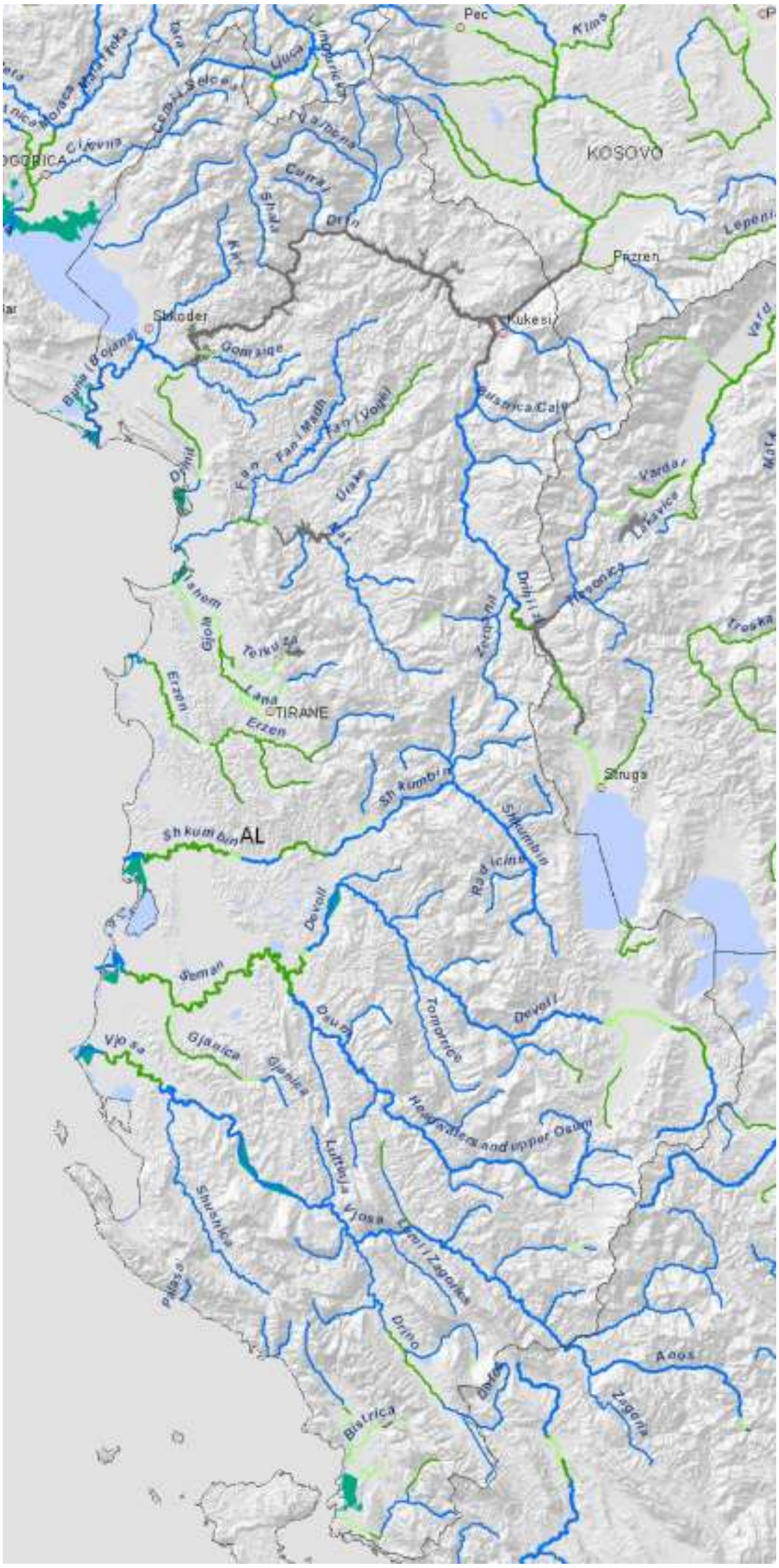


Figure 52: Conservation value for AL.

The ecological intactness of rivers in general reaches in several cases from the headwater to the deltas into the Adriatic Sea, which is mostly unique for Adriatic or even European Mediterranean catchments and rivers of this size. Due to limited coherent protection network some rivers fall in the lowlands only in the second class.

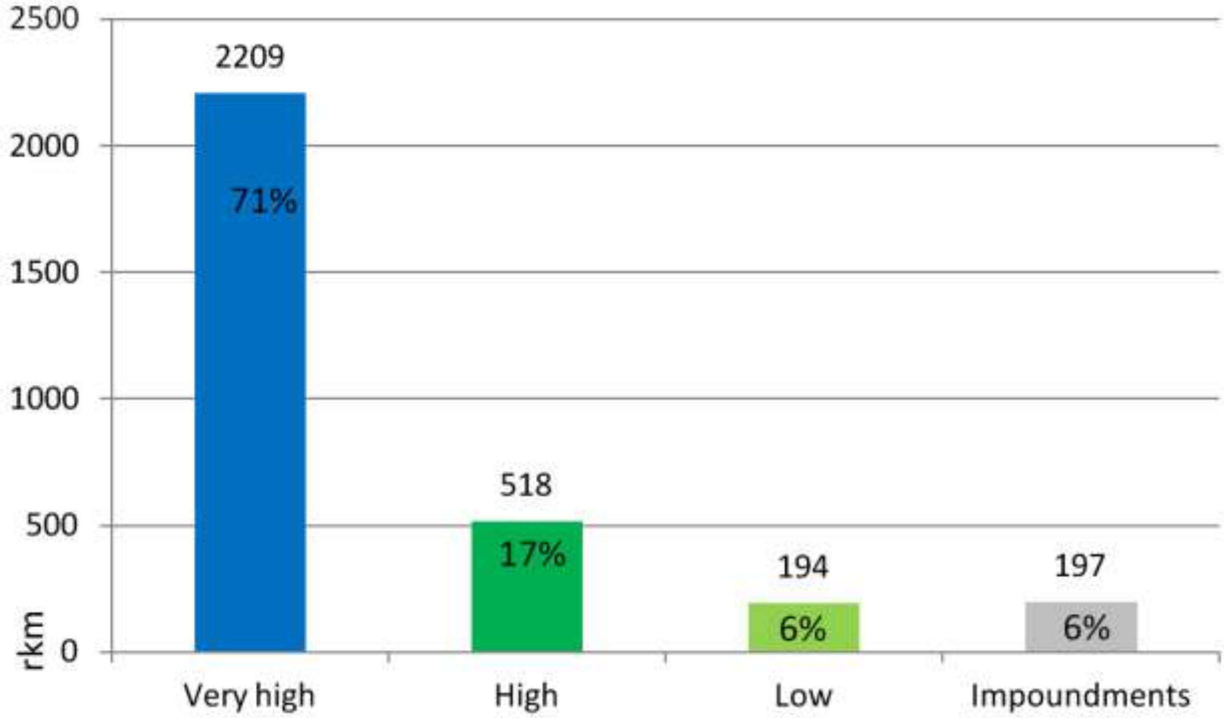


Figure 53: Conservation value in rkm for AL.

3.4.9 Greece

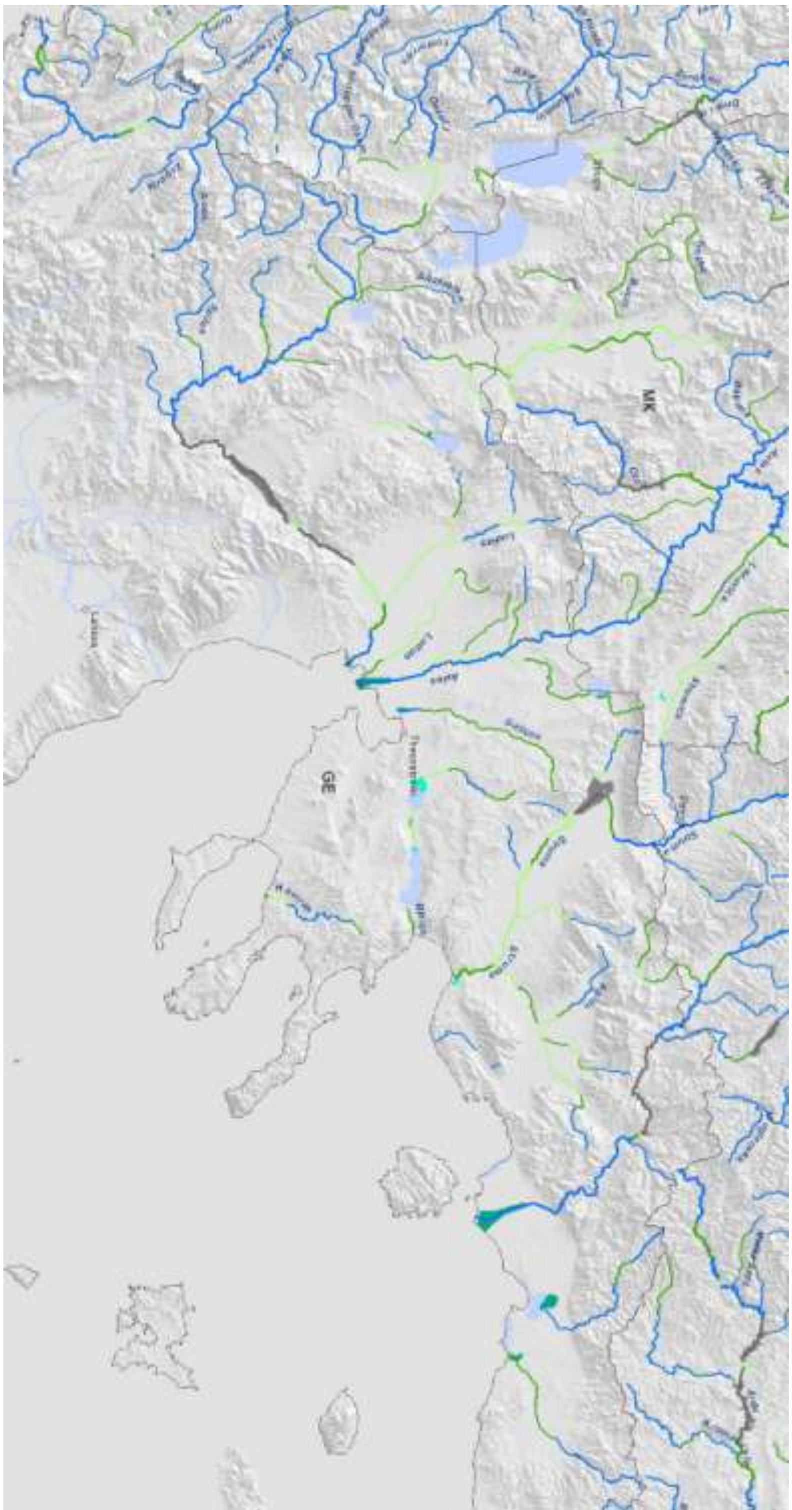


Figure 54: Conservation value for GR.

The assessment for the northern part of Greece is remarkable for an EU country, still a great number of rivers provide very high conservation values.

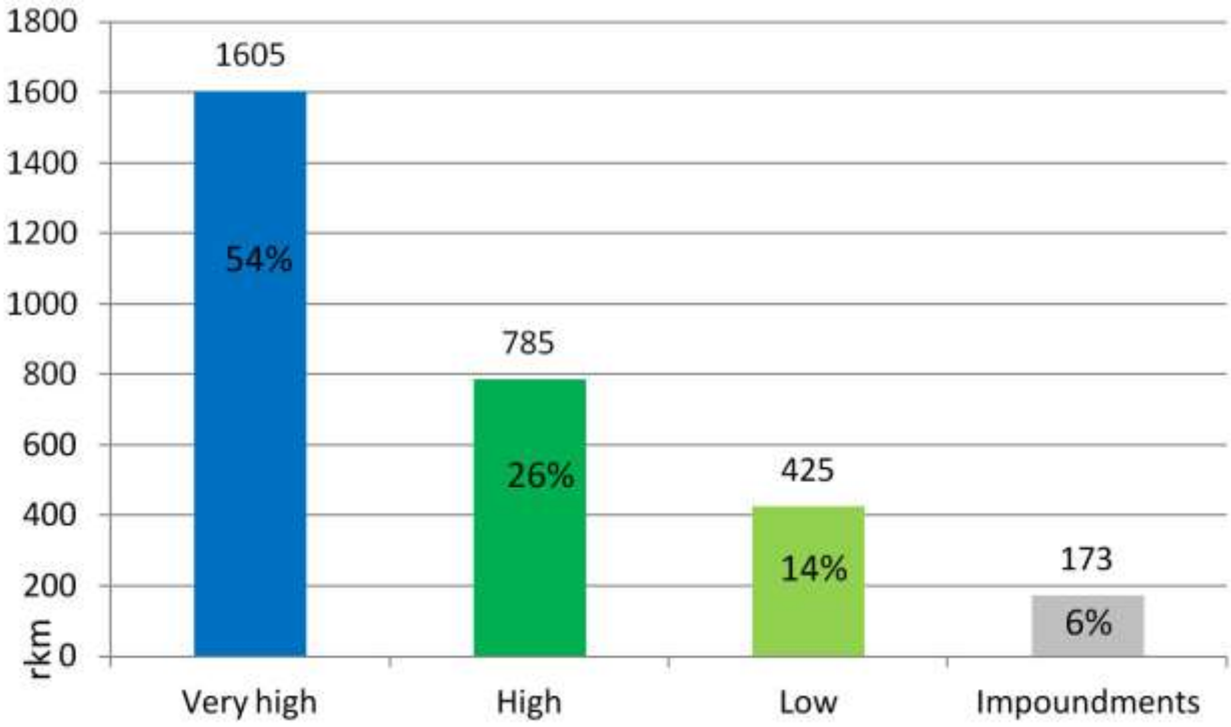


Figure 55: Conservation value in rkm for GR (remark: as only some northern Greece catchments are covered the results are not representative for entire country).

3.4.10 Bulgaria

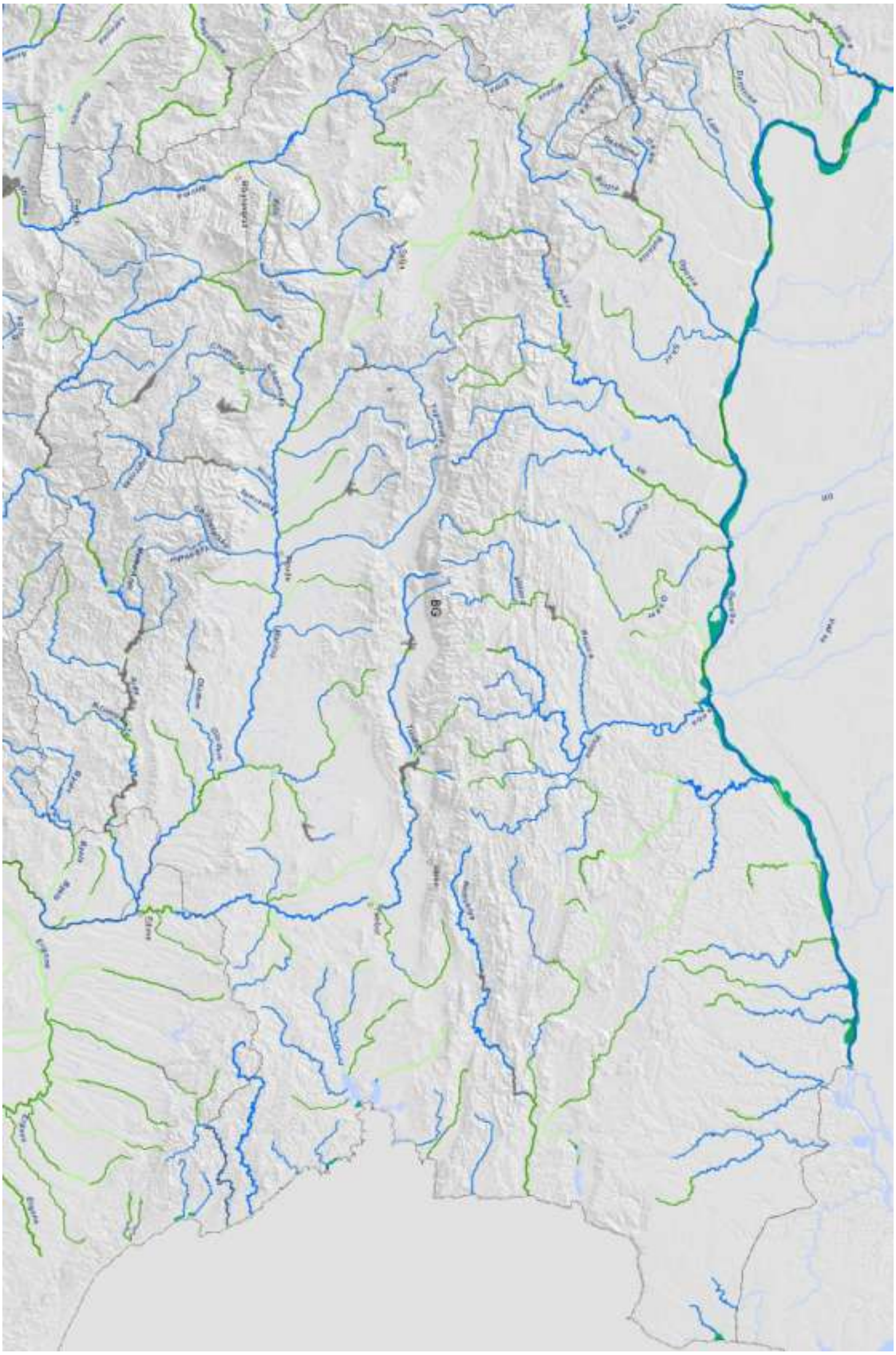


Figure 56: Conservation value for BG.

Due to the dense network of protected areas -similar to Slovenia- many stretches fall into the very high conservation value class. With over 5,500 rkm BG hosts most of the river stretches with very high conservation value regarding the total value.

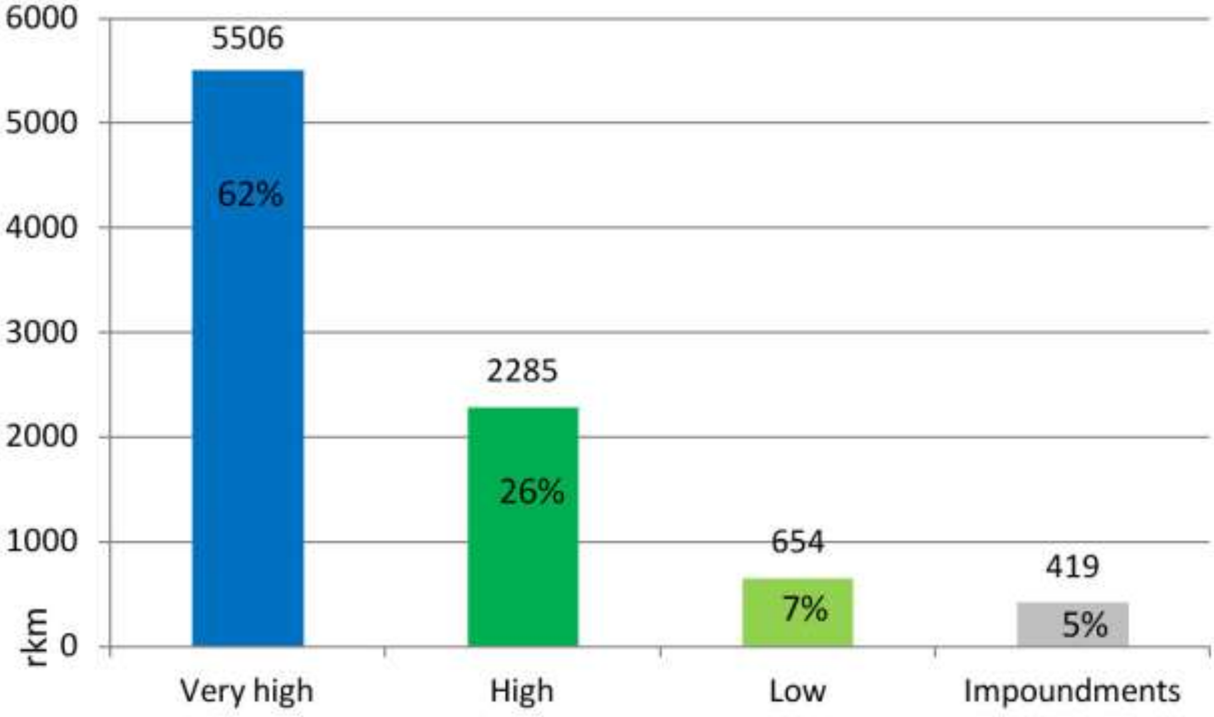


Figure 57: Conservation value in rkm for BG.

3.4.11 Turkey

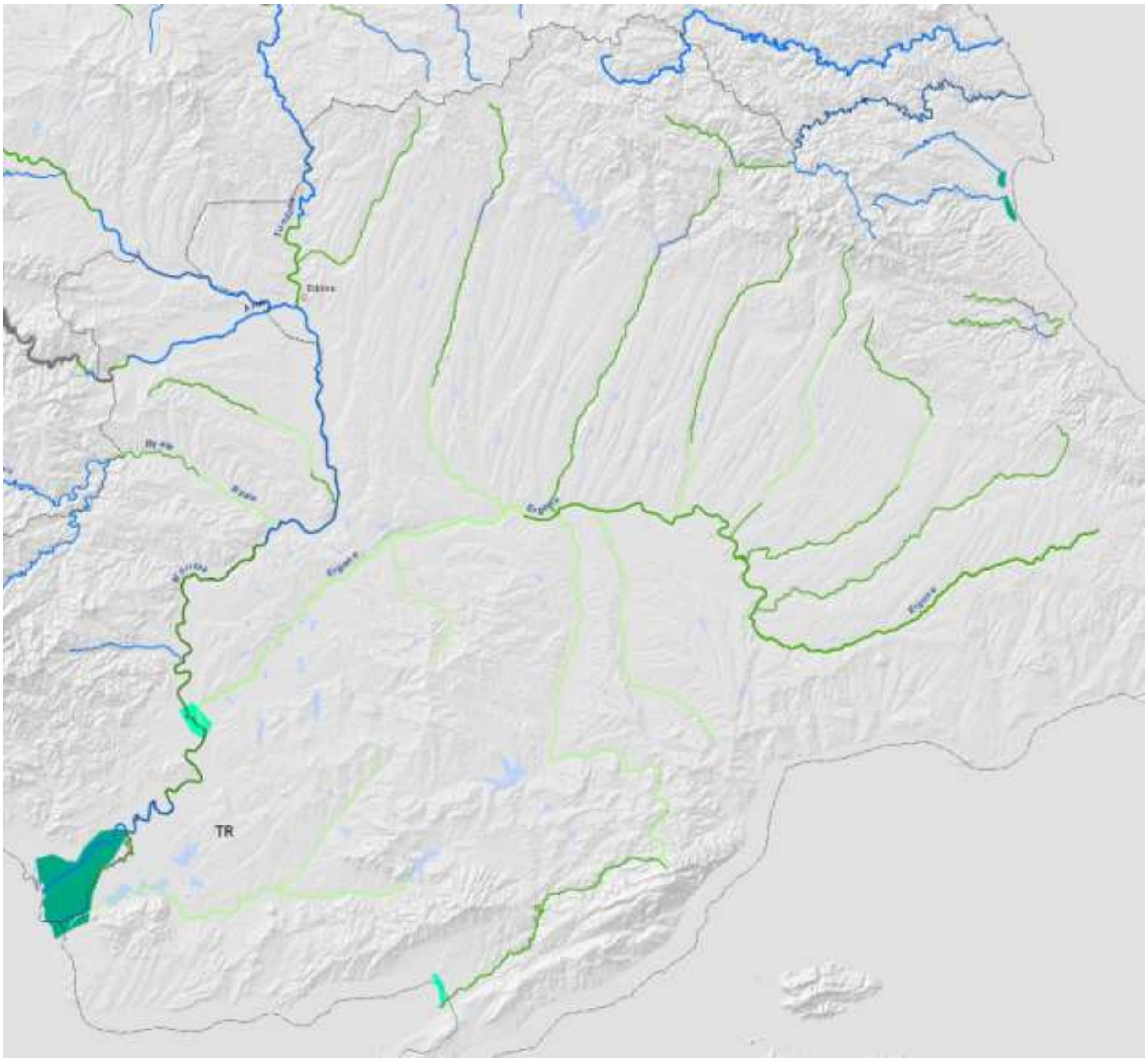


Figure 58: Conservation value for TR.

Only the border rivers to Bulgaria and Greece fall into the very high class, the rivers on the planes are mostly intensively used for water supply.

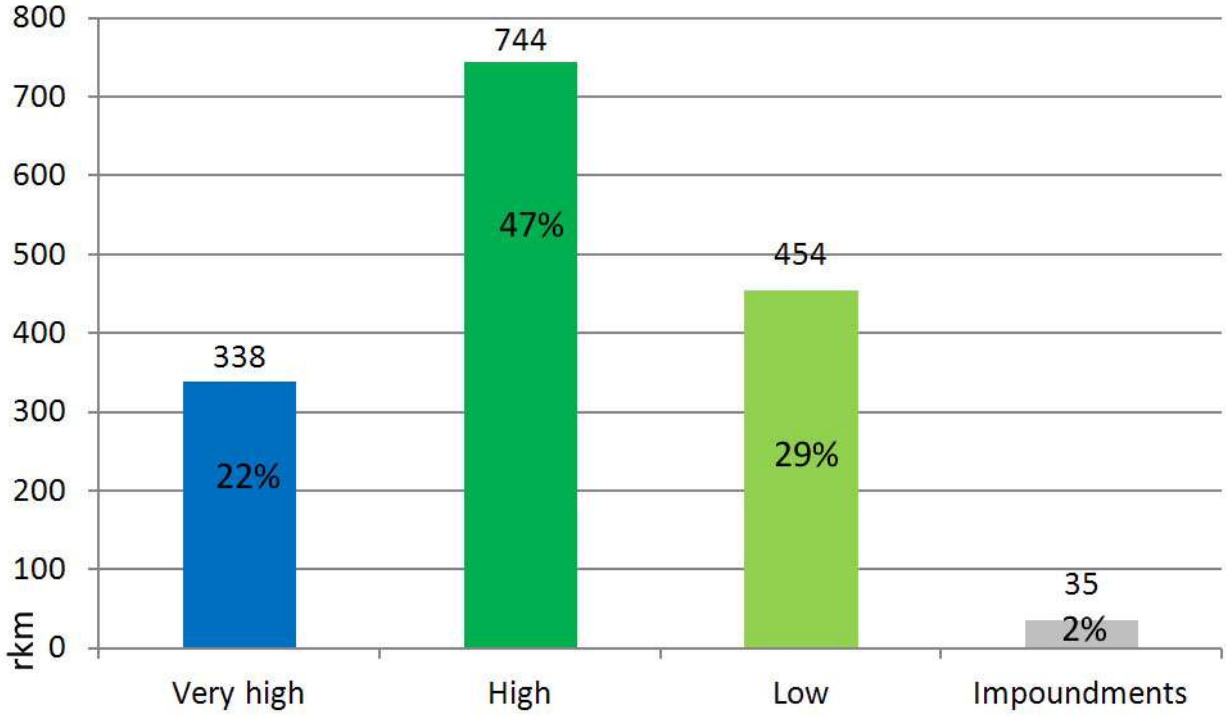


Figure 59: Conservation value in rkm for TR (remark: as only some European parts of Turkey are covered the results are not representative for entire country).

3.4.12 Entire Balkan region

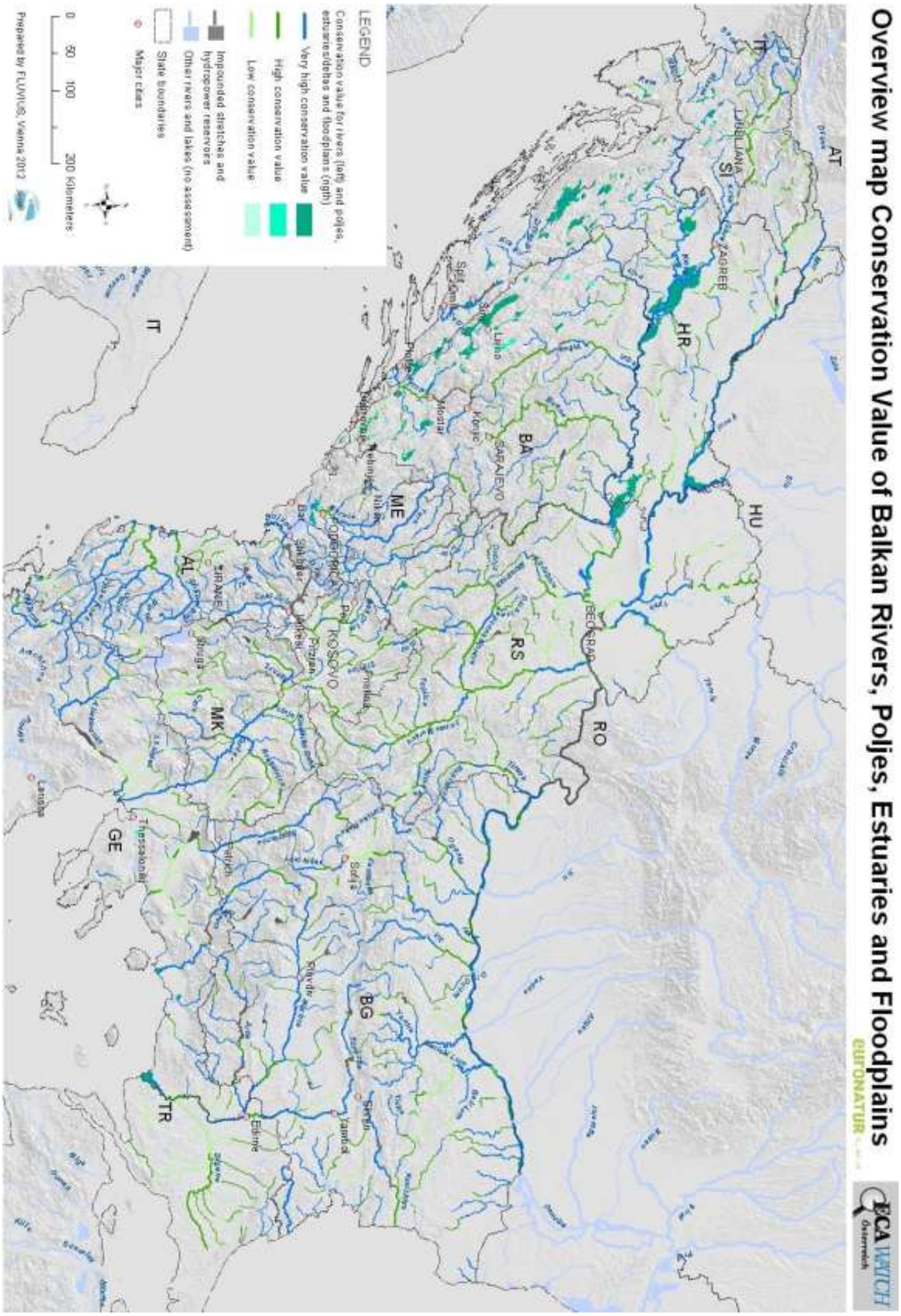


Figure 60: Conservation value for Poljes, Estuaries/Deltas and Floodplains.

In total the very high and high conservation values prevail significantly across the entire Balkan. The chart should be also set in relation to the hydromorphological assessment for entire Balkan (Figure 33) where “only” 30% fall in the first ”blue” class, indicating that the 20% additional river stretches almost lost their hydromorphological near-natural characteristics but still provide important habitats within protected areas for many threatened or even endemic species of the Balkan.

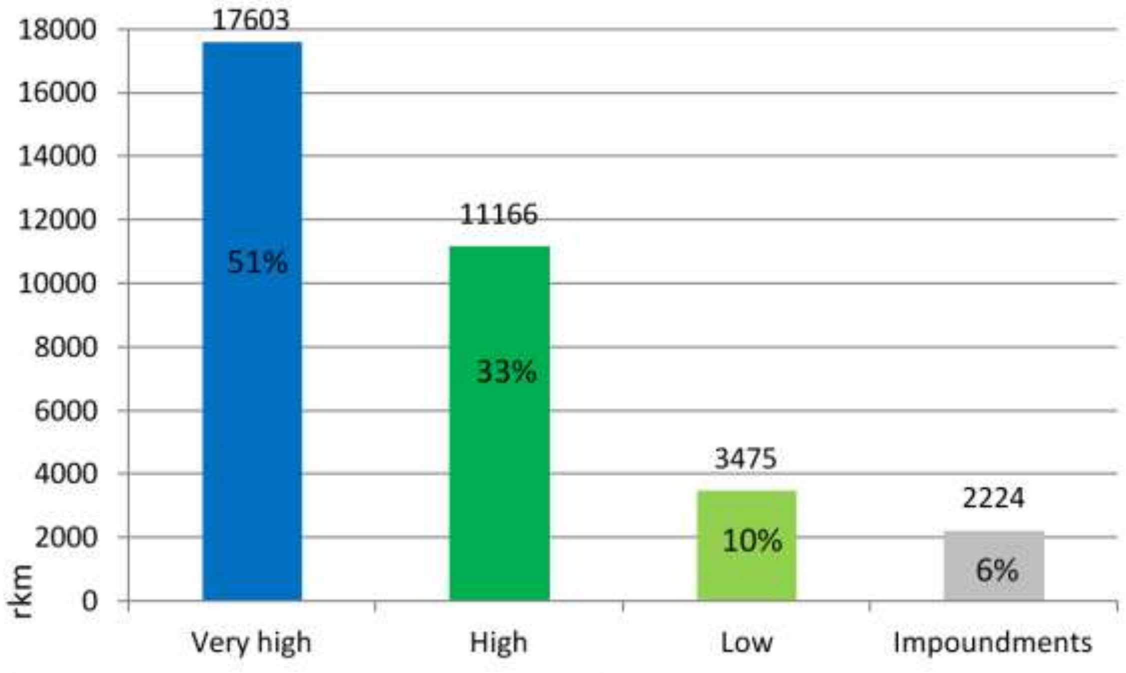


Figure 61: Conservation value for the entire project area.

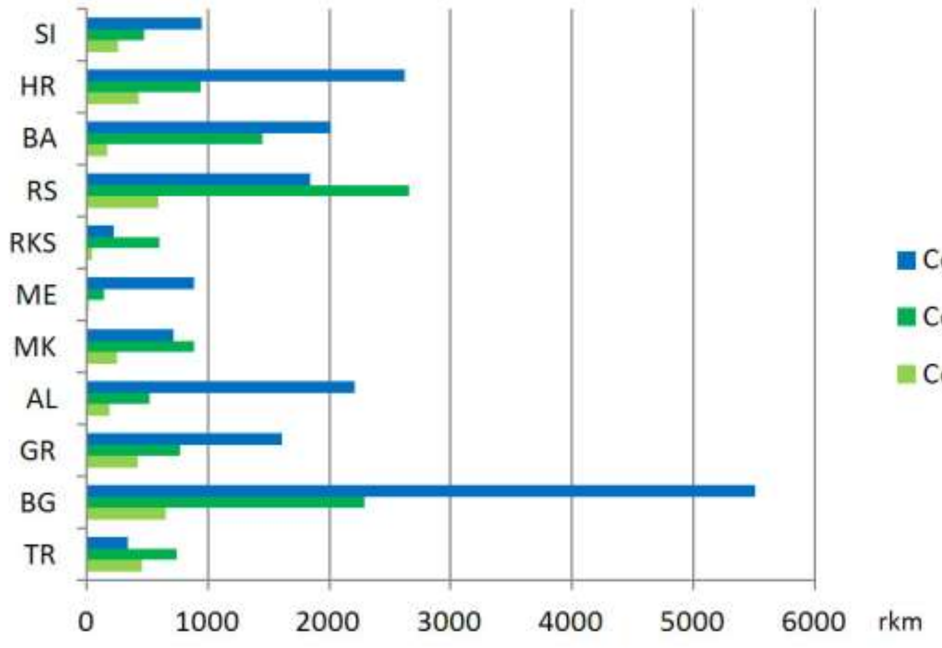


Figure 62: Country distribution of conservation value in the entire project area. Quantitatively Bulgaria has by far the largest river network within Natura 2000 areas.

3.5 Hydropower plants

Hydropower plants were recorded firstly according to the “status” into “existing/operating”, “under implementation” and “planned”.

They are further divided into three size classes: 1-10 MW, 10-50 MW, and larger than 50 MW. The type of HPP’s varies from run of the river plants to pumping HPP’s etc., making the comparability and impacts more complex.

Out of the more than 1,000 investigated hydropower plants only 861 were finally used for this analysis mostly due to the size (must be > 1 MW) or insufficient data . The hydropower plant inventory is dynamic as some plants will be building within the next years, many new will be planned, and other planning will become obsolete. The planning framework for all plants is about 10 years from now, which not means that mega projects like on Danube would need a planning period of maybe 15 years.

Many of the hydropower projects are planned with involvement of western European companies and/or investors. Italian companies are leading in investment and project development activities while Germany provides most investment. In almost two-thirds of all projects, Austrian companies contribute to project development and technical knowhow provision.

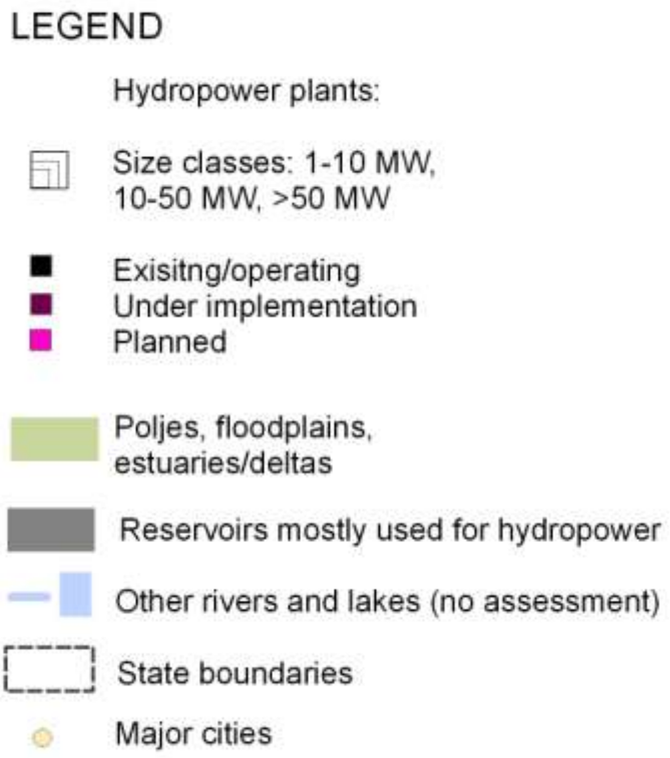


Figure 63: Legend for the following maps of chapter 3.5. To save space for country maps legend and title was not added to individual maps (river names outside the project area are incomplete).

3.5.1 Slovenia

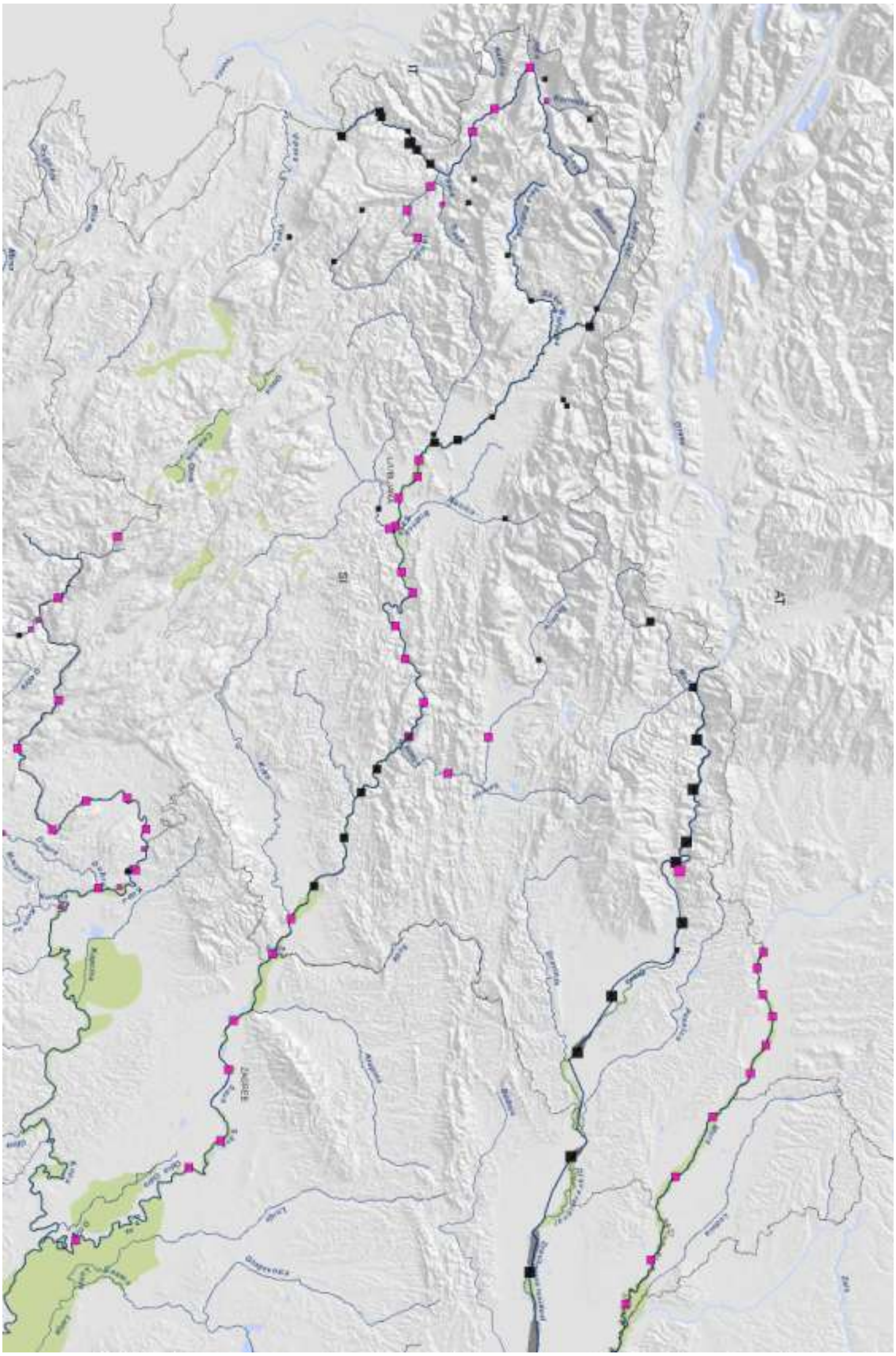


Figure 64: Hydropower plants for SI.

Slovenia developed hydropower firstly on Drava and Soča, but in particular on Sava rather new projects were finished within last years and many new ones are planned to complete the chain.

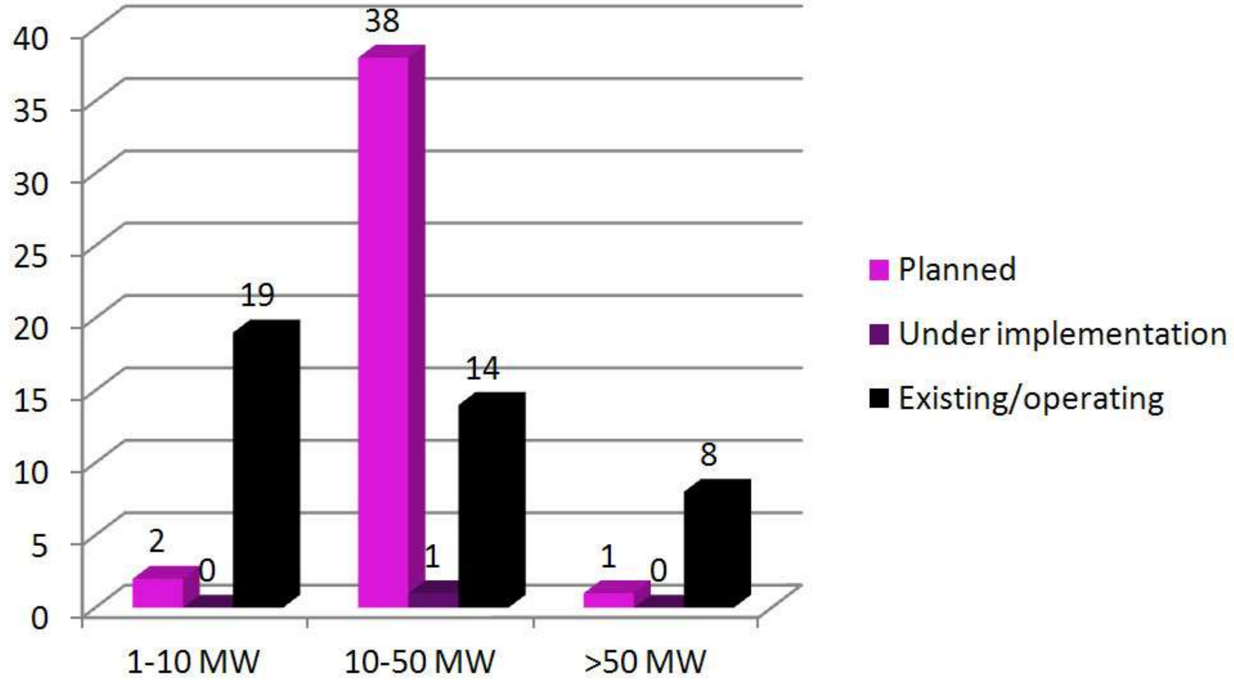


Figure 65: Distribution of hydropower plants for SI.

3.5.2 Croatia

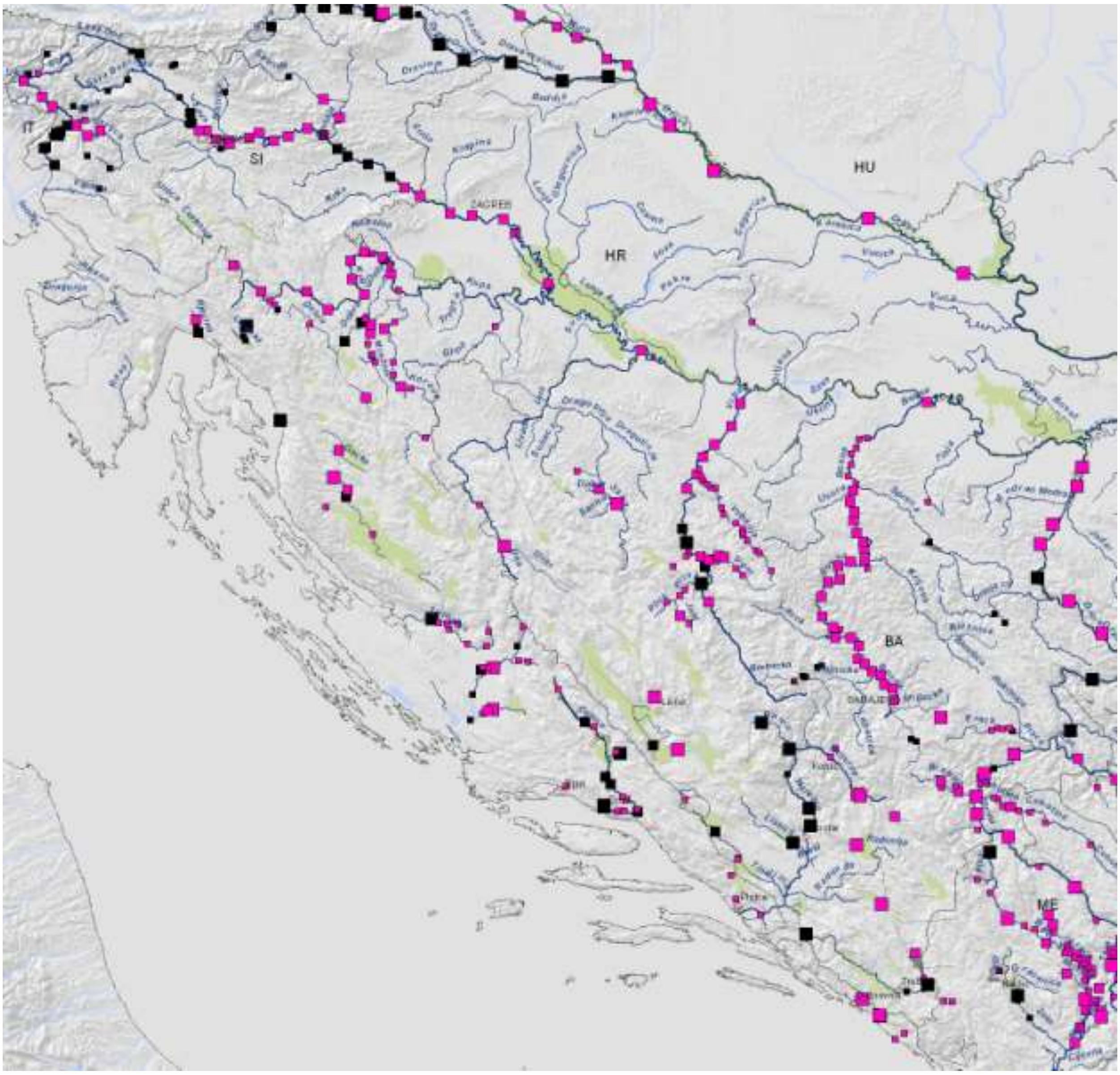


Figure 66: Hydropower plants for HR.

Croatia plans a significant number of hydropower plants along all rivers and all sizes: Sensible karst rivers will be affected as well as the large lowland rivers such as Drava, Sava and Kupa.

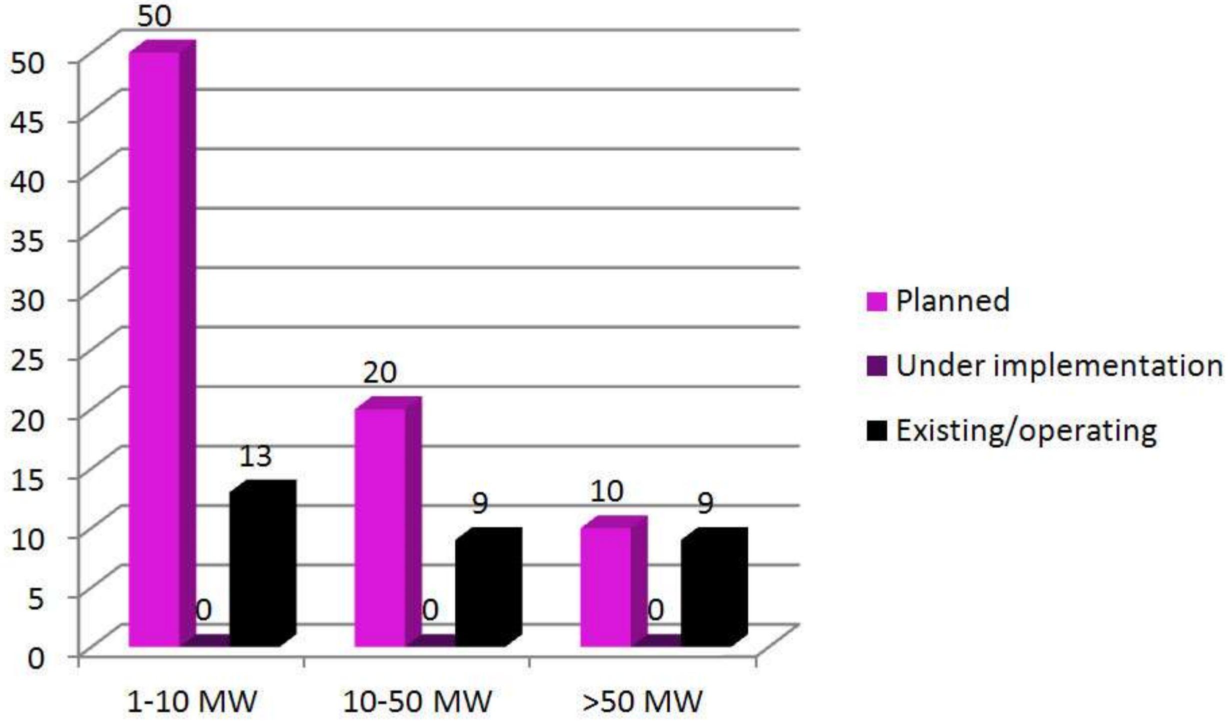


Figure 67: Distribution of hydropower plants for HR.

3.5.3 Bosnia & Herzegovina

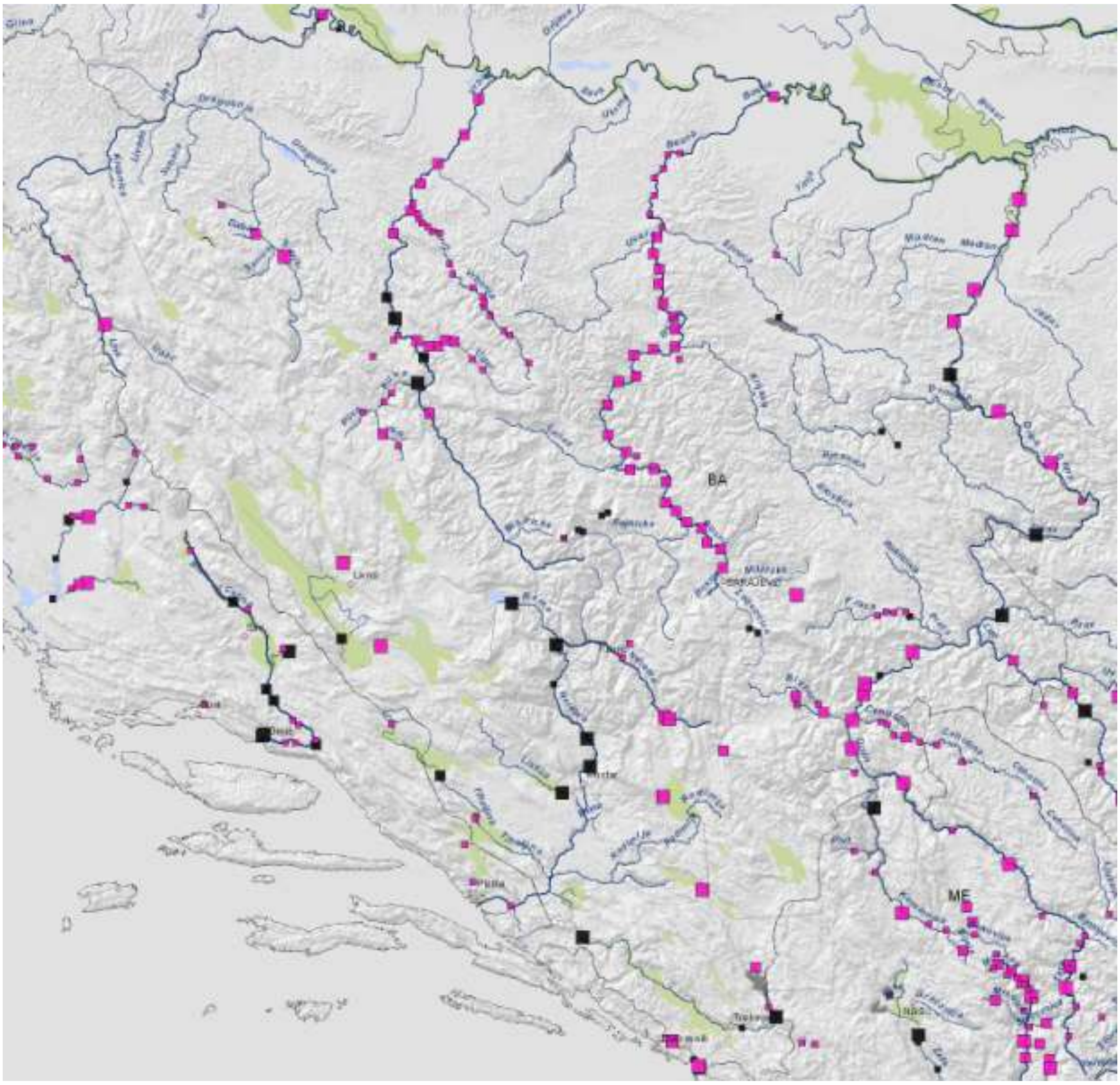


Figure 68: Hydropower plants for BA.

So far only some larger HPP’s can be find on Vrbas and Drina rivers. New plans focus on Vrbas, Bosna and Drina.

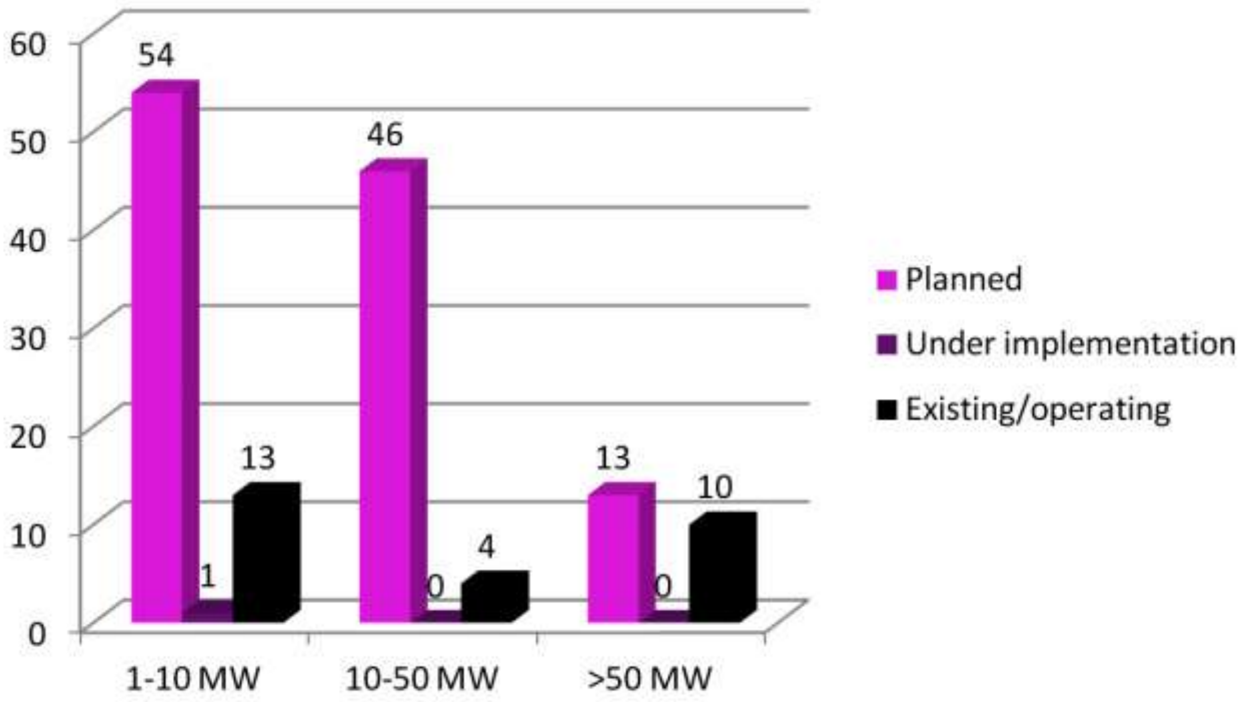


Figure 69: Distribution of hydropower plants for BA.

3.5.4 Serbia

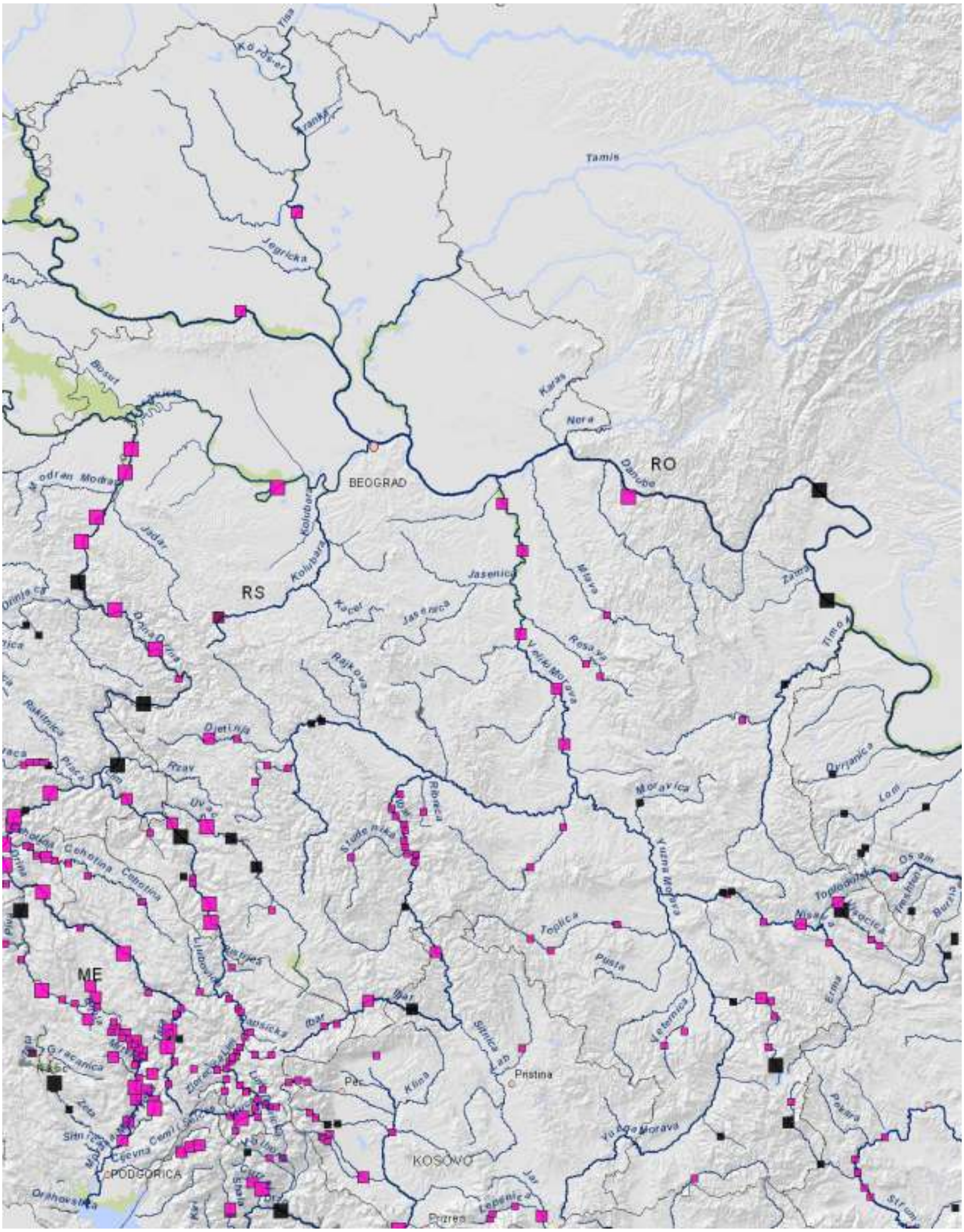


Figure 70: Hydropower plants for RS.

The Iron Gate 1 HPP is the largest in the Danube basin (and western and central Europe) with about 1,000 MW installed power. It impounds the Danube for some 320 rkm. Other HPPs can be find in particular on Drina. Many new ones are planned on Veliki Morava and Ibar rivers. On Danube a huge pumping storage plant is projected (so called Iron Gate 3).

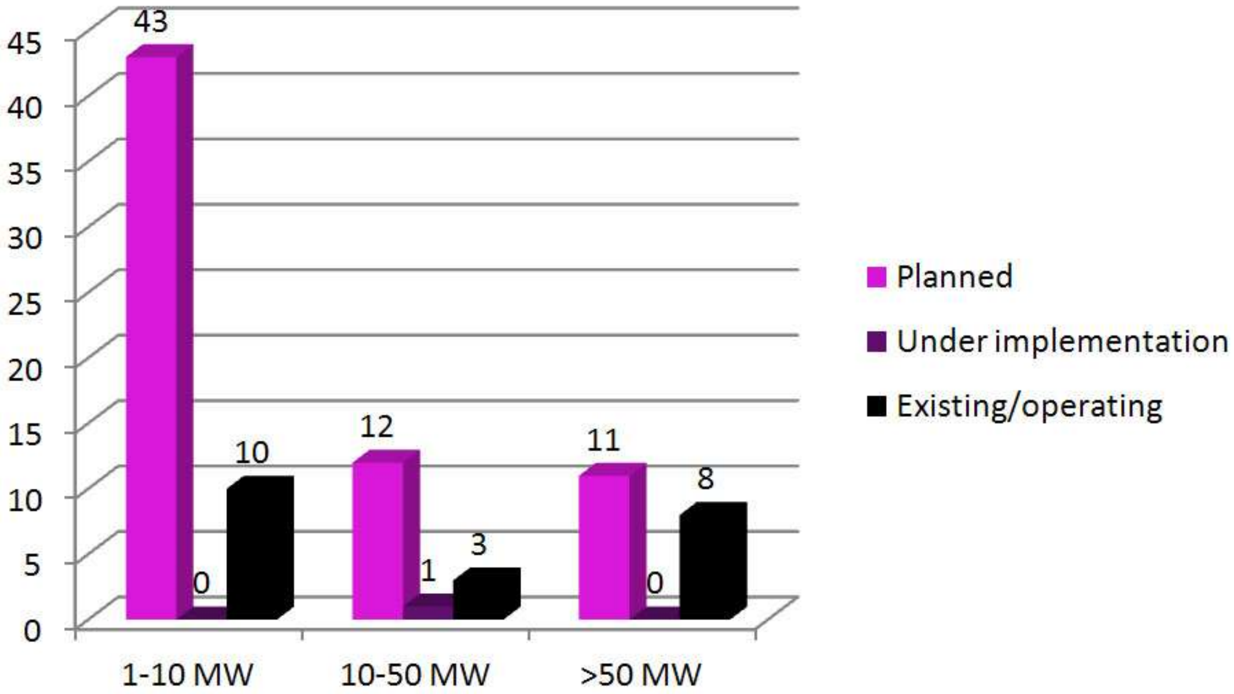


Figure 71: Distribution of hydropower plants for RS.

3.5.5 Kosovo

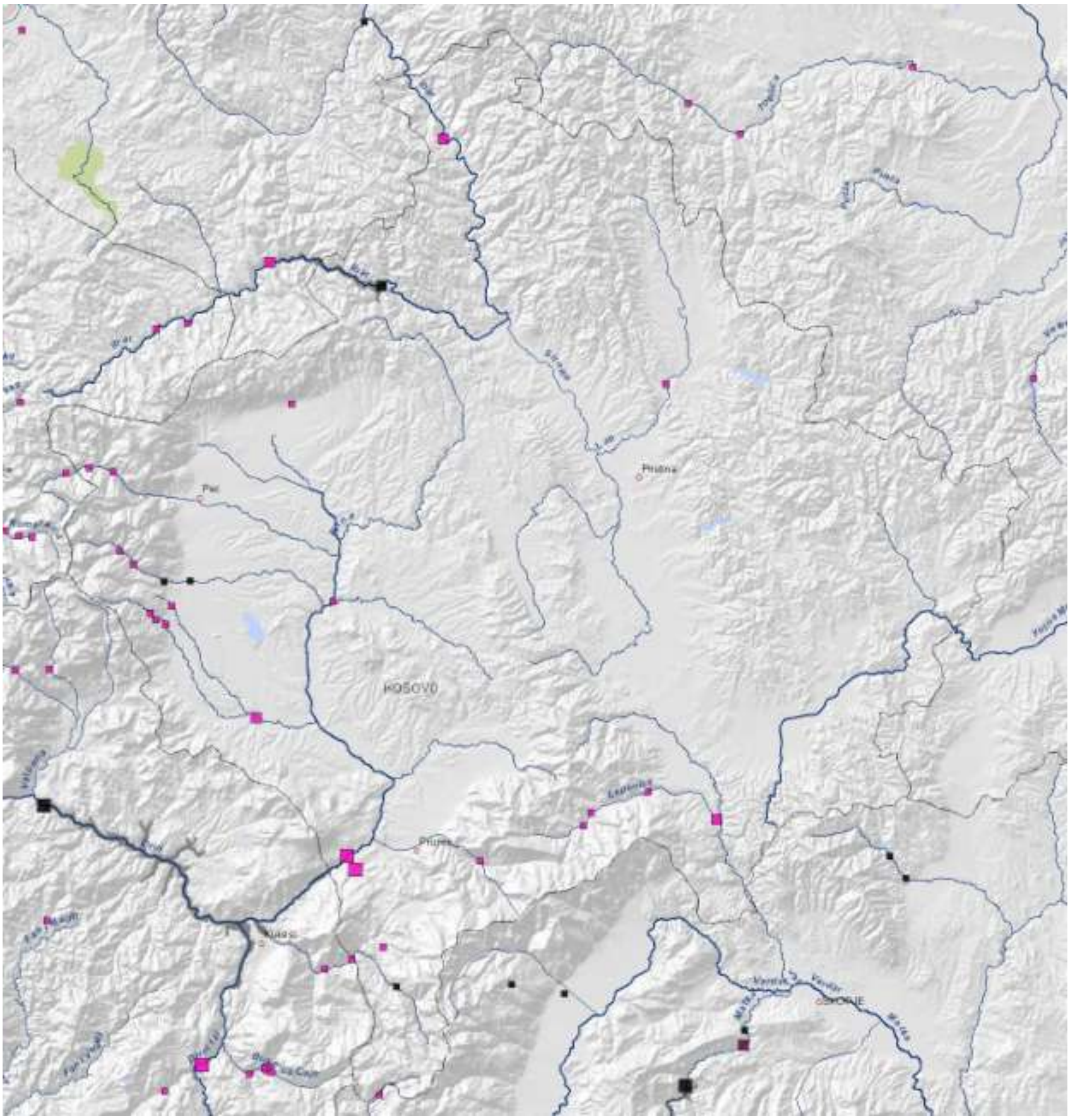


Figure 72: Hydropower plants for Kosovo.

Only one large HPP is located on Ibar, several small ones are planned.

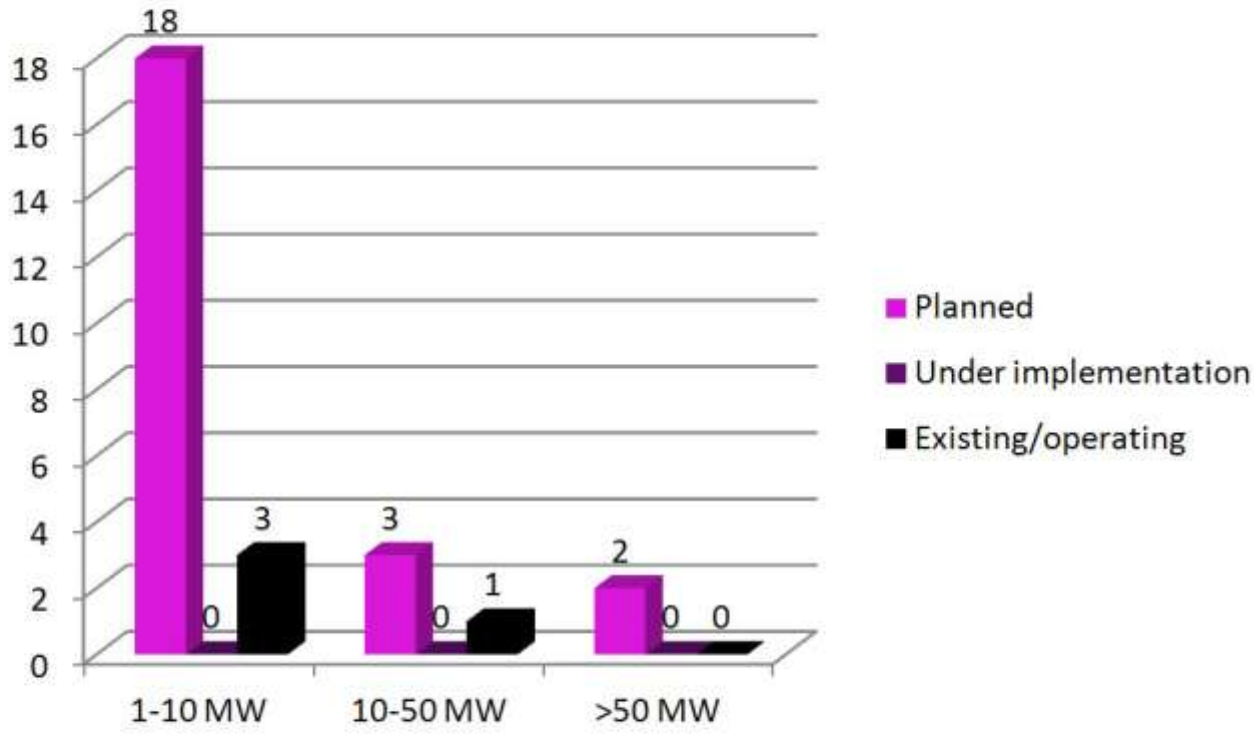


Figure 73: Distribution of hydropower plants for Kosovo.

3.5.6 Montenegro

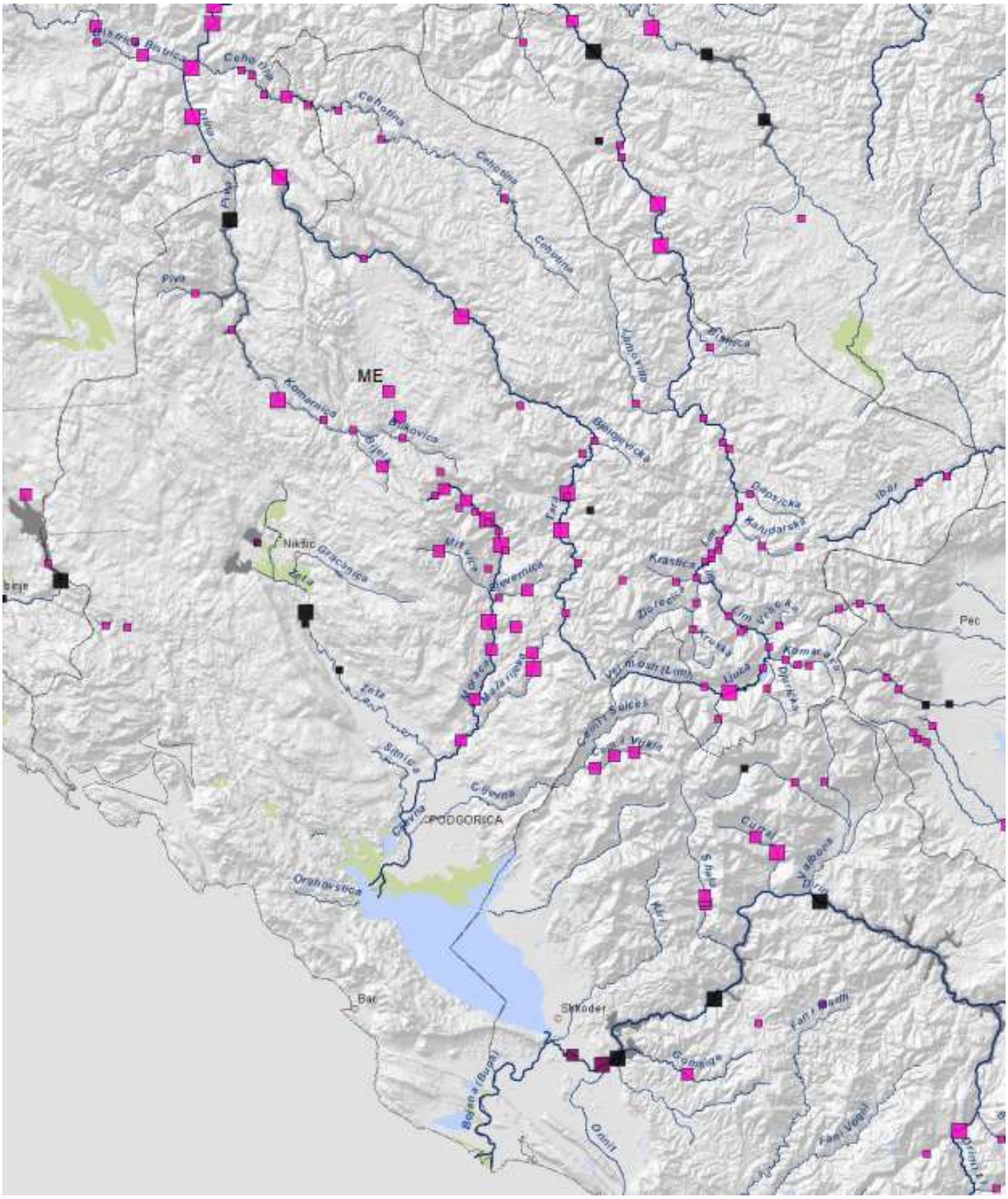


Figure 74: Hydropower plants for ME.

There are two major HPP's, one feed by the Zeta from the Nikšićko Polje and another one at upper Piva. Many new hydropower plants are foreseen along Morača and Tara.

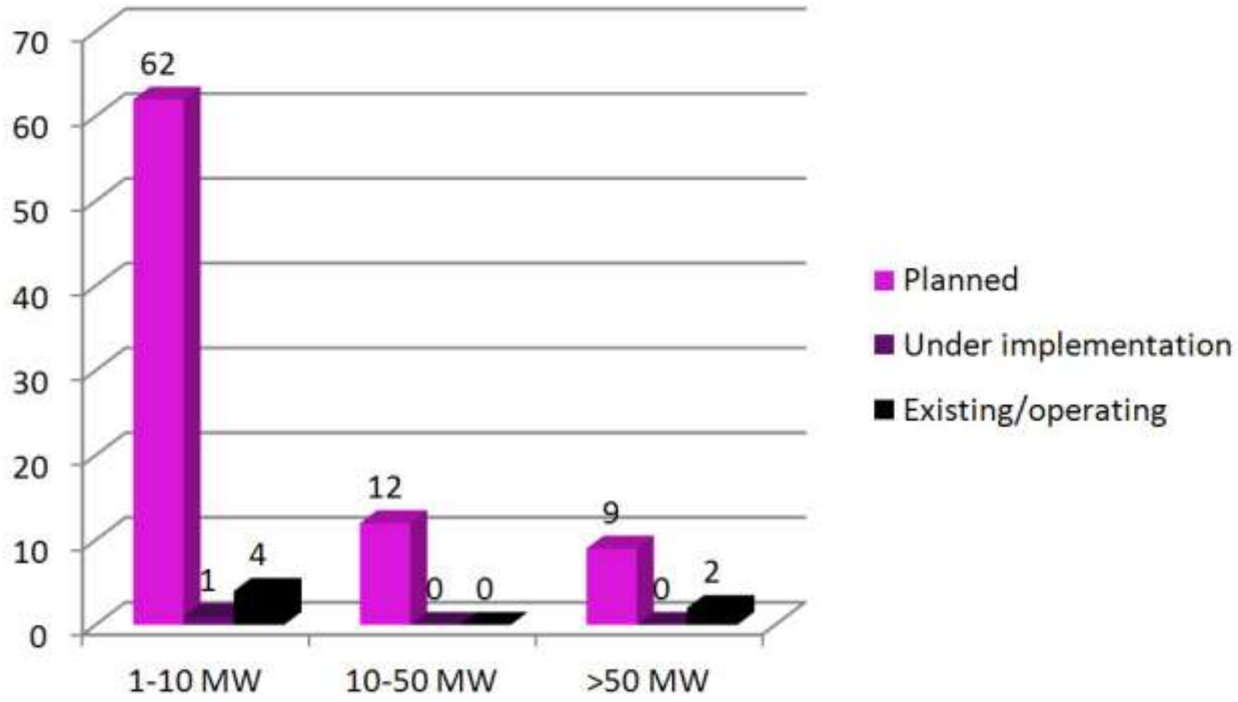


Figure 75: Distribution of hydropower plants for ME.

3.5.7 Macedonia

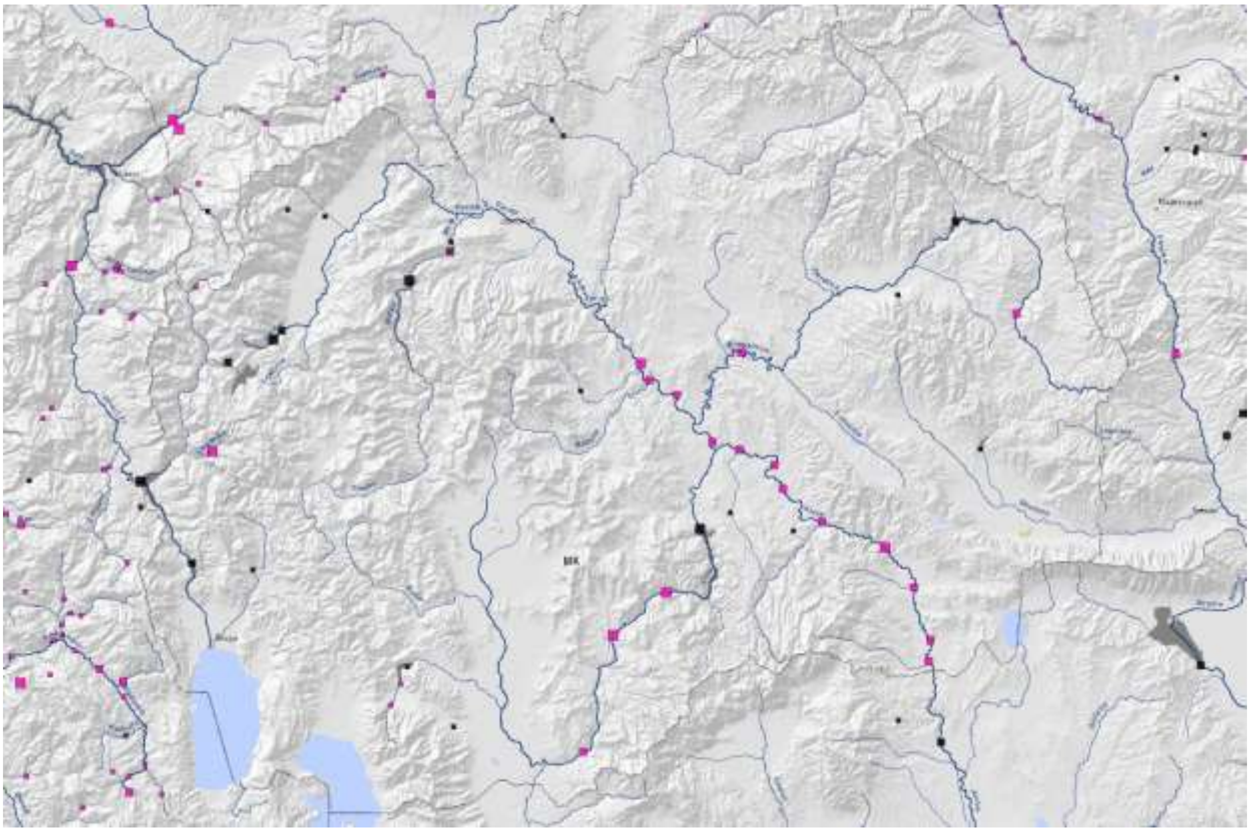


Figure 76: Hydropower plants for MK.

Macedonia has so far only a few larger HPP's, but along Vardar, the largest river of the country many new dams are planned.

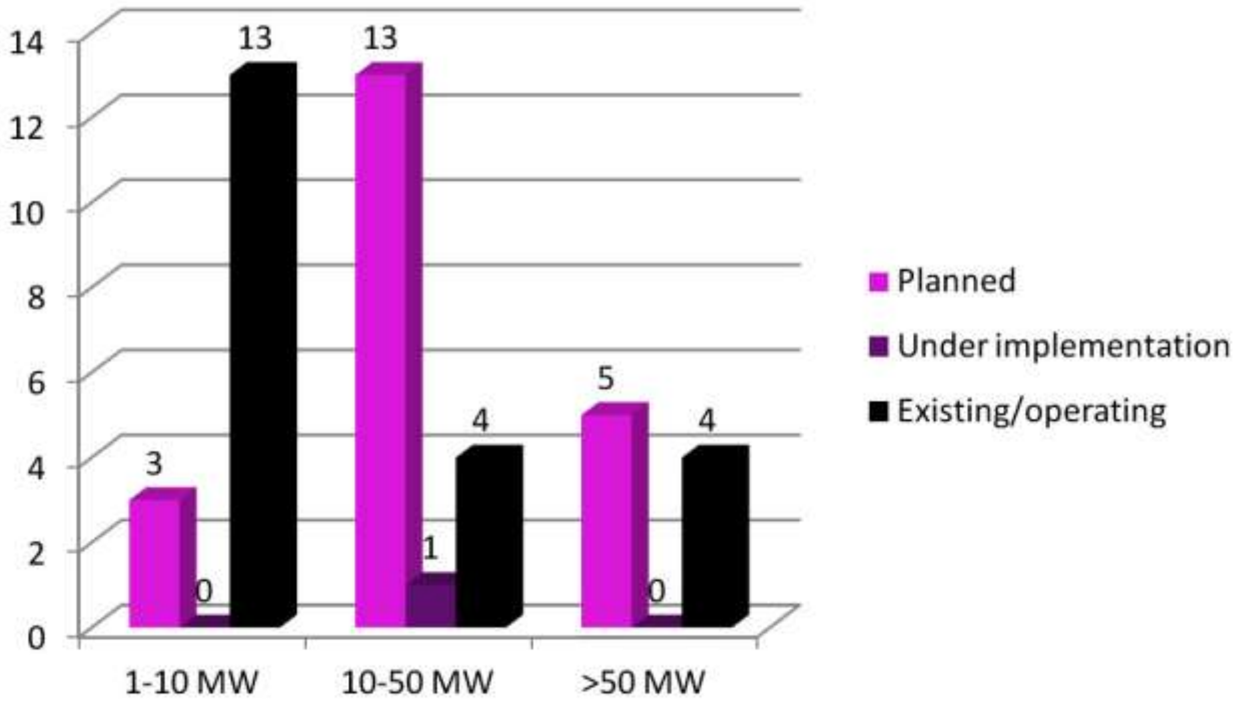


Figure 77: Distribution of hydropower plants for MK.

3.5.8 Albania

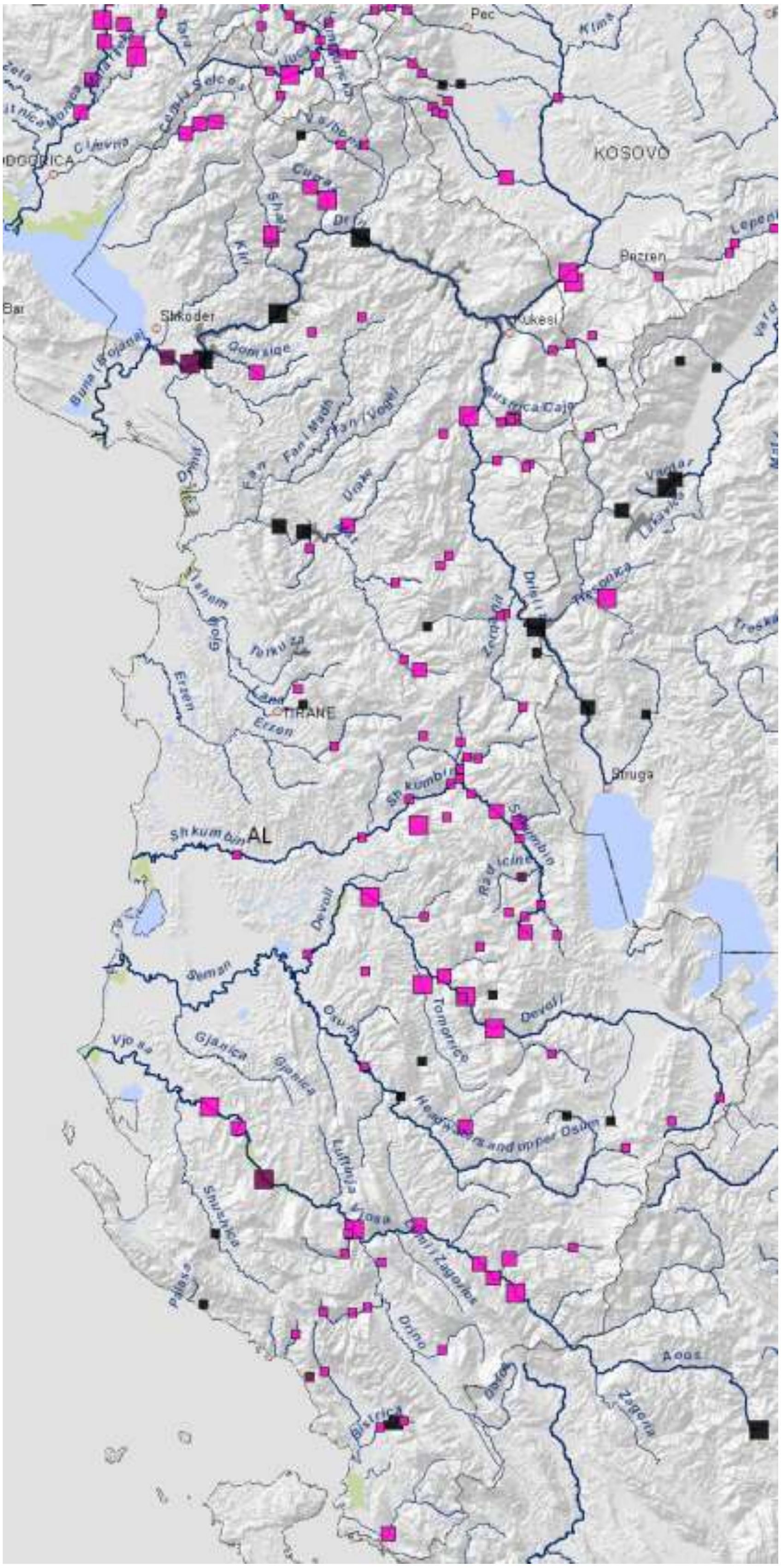


Figure 78: Hydropower plants for AL.

The Drin river is the largest used river in Albania for hydropower and the chain of major dams summed up to more than the half of the Iron gate 1 impoundment with some 170 rkm. Other major dams can be so far find only in the northern part of the country. All rivers in mountainous reaches are subject of hydropower development.

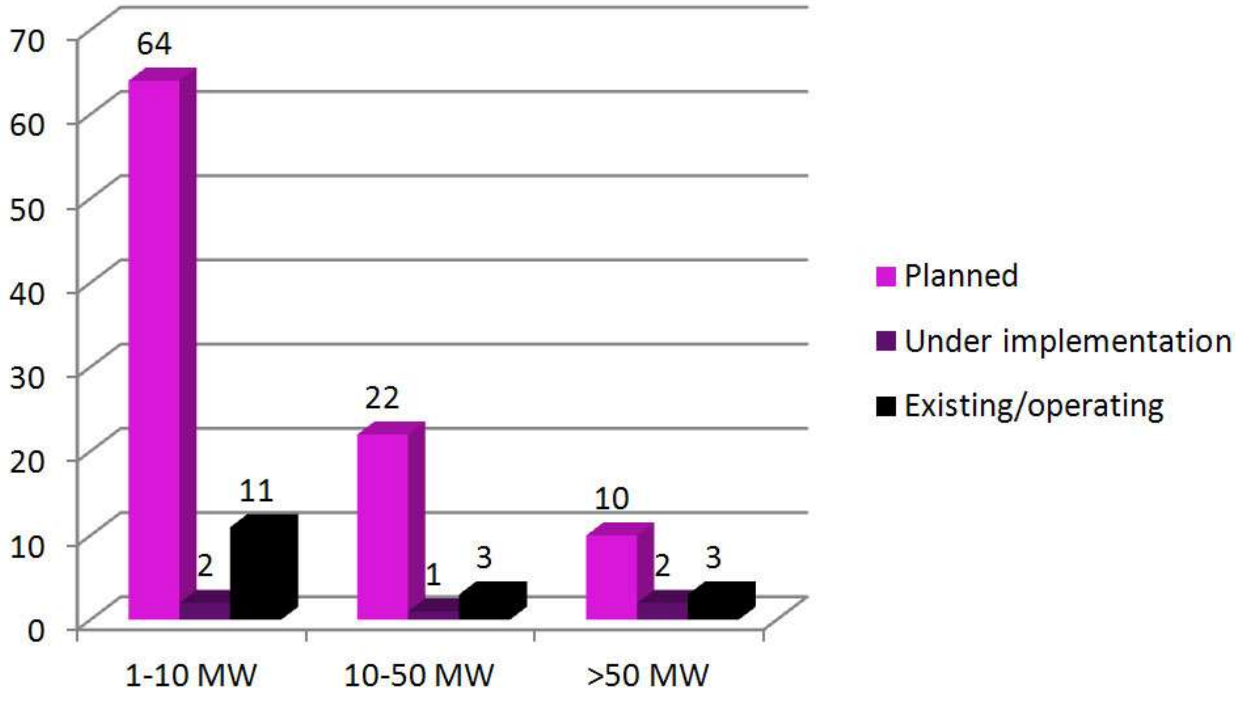


Figure 79: Distribution of hydropower plants for AL.

3.5.9 Greece

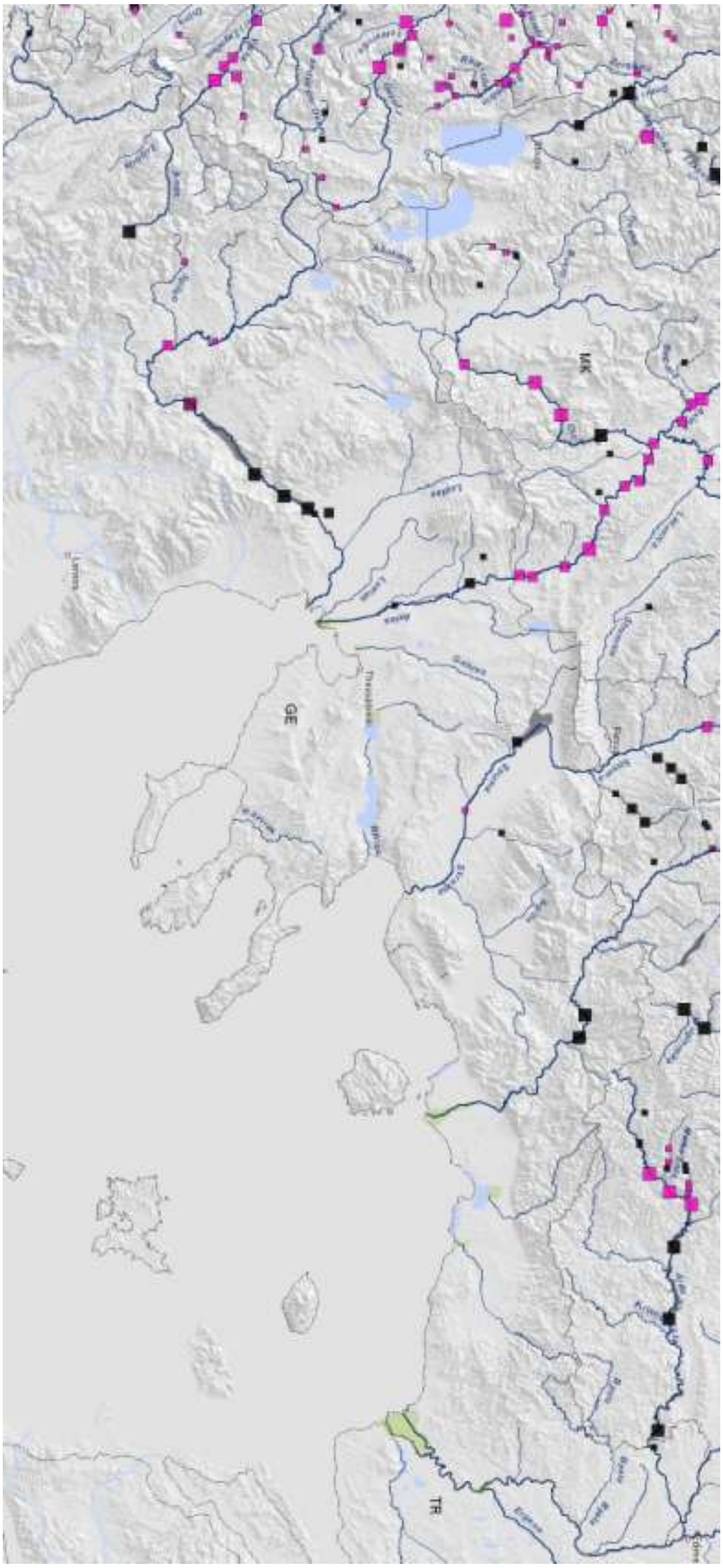


Figure 80: Hydropower plants for GR.

The dams along lower Aliatmon and Nestos are the biggest in the country.

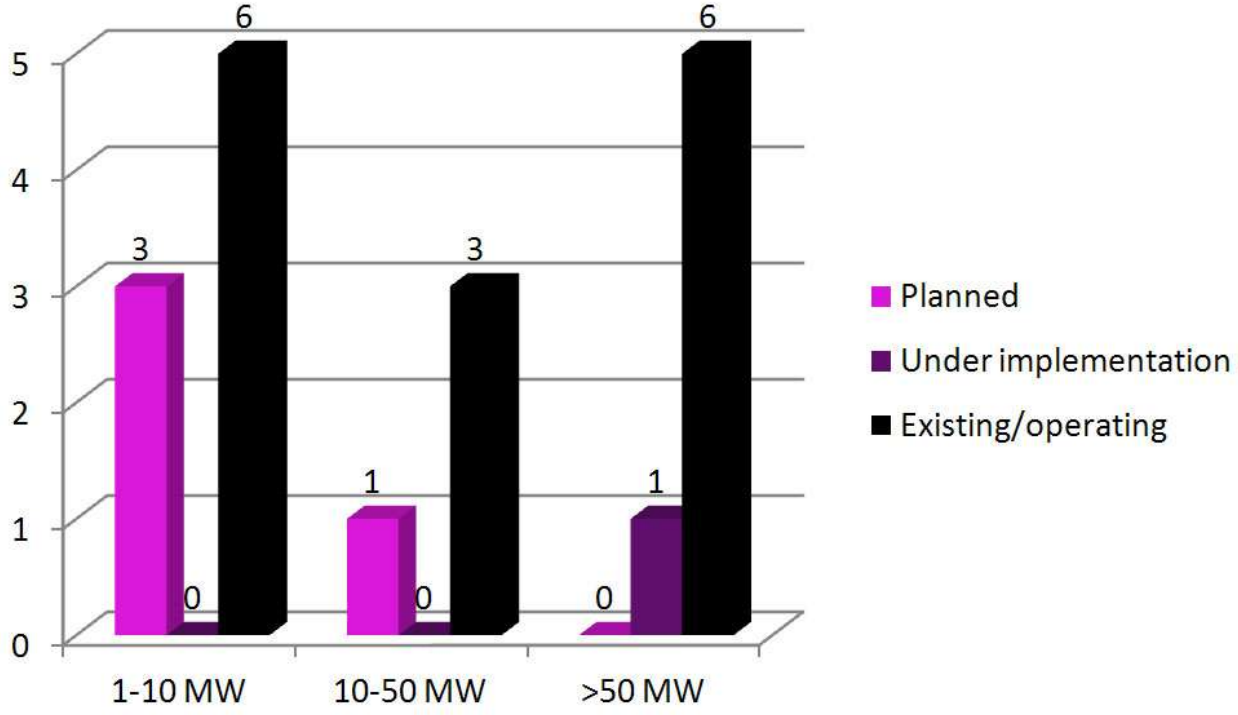


Figure 81: Distribution of hydropower plants for GR.

3.5.10 Bulgaria

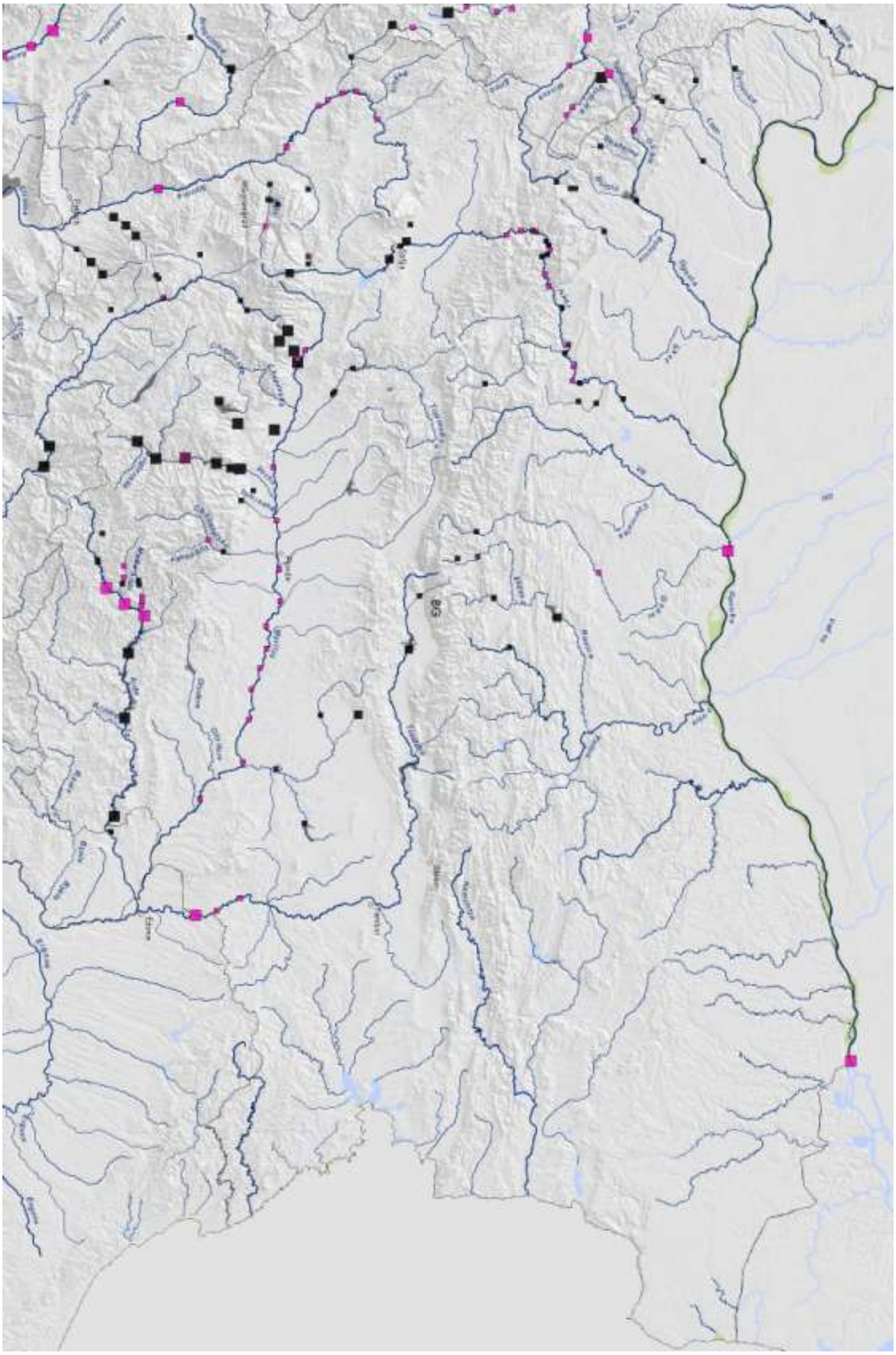


Figure 82: Hydropower plants for BG.

The upper courses of Iskar, Maritsa tributaries and Arda are the most affected regions by dams (often collecting systems with mountain reservoirs).

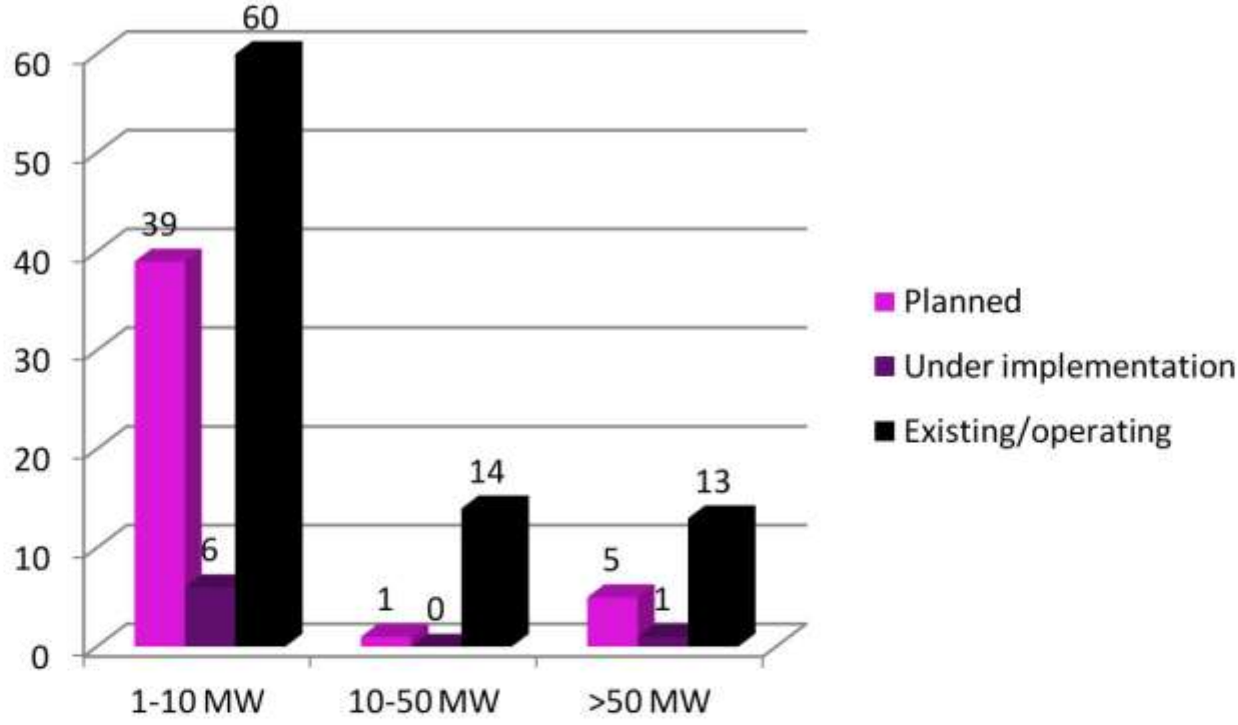


Figure 83: Distribution of hydropower plants for BG.

3.5.11 Turkey

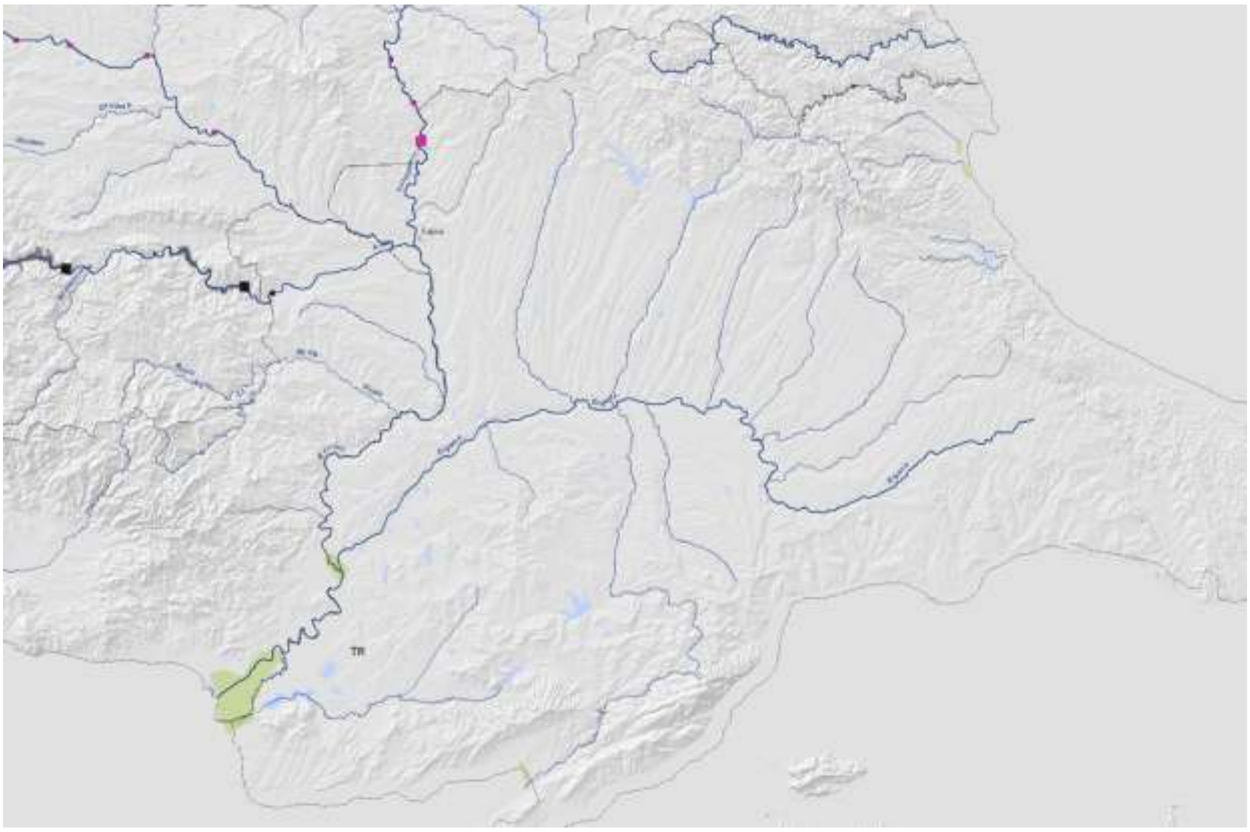


Figure 84: Hydropower plants for TR.

One trans-boundary large multipurpose dam at the Tundzha is planned (flood protection for Edirne, hydropower production and irrigation water/ low water control even together with Greece agriculture. The planned project fall in the category “>50 MW”, no chart is added. Other reservoirs serve mostly for water supply.

3.5.12 Entire Balkan region

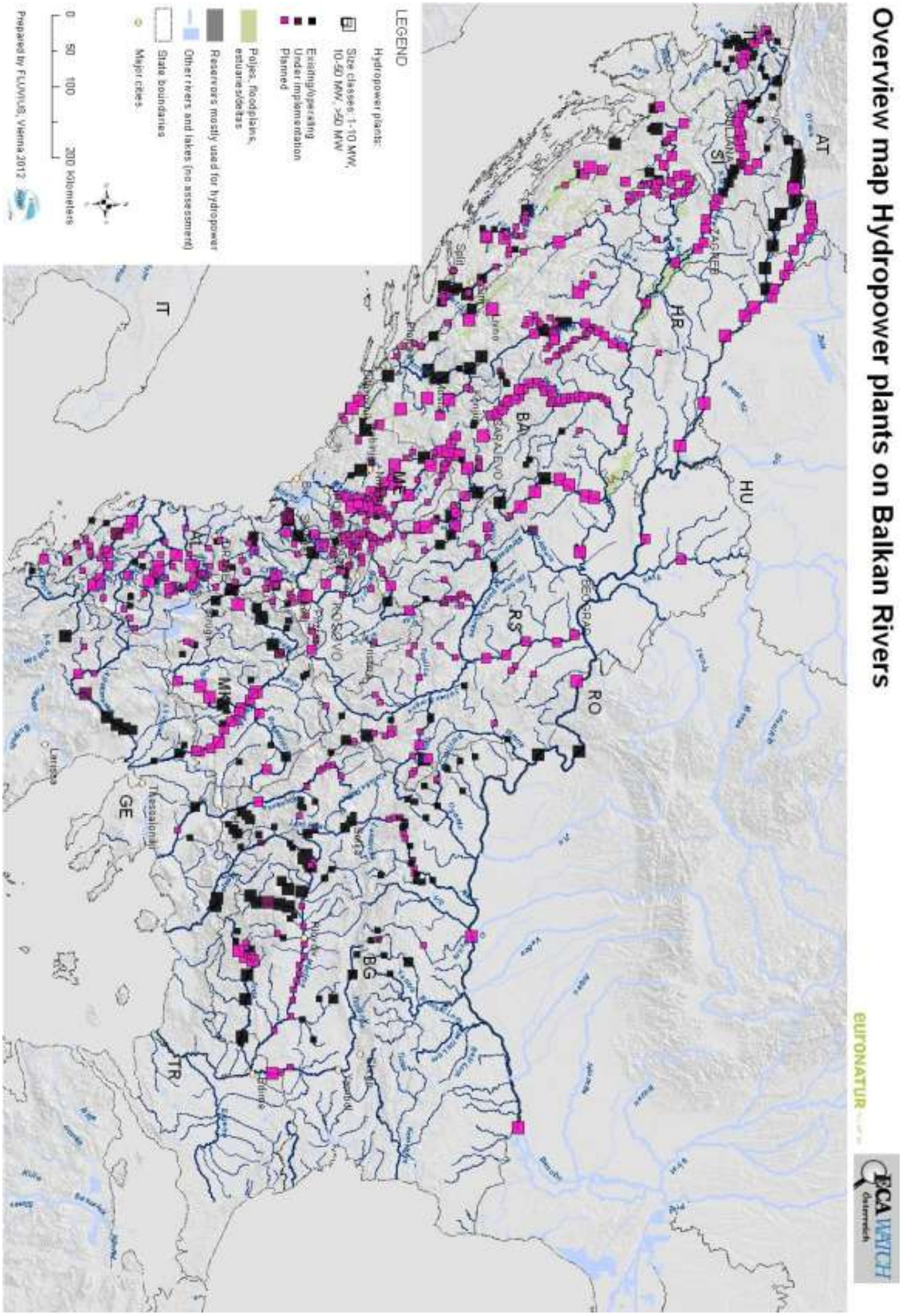


Figure 85: Hydropower plants for the entire project area.

Many new power plants (573) are planned for the Balkan region mostly in the size categories of 1-10 and 10-50 MW. Hence the high number of smaller and medium hydropower plants cover many rivers and unfortunately many rivers with very high or high conservation value.

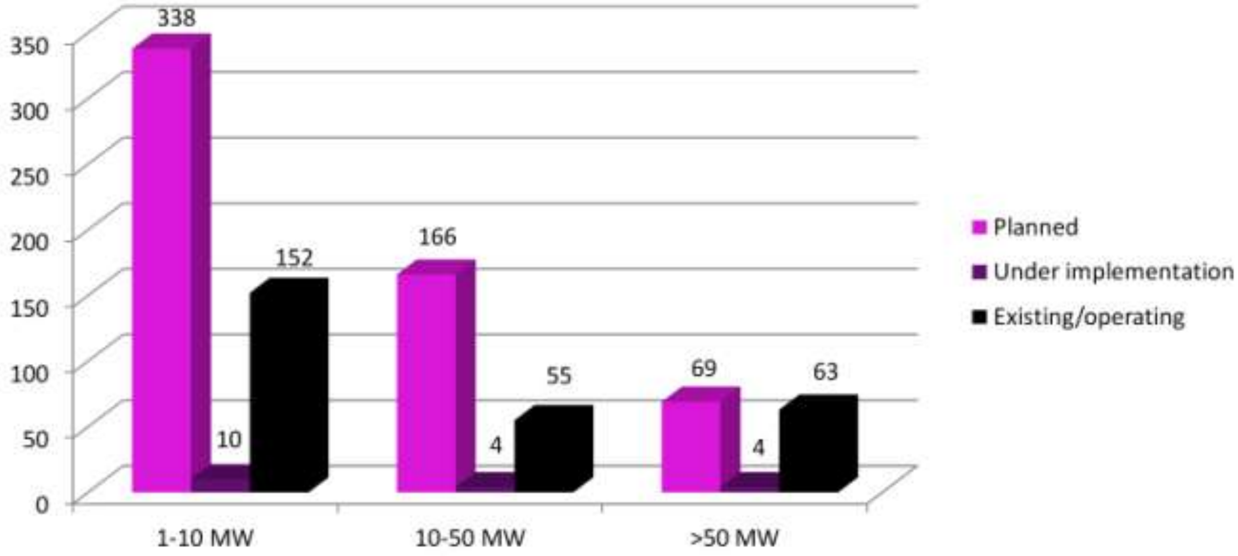


Figure 86: Distribution of hydropower plants for entire project area.

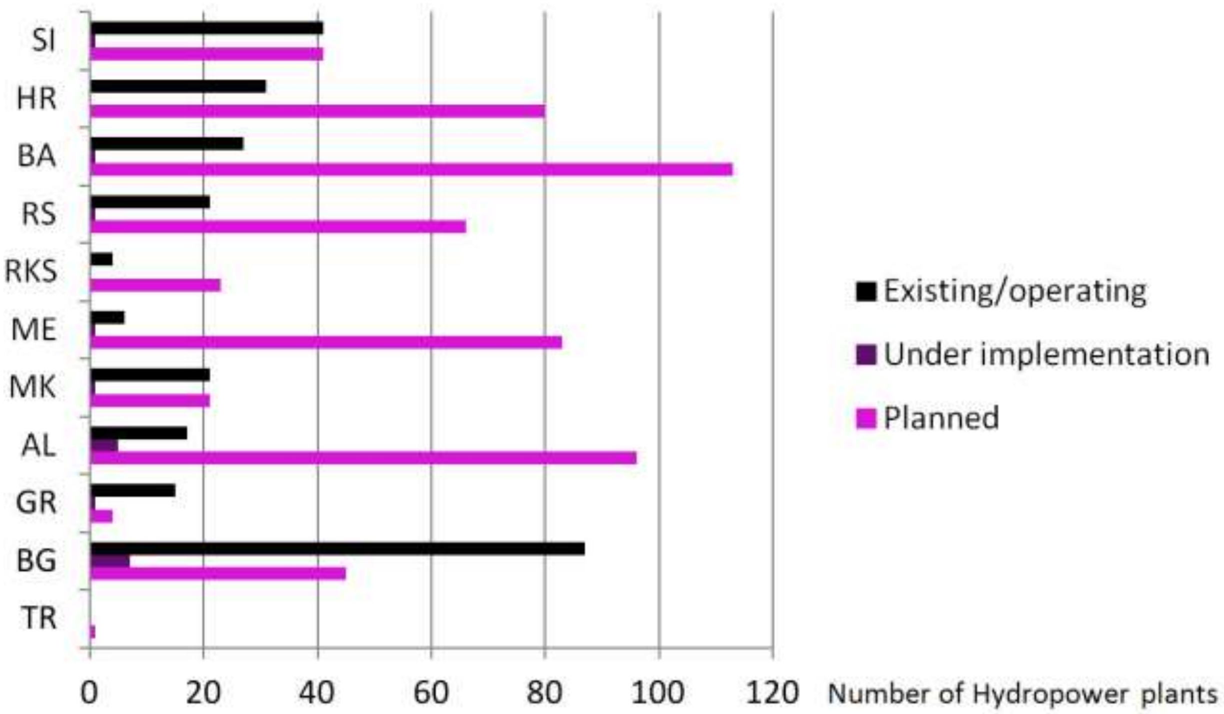


Figure 87: Country distribution of hydropower plants for entire project area.

3.6 Affected river stretches with conservation value by hydropower

This chapter combines the information of the "Conservation Value" with the hydropower plants. Due to the limited information how far the impact of planned HPP's is affecting the rivers downstream only the number of HPP's impacting very high, high and low conservation stretches is calculated and visualized. For some pumping storage hydropower plants, water collection reservoirs and specific types (or on very small tributaries) not directly associated to a larger river the next close assessed river (sub-basin) was taken to get the information of impacted river network.
To show the rather sustainable renovation and improvement of already existing plants the category "existing impoundments" was add to the charts (unfortunately only a few plants will be renovated many entries remain empty).

The chapter is enriched by fife case studies to show conflicts between river stretches with very high and high conservation value and potential construction sites.

Figure 88: Legend for the following maps of chapter 3.6. To save space for country maps legend and title was not added to individual maps (river names outside the project area are incomplete).

3.6.1 Slovenia

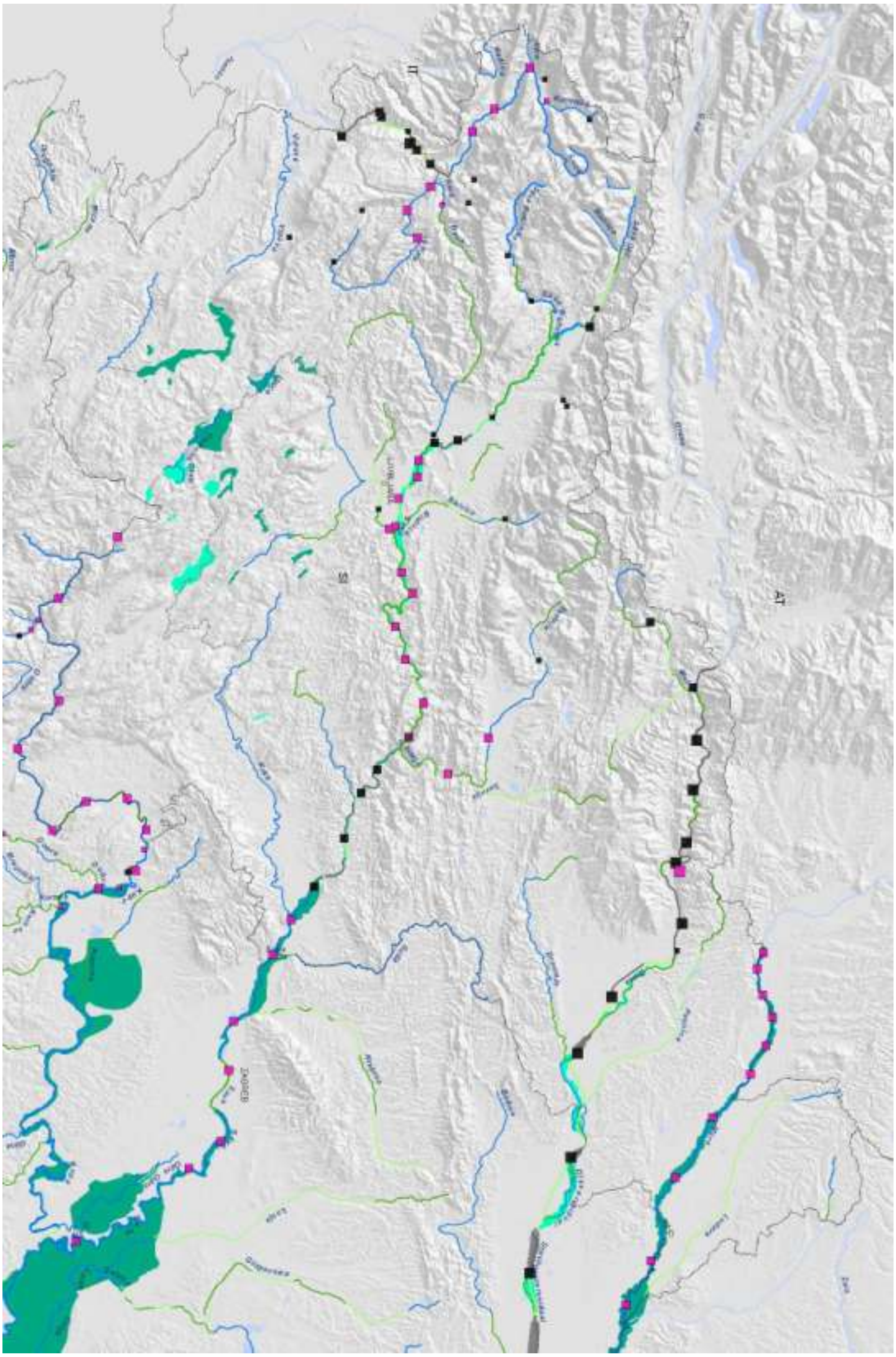


Figure 89: Affected very high and high conservation stretches by planned hydropower plants for SI.

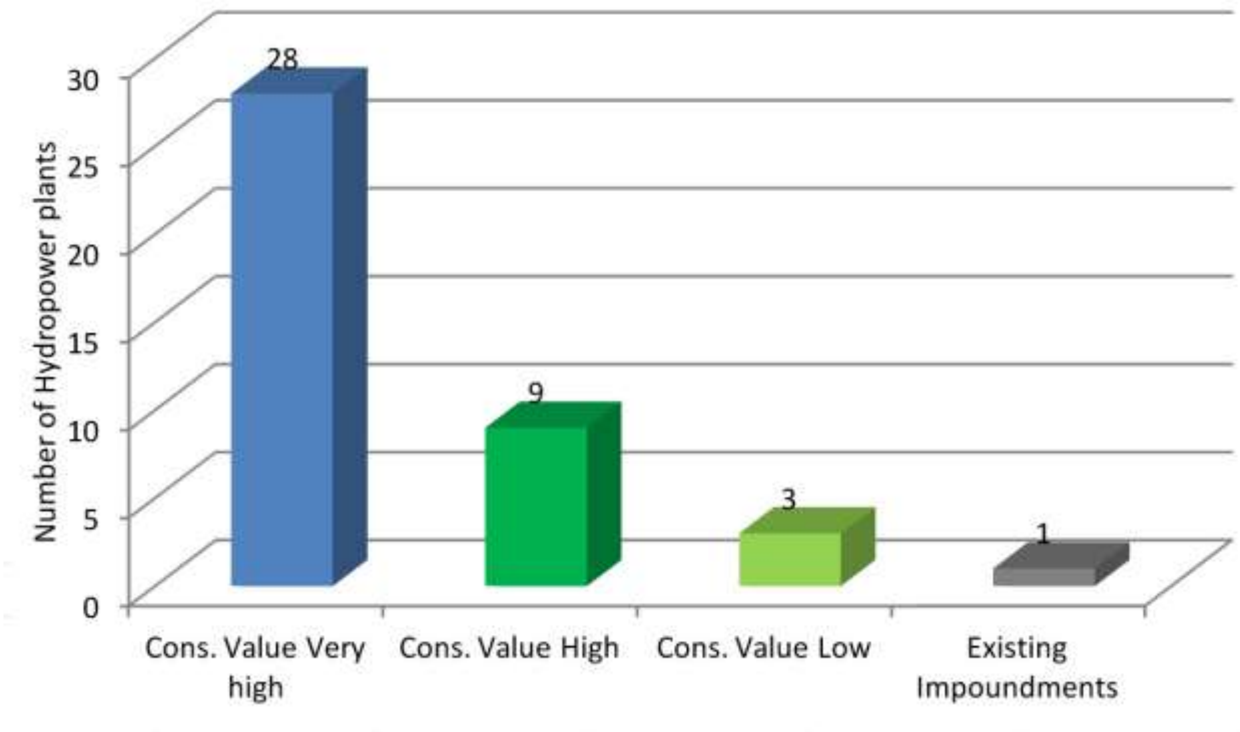


Figure 90: Number of planned hydropower plants that would affect very high, high and low conservation stretches for SI.

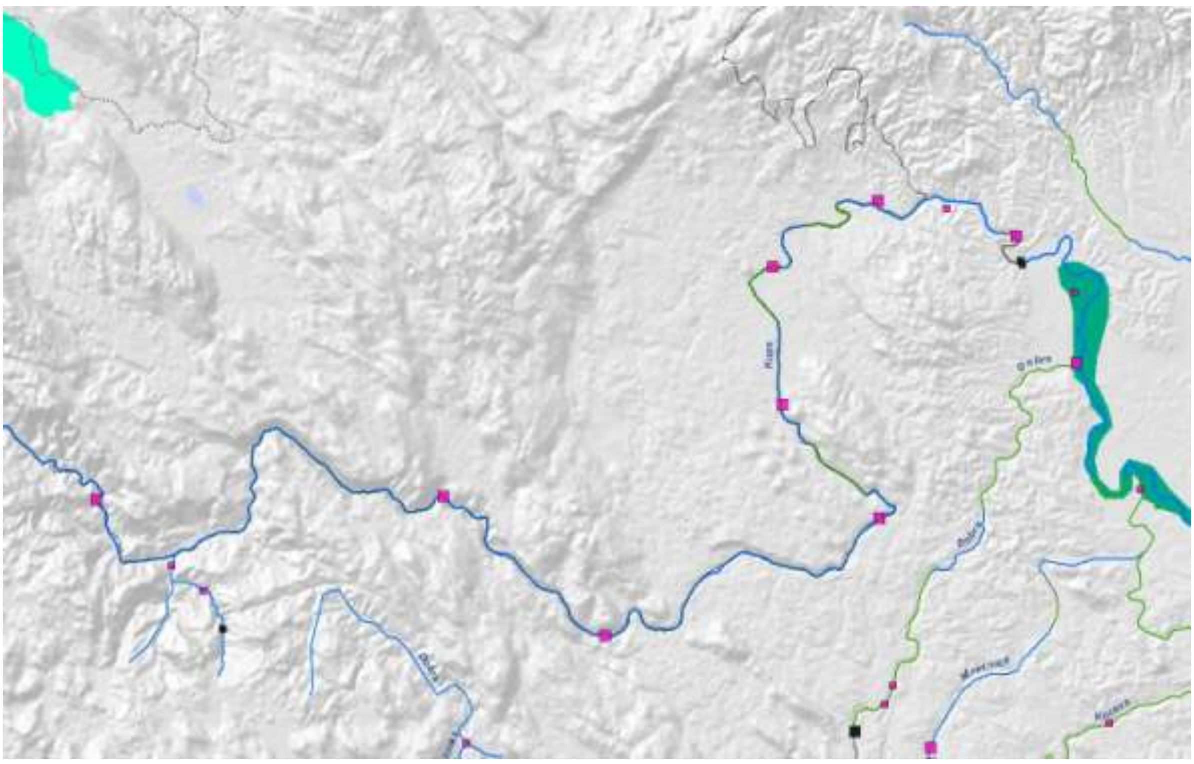


Figure 91: Map zoom on the Kolpa/Kupa rivers: Numerous hydropower plants in SI and HR will impact large stretches of the rivers.

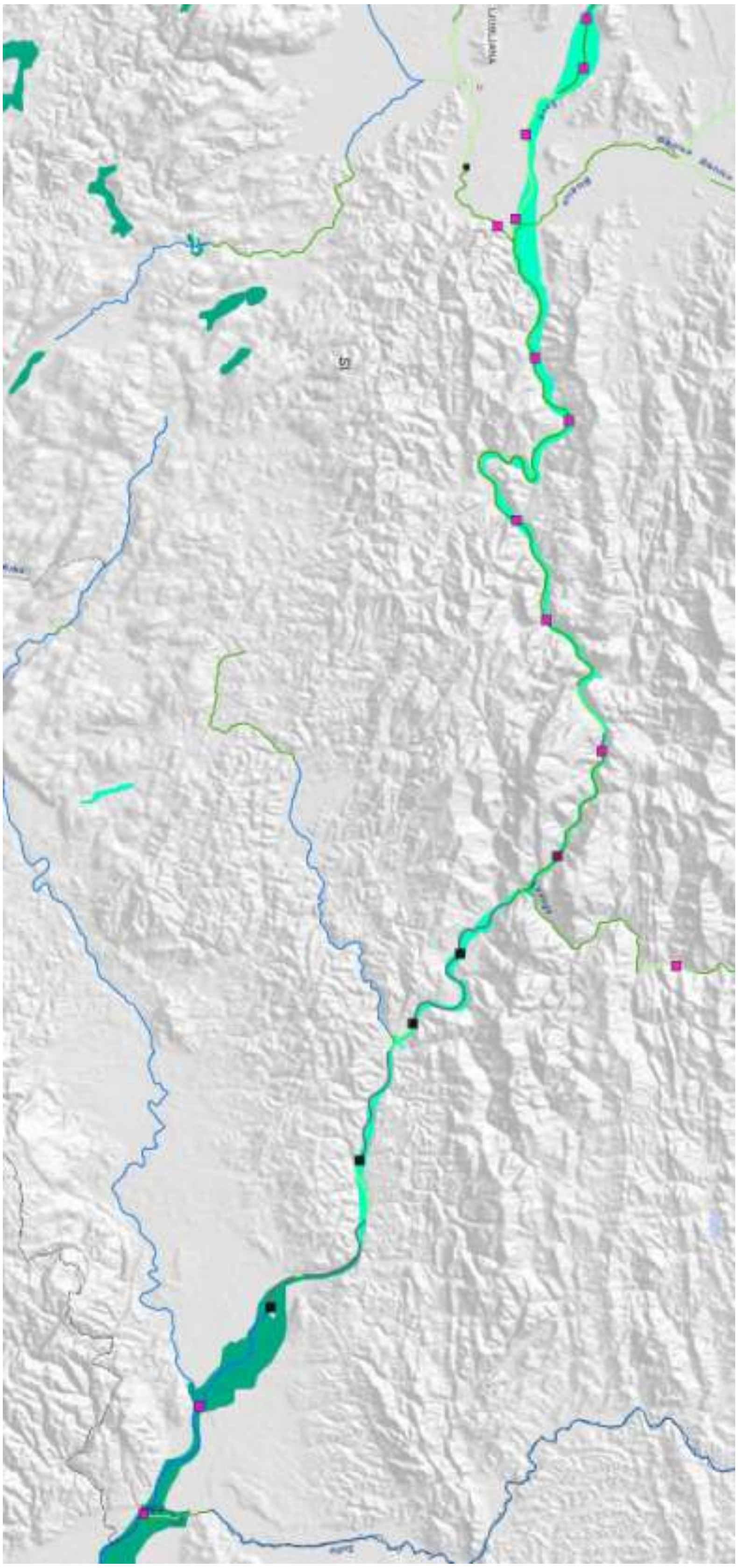


Figure 92: Map zoom on the upper Sava and tributaries: Plans will systematically turn the still free-flowing stretch and lower tributaries into a chain of hydropower plants (stretch is excluded from Natura 2000).

3.6.2 Croatia

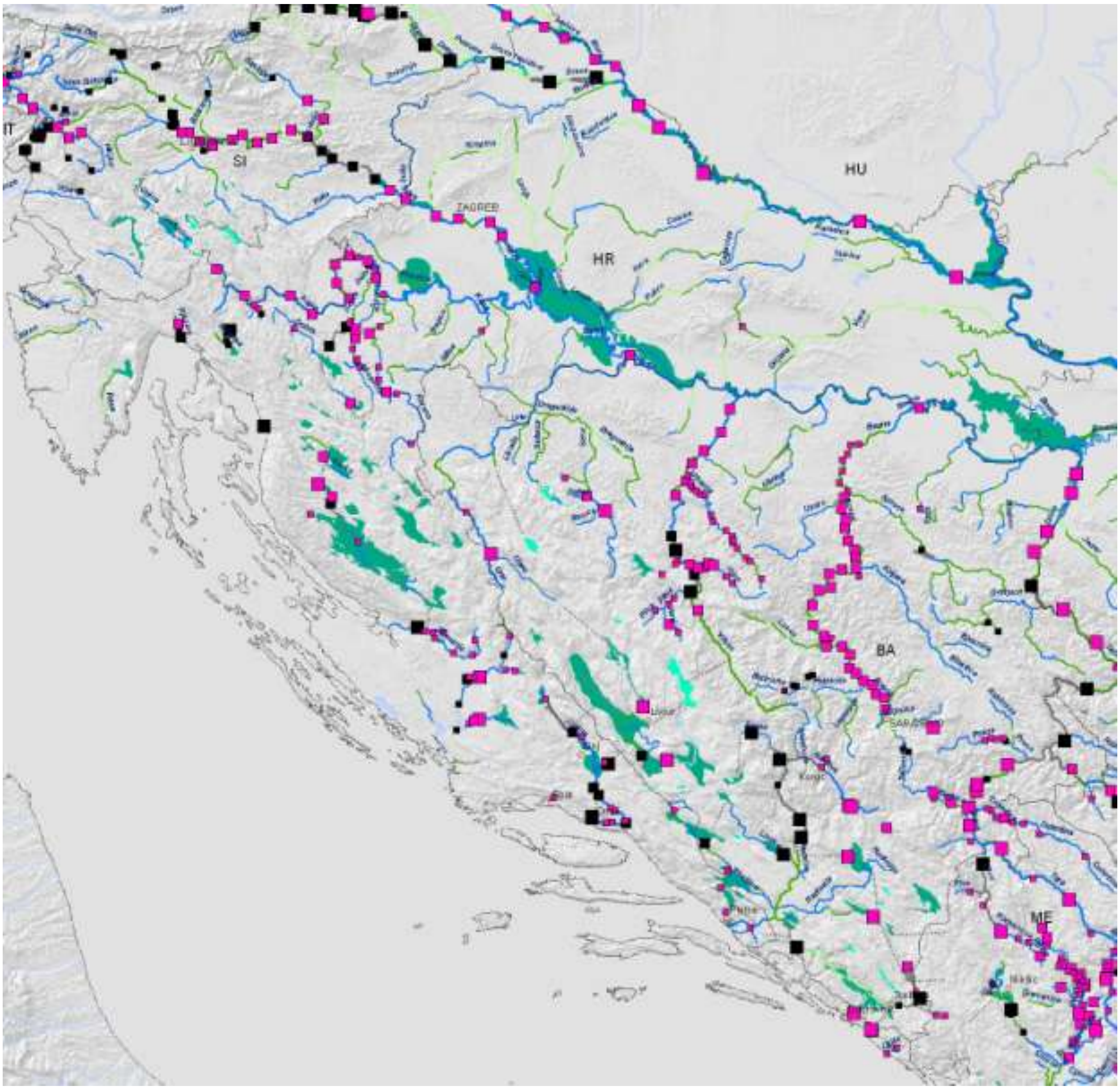


Figure 93: Affected very high and high conservation stretches by planned hydropower plants for HR.

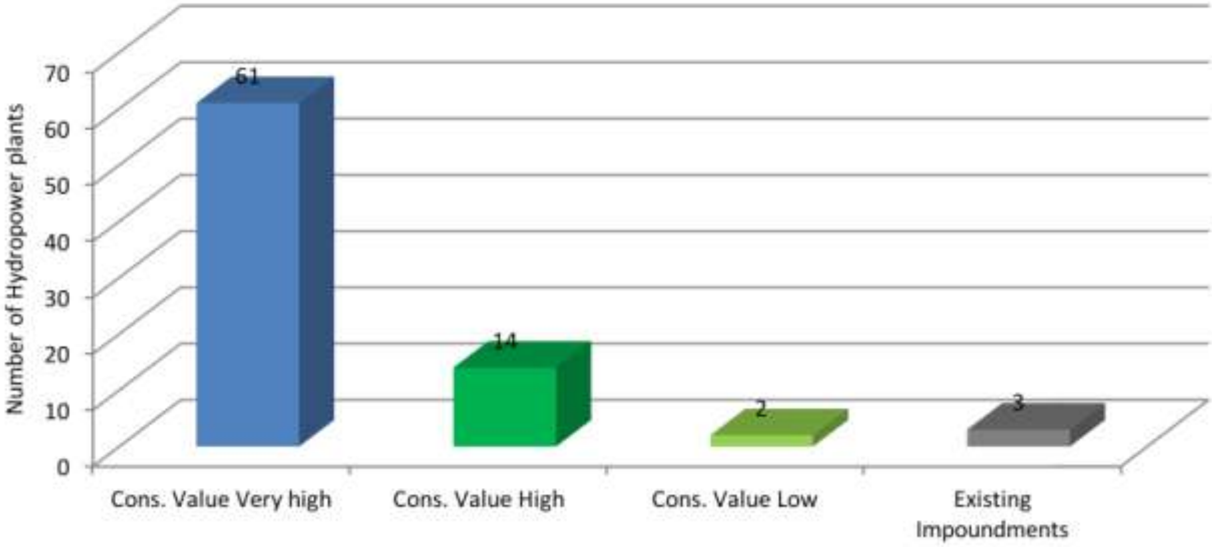


Figure 94: Number of planned hydropower plants that would affect very high, high and low conservation stretches for HR.

Figure 95: Map zoom on lower Drava: New hydropower plants would be in contradiction to the declared transboundary biosphere park in the entirely designated protected area (Molve 1 and 2 just downstream of the Mura confluence replacing the earlier “Novo Virje” project and “Mota” on Mura are the most advanced proposals.

Case 1, Croatia

The recently completed hydropower plant "Lešče" is located at upper Dobra River. The project was implemented by HEP (Hrvatska Elektroprivreda) and is the first large hydropower plant built in Croatia since independency in 1991. The plant is a storage type with an installed power of 42 MW. The dam crest has 52.5 m and the length of the impounded reservoir is 13 rkm. The narrow valley used to be among the few with near-natural conditions in this part of Croatia. It has turned into a stagnant hydropower reservoir.

Construction works in 2008 (Google Panoramio, by user haze 2005).

Dobra before construction left (Google Panoramio, user lordstocks) and after clear-cut as preparation for flooding on right side (by Ivan Perković).

3.6.3 Bosnia & Herzegovina

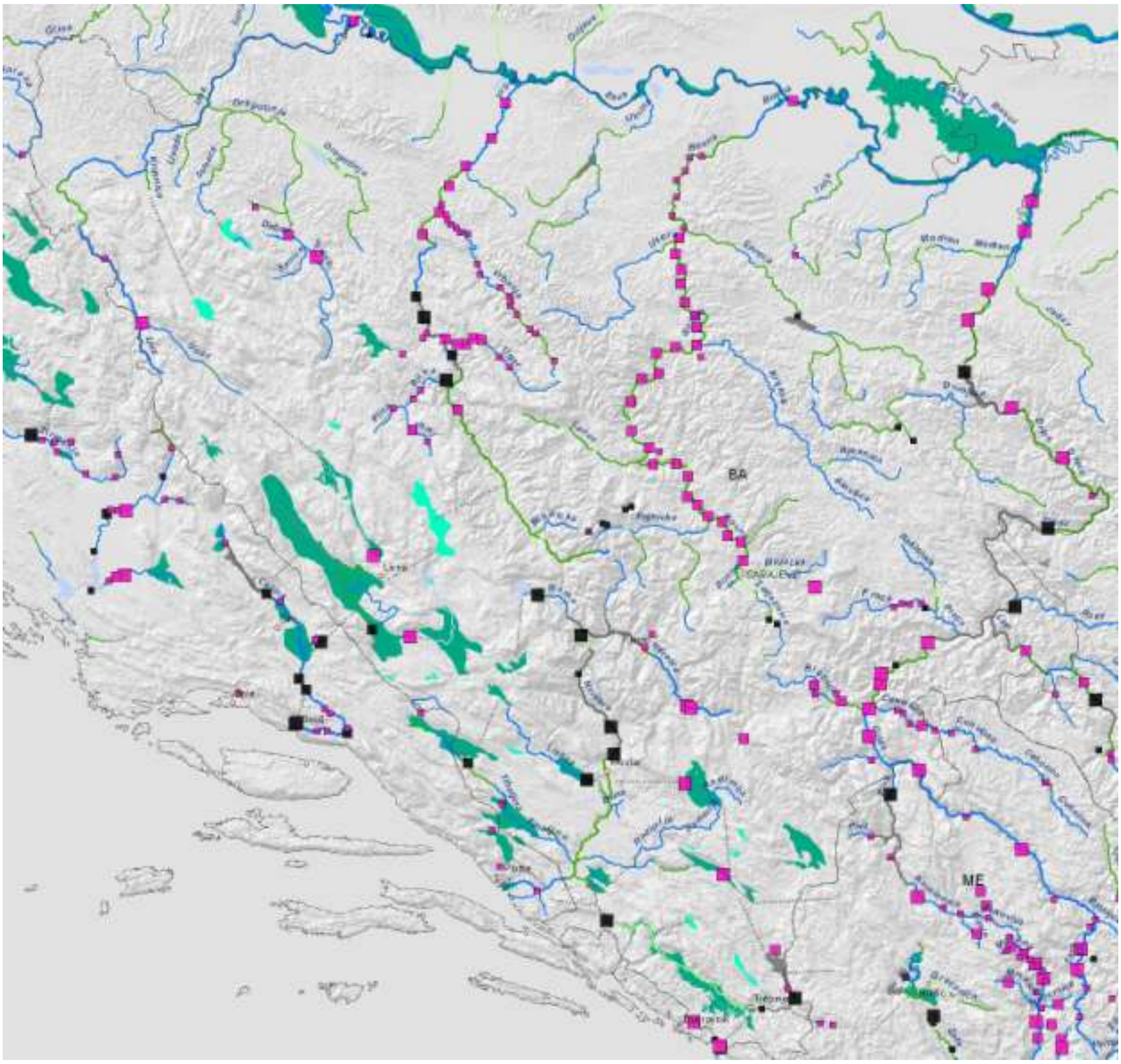


Figure 96: Affected very high and high conservation stretches by planned hydropower plants for BA.

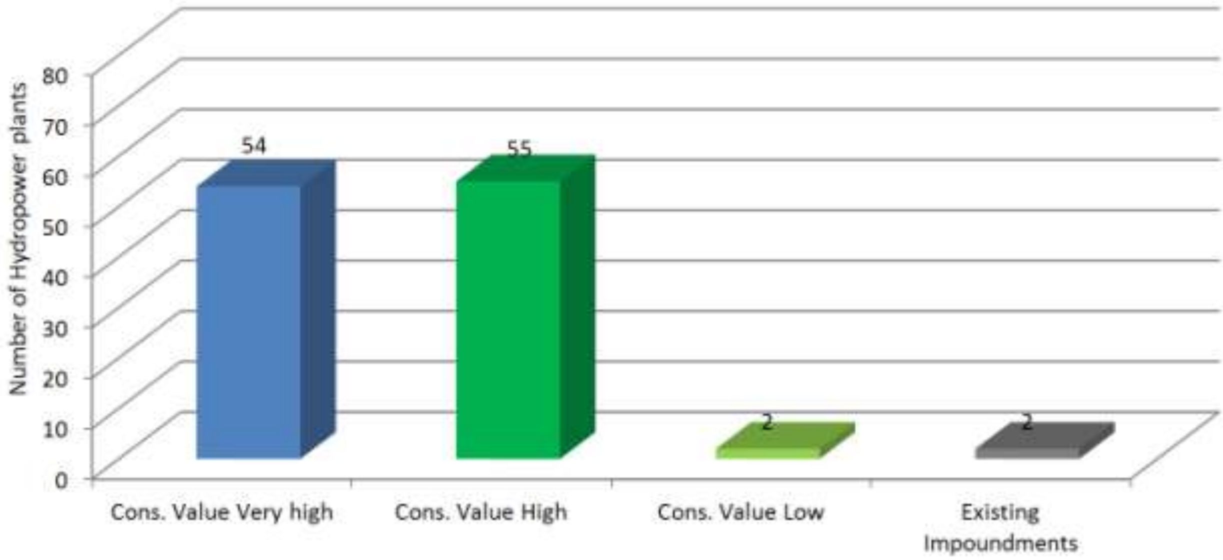


Figure 97: Number of planned hydropower plants that would affect very high, high and low conservation stretches for BA.

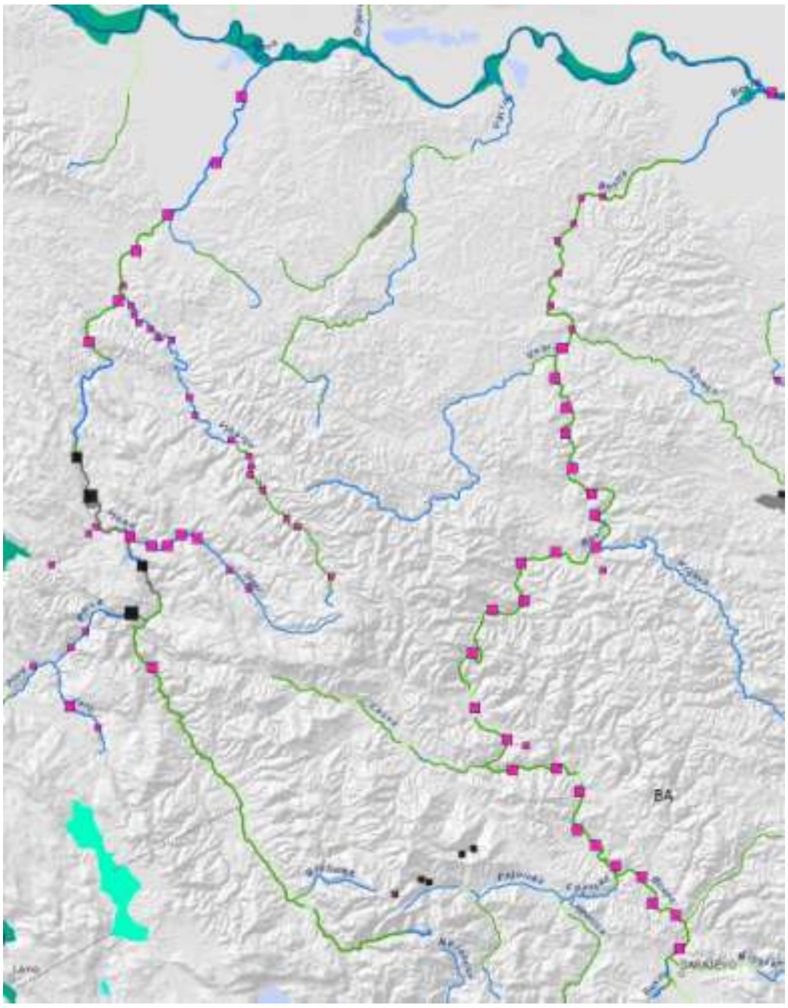


Figure 98: Map zoom on Vrbas (left) and Bosna (right): Planned chains of hydropower plants will impact both river systems systematically. For Bosna further the regulation from 200 to 30 m width is foreseen, a complete canalization of the river.

Case 2, Bosnia & Herzegovina and Croatia

Karst systems with significant altitude levels of different poljes (900 to 200 m above sea level) in combination with power stations at sea level are rather attractive for hydropower generation. In the past, this has led to the development of a complex system of reservoirs, tunnels, canals and power plants. In the Neretva basin, several projects aim to improve water availability through storage and drainage systems in poljes, new tunnels and power stations. In the Cetina basin, the situation is similar. In the example below, a tunnel connection between Dabarsko and Fatničko polje transfers most flood water into a different subbasin (from Neretva to Trebišnica and the HPP Dubrovnik/Adria). This is impacting river Bregava (estimated loss > 50% of flow), the Ramsar site Hutovo Blato (BA) and the whole Neretva Delta (HR). In the Cetina basin (HR, BA), the situation is similar. Here new planned projects endanger the natural connections of Ramsar Site Livanjsko Polje (BA) and threaten endemic fish species.

Overview map of Neretva karst basin with poljes and underground water system as well as hydropower use. The red arrow is marking the violated basin border. (Powerpoint presentation: Primer primene UNESCO-vog principa PCCP STUDIJA UTICAJ PREVOĐENJA VODA KROZ TUNEL FATNIČKO POLJE ⇨ AKUMULACIJA BILEĆA NA REŽIM VODA REKE BREGAVE).

Dabarsko polje to Fatničko polje tunnel connection reducing flood dynamics in poljes and rivers collecting water for hydropower (Martin Schneider-Jacoby, Euronatur).

3.6.4 Serbia

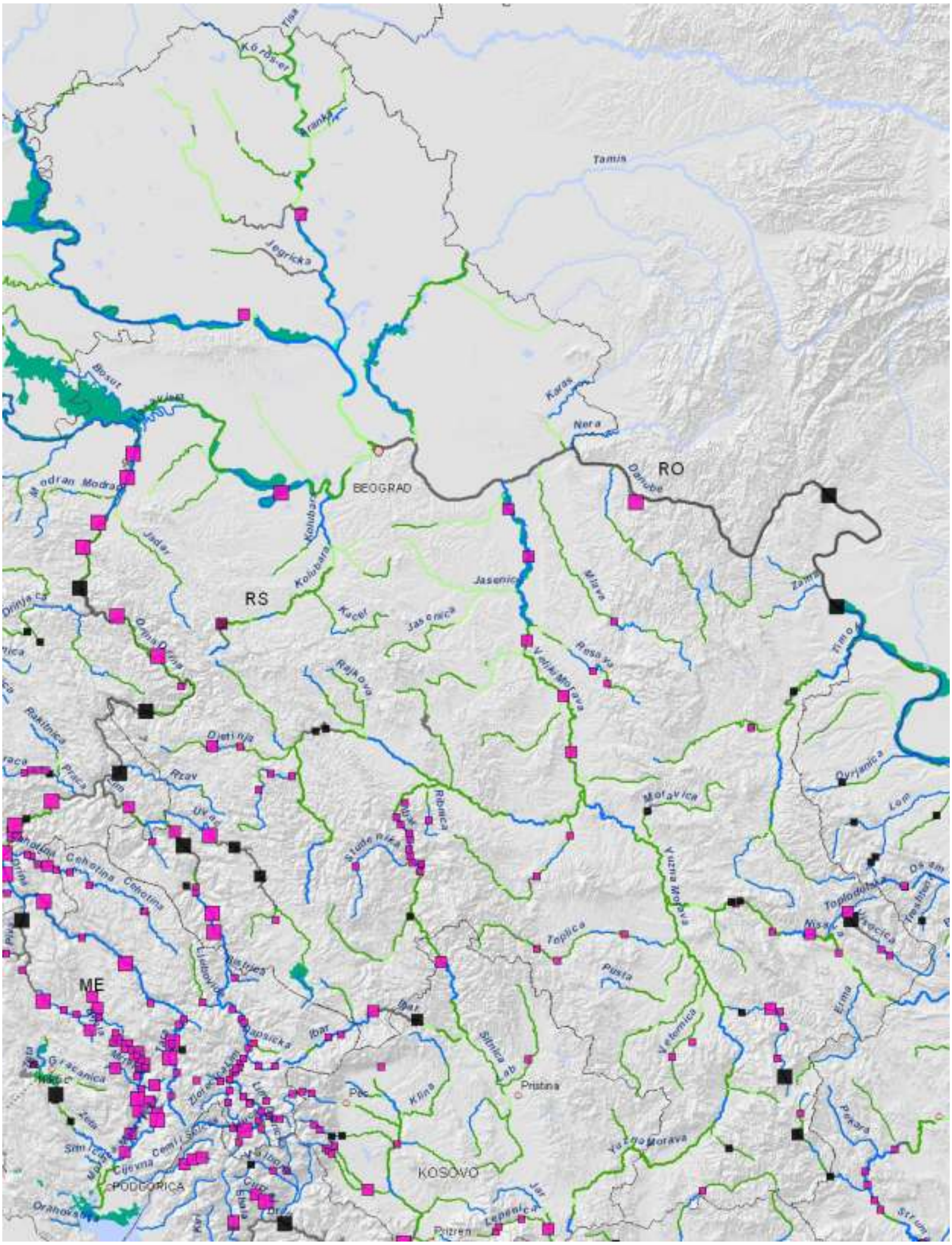


Figure 99: Affected very high and high conservation stretches by planned hydropower plants for RS.

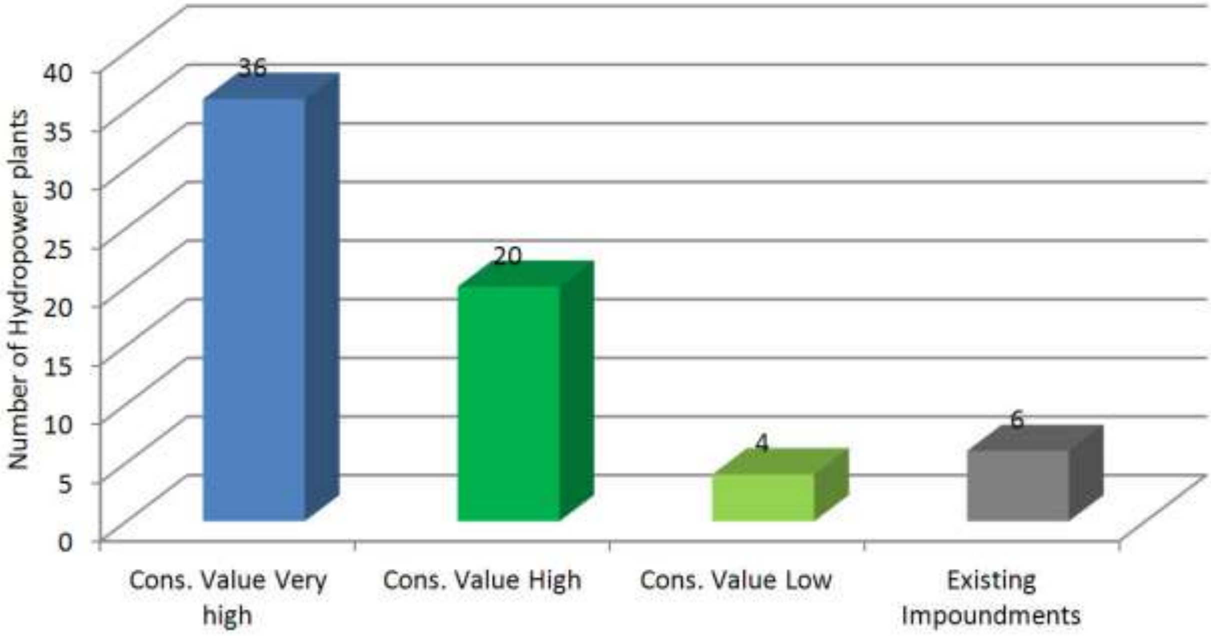


Figure 100: Number of planned hydropower plants that would affect very high, high and low conservation stretches for RS.

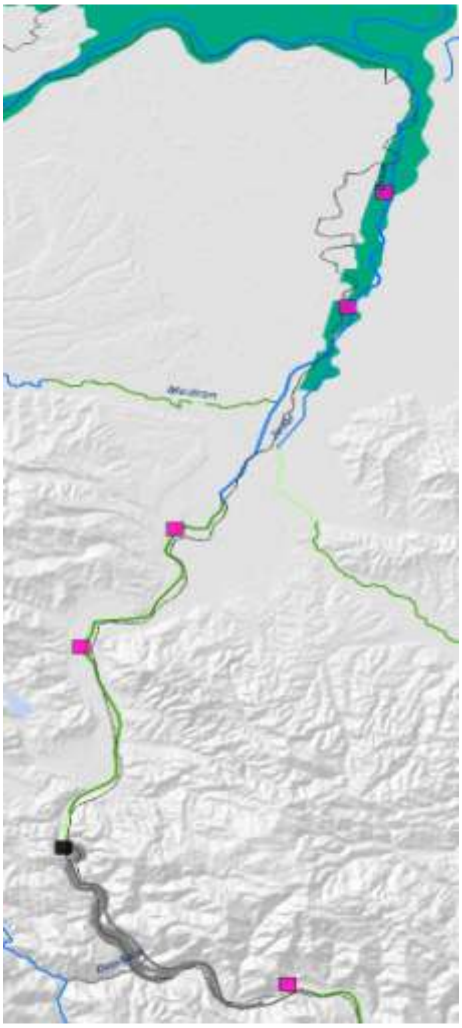


Figure 101 (left): Map zoom lower Drina: The remaining free-flowing and meandering 80 rkm would be interrupted by new dams.

Figure 102: Lower Drina: Braided toward meandering channels with many pioneer areas on gravel and floodplain forests.

Figure 103: Rafting tour on Ibar, by Google Panoramio user

Figure 104: Map zoom Ibar: The gorge of Ibar would be systematically impacted by hydropower.

3.6.5 Kosovo

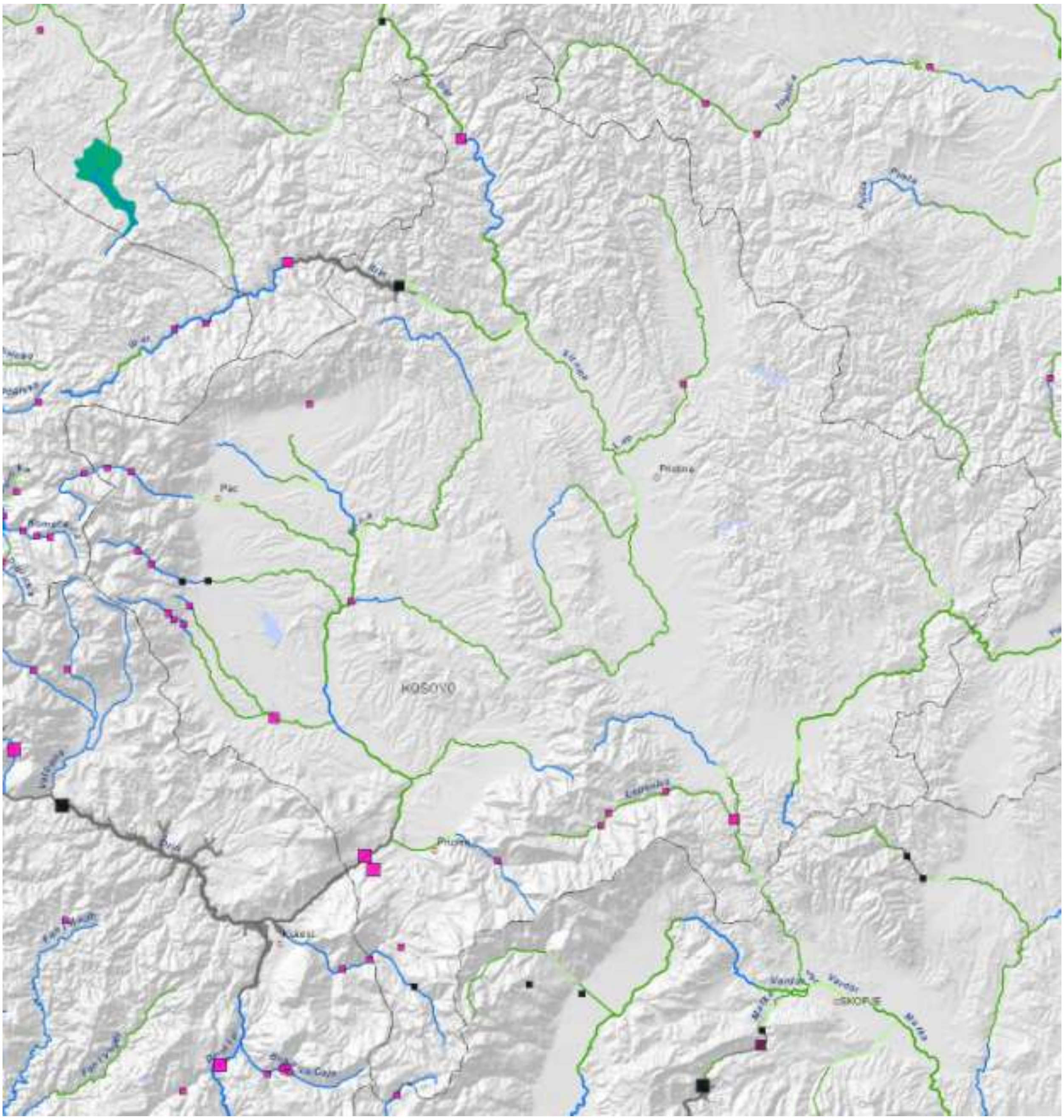


Figure 105: Affected very high and high conservation stretches by planned hydropower plants for Kosovo.

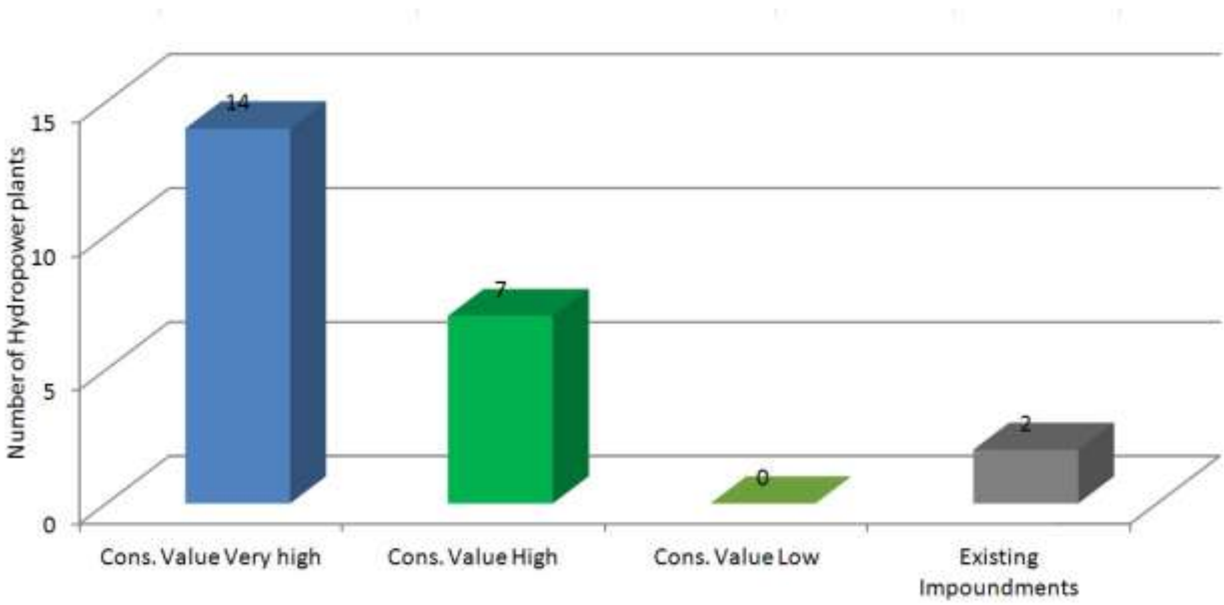


Figure 106: Number of planned hydropower plants that would affect very high, high and low conservation stretches for Kosovo.

3.6.6 Montenegro

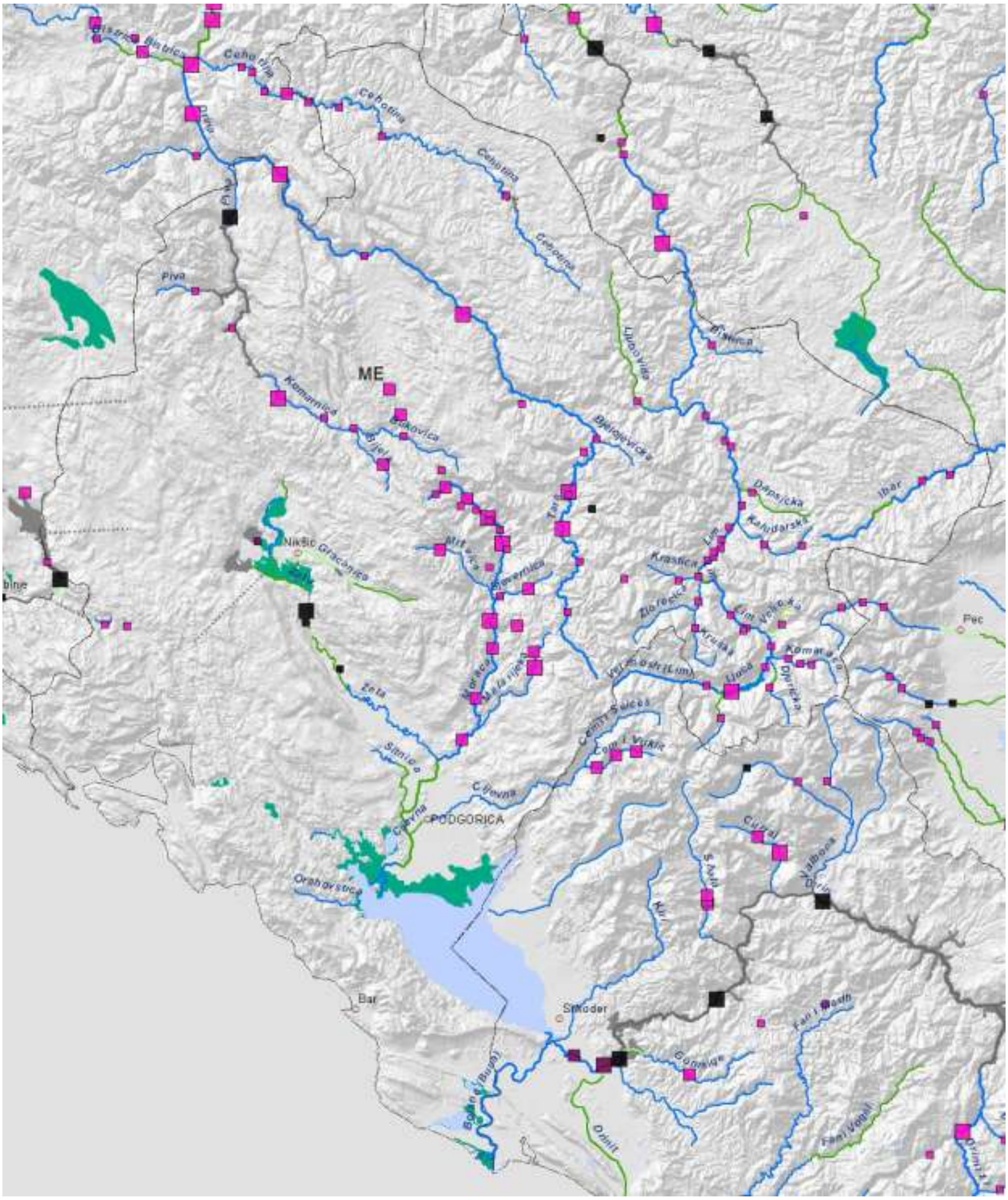


Figure 107: Affected very high and high conservation stretches by planned hydropower plants for ME.

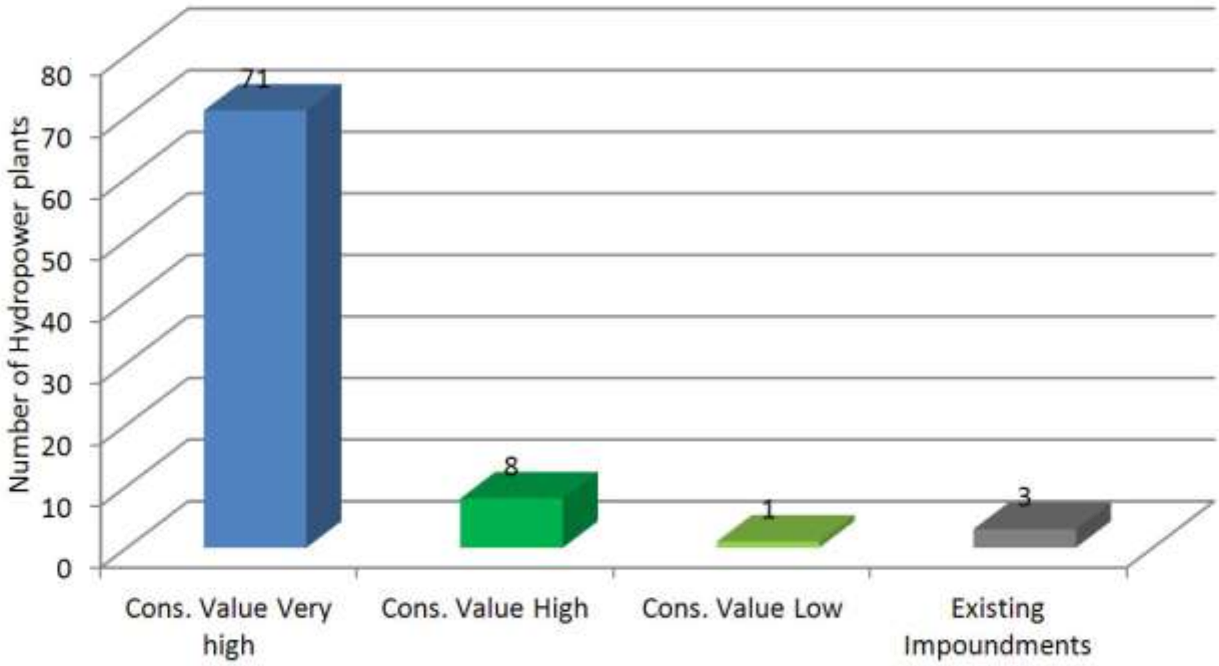


Figure 108: Number of planned hydropower plants that would affect very high, high and low conservation stretches for ME.

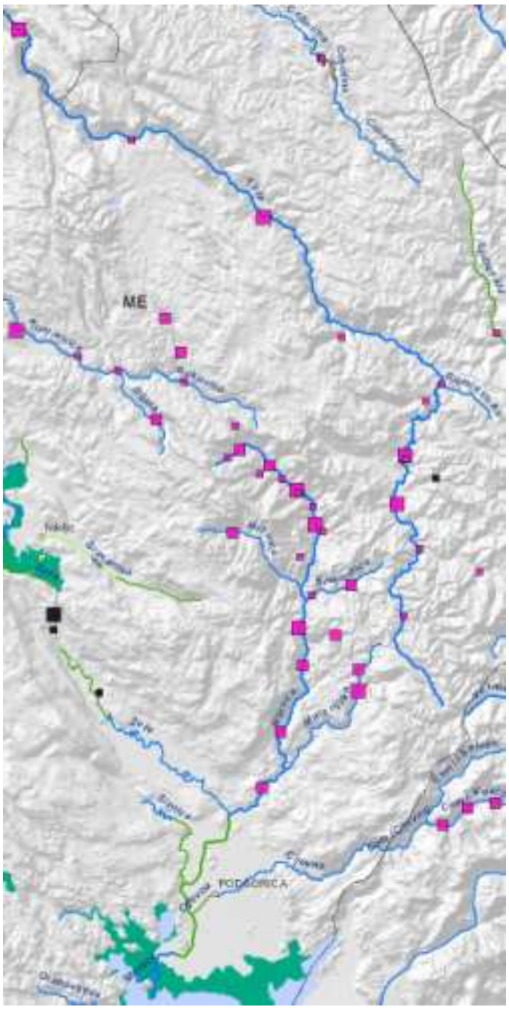


Figure 109: Map zoom on upper Morava and Tara rivers: Nearly pristine upper courses and even entire river systems of typical karst gorge rivers would be interrupted.

Case 3, Montenegro


Upper Morača Canyon (Mathias Dieckmann).

The river Morača is the most important tributary of Lake Scutari. Together with Bojana-Buna, they form an entirely free flowing connection from the Adriatic sea to the high mountains of Zagradac ridges at 2000 m. A hydropower development foresees a cascade of four huge dams (Andrijevo, Raslovići, Milunović, and Zlatica) with crest heights between 60 and 150 m and installed power between 37 and 127 MW. The length of impoundments sums up to 40 rkm. In addition, on the upper Morača the hydropower plant Kostanica with 550 MW is planned. In sum this makes the largest project in the entire Balkan, impounding also upper Tara (with two dams) and tunnels to feed the water into the Morača catchment.

Lake Scutari Ramsar site would be heavily impacted and the maximum size shrink about 100 km². The total investment sum was estimated with almost 700 Million €.


A part of the delta of the Morača river into Lake Scutari with its unique flood pulse (5 m annual water level dynamics with some 20,000 ha of intact river-lake floodplains) will be threatened by the hydropower plans (Ulrich Schwarz, FLUVIUS).

3.6.7 Macedonia

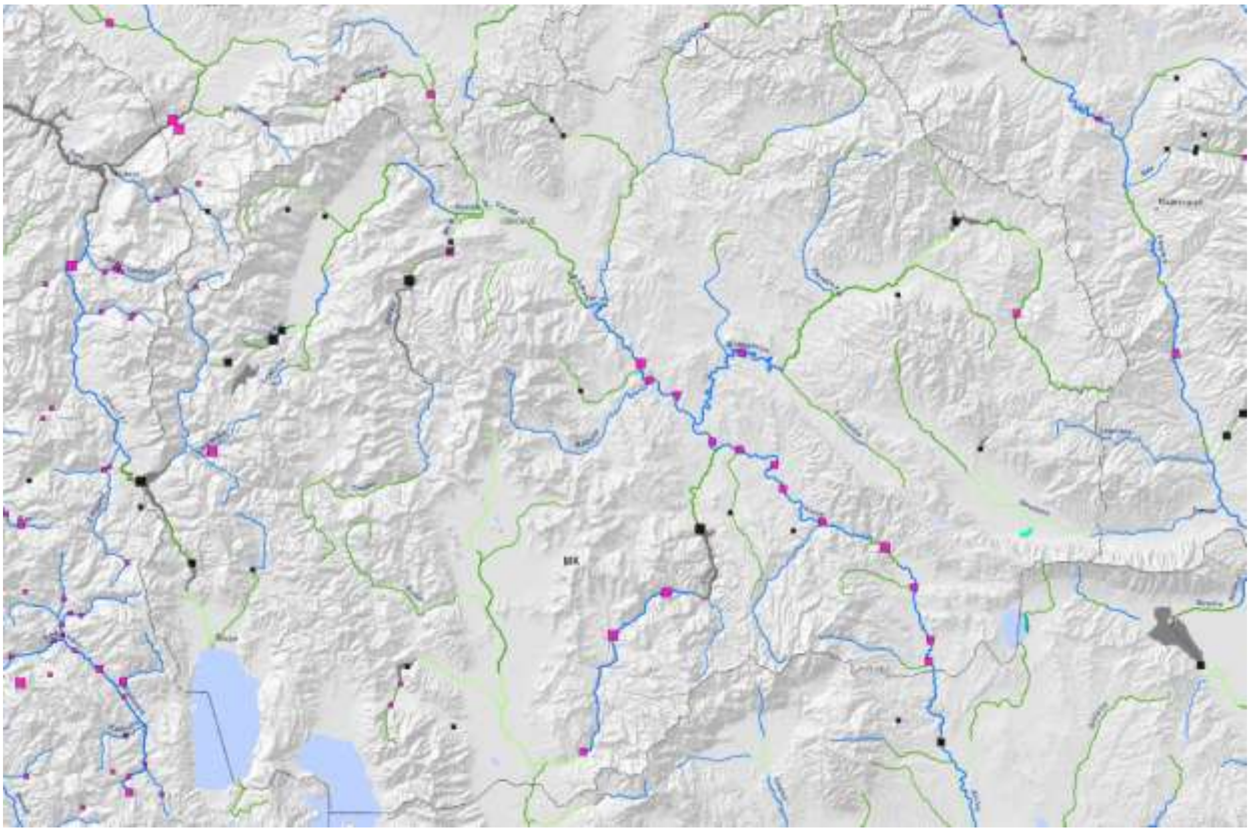


Figure 110: Affected very high and high conservation stretches by planned hydropower plants for MK.

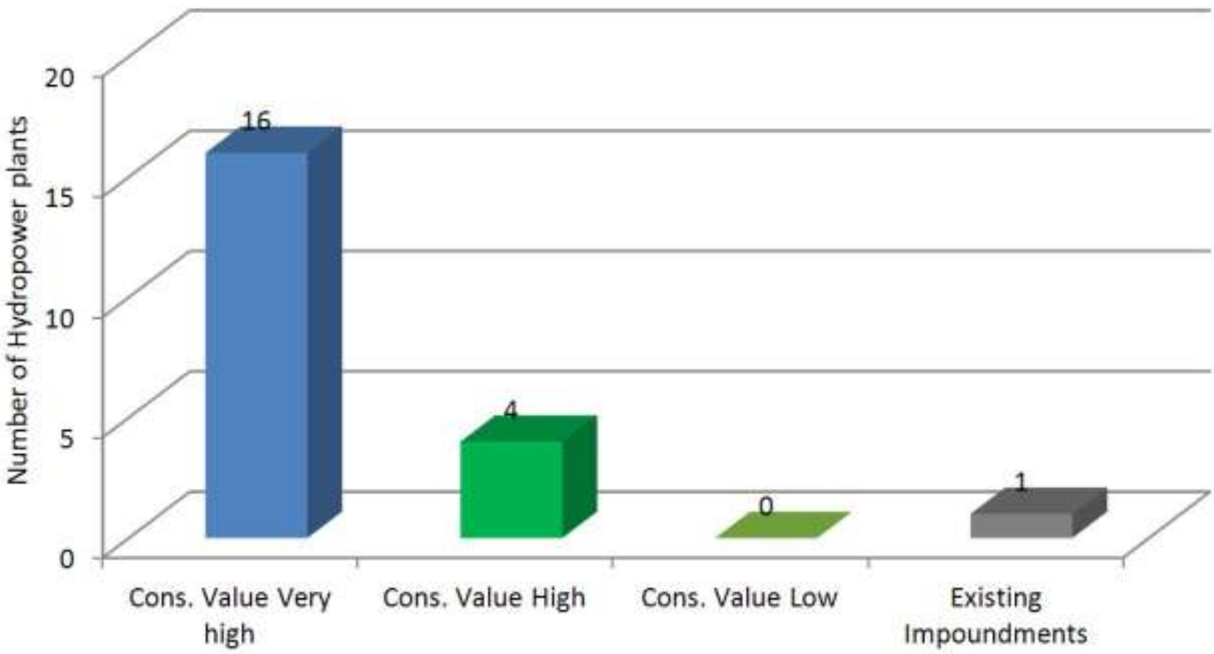


Figure 111: Number of planned hydropower plants that would affect very high, high and low conservation stretches for MK.

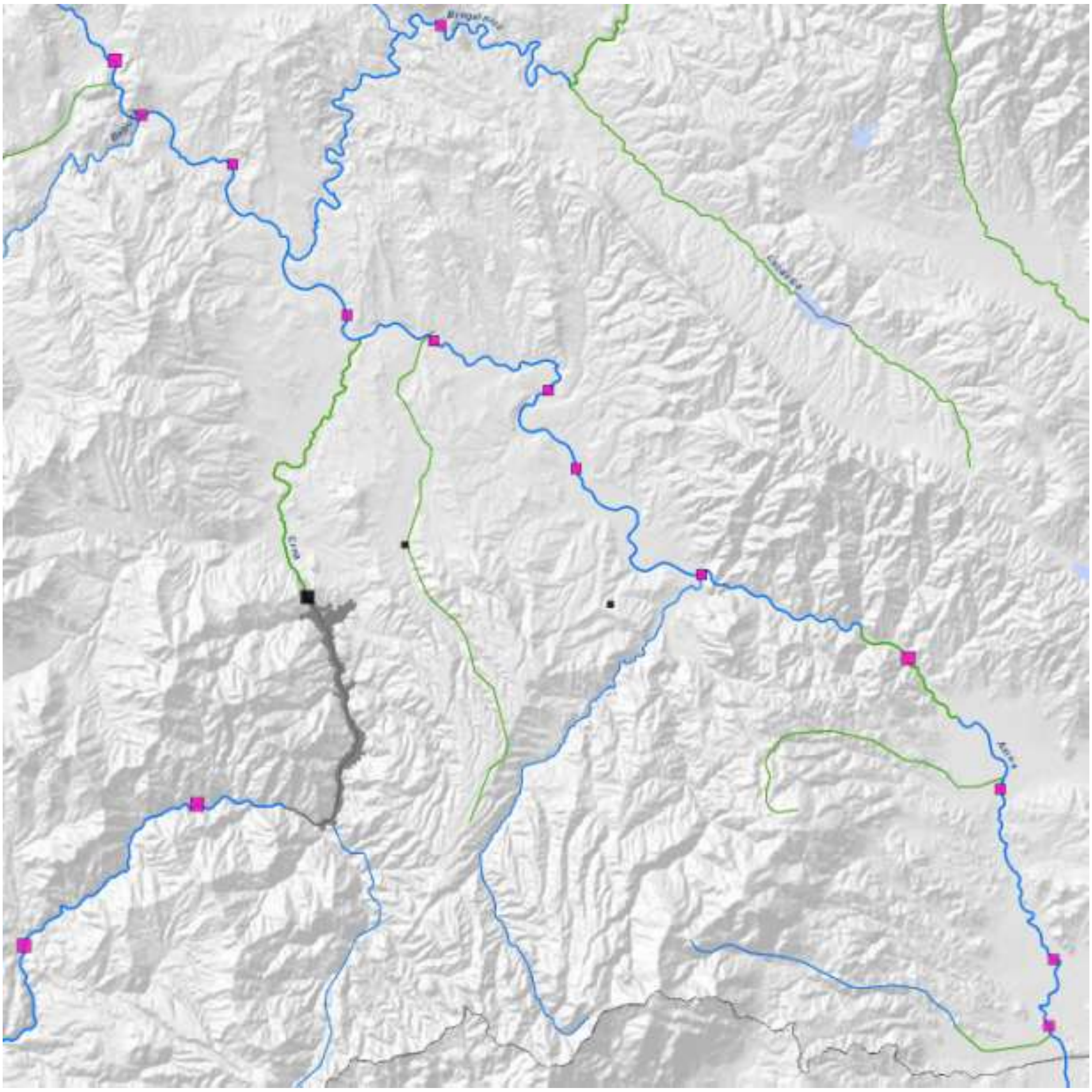


Figure 112: Map zoom Vardar: Entire lower river in MK is subject of systematic hydropower planning.

3.6.8 Albania

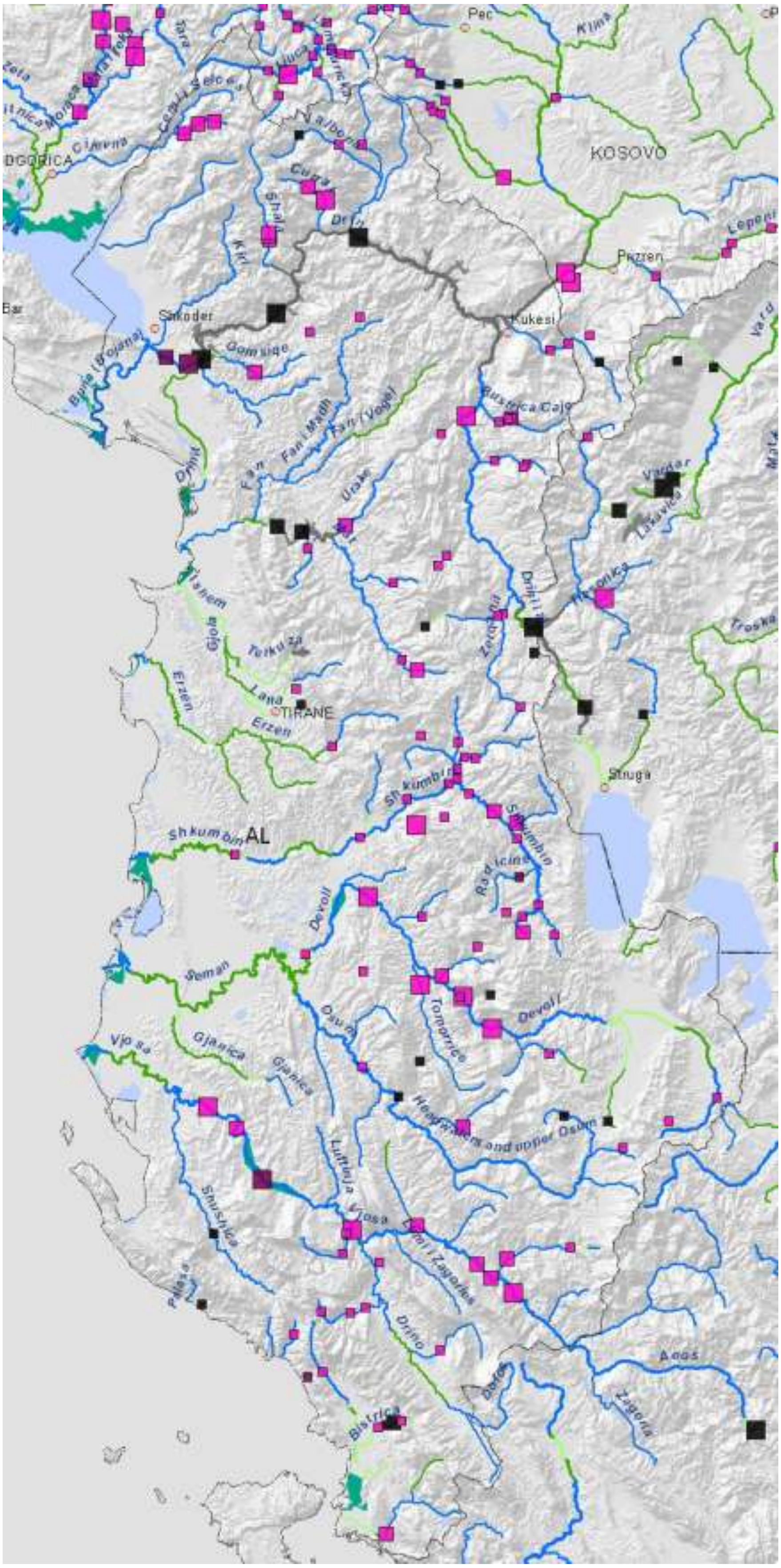


Figure113: Affected very high and high conservation stretches by planned hydropower plants for AL.

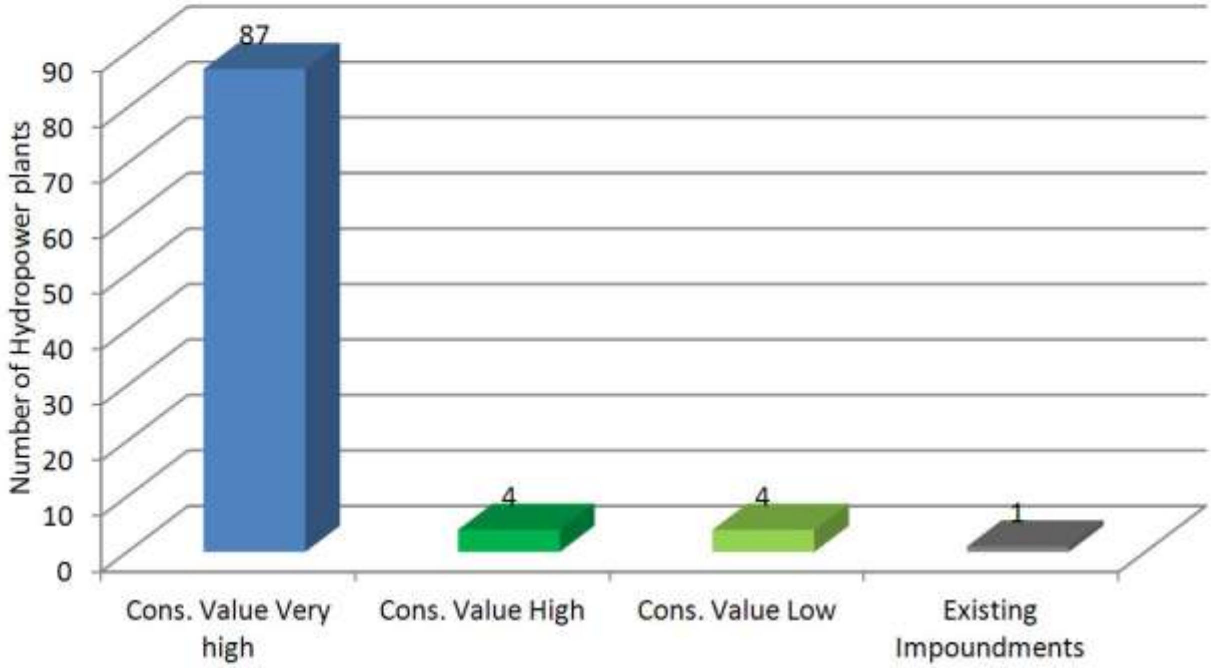


Figure 114: Number of planned hydropower plants that would affect very high, high and low conservation stretches for AL.

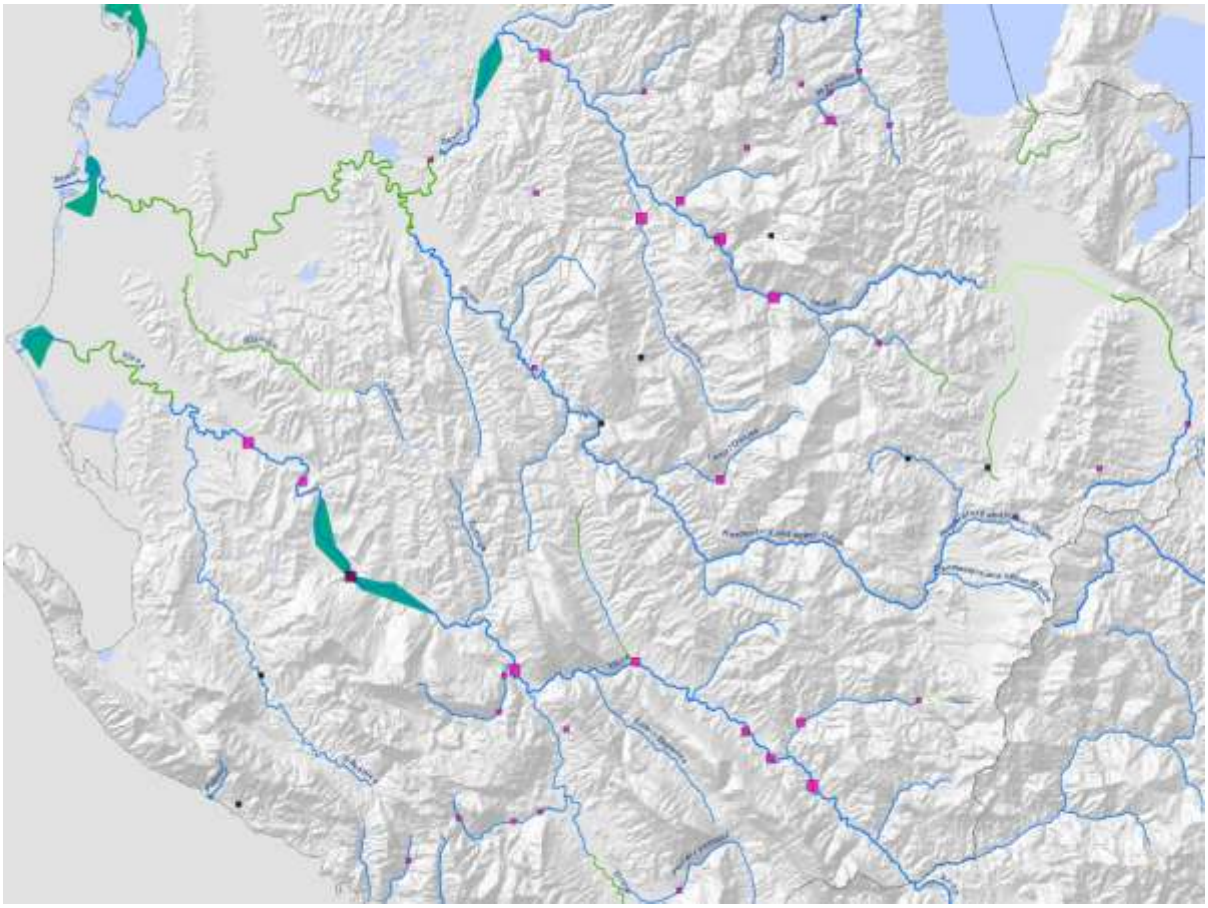


Figure 115: Map zoom Devoll (top) and Vijosa (bottom): Large scale dam projects will interrupt both river systems.

Case 4, Albania

Before the construction of the Kalivac dam, the Vijosa system was one of the most natural entirely free flowing river systems of Western and Central Europe. The dam under construction by an Italian company, due to be finalised next year, will interrupt the river continuum about 90 rkm from the delta into the Adriatic sea. The installed power will be some 100 MW, the dam crest is at 45 m and is expected to influence the whole river system.

Intact Vijosa river landscape before construction of dams (Arno Mohl, WWF Austria).

Construction works of Kalivac Dam in 2008 (Arno Mohl, WWF Austria).

3.6.9 Greece

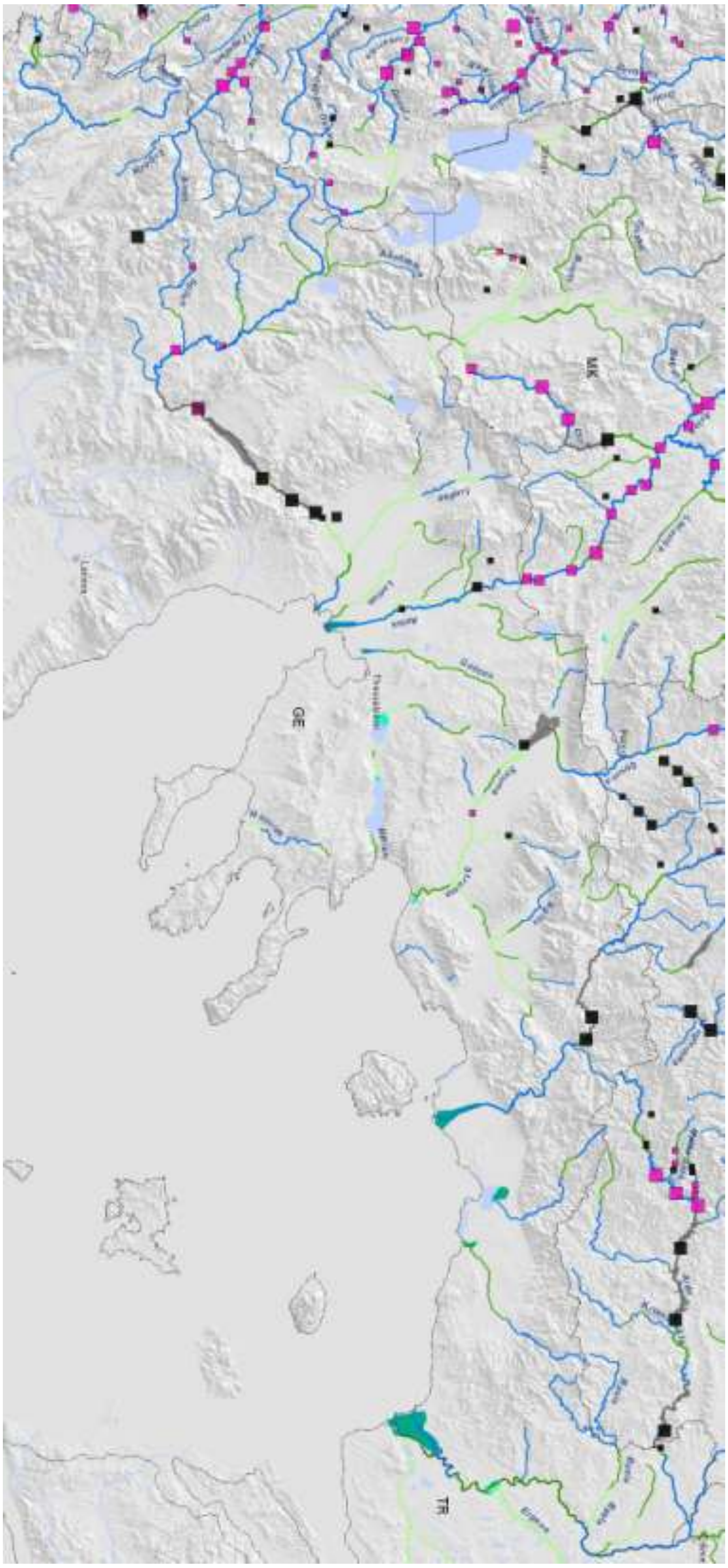


Figure 116: Affected very high and high conservation stretches by planned hydropower plants for GR.

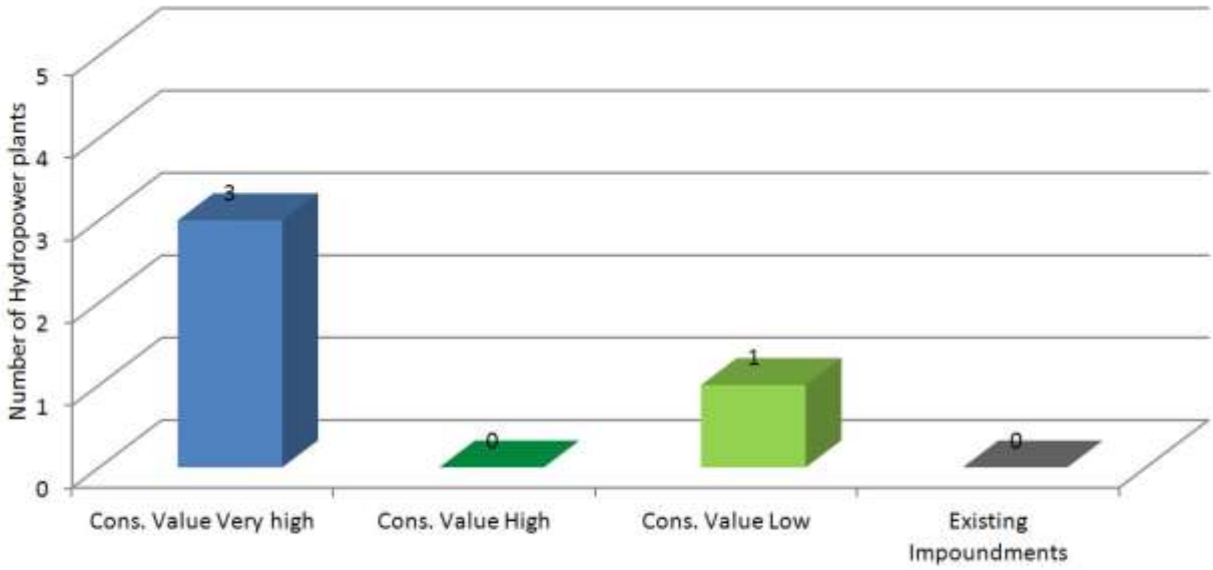


Figure 117: Number of planned hydropower plants that would affect very high, high and low conservation stretches for GR.

Case 5, Greece

The lower Aliakmon river is already impounded on more than 60 rkm. The Ilarion dam with 160 MW installed power and a dam crest of 125 m will prolong the chain impounding the "Red gorge „and touching a cultural heritage site with a small monastery for some additional 25 rkm.

Ilarion dam construction under finalisation (Google panoramio, by user Billys).

Cultural landscape with abandoned monastery before (Google panoramio, by user gmmk).

3.6.10 Bulgaria

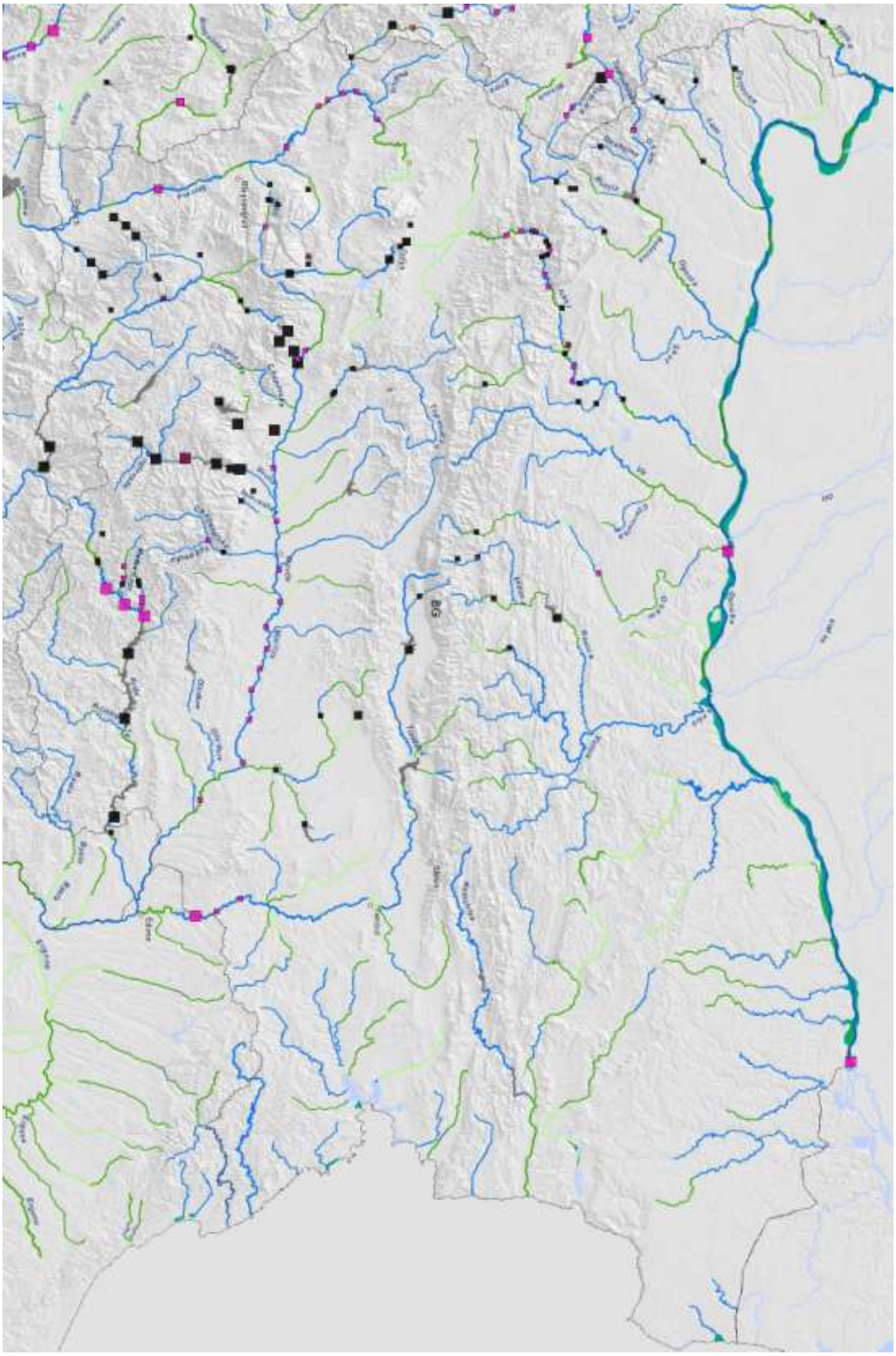


Figure 118: Affected very high and high conservation stretches by planned hydropower plants for BG.

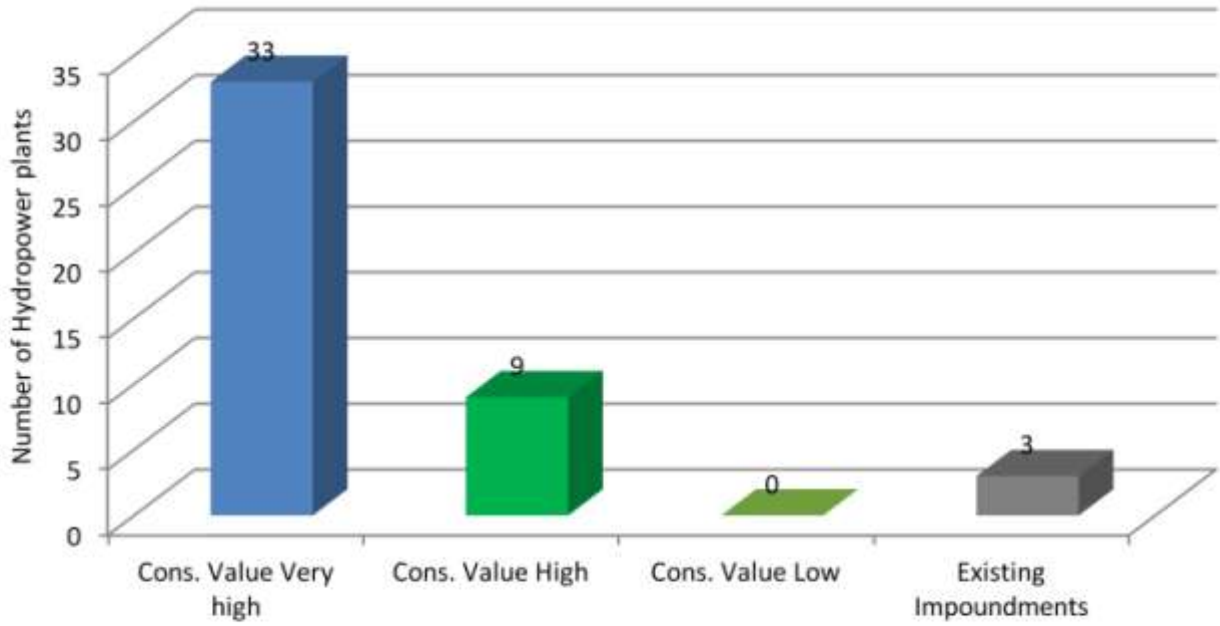


Figure 119: Number of planned hydropower plants that would affect very high, high and low conservation stretches for BG.

Figure 120: Map zoom Danube: The two planned hydropower plants (together with RO) would destroy the “Lower Danube Green Corridor” and impound more than 500 rkm downstream of the existing Iron Gate dams.

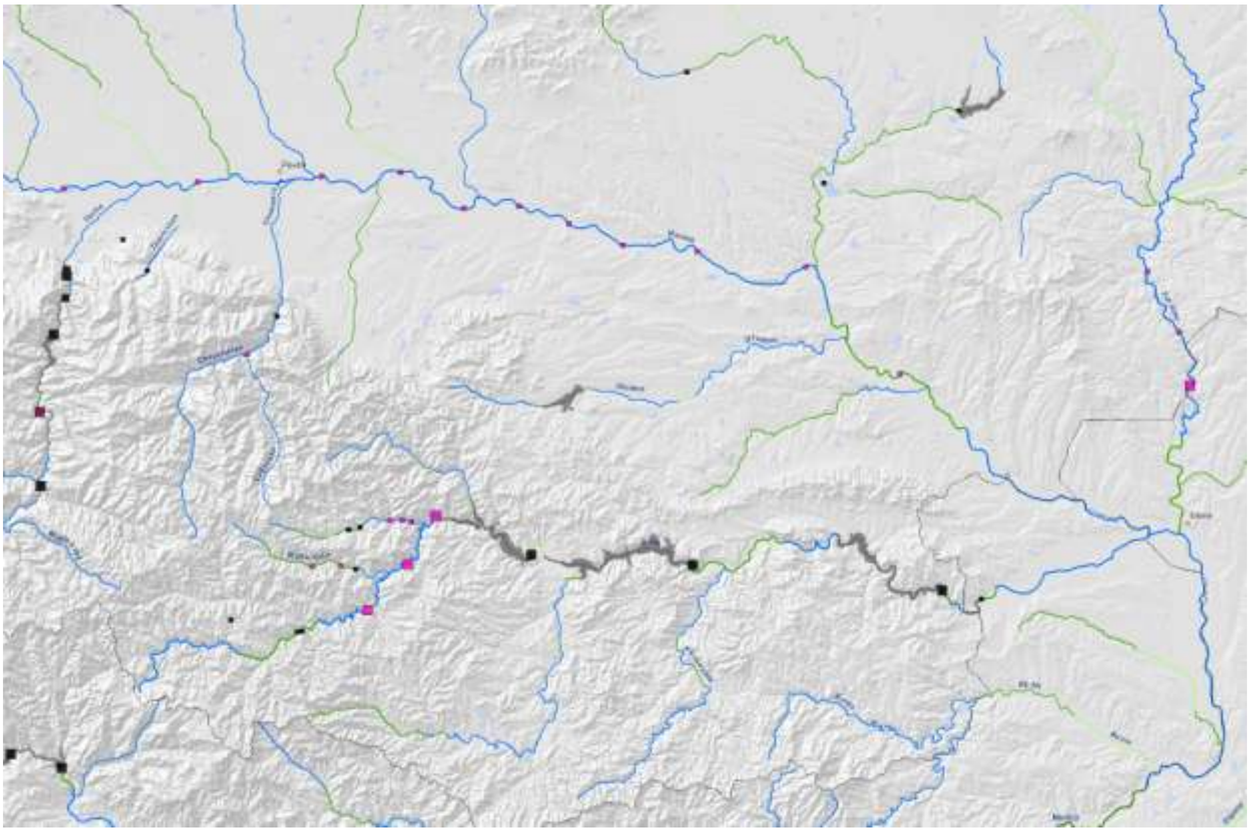


Figure 121: Map zoom on Maritsa, lower Tundzha and upper Arda: Many medium sized dams will interrupt entire river systems.

3.6.11 Turkey

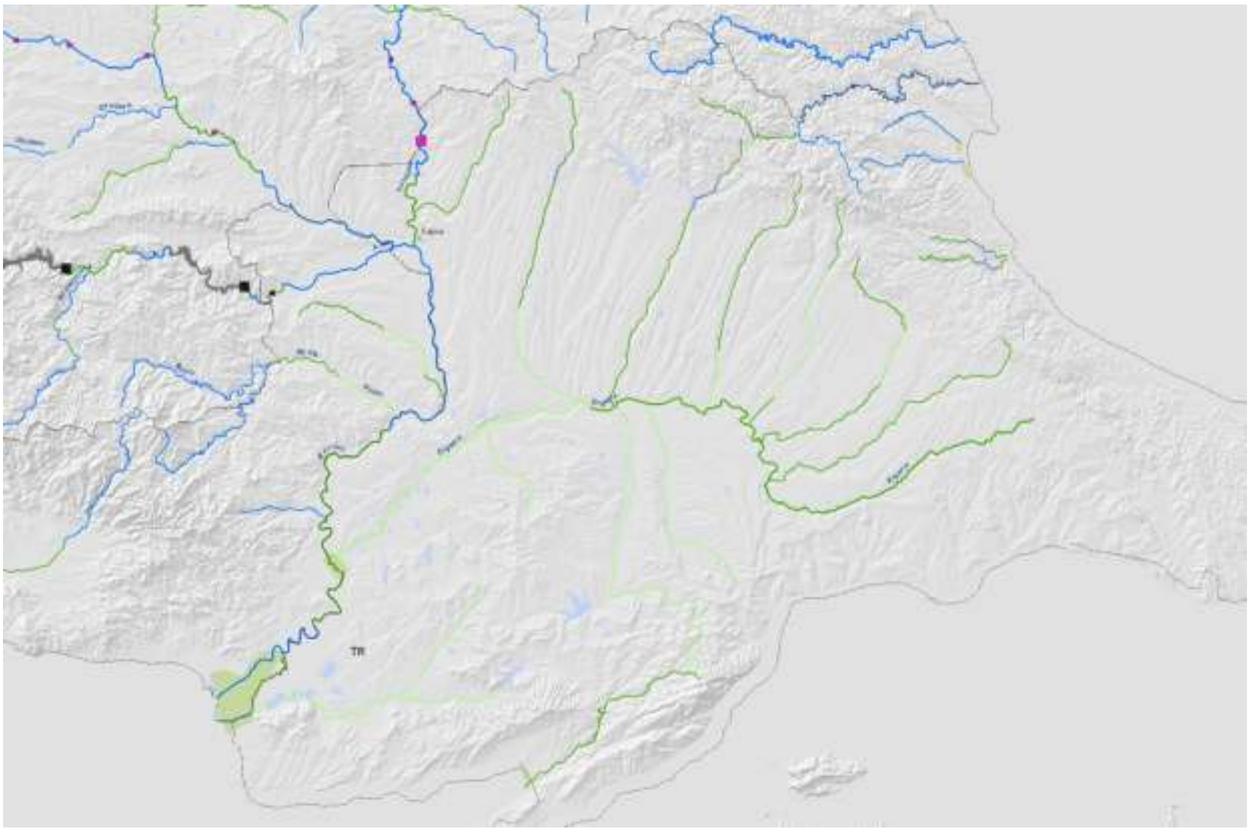


Figure 122: Affected very high and high conservation stretches by planned hydropower plants for TR.

The one planned dam in Turkey (also planned for flood retention to prevent damages in Edirne) will impact a very high conservation value stretch (no chart is added). Other dam projects related to the drinking water supply for Istanbul would affect the “blue” border rives to BG.

3.6.12 Entire Balkan region

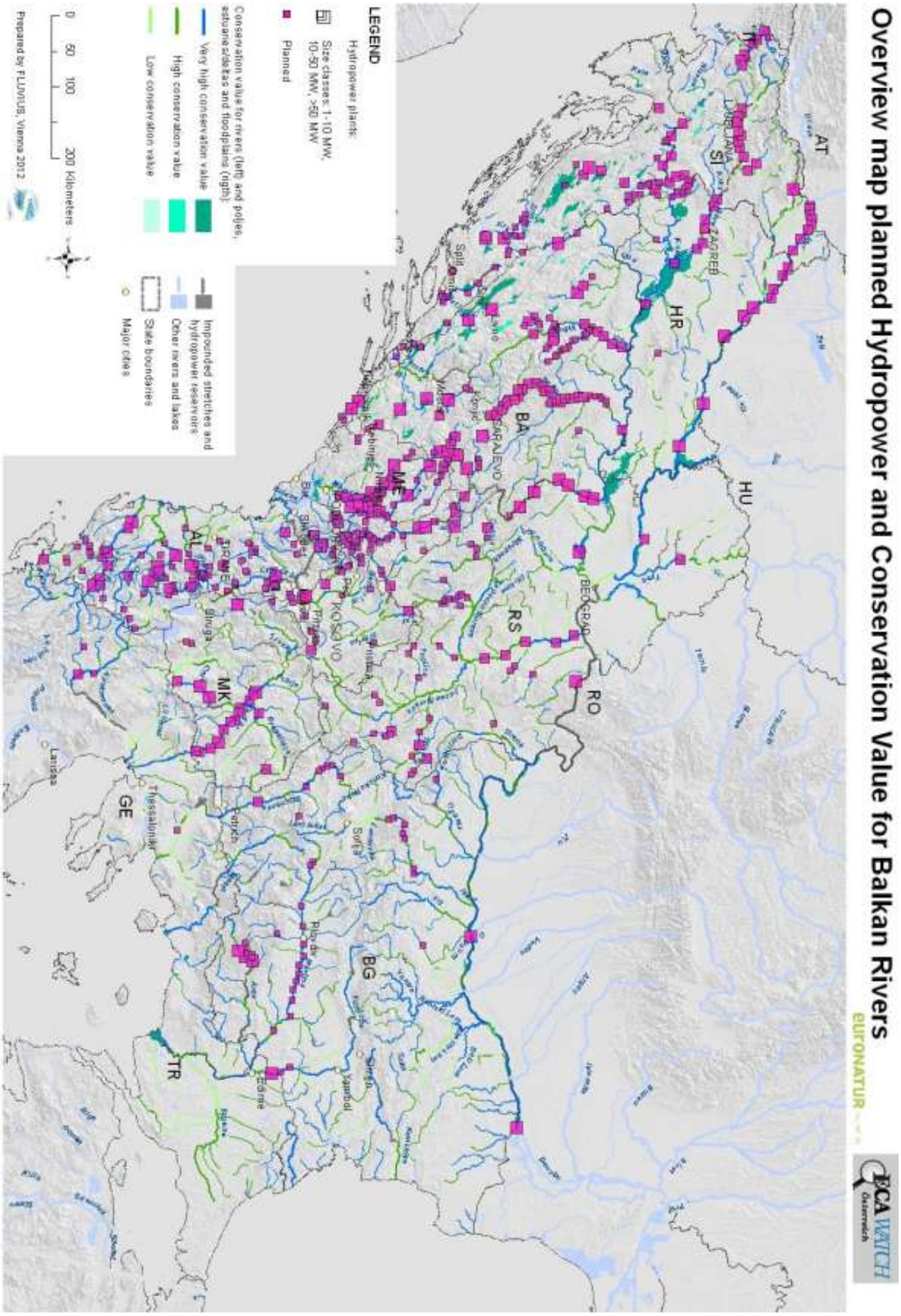


Figure 123: Affected very high and high conservation stretches by planned hydropower plants for the entire project area.

According to next figure in total 70% of all currently planned projects would fall into the very high conservation value class, 23 % in the high and 3% in the low class (in addition 22 HPP's (4%) would fall into existing impoundments not touching free flowing river stretches).

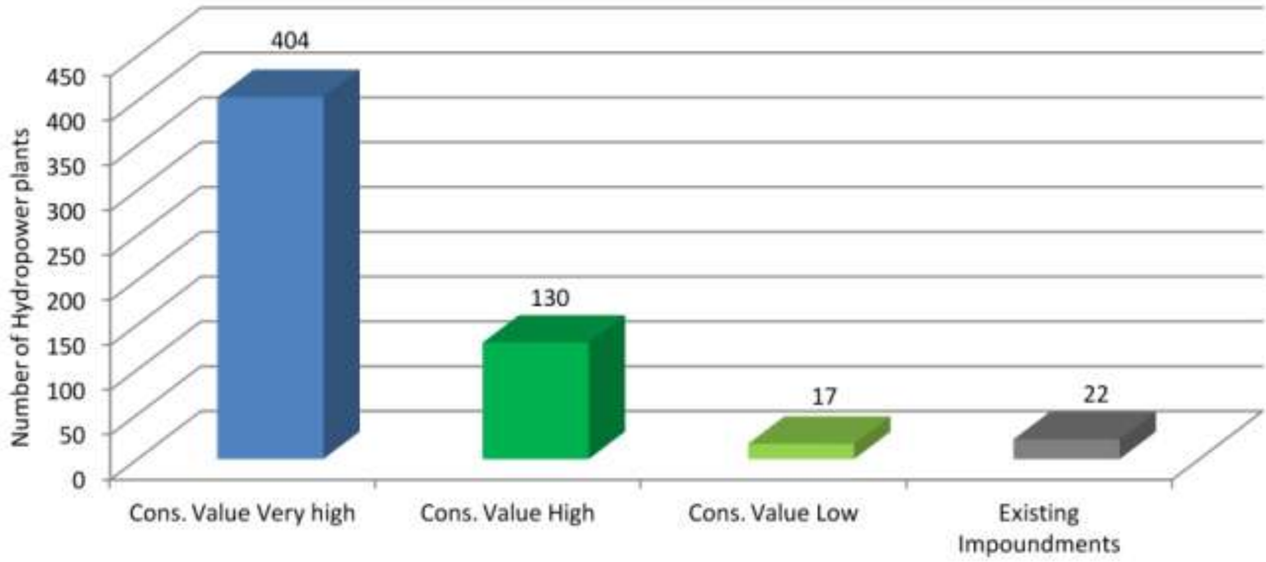


Figure 124: Number of planned hydropower plants that would affect very high, high and low conservation stretches for the entire project area.

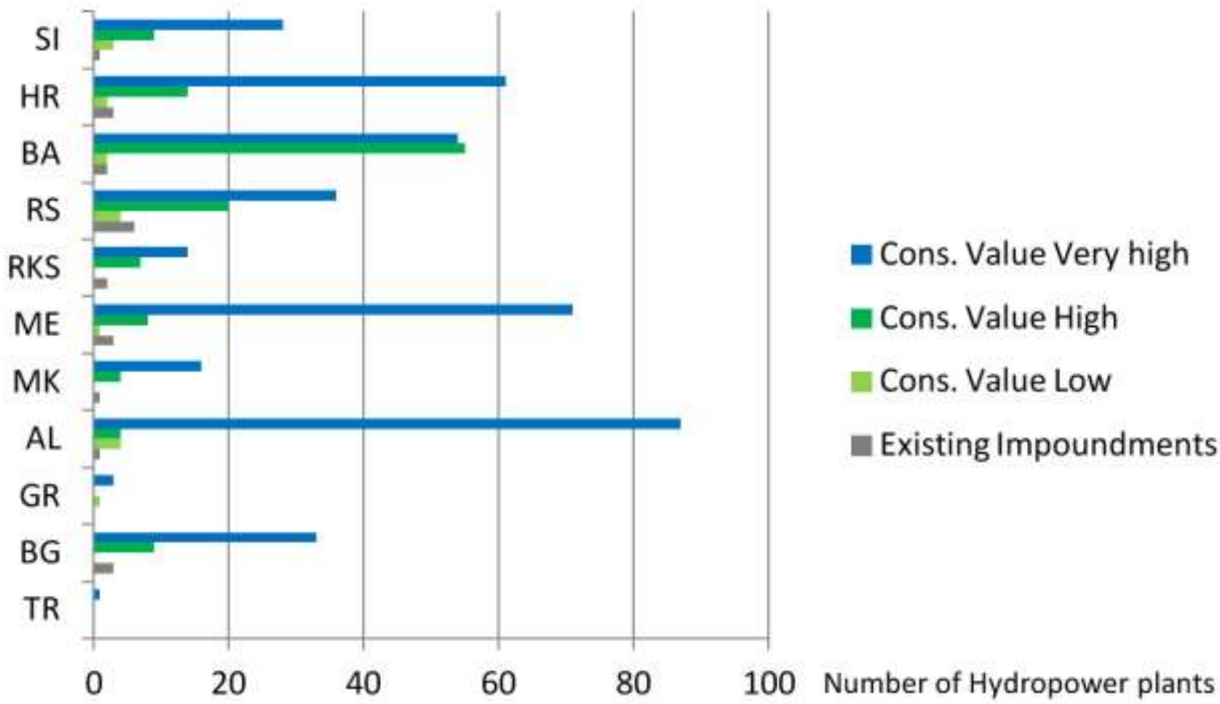


Figure 125: Country comparison for the entire project area again highlights the high number of hydropower plants affecting pristine rivers in ME and AL

3.7 Comparability of results with western European examples

According to the hydromorphological status nearly 30 % of rivers provide such good hydromorphological conditions that they are of “very high conservation value”. In Germany only 10% of rivers, in Austria 6%, and in Switzerland 7% have still this level of intactness.

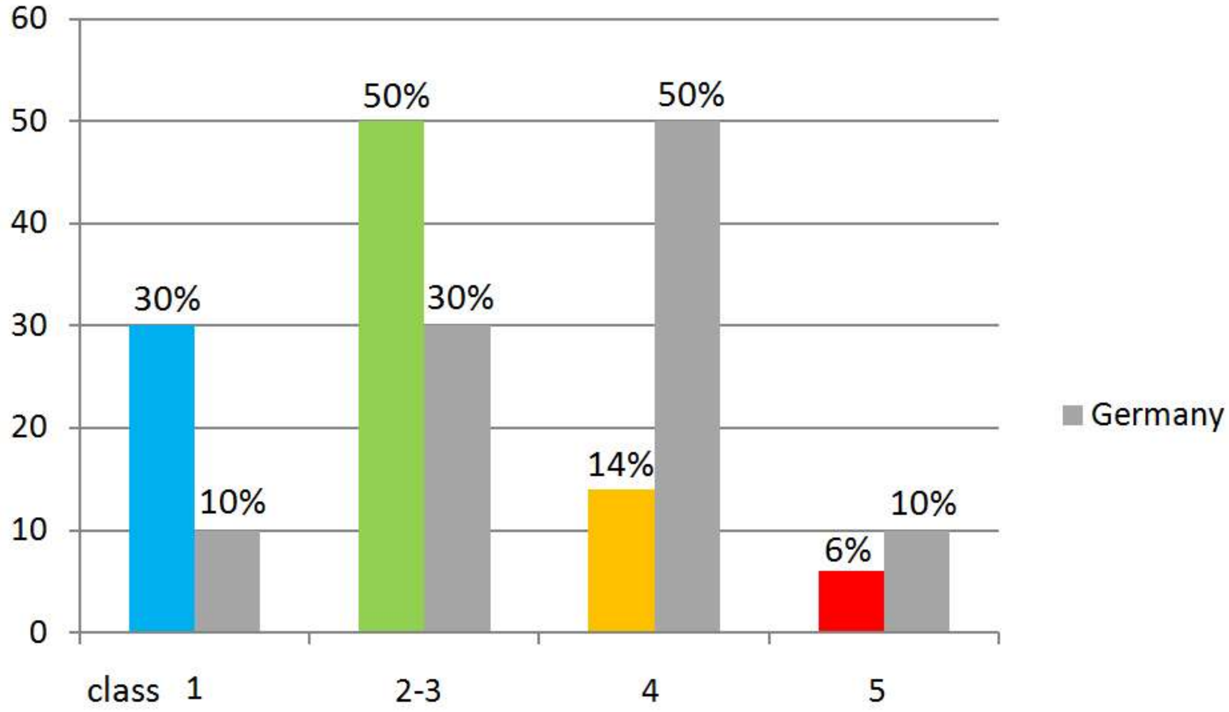


Figure 126: Comparison of the 5 hydromorphological classes in the European context. In particular the first two classes highligh the still high ecological value of Balkan rivers against the third class which is prevailing in Western Europe.

The direct comparison of results from Switzerland and Austria is not possible as different scales were assessed. In Switzerland, for example, very small rivers including near-natural headwaters were included in the assessment, which increases the total length of the assessed drainage network and changes the overall result significantly. Therefore only the German overview fits regarding size of assessed rivers. For Austria an independent analysis of all rivers larger than 500 km² (Muhar et al 2000) delivered comparable figures (class 1: 6%, class 2: 15%, class 3 and 4: 63% and class 5: 16%).

The comparisons of large rivers on the next pages show first an example from the Balkan region followed by an image of Germany and Austria. Deliberately the examples were chosen representative (ecologically valuable stretches in western European countries). The landuse in the lowland valleys is very intensive in both regions while water management, river regulation and maintenance are significantly different.

Braided River type

Figure 127: Braided river Arda in BG (Google earth 2010).

Figure 128: Formerly braided Isar river at its best “reference” stretch near Gartenberg (catchment, discharge, substrate comparable with Arda) (Google earth 2010).

Meandering river type

Figure 129: Veliki Morava in Serbia with rather intact meander dynamics (Google earth 2010).

Figure 130: Morava river in Austria lost most of its meanders due to cutting off and fixation of banks to prevent lateral shift, but still has high conservation values (Google earth 2010).

Figure 131: Mulde river confluence into Elbe, a “national river jewel” in Germany as a further step of degradation (compare figures 129 and 130) (Google earth 2010).

Floodplains

Figure 132: Hugh floodplains exist only sparsely in the mountainous Balkans (with the exeption of poljes). Lake Scutari with high water level dynamics driven by river Morača and its delta (picture) is an example with some 20,000 ha (Google earth 2010).

Figure 133: Same scale image of the confluence of the Tiroler Achen into the Chiemsee in Bavaria, a national river-floodplain jewel (some 200 ha) in Southern Germany (Google earth 2010).

4. Conclusion and recommendations

The methodology applied for this study has carried out a first overview of the most ecologically valuable river stretches in the Balkan region based on the hydromorphological intactness and protected areas as well as the location of existing and planned hydropower plants. An overlay shows where hydropower planning poses the biggest threat to river ecology.

Overall, regions and catchments of the Balkans have retained many more largely intact river landscapes than western and central European rivers. About 30% of large rivers are still near-natural and of very high conservation value, in Albania and Montenegro even more than 50%, while in Germany only 10%, in Switzerland 7% and in Austria 6% of the rivers (of comparable size) are in such very good state.

In conclusion, the Balkan is one of Europe´s regions with the highest proportion of rivers with high conservation value. The river systems are rich in endemic fish and mollusc species, (compare IUCN 2006, Freyhof 2012) which makes them globally important in terms of biodiversity conservation.

Extensive hydropower development would impact regional freshwater ecology significantly. More than 573 new dams larger than 1 MW are planned impacting in 70% of cases rivers with “very high conservation value” and in 23% of cases rivers with “high conservation value”. Only 4% are related to existing dams (improvement or enlargement of existing turbines).

Hydropower dams modify entire river landscapes, lead to a loss of characteristic and endangered habitats and species, interrupt river corridors, hamper sediment transport and produce channel degradation further downstream. Dams disconnect the river continuum for living organisms. Fish passes can only reduce this effect to a certain degree and are not feasible for all projects, in particular for dams higher than 20 m. Reduced sediment transport causes coastal erosion as is the case along the Albanian Riviera. The fragmentation of rivers by dams leads to long-term degradation of the river system and is particularly damaging in still free flowing stretches or even entirely free-flowing catchments. As many of the planned hydropower plants will be located in ecologically valuable areas, the expected damage to river ecosystems is particularly high. This threat appears to be highest in Albania and Montenegro.

The Balkan´s remaining river stretches with very high conservation value are mostly natural jewels of regional and even European importance. They should be kept as far as possible free of new river infrastructure development such as new hydropower dams to contribute furthermore to Europe´s biodiversity and freshwater conservation targets e.g. for several endemic fish species and deliver their ecosystem goods and services such as self purification, flood protection for settlements further downstream, and coastal protection.

Hydropower is one renewable energy source among others and can partially help to meet Europe´s target of reducing the emission of greenhouse gases. However, intact river landscapes are not renewable. Therefore the location of new dams is to be chosen very carefully in order not to create new ecological problems. Ecological compensation measures can never fully balance the loss of biodiversity at a certain place.

Therefore priority should not be given to building new hydropower dams but upgrading existing ones and lowering energy demand by increasing energy efficiency, for which the potential in the Balkan region is huge. Developing and using ecologically sustainable alternative sources such as solar power is particularly high in this part of Europe. Existing dams should mitigate impacts, e.g. by being made passable at least for fish, where feasible also for sediment.

While river landscapes of highest conservation value should not be developed at all, those of lesser value are not necessarily recommendable for development. Some of them might be important for e.g. endemic species, for river continuity as fostered by the Water Framework Directive, for natural flood protection or future restoration. It is therefore clear that this study can only provide the basis for complex political decisions that need to be reached with stakeholder involvement. It hopes to give an important impulse to the identification of "no-go" areas as suggested by the European Water Directors and to develop hydropower planning strategies that will minimise ecological impacts at lower costs.

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6. Annex (River Catalogue, external document)

River catalogue as external document containing full lists of river stretches with very high conservation value and planned hydropower plants as well as a detailed presentation of selected “River Jewels”.